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Technology and Health Book Series

Volume 3

Early childhood development and intervention in a majority world context

A multi-disciplinary perspective



Edited by
Berna Gerber, Marlette Burger,
Sylnita Swartz-Filies & Evette van Niekerk

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**Berna Gerber, Marlette Burger,
Sylnita Swartz-Filies & Evette van Niekerk (eds.)**



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The publisher (AOSIS) endorses the South African 'National Scholarly Book Publishers Forum Best Practice for Peer-Review of Scholarly Books'. The book proposal form was evaluated by our Health and Veterinary Sciences editorial board. The manuscript underwent an iThenticate similarity evaluation to compare the level of originality with other published works and confirmed originality and appropriate acknowledgements to other published works. The manuscript was subjected to a rigorous two-step, single-blind, peer-review assessment before publication by three technical expert reviewers in the field, who did not include the volume editors and were independent of the volume editors, with the identities of the reviewers not revealed to the authors. The reviewers were independent of the publisher, volume editors and authors. The publisher shared feedback on the similarity reports and the reviewers' assessments with the manuscript's volume editors and authors to improve the manuscript. Where the reviewers recommended revisions and improvements, the volume editors and authors responded adequately to such recommendations. The reviewers commented positively on the scholarly merits of the manuscript and recommended that the book be published.

Research justification

This book on early childhood development and intervention in South Africa collates local research regarding the multifaceted challenges young children and their families face, and advocates for their well-being.

Development in the first years of life is fundamentally shaped by context. Unfortunately, young children in South Africa face many hardships that may have a negative and lasting effect on their development and opportunities throughout their life course. These include poverty, prenatal exposure to harmful substances and the human immunodeficiency virus (HIV). Besides these behavioural and environmental risk factors, the child's social and cultural context should be carefully considered when educational and health interventions are planned and delivered. The research in this book aims to grow the sparse local evidence available to health professionals and policymakers, to provide adequate, fair and relevant services to young children and their families so that the multiple risks to their well-being can be mitigated. Most of the chapters in the book describe research conducted in and around the Cape Town area of the Western Cape province of South Africa. This knowledge holds value for clinicians, researchers and policy makers in other geographical locations with similar characteristics. Many of the topics have not been addressed in the literature before and are of great relevance for the vision to improve early childhood development by 2030.

The book is a timely endeavour in keeping with the drive for Afrocentric child health solutions. Much of the knowledge in this field originates from the minority world that is typically less diverse in language and culture, and resource rich. The chapters in this volume document high-quality research that describes our local populations, the challenges they face and how we can respond to their health care and educational needs in contextually relevant ways.

The chapters are organised in two themes, namely (1) advocacy, access to health and educational services, and contextual relevance (Chapters 1–6), and (2) clinical descriptions of local populations such as children with foetal alcohol spectrum disorders (FASDs) and children living with HIV (Chapters 7–12).

Access to health and educational services is a pressing issue in South Africa, with many children facing barriers such as poverty, geographic isolation and inadequate infrastructure. The first six chapters explore strategies to improve access, including innovative service-delivery models, community-based interventions and recommendations tailored to South Africa. By identifying obstacles and showcasing successful interventions, the book provides insights for practitioners, policymakers and researchers to ensure equitable access to education and health services for all children in South Africa.

Theme 2 also comprises six chapters. In Chapter 7, the authors investigate the validity of measuring instruments to determine the gross motor outcomes in high-risk infants. Chapter 8 determines the prevalence of feeding difficulties and the association between neurodevelopment status in children with HIV and feeding difficulties. The research aim in Chapter 9 was to investigate paediatric hearing loss at a tertiary hospital over a 10-year period. Chapter 10 investigates whether financial and education-related resources associated with mid-socio-economic status mitigate the negative effects of health- and household-related risks for language development difficulties. Chapter 11 focuses on balance impairments in children with FASD. The final chapter in the book addresses various issues related to the importance of play in the development of children in South Africa.

These clinical descriptions of local populations, such as infants born prematurely, children with FASD and children living with HIV, are crucial for understanding and addressing the unique challenges faced by these vulnerable groups and responding to the gaps in the current knowledge base. This book reports insights and interventions tailored to the South African (mostly Western Cape) context and its specific disease and disability profile. It will serve as a valuable resource to promote optimal development and well-being for all children in South Africa.

The book contains original research, and any material reproduced herein has been appropriately referenced. Permission was obtained for the reproduction of material, where applicable. We declare that the material in this book has not been plagiarised from any source(s), which we confirmed by using iThenticate as an anti-plagiarism software. We confirm that the scholarly book meets the minimum criteria of the Department of Higher Education and Training's (DHET) Research Outputs Policy of 2015.

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List of abbreviations and acronyms

ABR	auditory brainstem response testing
AFPAN	African Physical Activity Network
AIDS	acquired immunodeficiency syndrome
AIMS	Alberta Infant Motor Scale
ANOVA	analysis of variance
AP	anteroposterior
app	mobile application
ARND	alcohol-related neurological deficits
ART	antiretroviral therapy
AUC	area under the curve
CA	corrected age
CAPS	*Curriculum and Assessment Policy Statement*
CDI	MacArthur-Bates Communicative Development Inventory
CHER	Children with HIV Early Antiretroviral
CI	confidence interval
COP	centre of pressure
COPCA	coping with and caring for infants with special needs early intervention programme
COVID-19	coronavirus disease 2019
CP	cerebral palsy
dB	decibel
dBHL	decibel hearing loss
DEC	dominant eyes closed
DEO	dominant eyes open
DQ	developmental quotient
DSD	Department of Social Development
ECD	early childhood development
EHDI	Early Hearing Detection and Intervention
ELBW	extremely low birth weight

EPDS	Edinburgh Postnatal Depression Scale
FAS	foetal alcohol syndrome
FASD	foetal alcohol spectrum disorders
FMs	fidgety movements
FSQ	feeding and swallowing questionnaire
GMA	General Movement Assessment
GMFCS	Gross Motor Function Classification System
HIE	hypoxic-ischaemic encephalopathy
HINE	Hammersmith Infant Neurological Examination
HIV	human immunodeficiency virus
ICU	intensive care unit
IQR	interquartile ratio
LBW	low birth weight
LMICs	low- and middle-income countries
MABC-2	*Movement Assessment Battery for Children* (second edition)
ML	mediolateral
mLearning	mobile learning
MOS	Motor Optimality Score
MOS-R	Motor Optimality Score–Revised
MOS-SSS	medical outcome study social support survey
NEO	non-dominant eyes open
NEC	non-dominant eyes closed
NGO	non-governmental organisation
NICU	neonatal intensive care unit
NIECD	National Integrated Early Childhood Development
NPV	negative predictive value
NQF	National Qualifications Framework
OR	odds ratio
PAE	prenatal alcohol exposure
PFAS	partial foetal alcohol syndrome
PLS	plain language summary
PPV	positive predictive value
Q1	first quartile
Q2	second quartile
ROC	receiver operating characteristic
RTP model	Cornell Research to Practice Consensus Workshop model
SA	South Africa

SADHS	South African Health and Demographic Survey
SDGs	sustainable development goals
SES	socio-economic status
SLS	single-leg standing
SMS	short message service
SPSS	Statistical Package for the Social Sciences
TD	typically developed
TSS	total standard score
TTB	time-to-boundary
UN	United Nations
UNCRC	United Nations Convention on the Rights of the Child
UNICEF	United Nations Children's Fund
USA	United States of America
US$	American dollar
VLBW	very low birth weight
WCED	Western Cape Education Department
WHO	World Health Organization
ZAR	South African rand

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To the readers, may this book inspire and inform your work as much as it has ours. It is our hope that the knowledge shared within these pages sparks new ideas, encourages critical discussions and contributes to the advancement of our field. Your engagement and perspectives will continue to shape and refine the conversations we have begun here and we look forward to seeing how this work influences future research and practice.

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Glossary

Antenatal: The time before birth; during or relating to pregnancy.

Anthropometric status: Refers to the measurement and interpretation of body dimensions in relation to nutrition.

Area under the curve: Statistical measurement obtained from a receiver operating characteristic (ROC) curve. The area under the curve (AUC) is defined as the average value of sensitivity for all the possible values of specificity (Hajian-Tilaki 2013). An optimal AUC = 1.00.

Bilateral hearing loss: Refers to hearing loss in both ears (American Speech-Language and Hearing Association 2023).

Chronological age: The time that has passed since birth expressed in days, weeks, months and/or years of age.

Community-based: Concerned with the local community (Department of Social Development 2006).

Conception: The action of conceiving a child or of one being conceived.

Corrected age: Age of a child and/or infant from expected date of delivery. It is calculated by subtracting the number of weeks an infant was born preterm and/or premature (before 40 weeks of gestation) from the chronological age. As an example: if an infant is now 24 months old and was born at 28 weeks' gestational age (thus 12 weeks premature), the corrected age is 21 months: 24 months – ([40 weeks – 28 weeks] x 1 month and/or 4 weeks).

Degree of hearing loss: Refers to a standardised way in which the severity of hearing loss is reported (World Health Organization 2021).

Development: The process of developing or being developed.

Double-duty actions: Double-duty actions include policies, programmes and interventions that have the potential to simultaneously reduce the risk of undernutrition and overnutrition in contrast to interventions that address a single form of malnutrition (under or overnutrition).

Early childhood development (ECD) centre: Early child development centres are defined in South Africa as partial care facilities providing temporary care for more than six children, including babies, toddlers and preschool-aged children, also known as an ECD site, crèche, day care centre, playgroup, or preschool (Department of Social Development 2006). A facility that provides children from birth to the year before they enter

Grade R or formal schooling with partial care early childhood programmes (Department of Social Development 2015).

Early childhood development (ECD) practitioner: An individual who provides early childhood development services through playgroups, family services, formal programmes and training, as well as those who provide management support (Department of Social Development 2015).

Early childhood development (ECD) programmes: Programmes focusing on daily care, development, and early learning for children from birth to the year before they enter school, including community-based play groups, outreach programmes, parenting support, psychosocial support, and other programmes aimed at supporting children's psychosocial needs and development (Department of Social Development 2006).

Early childhood development (ECD) services: A variety of services or support for 'emotional, intellectual, mental, spiritual, moral, physical and social development and growth of children from birth to 9 years' (Department of Social Development 2006).

Early childhood: The time in a child's life from birth until the year before they start formal schooling (Department of Social Development 2015).

Early learning or early learning programmes: Programmes that provide children with activities that foster imagination, language and cognitive development before they enter formal schooling (Department of Social Development 2006).

Extremely low birth weight (ELBW): A birth weight of ≤ 1,000 grams that includes up to and including 999 grams.

Fee-paying school: Public schools in South Africa that require parents to pay a school fee as a supplement to government funding.

Fine motor skills: Hand skills associated with manual dexterity and components thereof including hand strength, fine motor grasps, finger isolation and tactile discrimination.

First 1,000 days of life: In some contexts, it refers to the period from conception until the child turns 2 years old and includes pregnancy, the newborn period and infancy. In other contexts, it refers to the first three years of the child's life, i.e. the period from birth to the child's third birthday.

First 3,000 days of life: Refers to the period from conception until the child turns 8 years old and includes pregnancy, the newborn period and infancy, toddlerhood and the school-aged child.

Food insecurities: A lack of consistent and equitable access to healthy, safe and affordable foods that promote optimal health and well-being.

Food poverty line: The minimum amount of money that an individual needs to afford an adequate food intake.

Foundation phase: Based on the South African education curriculum, the foundation phase refers to Grade R to Grade 3 in public schools.

Fundamental movement skills: A specific set of gross motor skills associated with physical development, which includes running, jumping, hopping, throwing and catching.

Gestational age: The time that has elapsed between the first day of a woman's last menstrual cycle and the day of delivery and/or birth. This definition can be used to calculate the expected date of delivery of an infant.

Gross motor skills: Larger body movement skills including postural skills balance and coordination.

Hearing loss: Refers to not being able to hear as well as someone with normal hearing. Normal hearing is defined as having hearing thresholds of 20 decibels (dB) or better in both ears (World Health Organization 2021).

Imposed occupations: Occupations that are sustained by oppressive practices, norms and values.

Inclusive playground: Playgrounds that were developed to be inclusive to all children, with or without developmental challenges and/or disabilities.

Language impairment or disorder: A disorder or impairment which interferes with typical communication such as problems with speaking and/or understanding language.

Low socio-economic: Pertains to settings where children lack access to quality early learning, health and social services (Black et al. 2017). Adversity in early childhood circumstances because of lack of resources (Naicker et al. 2022).

Low socio-economic area: An area associated with low income and poverty, high levels of unemployment and low educational attainment.

Low-resourced setting: A predominantly low socio-economic area with many rural areas and limited therapy resources.

Manual dexterity: The ability to use the hands to perform an activity skilfully and timely.

Maternal: Relating to a mother, especially during pregnancy or shortly after childbirth.

Middle ear infection: A swelling and infection of the middle ear, namely, the space immediately behind the eardrum.

Mild hearing loss: Hearing thresholds from 26 decibel hearing loss (dBHL) to 40 dBHL (Clark 1981 cited by American Speech-Language and Hearing Association 2023).

Minority-world contexts: Parts of the world where the minority of the world's population resides and that are considered to have well-developed economies.

Moderate hearing loss: Hearing thresholds from 41 dBHL to 55 dBHL (Clark 1981 cited by American Speech-Language and Hearing Association 2023).

Moderately severe hearing loss: Hearing thresholds from 56 dBHL to 70 dBHL (Clark 1981 cited by American Speech-Language and Hearing Association 2023).

Motor skill impairment: A term to describe concerns with motor skill development caused by specific health conditions or as a hidden disability.

Motor skills: A function that involves specific movements of the body's muscles to perform a certain task.

Multidimensional poverty rate: The extent to which a child experiences deprivation across indicators that include water, sanitation and hygiene, housing, nutrition, protection, health, child development, information and education (UNICEF 2020).

Multidimensionally poor: Poverty that is experienced across a range of factors such as access to adequate health care, education, occupation, sanitation, nutrition, etc.

National Qualifications Framework (NQF): The NQF is a platform for the registration of established measures and qualifications with the primary goal of integrating different education and training systems into one, national system (Department of Social Development 2006).

Neurobehavioural skills: How the brain affects emotion, behaviour and learning.

No-fee schools: Specific schools, in low socio-economic areas, identified by the South African government, where parents do not have to contribute school fees.

Non-governmental organisation: Organisations (non-profit, non-governmental) that work to improve society or individuals. Non-governmental organisations are private, autonomous organisations that work in the public interest, not for profit, and that support communities through social security, growth, faith-based support, education and research (Department of Social Development 2006).

Nurturing care: A safe environment provided by caregivers that fosters early learning through emotionally caring and responsive interactions while supporting good health and nutrition of the child (World Health Organization, United Nations Children's Fund & World Bank Group 2018, p. 5).

Nurturing care: Characterised by a home environment that is sensitive to children's health and nutritional needs, responsive, emotionally supportive and developmentally stimulating and appropriate, with opportunities for play and exploration, and protection from adversities.

Nutrition-sensitive interventions: Address the underlying determinants of foetal and child health, food security, adequate caregiving resources at the maternal, household and community levels, and access to health services and a safe, hygienic environment.

Nutrition-specific interventions: Address immediate determinants of foetal and child nutrition and development, namely, adequate food and nutrient intake, feeding, caregiving and parenting practices, and low burden of infectious diseases.

Occupation: The everyday activities that people do as individuals, in families, and with communities to occupy time and bring meaning and purpose to life.

Occupational therapist: A client-centred health profession concerned with promoting health and well-being through occupation.

Physical development: The achievement of physical developmental milestones, to reach a level of age-appropriate fundamental movement skills.

Playgroup facilitator: A worker based in the community who is primarily in charge of early learning and development programmes offered to children through a playgroup at a community facility or, occasionally, at a parent's house (Department of Social Development 2015).

Positive outcomes: Denotes favourable learning and developmental outcomes of a child (Department of Basic Education 2022).

Post-menstrual age: The time elapsed between the first day of the last menstrual cycle and birth of the infant, plus the time that has elapsed after birth (infant's gestational age). Described in number of weeks.

Postnatal depression: Depression experienced by a mother after childbirth, with a perinatal onset of depressive symptoms.

Postnatal period: The first 12 months after childbirth.

Prenatal: The time before birth; during or relating to pregnancy.

Preterm birth or prematurity: Infants born alive prior to 37 weeks' completed gestation, or fewer than 259 days since the first day of a woman's last menstrual period. Preterm births can be further classified as extremely preterm (< 28 weeks' gestation), very preterm (28 to < 32 weeks' gestation) and moderate to late preterm (32 to < 37 weeks' gestation).

Prevalence study: The number of cases of a condition in a specific area and over a specific time span.

Primary caregiver: The individual with whom the child is permanently residing and has the right to care for that child and supervise his or her daily life.

Profound hearing loss: Hearing thresholds worse than 90 dBHL (Clark 1981 cited by American Speech-Language and Hearing Association 2023).

Protective factor: A characteristic or variable that decreases the likelihood of some negative outcome.

Pseudonym: A fictitious name.

Quality of language input: The type and complexity of language that an individual is exposed to.

Quality: Quality in ECD concerns diverse activities promoting child development, balancing self-initiated and teacher-guided tasks. The child–teacher relationship is crucial, providing a secure environment for learning (Biersteker et al. 2016).

Quantity of language input: The number of words or utterances that an individual is exposed to.

Risk factor: A characteristic or variable that increases the likelihood of some negative outcome.

Risk factors: Circumstances that make a child vulnerable to poor early childhood development and include, among others, inadequate caregiving, poverty and living in a rural setting (Department of Social Development 2015).

Severe hearing loss: Hearing thresholds from 71 dBHL to 90 dBHL (Clark 1981 cited by American Speech-Language and Hearing Association 2023).

Social determinant: The non-medical factors that influence health outcomes.

Social support: Is information or resources exchanged at an interpersonal level perceived to be for the betterment of the receiving party, including factors such as emotional support, physical and instrumental assistance.

Socio-economic status (SES): A person or family's social and economic standing in society, usually measured by education, occupation or income or a combination of these and other factors.

South African Qualification Authority: The South African Qualification Authority supports the NQF, helps each learner reach their full potential and advances the social and economic development of the country (Department of Social Development 2006).

Stunted growth or stunting: Refers to a low height and/or length for age, directly caused by long-standing undernutrition and lack of care and indirectly by a myriad of social, commercial, political and economic factors.

Training and support: Concerns the qualification and ongoing development of skills and knowledge of ECD practitioners (Department of Higher Education and Training 2017; Department of Social Development 2006).

Triple burden of malnutrition: Refers to undernutrition, micronutrient deficiencies and overnutrition.

Unilateral hearing loss: Refers to hearing thresholds of < 20 dB in the better ear, 35 dB or greater in the worse ear (World Health Organization 2021).

Universal access: Access to early learning, reading programmes, health and nutrition, and social support (Labantwana & Bana 2018).

Upper-middle-income: An upper-middle-income economy is defined as a country with a Gross National Income per capita between US$4,466 and US$13,845 using the World Bank Atlas Method. The terms country and economy are used interchangeably (World Bank 2023).

Validity: The extent to which an assessment and/or tool measures what it is intended to measure, or the extent to which a concept is measured accurately.

Very low birth weight (VLBW): A birth weight of ≤ 1,500 grams, including and up to 1,499 grams.

Vulnerability: Increased exposure to risk factors because of one's circumstances (Department of Social Development 2006).

Vulnerable: Exposed to the possibility of being attacked or harmed, either physically or emotionally.

Chapter 1

Social support in early intervention: Its role in postnatal mothers with admitted infants

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Abstract

Background: Social support can have a profoundly positive impact on child development and maternal mental health. Mothers with hospitalised infants are at greater risk of adverse mental health outcomes. Sufficient social support may be an important early intervention.

Aim: To describe the maternal perceived social support characteristics and their associations, and to determine the expressed social support needs of mothers with hospitalised infants within a South African public hospital.

Methods: A total of 105 mothers with hospitalised infants under the age of 12 months were included in a cross-sectional observational study. Participants completed clinical and sociodemographic questionnaires.

Results: Social support, measured as a continuous scale, was significantly associated with maternal postnatal depressive symptoms ($p < 0.001$) and the expressed support needs scale for positive social interaction ($p = 0.025$). Use of continuous scales provided more nuanced information, including subclinical depressive experiences. Regression models, adjusting for covariates, showed significant associations between insufficient social support (below the 50th percentile) and maternal postnatal depressive symptoms ($p = 0.013$). Insufficient social support was also significantly associated with the expressed needs scale of positive social interaction ($p = 0.049$). Low social support (below the 20th percentile) was significantly associated with the age of the mother ($p = 0.008$), and the relationship status of the mother ($p = 0.001$), and showed an association with maternal postnatal depressive symptoms, nearing significance ($p = 0.056$).

Conclusion: The association between social support and maternal postnatal depressive symptoms highlights social support as an early prevention and intervention. Single and/or older mothers had significantly lower levels of social support. Sociocultural aspects need consideration. Formal and informal social support networks may be strengthened by infant mental health programmes.

Introduction

The South African concept of *Ubuntu* is explained by the phrase *umuntu ngumuntu ngabantu* – a person is a person by other people. This concept can be clearly illustrated by the mother-infant relationship. As Donald W Winnicott said, 'There is no such thing as a baby, there is a baby and someone' (Winnicott 1960, p. 585). Babies develop personhood through the relationship with their caregiver, the first of many subsequent social

relationships on the road to development (Winnicott 1960). The child is formed through relationships, just as threads are woven together to form a colourful tapestry.

Close, affectionate relationships between the infant and their parents or other caregivers create positive experiences through nurturing care. Nurturing care early in life provides lifelong benefits to the child, such as improved mental and physical health and learning opportunities (Richter et al. 2016). Early positive relational experiences are very important because of the critical period of brain growth and development in the first years of life (Schore 2005). Positive early relationships are crucial to a child's positive developmental trajectory.

The mother's relationship with the child, therefore, needs to be supported, especially during the postnatal period. Maternal health and well-being, especially maternal mental health, directly influence the mother's ability to provide nurturing care for the infant (World Health Organization 2018). As Bowlby, renowned for the development of attachment theory, pointed out,

> [j]ust as children are absolutely dependent on their parents for sustenance, so [...] are parents, especially their mothers, dependent on a greater society for economic provision. If a community values its children it must cherish their parents. (Bowlby 1952, p. 84)

Bowlby recommended the involvement of the community and society in supporting the mother for the sake of the infant. This aligns with the socioecological model of development, which views development as expanding outward from the individual to the family, community, and society (Bronfenbrenner 1979). In this model, social support is described as a transactional process, where societal or community factors and resources directly impact the family, which in turn impacts the parent and then the child (Bronfenbrenner 1979). These layers of support are interwoven to form both formal and informal support structures.

Social support is usually defined as information or resources exchanged at an interpersonal level, perceived to be for the betterment of the receiving party, including factors such as emotional support, physical and instrumental assistance (Espe-Sherwindt & Serrano 2020; Wallace et al. 2019; Woodman 2014).

Sufficient social support has consistently been shown to have a positive impact on general physical and mental health and mortality (Reblin and Uchino 2008; Uchino et al. 2012; Umberson & Montez 2010). It also has a positive impact on parent–child interactions, child behaviour and development and family well-being, including lower levels of parental stress (Espe-Sherwindt & Serrano 2020; Green, Furrer & McAllister 2007; Woodman 2014). Possible pathways by which social support impacts

caregiver mental health include direct and indirect effects on mental health through the mediating effects of resilience factors and coping mechanisms, as well as indirect effects through directly addressing stressors (Casale 2021). Sufficient levels of maternal social support are also associated with a reduction in clinical postnatal depression (Hetherington et al. 2018; Silva & Loureiro 2014).

The postnatal period is associated with a higher risk of mental health disorders in mothers (Fisher et al. 2012). Infant hospitalisation renders both mother and baby vulnerable to additional postnatal psychosocial stressors in the form of potential child morbidity or mortality and disruption of mother–infant attachment opportunities (Miles et al. 2007).

Postnatal mothers with hospitalised infants may be seen as at-risk dyads that may benefit from early prevention and intervention efforts in the form of enhancement of maternal perceived social support, especially in resource-limited settings such as the public health sector in South Africa. Earliest definitions of early intervention focused on the delivery of health, educational and social services, whereas more recent definitions have included the parenting support provided by formal as well as informal social support networks (Espe-Sherwindt & Serrano 2020). This highlights the importance of strengthening informal social support as part of potential early intervention opportunities.

In order to learn how health care professionals can assist in the strengthening of social support in at-risk postnatal mothers, especially those with admitted infants, more context-specific information is needed. Sufficient social support tailored to the needs of these mothers may be an important early intervention.

There is limited research regarding the perceived social support of mothers with admitted infants, especially in Africa, where social connections are highly valued. The characteristics of social support in these mothers, as well as what factors are associated with insufficient social support, need to be explored. The mothers' expressed needs for specific types of support also must be considered in order to provide prevention and intervention models suitable for the recipient mothers (McNab et al. 2022). This study aims to contribute to culture- and context-specific knowledge from South Africa that may inform the development and practice of support services for mothers of hospitalised infants who are already in contact with health care services, presenting a unique opportunity for early intervention efforts.

Research aim

This study aimed to describe the characteristics of maternal perceived social support and their associations, and to determine the expressed

social support needs of postnatal mothers with hospitalised infants within a South African public hospital.

Methods

Study design, population and setting

A cross-sectional observational study was conducted at Tygerberg Hospital in Cape Town, South Africa, with participant recruitment taking place from April to July 2022. The participants – postnatal mothers with admitted infants – were recruited from paediatric wards during routine health talks for caregivers done in the respective wards.

Tygerberg Hospital is a secondary- and tertiary-level referral centre for general paediatric health services. The patient population mostly includes people with high levels of contextual adversity, such as socio-economic difficulties, unemployment, high levels of substance abuse and violence and overcrowded living conditions (Van Heyningen et al. 2017).

The sample size was determined by the investigation of the possible correlation between common perinatal mental disorders and social support. Sample size was calculated at $n = 103$ (given a possible correlation of 0.3, 80% power to detect differences, with a level of significance set at $p < 0.05$).

Inclusion and exclusion criteria

The inclusion criteria consisted of participants older than 18, in the postnatal period (defined as the first 12 months after childbirth), and having an infant younger than 12 months who was currently admitted to a neonatal or paediatric ward in Tygerberg Academic Hospital.

Exclusion criteria consisted of any acute illness in the participating mother and/or inability to give informed consent in one of the three local languages – isiXhosa, Afrikaans or English (with informed consent done in the participant's preferred language).

Data collection

The informed consent process and data collection, including the completion of questionnaires, were conducted by researchers in a private counselling room. The questionnaires were provided in English, and participants who were proficient in written English completed the forms independently, with assistance provided as needed. The multilingual research assistants are experienced lay counsellors and offer further

translation or clarification, as well as basic counselling or debriefing, as needed, in the participant's preferred language. The principal researcher and research assistants engaged mothers of admitted infants during their daily routine health talks in the paediatric wards. Research assistants were trained by the principal researcher on the protocol as well as on conducting structured interviews using standardised tools. Mock interviews were conducted to ensure that the correct data collection processes were followed, and quality assurance procedures were implemented after each completed interview. To minimise selection bias, clear inclusion and exclusion criteria were used to prevent recruitment based on subjective criteria. Information bias was further prevented by the use of standardised data collection tools. Participants who provided information requiring further intervention or who obtained scores above the threshold on screening tools were referred for further management according to local referral pathways.

Measures

Participants completed sociodemographic and clinical questionnaires. The medical outcome study social support survey (MOS-SSS) (Sherbourne & Stewart 1991) was used to measure maternal perceived availability of social support by types of support. This self-administered scale consists of 19 items representing four types of available support, namely, emotional and/or informational (someone to confide in, and provide advice and information), tangible (someone to help with daily chores, meals or transport), affectionate (someone to show love and affection), and positive social interaction (someone to have a good time or relax with) (Sherbourne & Stewart 1991). Each item is scored on a five-point Likert scale, with higher scores indicating higher levels of perceived available social support. Each social support subcategory score is measured by calculating the mean scaled score (Sherbourne & Stewart 1991).

The MOS-SSS is validated and widely used globally, as well as in postnatal women in the context of low- and middle-income countries (LMICs) (Dao-Tran et al. 2023; Wan Mahmud, Awang & Mohamed 2004), and was proven reliable for use within human immunodeficiency virus (HIV)-affected individuals in South Africa (Crohnbach's alpha = 0.64) (Casale et al. 2014; Drain et al. 2015; McInerney et al. 2008). The MOS-SSS is a continuous scale, with no defined cut-off scores.

Similar to study data in *Scientific Reports* (Matsumoto et al. 2017), additional information on the MOS-SSS regarding the main sources of each type of support was collected. Sources of support included family; partner; friends and neighbours; religious and other organisations, medical staff, and others; or no-one. Expressed social support needs of the participants

were also determined by asking them to rate each type of social support on a 4-point Likert scale in order of most needed (1) to least needed (4).

The validated Risk Assessment Tool of the South African Perinatal Screening Advisory was used to screen for variables found to be most predictive of perinatal depression and anxiety in the South African context (McKenna et al. 2017). These include previous history of mental health problems, previous history of maternal childhood abuse, recent (past year) traumatic events, and current domestic violence (McKenna et al. 2017). Information regarding infant age and severity of illness was also gathered, using the admission ward (general, high care, or intensive care wards) of the infant as a proxy for the severity of current illness in the infant necessitating hospitalisation. Monthly household income was used as an indication of socio-economic status. Other maternal clinical data collected included HIV status and screening for maternal postnatal depression.

The Edinburgh Postnatal Depression Scale (EPDS) (Cox, Holden & Sagovsky 1987) was used to measure postnatal depressive symptoms. It is widely used globally and is validated for use in South Africa (Lawrie et al. 1998). Above-threshold scores for the EPDS may have a wide variation depending on different local contexts (Kleine et al. 2022). The use of the EPDS as a continuous variable has recently gained interest, as it provides more nuanced information regarding the experience of depressive symptoms in postnatal mothers (Kleine et al. 2022) and may widen the scope to include subclinical populations. The EPDS was thus used as both a categorical and a continuous variable in this study. A local epidemiological cut-off score of > 12 was used to determine probable postnatal depression (Brittain et al. 2015; Stein et al. 2015). As a continuous variable, the EPDS was used to indicate a scale of maternal postnatal depressive symptoms.

Data analysis

STATA 17 (StataCorp LLC, College Station, Texas, USA) was used for the data analysis. Sociodemographic and clinical variables were described using descriptive statistics.

In this study, the social support score, or MOS-SSS, was used as a continuous variable in order to minimise any loss of information resulting from categorisation. A Spearman's rank correlation test was used to examine the correlation between social support as a continuous variable and other continuous variables, including the EPDS. Categorisation of total social support scores on MOS-SSS was also done by calculating the total social support score, which provided a receiver operating characteristic (ROC) value of 0.7, indicating a reasonable predictive performance.

This cut-off social support score was determined as 80, with a total score of 79 or less indicating insufficient social support, and a score of 80 or more indicating sufficient social support. This value corresponded with the 50th percentile (centile 79) or median score of total social support (MOS-SSS total). Low social support was also defined in this study as the lower 20th percentile (or scores between 19 and 60 in this study), similar to other large cohort studies' use of the MOS-SSS (Hetherington et al. 2018).

Significance level was set at $p < 0.05$. *T*-tests were used to examine the association between the total social support scale and each categorical variable. The analysis of variance (ANOVA) test was used for differences between groups. Pearson Chi-square tests were used to determine associations for categorical variables.

Quantile regression allowed the modelling of a percentile of the outcome variable. Modelling was performed using median social support scores, as the total social support scale was non-normally distributed. The quantile regression model, using the median social support score, determined associations between insufficient social support and variables while adjusting for covariates. The quantile regression model, using the 20th percentile of the social support score, determined associations between low social support and variables while adjusting for covariates.

Results

Sociodemographic and clinical characteristics

The study sample included a total of 105 mothers with currently hospitalised infants. Detailed maternal and infant sociodemographic and clinical characteristics are presented in Table 1.1. The study sample's median ages were mothers of 29 years old. Most mothers were in a relationship (89%). Three-quarters (76%) of them had a monthly household income of less than ZAR5,000 (approximately US$268). Almost 72% of mothers were unemployed, and only 21% had any tertiary education.

Psychosocial and clinical characteristics of the mothers also indicated high levels of adversity. A quarter (26%) of the mothers were HIV-infected. The prevalence of probable current postnatal depression in this sample of mothers was high, with 40% of mothers having above-threshold scores on the EPDS. Almost a quarter (24%) of mothers had a previous history of mental health problems. More than half of mothers (59%) had experienced trauma within the last year, and 16% of mothers reported current domestic violence. More than a quarter of mothers (29%) also reported having experienced previous childhood abuse.

TABLE 1.1: Maternal and infant sociodemographic and clinical characteristics (*N* = 105).

Variable	Number (*n*)	Percentage (%)	Median	IQR
Maternal				
Age of mother (years)	-	-	29	23–34
Number of children cared for by the mother	-	-	2	1–3
Relationship status: Currently in a relationship	93	88.57	-	-
Monthly household income				
< ZAR5,000 (US$268)	80	76.19	-	-
> ZAR5,000	25	23.81	-	-
Employment status: Unemployed	76	72.38	-	-
Highest level of education			-	-
Primary school	14	13.33	-	-
Secondary school	69	65.72	-	-
Tertiary education	22	20.95	-	-
HIV status				
HIV-infected	26	24.76	-	-
HIV-uninfected	74	70.48	-	-
Chose not to disclose	5	4.76	-	-
Current postnatal depression[†]	42	40.00	-	-
Previous history of mental health problems	25	23.81	-	-
Recent trauma exposure	62	59.05	-	-
Current domestic violence	17	16.19	-	-
History of maternal childhood abuse	30	28.57	-	-
Infant				
Age of infant (days)	-	-	30	13–92
Severity of infant illness as indicated by the admission ward				
General ward	66	62.86	-	-
High care	28	26.67	-	-
ICU	11	10.47	-	-

Source: Authors' own work
[†] Edinburgh Postnatal Depression Scale > 12
Key: IQR, interquartile range; ZAR, South African rand; US$, United States dollar; HIV, human immunodeficiency virus; ICU, intensive care unit.

The median age of the admitted infant was 30 days old, and almost two-thirds (63%) of the infants in the study sample were admitted to general paediatric wards.

Characteristics of maternal perceived social support are presented in Table 1.2. Total social support (MOS-SSS total) was expressed as a continuous variable. The total social support within this cohort was non-normally distributed, with a median score of 79 (interquartile range [IQR] 64–90). Half of the mothers had insufficient levels of social support, as indicated by a total score on MOS-SSS of less than 80.

The mothers' perceived availability of support by type (MOS-SSS subcategories) revealed that they had the highest availability of affectionate support, followed by tangible support, then emotional and/

or informational, and lastly, positive social interaction. The main sources of different types of support exhibit similarities, with all types of support having either a family member or a partner as the primary source of support. The mothers' expressed support needs Likert score (by type) revealed that they most want emotional and/or informational support, followed by affectionate support, then tangible support, and lastly, positive social interaction.

TABLE 1.2: Characteristics of perceived social support (*N* = 105).

a			
Total social support (MOS-SSS total)	**Percentile**	**Centile**	**95% confidence interval**
Low social support (< 20th)	20	60.2	55.74–66.00
Insufficient social support (< 50th)	50	79	73.97–84.02

b	
Perceived social support types (MOS-SSS subcategories)	**Mean scaled scores**
Emotional/informational	3.99
Tangible	4.04
Affectionate	4.23
Positive social interaction	3.94

c					
Main sources of perceived social support by type	**Total social support (%)**	**Emotional (%)**	**Tangible (%)**	**Affectionate (%)**	**Positive social interaction (%)**
Family	43.33	53.33	45.71	44.76	29.52
Partner	45.48	35.24	47.62	50.48	48.57
Friends and neighbours	5.95	3.81	2.86	1.91	15.24
Religious or other organisation / medical	2.38	4.76	0.95	0	3.81
None	2.86	2.86	2.86	2.86	2.86

d	
Expressed social support needs by type	**Mean Likert score (1 [most needed] to 4 [least needed])**
Emotional/informational	1.92
Affectionate	2.31
Tangible	2.58
Positive social interaction	3.18

Source: Authors' own work.
Key: MOS-SSS, medical outcomes study social support survey; %, percentage.

Social support associations

Spearman's rank correlation test was used to examine the correlation between the continuous variables, that is, the total social support scale, EPDS, age of mother, age of baby, number of children in mother's care, and Likert scales for expressed social support needs by the four types. From the continuous scales, only maternal postnatal depressive symptoms (EPDS) ($p < 0.001$) and Likert scale for positive social interaction ($p = 0.025$) were correlated with the total social support scale.

TABLE 1.3: Maternal and infant sociodemographic and clinical categorical variables associated with total social support (MOS-SSS Total) (*N* = 105).

Variable	Total *n*	Mean social support score	95% confidence interval	*p*-value	Test value (*t* / Chi² /ANOVA)
Employment status				**0.029***	−2.209
Unemployed	76	73.83	70.014–77.644	-	-
Employed	29	81.55	76.210–86.893	-	-
Monthly household income				0.170	−1.382
< ZAR5,000	80	74.74	71.041–78.434	-	-
> ZAR5,000	25	79.88	73.699–86.061	-	-
Highest level of education			-	0.511	0.053
Primary school	14	70.36	-	-	-
Secondary school	69	74.91	-	-	-
Tertiary education	22	82.82	-	-	-
Relationship status			-	0.067	−1.856
Not in a relationship	12	67.83	53.908–81.758		
Admission ward of infant					
General ward	66	77.88	74.405–81.353	0.118	−1.578
High care	28	72.18	64.388–79.969	0.153	1.441
ICU	11	74.09	62.230–85.952	0.690	0.404
Maternal HIV status			-	0.729	0.005
HIV-infected	26	67.04	-	-	-
HIV-uninfected	74	79.03	-	-	-
Chose not to disclose	5	77	-	-	-
Previous history of mental health problems	25	73.12	64.682–81.558	0.321	0.998
Recent trauma exposure	62	76.03	72.329–79.735	0.958	−0.053
Current domestic violence	17	64.71	55.303–74.109	**0.002***	3.247
Maternal childhood abuse	30	69.30	62.628–75.972	**0.008***	2.727

Source: Authors' own work.
*$p < 0.05$
Key: MOS-SSS, medical outcomes study social support survey; n, number; %, percentage; ANOVA, analysis of variance; ZAR, South African rand; ICU, intensive care unit; HIV, human immunodeficiency virus.

Associations between social support (MOS-SSS scale) and sociodemographic and clinical categorical variables are presented in Table 1.3. Statistically significant associations (in unadjusted analyses) were found between total social support and employment status (p = 0.029), current domestic violence (p = 0.002), and maternal childhood abuse (p = 0.008). No clinically significant associations were found between total social support and monthly household income, level of education, relationship status, severity of illness of infant (as indicated by admission ward), maternal HIV status, previous history of mental health problems, and recent trauma exposure.

A quantile regression model 1 (see Table 1.4) was used to determine the adjusted variables associated with insufficient social support (median total social support score). The regression model showed that postnatal depressive symptoms (as measured by EPDS) (p = 0.013) and positive

social interaction (Likert scale) (p = 0.049) remained statistically significantly associated with insufficient social support after adjusting for other covariates. For depressive symptoms, the median total social support score decreased by 1.2 units for every unit increase in the EPDS score. For every point on the Likert scale for positive social interaction, the median total social support score increased by 4.4 units, meaning that mothers who expressed a lower need for positive social interaction had higher levels of overall social support.

TABLE 1.4: Quantile regression model 1: Adjusted variables associated with social support (median).

Variable	Coefficient	95% confidence interval	Adjusted† p-value
Maternal postnatal depressive symptoms (EPDS)	−1.173	−2.096–0.25	**0.013***
Positive social interaction (Likert score)	4.445	0.022–8.868	**0.049***
Age of mother (in years)	−0.125	−0.841–0.591	0.729
Age of baby (in days)	0.005	−0.049–0.058	0.860
Employment	5.651	−6.795–18.097	0.369
Household income‡	−0.694	−13.192–11.804	0.912
Maternal HIV status	−3.165	−14.187–7.858	0.570
Current domestic violence	0.659	−12.632–13.951	0.922
Previous childhood abuse	−4.360	−14.980–6.259	0.417
In a relationship	1.481	−12.699–15.662	0.836
Education level	0.929	−10.930–12.788	0.877

Source: Authors' own work.
† Adjusted for all variables presented here.
‡ Monthly household income of > ZAR5,000 showed stronger associations than other household income subcategories and was therefore used in the model.
Raw sum of deviations = 702.5; Number of observations = 105; Pseudo R2 = 0.2317; *p < 0.05
Key: EPDS, Edinburgh Postnatal Depression Scale; HIV, human immunodeficiency virus; ZAR, South African rand.

Quantile regression model 2 (Table 1.5) was used to determine the association between the same variables as in model 1 and low social support, modelling the 20th percentile of the total social support score distribution. At this percentile, different variables were significant. Age of mother was significantly associated with low social support (p = 0.008), adjusting for other covariates. Age of mother had a negative association, showing a decrease of 1.1 units on the total social support score for every year older.

Relationship status of the mother (being in a relationship) was also significantly associated with low social support (p = 0.001). The relationship status of the mother had a large effect, where being in a relationship resulted in an increase of 26.1 units on the total social support score.

The association between low social support and maternal postnatal depressive symptoms (as measured by EPDS) neared significance (p = 0.056).

TABLE 1.5: Quantile regression model 2: Adjusted variables associated with low social support (20th percentile).

Variable	Coefficient	95% confidence interval	Adjusted† *p*-value
Maternal postnatal depressive symptoms (EPDS)	−0.973	−1.969–0.024	**0.056**
Positive social interaction (Likert score)	2.579	−2.195–7.354	0.286
Age of mother (in years)	−1.064	−1.837–0.291	**0.008***
Age of baby (in days)	0.022	−0.036–0.079	0.451
Employment	9.079	−4.354–22.513	0.183
Household income‡	−1.877	−15.366–11.613	0.783
Maternal HIV status	−5.608	−17.505–6.289	0.352
Current domestic violence	3.195	−11.151–17.541	0.659
Previous childhood abuse	−5.788	−17.249–5.674	0.319
In a relationship	26.071	10.765–41.377	**0.001***
Education level	3.847	−8.953–16.647	0.552

Source: Author's own work.
Key: %, percentage; EPDS, Edinburgh Postnatal Depression Scale; HIV, human immunodeficiency virus; ZAR, South African rand.
† Adjusted for all variables presented here.
‡ Monthly household income of > ZAR5,000 showed stronger associations than other household income subcategories and was therefore used in the model.
Raw sum of deviations = 522.8; Number of observations = 105; Pseudo R2 = 98; *$p < 0.05$.

Discussion

This study aimed to describe the perceived social support characteristics and their associations, and to determine the expressed social support needs of postnatal mothers with hospitalised infants. Our study's high prevalence rate (40%) for probable current postnatal depression is in keeping with other South African postnatal depression prevalence studies (ranging from 21 to 47%) (Dewing et al. 2013; Mokhele et al. 2019; Peltzer et al. 2018), as well as in keeping with global prevalence rates of postnatal depression in mothers with hospitalised infants, where rates of 40% were also found (Vigod et al. 2010).

Half of the mothers in our sample had insufficient levels of perceived social support. The main sources of all types of social support were overwhelmingly from the family or partner. The mothers expressed the greatest preference and need for emotional and/or informational support. Similar results were found in a large cohort study, where emotional and/or informational support was found to be the most important type of support for maternal mental health (Hetherington et al. 2018).

Our study found similar associations between social support and maternal mental health outcomes. Social support associations were determined by using social support as both a continuous and a categorical variable. The same approach was taken with the EPDS scale, where the categorical scale was used to indicate probable postnatal depression (EPDS > 12) and the continuous scale was used to report postnatal depressive symptoms, which therefore included subclinical depressive

experiences of the mothers in the sample. Our results, therefore, give a nuanced description of the relationship and experience of social support and mood postnatally.

Social support levels as a continuous scale were significantly associated with maternal postnatal depressive symptoms (EPDS) ($p < 0.001$). Regression models showed statistically significant associations between insufficient social support (below the 50th percentile) and maternal postnatal depressive symptoms ($p = 0.013$). Regression models for low social support (below the 20th percentile) also showed an association with maternal postnatal depressive symptoms, nearing significance ($p = 0.056$).

The association between maternal postnatal depressive symptoms and social support as a continuous variable, as categorical insufficient social support and as categorical low social support, therefore supports the significant role that social support may play in maternal mental health, especially in this at-risk group of postnatal mothers with hospitalised infants. This finding is in line with recent literature that reports social support to be both a risk for postnatal mental disorders, if low or insufficient, and protective against postnatal mental disorders, if sufficient support levels are available to the mothers (Erbaba & Pinar 2021; Hetherington et al. 2018; Leung et al. 2017; Pao et al. 2019; Van Heyningen et al. 2016).

Insufficient social support was also significantly associated with the expressed need Likert scale of positive social interaction ($p = 0.049$). The association between the expressed need scale for positive social interaction is expected, as it indicates that mothers with a lower expressed need for positive social interaction have higher levels of perceived social support availability.

Low social support (below the 20th percentile) was also statistically significantly associated with the age of the mother ($p = 0.008$) and the relationship status of the mother ($p = 0.001$). A recent study yielded similar results to ours, indicating that older mothers received less parental support than younger mothers (Goisis 2023). Another study also showed that single mothers had less social support antenatally, and that this lack of social support had a stronger association with postnatal depression than for those in a relationship (Taylor et al. 2022).

The interplay between culture, social support and mental health appears to be intricately intertwined, particularly within African contexts. A systematic review of perinatal maternal psychological well-being in Africa found that insufficient social support and family and marital conflict were associated with maternal mental health difficulties (Sawyer, Ayers & Smith 2010). The lack of social support seems to have an even stronger effect in collectivist cultures, where social support and family unity are highly valued. The role of supportive family members and partners may be

particularly important for the well-being of the mother and child, more so for postnatal mothers with hospitalised infants. Our study showed that family and partners are the most important sources of social support. Other sources of support, like those of friends and neighbours, organisations and health care teams, play a much smaller role for the mother. One may suggest that these other sources of support may well provide better support by indirectly supporting the mother by assisting family members and partners to be able to adequately support the postnatal mother.

Context and culture-specific associations with low social support in these at-risk mothers with hospitalised infants need consideration. Our study found that low social support in mothers was significantly associated with the mother's age and relationship status. Other socio-economic, health or even risk factors such as abuse did not remain associated with low support. Single and/or older mothers were at the greatest risk of having low social support. One may postulate that older mothers are expected by society to cope better than younger mothers and, therefore, may receive less support from others. Social constructs and narratives around motherhood may play a role in the levels of support these postnatal, single, older mothers receive and need further exploration.

As Olayiwola and Olowomni (2013) aptly put it:

> The African traditional view of womanhood configures the social construction of the African woman and the role-participant carved for her in her society. In view of this, in virtually every place and time, two words have been employed to denote and qualify the African woman: marriage and maternity. (p. 141)

Single mothers in contemporary African societies face new socio-cultural and economic challenges, having to navigate the decreased privileges of support from family, partners and society (Olayiwola & Olowomni 2013). Motherhood may make mothers into a positive object of social fantasy, yet singleness (or HIV status or having an ill child) may make them a recipient of society's negative projections (Long 2006).

A sub-Saharan African study suggests that the economic challenges that single mothers face may be attenuated by family support, yet support is influenced by the cultural appropriateness of single motherhood, as well as by the increase in urbanisation of families, making support from family more difficult (Ntoimo & Odimegwu 2014). Single mothers may therefore need the assistance of other support structures outside of their families.

Interventions and approaches within the field of infant mental health may therefore be a suitable fit within health-related follow-up visits and in-facility perinatal programmes. Infant mental health interventions are strength-based and culture-sensitive, and are focused on building relationships, not only between the mother and infant, but also between family members. A recent review of social support as an early intervention

strategy revealed that health care professionals should guide caregivers in identifying and establishing support relationships, particularly with family members, and then assist in strengthening these informal support networks (Yang et al. 2022).

Our study also revealed relevant negative findings. No significant associations were found between social support levels and HIV status. HIV-infected mothers are known to be stigmatised within society (Long 2006), yet these results may point to successful efforts of reducing stigma and isolation in HIV-infected mothers. The severity of illness of the infant (as indicated by the admission ward) was also not associated with lower levels of social support for the mother. Socioeconomic difficulties were also not significantly associated with lower social support. One must also note that mothers did not indicate a need for tangible support, despite the high socio-economic adversity in this study sample. One may postulate that a lack of socio-economic wealth does not necessarily mean that mothers lack relational wealth. Previous history of childhood abuse and presence of current domestic violence also did not remain significantly associated with the level of social support. More research is needed to unravel the social dynamics within abusive relationships, which fall outside the scope of this study.

Limitations within this study included the single centre as a study site in a very select group – postnatal mothers with hospitalised infants in a public hospital. The sample size was also small (N = 105). The maternal HIV status was self-disclosed information and not collected from medical records. The incorrect reporting of self-disclosed data of stigmatised illnesses or symptoms, such as HIV and mental health symptoms, may have potentially influenced results, especially in mothers requiring assistance from research assistants. The self-reported tools may also be a limitation, yet the EPDS, MOS-SSS and Risk Assessment Tool of the Perinatal Screening Advisory were validated tools. The additional information on sources and expressed needs of specific types of support was not obtained from validated tools. Despite this, information gained from at-risk population groups remains invaluable.

Our study highlights the need for social support to help mitigate postnatal depressive mood symptoms. Priority needs to be given to screening and supporting at-risk mothers, especially those with admitted infants already in contact with medical services. Special attention also needs to be given to linking single and/or older mothers to existing support networks within the community. Provision of sufficient social support may help protect against the development of future clinical postnatal depression, especially during periods of increased stress, like the hospitalisation of an infant. Recent studies have shown that even subclinical

maternal depressive symptoms may adversely influence child behaviour outcomes (Kleine et al. 2022), therefore social support may prevent or mitigate psychopathology in both mother and child.

The support may help build resilience and contribute to the well-being of mothers and children, especially if family members and partners are involved in providing the desired types of support, which in most cases are emotional and/or informational support. More formalised social support structures may be a beneficial alternative in settings, like South Africa, where access to mental health screening and assessment is limited. Motherhood support groups following infant mental health approaches may strengthen the family and partner relationships, and therefore possibly improve maternal perceived availability of social support. Long-term sufficient social support may therefore be obtained by strengthening the informal support networks of at-risk mothers and infants, which in turn may buffer the mother and infant from adverse mental health outcomes. In this way, a colourful tapestry of support is woven by utilising all relationships, especially those that the mother holds dearest – a return to *Ubuntu*.

Conclusion

Social support has been shown to have a positive impact on maternal mental health. Postnatal mothers with hospitalised infants are at greater risk of adverse mental health outcomes. The association between social support and maternal postnatal depressive symptoms highlights social support as an early prevention and intervention. Social support needs to be provided according to the mother's expressed needs. Sociocultural aspects and context need consideration and appreciation in a diverse country like South Africa. Formal and informal social support networks may be strengthened by context- and culture-sensitive infant mental health programmes.

Declarations

Ethical considerations

Ethical approval for this study was granted by the Health Research Ethics Committee of Stellenbosch University (HREC1; reference number S21/09/184). Institutional approval was also granted by hospital management. The study was conducted in accordance with the International Declaration of Helsinki (2017), the South African Guidelines for Good Clinical Practice (2006), the Medical Research Council (MRC) Ethical Guidelines for Research (2002) and the Department of Health Ethics in Health Research: Principles, Processes and Studies (2015).

Consent

Informed consent was obtained from all participants.

Author contributions

Michelle du Plessis: Conceptualisation, Data curation, Formal analysis, Investigation, Methodology, Resources, Supervision, Validation, Writing – original draft preparation.

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All authors reviewed the article, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

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Competing interests

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Chapter 2

Nutrition and nurture in early childhood development

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Abstract

Background: In this chapter, the authors describe the global and South African nutritional profiles of infants and young children, followed by a detailed discussion of the causes and consequences of malnutrition, complemented with evidence-based interventions for improved nutrition outcomes in these vulnerable groups. This is followed by relevant research from the South African context.

Aim: To describe the nutrition and nurture profile of children attending early childhood development (ECD) centres in the Breede Valley, Western Cape province.

Methods: Mothers (*N* = 276) of children attending 29 randomly selected ECD centres completed self-administered questionnaires. Children (< 5 years; *N* = 341) were weighed and measured. Interviews were conducted with 29 ECD centre managers and/or staff.

Results: Mothers had an average of 1.95 children (SD = 0.97). Most (96%; *n* = 242/253*) received micronutrient supplements during pregnancy, and 82% (*n* = 223/272*) gave birth in a hospital with a skilled health care professional present. About half described their neighbourhood as safe (57%; *n* = 155/271*) and clean (50%; *n* = 137/272*). The anthropometric profile of children showed stunting at 13% (*n* = 42), overweight at 5% (*n* = 16), obesity at 4% (*n* = 12), underweight at 6% (*n* = 21), and severely underweight at 1% (*n* = 2). Generally, children's immunisations (91%; *n* = 236/260*) were up to date. Most ECD centres provided meals for children. Responsive caregiving and early learning were cultivated through communication and relationship building. Primary school preparedness was ensured through various early learning activities. (**missing responses*)

Conclusion: The components of nurturing care, namely: Health, nutrition, safety and security, responsive caregiving, and early learning appeared mostly in place in ECD centres in the Breede Valley.

Introduction

Early childhood development (ECD) and nutritional health are fundamentally connected (Black et al. 2017). From a nutrition and development perspective, the first 1,000 days of life (i.e. pregnancy, newborn and infancy) are the most impactful window of opportunity for nutrition interventions (Victora et al. 2013). Inaction or delay of action can have devastating and long-lasting effects on health and development. These include increased mortality and morbidity in childhood, decreased cognitive, motor and socioemotional development that result in poor school performance and learning capacity, impaired growth which leads to lower adult stature,

increased obesity and non-communicable diseases, as well as reduced adult work capacity and productivity (Black et al. 2013). The next 2,000 days, that is, up to age eight (toddler and school-aged child), should be viewed as a continuum in the investment in nutritional health (Republic of South Africa 2015).

Global and local nutritional profiles of infants and young children

At a global level, 43%, or around 250 million children under 5 years of age, are at risk of not reaching their full developmental potential. This is mainly because of poverty and social injustice (Black et al. 2017). Globally, a significant number of young children, mostly between 2 and 5 years old, attend some form of day care (Black, Pérez-Escamilla & Rao 2015). This is observed in both high-income and low- and middle-income countries (LMICs) and is largely ascribed to urbanisation and increasing numbers of mothers who are contributing to the workforce (Leroy, Gadsden & Guijarro 2012).

In South Africa (SA), ECD centres are defined as partial care facilities that provide an early childhood programme focused on early learning and development for children from birth until the year before they enter Grade R/formal school (Republic of South Africa 2015). Of the seven million children aged 0–5 years in SA, 3 million (66%) attend some form of early childhood care (May, Witten & Lake 2021), with children older than age two more likely to attend an ECD centre. Approximately 70% of children aged 0–2 years are, however, likely to be cared for at home (Hall et al. 2019).

Over the past three decades, SA national surveys have shown slow progress in addressing the problem of childhood malnutrition. The 2012 SA National Health and Nutrition Examination Survey indicated that one in four children under 5 years old was stunted (low height-for-age), with economically vulnerable children at the highest risk for stunting (Shisana et al. 2013). Young children under the age of 3 years had the highest prevalence of stunting (26.9% for boys and 25.9% for girls). The survey further showed an upward trend in obesity levels in young children, with the highest prevalence of overweight (18.9% for girls and 17.5% for boys) and obesity (4.9% for girls and 4.4% for boys) in the 2–5-year age group (Shisana et al. 2013). The subsequent SA Health and Demographic Survey of 2016 (SADHS 2016) reported similar findings, with a 27% prevalence for stunting, 3% for wasting, and 13.3% overweight in children under 5 years. The most recent National Food and Nutrition Security Survey (Simelane et al. 2023) found that, in children aged 0–5 years, the national prevalence of stunting was 28.8%, wasting 5.3%, underweight 7.8%, and overweight 22.6%. It appears that the proportion of children with acute and chronic

undernutrition and overnutrition has increased slightly over the past decade. These findings indicate that a double burden of under- and overnutrition is already apparent in early childhood.

Causes and consequences of malnutrition

The United Nations Children's Fund (UNICEF) powerfully described the multifactorial causes of malnutrition, specifically undernutrition, in a seminal publication of 1990 (UNICEF 1990).

Immediate causes (inadequate diet and disease) are driven by underlying causes (inadequate access to food; care; health care services; and an unhealthy environment) which are rooted in basic causes (the broader social, economic and political forces that perpetuate and produce poverty and inequality, neglect human rights, and deny people access to essential resources) (UNICEF 1990).

Undernutrition can have profound and detrimental consequences on neurodevelopment, impacting cognitive, motor, and socioemotional functions. These neurodevelopmental impairments can hinder educational attainment and intellectual potential. This, in turn, poses challenges in securing employment and contributing effectively to the workforce. Undernutrition is estimated to reduce a nation's economic advancement by at least 8% (Black et al. 2013). Furthermore, conditions such as stunting and severe wasting, in the first two years of life, cause irreparable harm by impeding physical growth and, if followed by rapid weight gain in the 3–5-year age range, this increases the risk of obesity and chronic diseases later in life (Black et al. 2013). Understanding the multilevel causes of malnutrition is critical to delivering appropriate, effective, and sustainable interventions and solutions, and adequately meeting the needs of the most vulnerable (UNICEF 2013).

The updated UNICEF conceptual framework (UNICEF 2020) builds on the UNICEF's 1990 framework and acknowledges the increasing triple burden of malnutrition – undernutrition, micronutrient deficiencies and overnutrition – and highlights the role of diets and care as immediate determinants of maternal and child nutrition. The updated framework uses a positive narrative about what contributes to good nutrition in children and women, and provides conceptual clarity on the enabling, underlying and immediate determinants of adequate nutrition, their vertical and horizontal interconnectedness, and the positive survival, growth, development, learning, economic and social outcomes resulting from improved maternal and child nutrition. This narrative embodies nutrition's powerful contribution to the United Nations Sustainable Development Goals (SDGs) (Development Initiatives 2017).

Evidence-based interventions to address malnutrition

Together with a better understanding of the causes of malnutrition, a large body of evidence-based interventions for improved nutritional and development outcomes has been documented over time. These nutrition actions are classified as either nutrition-specific or nutrition sensitive, depending on the determinant they address (Black et al. 2013).

Nutrition-specific interventions address immediate determinants of foetal and child nutrition and development, namely, adequate food and nutrient intake, feeding, caregiving and parenting practices, and low burden of infectious diseases. Examples of interventions include adolescent, preconception and maternal health and nutrition; maternal dietary or micronutrient supplementation; promotion of optimum breastfeeding; complementary feeding and responsive feeding practices and stimulation; dietary supplementation, diversification, micronutrient supplementation or fortification for children; treatment of severe acute malnutrition; disease prevention; and management and nutrition in emergencies (Black et al. 2013; UNICEF 2013).

These interventions should be complemented by broader, nutrition-sensitive approaches to address the broader drivers of the double burden of malnutrition. *Nutrition-sensitive* interventions address the underlying determinants of foetal and child health; food security; adequate caregiving resources at the maternal, household and community levels; and access to health services and a safe, hygienic environment. Examples of interventions include agriculture and food security; social safety nets; ECD; maternal mental health; women's empowerment; child protection; schooling; water, sanitation, and hygiene; and health and family planning services (Black et al. 2013; UNICEF 2013).

The interventions to address different forms of malnutrition are, however, often governed by separate policies, programmes, management structures and funding streams. By contrast, double-duty actions include policies, programmes and interventions that have the potential to simultaneously reduce the risk of undernutrition and overnutrition. Double-duty actions are not necessarily new actions, but are often actions that are already used to address single forms of malnutrition, while also having the potential to address multiple forms concurrently; for example, promotion of breastfeeding and complementary feeding (Hawkes et al. 2020).

Beyond nutritional health, however, is a requirement for an integrated and holistic approach that includes nurturing care.

Nurturing care for early childhood development

A Lancet Series on ECD (Lancet 2017) highlighted the various components necessary for children to reach their developmental potential as well as health and well-being throughout the life course. These components are grouped under an umbrella term, namely, nurturing care.

> Nurturing care is characterised by a home environment that is sensitive to children's health and nutritional needs, responsive, emotionally supportive and developmentally stimulating and appropriate, with opportunities for play and exploration and protection from adversities. (Black et al. 2017, p. 79)

The series presented a life course conceptual framework of ECD that illustrates the five necessary components of nurturing care, namely, health; nutrition; security and safety; responsive caring; and early learning. These components are interrelated and encompass interaction between children, caregivers, and their environment.[1] The child's immediate environment consists of either parents or caregivers, and emerging evidence shows the positive influence that parental education and support have on children's cognitive and language development. Interventions and programmes aimed at the inclusion and interaction of these components will lead to better ECD and greater higher education potential, which will, in turn, lead to increased adult annual income. For optimal nurturing care, an enabling environment must be established for the caregiver, family and community through a sustainable social, economic and political foundation (Black et al. 2017).

Summary

Safeguarding children's nutritional health requires interventions at every stage in the life course, especially during the first 1,000 days of life. A large body of evidence, developed over time, provides critical insights into the causes and consequences of malnutrition (UNICEF 1990, 2020), the evidence-based interventions that can lead to optimal infant and young child health, nutrition and development (Black et al. 2013), and the need for an integrated and multisectoral approach that extends beyond good health and adequate nutrition to include responsive caregiving, and opportunities to explore and learn, within a secure and safe environment (Black et al. 2017). The Nurturing Care framework makes clear how malnutrition is embedded in the social, economic and physical environment in which children are conceived, born and raised (Black et al. 2017). An intersectoral, whole-of-society approach in conjunction with various government departments (Health, Education, Social Development, Labour, Trade and Industry) can harness such interventions to create a more equitable and enabling environment for children globally, including for SA's children (May et al. 2021).

1. See: https://ars.els-cdn.com/content/image/1-s2.0-S0140673616313897-gr1_lrg.jpg

Local research project

In the sections to follow, we report on research from the local (South African) context that aimed to describe the nutrition and nurture profile of ECD centres in Worcester and surrounding farms in the Breede Valley, situated within the Cape Winelands district in the Western Cape province. The semi-rural town of Worcester is the administrative capital of the district and forms part of Stellenbosch University's rural service and community engagement area. Previous research conducted in vulnerable communities in Worcester revealed poor infant and young child nutrition (Du Plessis, McLachlan & Drimie 2018) and gave impetus to this research study in ECD centres.

Methods

This research employed mixed methods (qualitative and quantitative) with a convergent parallel design. The research objectives included an exploration of the ECD environment by describing parental characteristics and the opinions and experiences of ECD centre staff regarding child development, as well as the activities and programmes available at ECD centres. In addition, the components of nurturing care – including health, nutrition, safety and security, responsive caregiving and early learning – within selected ECD centres were described. Furthermore, the nutritional status of children in ECD centres was assessed. Lastly, the alignment with national guidelines and integration of nutritional support within nurturing care practices were discussed, and strengths and gaps in caregiver knowledge, ECD centre resources and policy implications were identified.

Sample selection and inclusion criteria

A list of all ECD centres in Worcester town and surrounding farms was obtained from the Department of Social Development (DSD) in the Breede Valley. With the assistance of the DSD, all ECD centres where research or other interventions were taking place were removed from the list before sample selection. Early childhood development centres were randomly selected from the list. Convenience sampling was used to select the study participants, including staff from ECD centres and mothers of children attending selected ECD centres. All consenting ECD centres, staff and mothers were eligible for inclusion in the study. This study was a community-based project and did not include a therapeutic focus on specific medical conditions, such as developmental disabilities in children.

Data collection tools

A self-administered questionnaire, available in the three official languages in the Western Cape (English, Afrikaans, and isiXhosa), was used to obtain

data from mothers. The life course conceptual framework of ECD (Black et al. 2017) was used as a basis for the development of the questionnaire. Caregiver and family characteristics, which form the 'enabling environment' level of this conceptual framework, were explored. These characteristics include parental education, parental physical and mental health, age of marriage, nutrition during pregnancy, antenatal care, safe delivery, birth spacing and family planning, safety and cleanliness of neighbourhoods and presence of stigma.[2]

A standard protocol was used to assess the anthropometric status of children in accordance with World Health Organization (WHO) child growth measurements (WHO 1995).

A discussion guide was developed to direct the interviews, based on the life course conceptual framework of ECD 'nurturing care' level (Black et al. 2017). These components include health, nutrition, safety and security, responsive caregiving and early learning.[3] Subcomponents applicable to ECD centres were also explored.

Methodology

Data collection took place at ECD centres in Worcester Central, Avian Park, Zweletemba and on farms in the Worcester area in March 2018. Fieldworkers contacted ECD centres to inquire if they were willing to participate in the study and discuss logistical arrangements. For ECD centres situated on farms, permission from farm owners to enter their property was first obtained before contacting the ECD centres. Consent forms were delivered for the mothers, as well as the questionnaires, to centres willing to participate. When delivering the forms, a suitable date and time most convenient for ECD centre staff were discussed for data collection. Fieldworkers explained to the ECD centre staff that all forms intended for mothers needed to be returned by the agreed-upon date. Fieldworkers offered to assist mothers who were illiterate or needed clarification with the completion of the questionnaire on the day of data collection at the specific ECD centre.

Completed forms were coded and this information was logged into a record-keeping book.

Children for whom informed consent was received were weighed and their heights were measured according to standardised procedures (Cogill 2003; WHO 1995).

In-depth interviews were conducted with the manager or a coworker at the ECD centre. Each interview was audio-recorded. Consent for both the interview and the audio recording was obtained before commencing with the interview.

2. See: https://ars.els-cdn.com/content/image/1-s2.0-S0140673616313897-gr1_lrg.jpg

3. See: https://ars.els-cdn.com/content/image/1-s2.0-S0140673616313897-gr1_lrg.jpg

Data analysis

Data were captured in Microsoft Excel, and WHO AnthroPlus (WHO 2011) was used to analyse the anthropometric measurements. Summary statistics were used to describe the variables from the questionnaire data. Frequency tables and histograms were used to present the descriptive data.

Content analysis was performed on the transcribed interview data. Key information was quoted from each interview according to the main components and applicable subcomponents of nurturing care. Short descriptive themes were established related to the objectives.

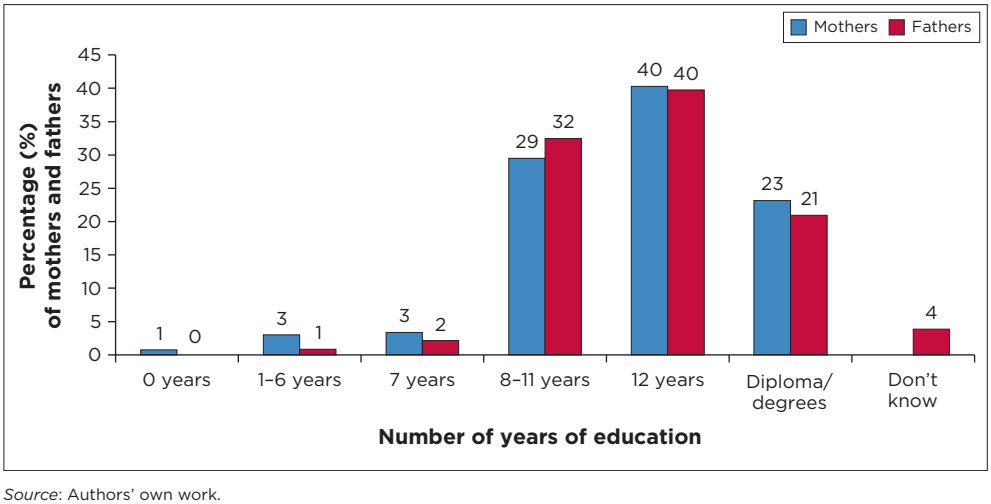
Results

A total of 276 mothers completed the self-administered questionnaire. A total of 29 ECD centres participated and 29 interviews were conducted with centre managers and staff.

Characteristics of the enabling environment created by the caregiver, family and community

Parental education

Mothers and fathers had similar levels of education. Forty per cent (n = 201) of parents had reached Grade 12, around 30% (n = 155) had achieved between 8 and 11 years of schooling, and 22% (n = 111) of parents had some form of higher education (Figure 2.1).



Source: Authors' own work.

FIGURE 2.1: Parental level of education.

Parental physical and mental health

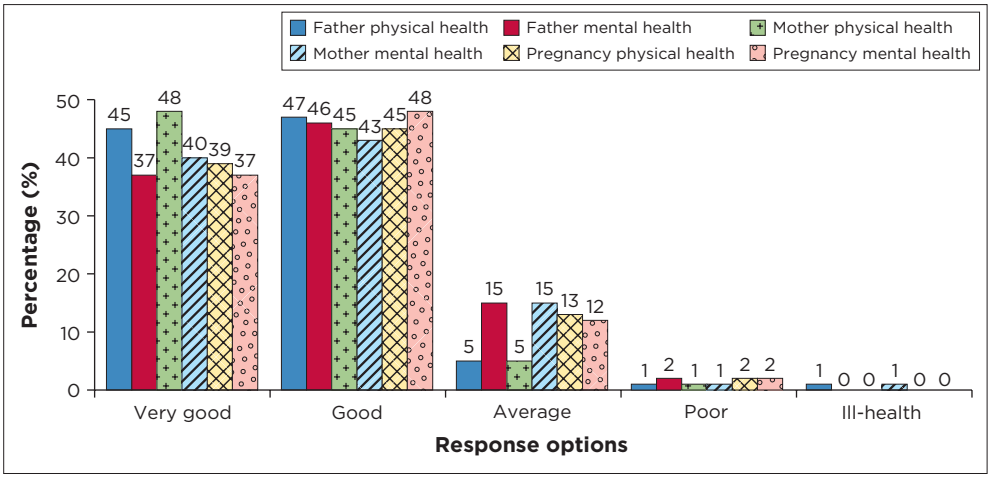
Mothers were asked to describe their own, as well as the father of the child's physical and mental health. Forty-eight per cent (48%; *n* = 130) of mothers rated their physical health as 'very good', and 45% (*n* = 123) rated it as 'good' (Figure 2.2).

Mothers reported mental health ranged from 'very good' (40%; *n* = 106), and 'good' (43%; *n* = 116), to 'average' (15%; *n* = 40) (Figure 2.2). The reported 'average' mental health was attributed to stress, work pressure, short-temperedness and depression.

The data showed that 83% (*n* = 213) of fathers were reportedly present in their child's life, referring to the father living with his biological children and taking part in domestic caring responsibilities in any form. When the father's physical health was described as 'very good' (45%; *n* = 106) or 'good' (47%; *n* = 112), common points of elaboration were that the father is active, plays sport or exercises regularly. When the father's mental health was described as 'average' (15%; *n* = 34) or 'poor' (2%; *n* = 4) (Figure 2.2), the descriptions provided were moody, angry or aggressive, as well as stressed and impatient.

Antenatal care

Most of the participants reported that their physical health during pregnancy was either 'very good' (39%; *n* = 104) or 'good' (45%; *n* = 121), with a similar trend found for mental health ('very good': 37%; *n* = 98; and 'good': 48%; *n* = 127).



Source: Authors' own work.

FIGURE 2.2: Parental physical and mental health.

Age of marriage

Forty-four per cent (44%; *n* = 118) of mothers were married. Mothers were a mean age of 26.20 years (standard deviation [SD] = 4.36) when they got married. The mean age of the mother at the birth of her first child was 21.75 years (SD = 4.37).

Nutrition during pregnancy

Almost all mothers (96%; *n* = 242) indicated that they used nutritional supplements during pregnancy. The supplement with the highest use was iron (82%; *n* = 197), followed by folate (46%; *n* = 112) and calcium (37%; *n* = 88). Only a few mothers (10.5%; *n* = 29) received an energy drink from the Nutrition Therapeutic Programme offered to underweight mothers at primary health care facilities.

Safe delivery

Most of the children attending the ECD centres were born in a hospital (83%; *n* = 223), followed by home births (16%; *n* = 44); 2% (*n* = 5) took place at the clinic. The majority (97%; *n* = 269) reported that a health care worker was present at the birth of their child.

Birth spacing and family planning

The mean number of children per mother was 1.95 (SD = 0.97). The majority of mothers (61%; *n* = 167) had more than one child, with some having two (35%; *n* = 96), three (17% *n* = 47), four (7%; *n* = 19) or five (1%; *n* = 3) children. Seventy-five per cent (75%; *n* = 206) of mothers said that they were using some form of family planning or contraception.

Safe and clean neighbourhoods

The feeling of safety in neighbourhoods was mostly reported as ‘very safe’ (25%; *n* = 68) or ‘safe’ (57%; *n* = 155). Fourteen per cent (14%; *n* = 38) of mothers said that they felt ‘unsafe’, 3% (*n* = 7) felt ‘very unsafe’, and 1% (*n* = 3) reported that they felt that their neighbourhoods are ‘very dangerous’.

The mothers were asked how clean they perceived their neighbourhood to be, and were given the options, ‘very clean’, ‘clean’, ‘average’, ‘dirty’ and ‘very dirty’. Most of the mothers perceived their neighbourhood to be ‘very clean’ (18%; *n* = 50) or ‘clean’ (50%; *n* = 137). Twenty-nine per cent (29%; *n* = 78) of mothers said that it is ‘average’, and 3% (*n* = 7) perceived their neighbourhood to be ‘dirty’.

Absence of stigma

The presence of possible stigmatisation was assessed by asking mothers if they thought that others talked about them behind their backs. Twenty-six per cent (26%; *n* = 73) of mothers said 'yes', while 59% (*n* = 163) of mothers said 'no'. There were also mothers who either left the question unanswered (12%; *n* = 33), or answered, 'I don't know' (3%; *n* = 7). Some mothers replied: 'It is nobody's business'.

They were also given options to choose from a list of what they thought people might say about them. Thirty-seven per cent (*n* = 26) of mothers said that they think that other people talk about their children, while 35% (*n* = 25) thought that other people talk about their home and home environment. Thirty-one per cent (*n* = 22) thought other people talk about what they provide for their children or the environment their children grow up in (30%; *n* = 21), and 14% (*n* = 10) thought others might talk about the number of children they have.

Components of nurturing care

Health

Immunisations and well-child visits

Ninety-one per cent (91%; *n* = 236) of mothers reported that their child's immunisations were up to date for the child's age. The majority (98%; *n* = 270) attended a clinic postpartum; of these 7% (*n* = 20) took their baby 'every week', 71% (*n* = 192) 'every month', 13% (*n* = 34) every '3 months', and 9% (*n* = 24) of mothers said that they took their baby 'now and again'.

The mothers were asked when their baby was last seen by a nurse or doctor. Sixty-five per cent (65%; *n* = 174) of mothers said that their child was seen by a nurse or a doctor within the last 3 months, 17% (*n* = 45) within the last 6 months, and 16% (*n* = 47) within the last 12 months.

Almost all of the ECD centres reported that health care professionals visit the centres at some point during the year. The frequency of these visits ranged from monthly to twice yearly, or only when there were health campaigns, for example, a measles campaign. At most of the farm ECD centres, nurses visited the centres monthly and ensured that immunisations and deworming were up to date, sick children were attended to, and mothers were provided with family planning services. One centre manager also mentioned that a dietitian visited the centre when malnourished children were identified. The town ECD centres were visited less frequently (once to twice a year), and services usually included immunisations and Vitamin A supplementation.

Disease treatment

The mothers were asked if their children had ever been treated for any illnesses. Twenty-three per cent (23%; *n* = 37) reported that their child was treated for diarrhoea, 59% (*n* = 96) were treated for flu, 2% (*n* = 4) for stomach pains and 16% (*n* = 27) received treatment for vomiting; 55% (*n* = 141) had not been treated for any illness.

Hygiene at early childhood development centres

Many of the centres did not have a dedicated cleaner and often relied on teachers to clean their classroom or area where they work. In the centres that had helpers for cleaning, this staff member was usually responsible for meal preparation and cleaning of all areas. Cleaning was often done daily or twice daily. The children were also taught the importance of hygiene through hand-washing routines before and after lunch, and after bathroom use. The toys were cleaned daily at some centres, and bedding was washed approximately once a week.

Nutrition

Breastfeeding

Different options were given for what the child was fed right after birth, with more than one response allowed. Eighty-nine per cent (89%; *n* = 244) of mothers said that they gave their babies breastmilk and more than a third of mothers (37%; *n* = 101) gave their babies formula milk right after birth. Six per cent (*n* = 16) of mothers gave their child water after birth, two per cent (*n* = 6) gave tea and one mother (0.37%) gave juice.

A broad range was reported for the duration of breastfeeding, with a mean duration of 13.32 months (SD = 12.61). Mothers were asked about breastfeeding and returning to work, with a 'yes' or 'no' tick box, as well as the option of 'I did not return to work'. Breastfeeding was continued by 55% (*n* = 131), while 27% (*n* = 64) of mothers were unable to continue breastfeeding when they returned to work. Eighteen per cent (*n* = 42) of mothers did not return to work. Reasons for stopping breastfeeding upon return to work were the distance from home, working hours, decreased milk production or that 'the baby did not want the milk anymore'. Some mothers were aware that cup feeding or expressing the milk would have helped to continue breastfeeding upon return to work.

Dietary diversity

Although dietary diversity was not measured directly, the interviews provided detailed information about the variety of meals at ECD centres.

Most ECD centres provided meals for the children, and those that did not asked parents to pack lunch, as they could not provide meals because of either the expense or lack of preparation facilities. Most of the centres provided breakfast and lunch for the children and asked the parents to pack snacks. Many had a weekly menu or a four-week cycle menu, which they would follow for the preparation of the meals. The breakfasts were mostly a rotation of maize meal porridge, oats or Weetbix. The lunch was a cooked meal (stews with rice, chicken, potatoes and vegetables, spaghetti and mince, or samp and beans) about three times a week and a sandwich for the other two days of the week. At some centres, fruit was given twice a week, or only if the mothers packed it. Another centre mentioned that they do not always prepare vegetables because many of the children did not eat them:

> 'I don't think the parents let them eat vegetables, because they waste a lot of vegetables.' (Interview MN003 to Bestbier, 28 February 2018)

Anthropometric profile

The anthropometric profile of children: Stunting 13% (*n* = 42), underweight 6% (*n* = 21), severely underweight 1% (*n* = 2), overweight 5% (*n* = 16) or obesity 4% (*n* = 12).

Safety and security

Reducing adversities

Steps were in place in ECD centres to ensure that no child was neglected, which included that no child was ever left alone, and there was always supervision. The majority of the ECD centres have a specific number of children assigned to a teacher. From the following statement, it is clear that the managers want the children to feel loved, and that all of them are equally important.

> 'As a child I was pushed aside by my teacher so that has been my motto from the start, that will never ever happen under my supervision.' (Interview MN001 to Bestbier, 28 February 2018).

Some of the managers admitted that it is sometimes challenging to give everyone equal attention and not to favour any child, but most showed an understanding of the importance of not showing favouritism.

Of the 29 ECD centres visited, only one had a case where they reportedly experienced neglect or abuse. Everyone who is involved in the centre reportedly knew exactly what to do and what steps to take when such a case occurred. Some of the managers felt that they should talk to the child first and then involve the parents, while other managers involve the social worker first and let them take it further. All of the

managers knew that they needed to involve a social worker at some point when abuse was suspected or present, or the police in more severe cases.

Responsive caregiving

Caregiving routines

Some centres had no set routine, while other centres had a structured, time-bound programme that they followed; all centres covered mostly the same activities throughout the day.

Free play with toys seemed to be a common aspect in each centre's routine. The children have ample time to play, and learning is reportedly incorporated into their play. The ECD centres also have a large focus on hygiene. Almost all the centres reported that they had specific times when the children had to wash their hands throughout the day, always before eating and at other times throughout the day as well.

The interviews with the managers also revealed that centres try to promote learning by doing a variety of different activities with the children, such as creative arts and educational development activities, for example, building blocks or puzzles.

Support of emotional development

Many of the managers said that they support the children's emotional development through communication. Some of the centres include learning about emotions as a theme covered in the teaching curriculum during the year.

Caregiver nurturance and continuity

Almost every ECD centre interviewed said that the staff who work there form good relationships with the children. Some of the coworkers mentioned that the children show trust in them. Another recurring theme from the answers from the managers and coworkers was that they show the children a lot of love and affection. Many said that they give the children 'a lot of hugs' and make them feel safe. Many of the managers also mentioned that they only hire staff who love children.

Early learning

Perception of quality childcare and continuity to primary school

All ECD managers and coworkers who were interviewed said that they believed that their children are ready for primary school in the year they

need to be enrolled for Grade R. They focus on teaching the children to count, use scissors, colouring in and pencil grip. Many said that they received positive feedback from the primary schools. Special effort is taken to identify children who struggle.

> 'If I see a child is struggling, I make the effort to ensure that that child is ready for Grade R.' (Interview MN017 to Kayser, 07 March 2018)

Books, toys and play materials

The ECD centres have a variety of educational tools and toys used to promote learning in the children. The common educational tools throughout the centres were puzzles, books, crayons, clay, hula hoops and building blocks.

Discussion

Nurturing care during early childhood has been described as the essential foundation for human capital development (Black et al. 2015). Therefore, the burden of children not reaching their developmental potential can lead to huge deficits in a country's economic income (Berlinski & Schady 2015). To ensure optimal development, it is vital that all necessary components of nurturing care are in place (Black et al. 2017).

Our findings suggest that the components of nurturing care are largely in place for children attending ECD centres in Worcester town and surrounding farms in the Breede Valley, and an enabling environment exists to support these components.

Almost all mothers reported that their child's immunisations were up to date for their age, and reported having regularly visited the clinic after the birth of their child. Early childhood development centres were also aware of the importance of hygiene in disease prevention and reported having health care professionals visit the centre. It was noticed that ECD centres on farms had more regular visits from health care professionals as compared to town ECD centres, probably because there are fixed clinics in the town areas and mobile services are available for more remote areas. It is encouraging that primary health care outreach was reported in this study, because early identification and appropriate classification or diagnosis of childhood health conditions is critical for appropriate and timely intervention, especially in children under 5 years of age (National Department of Health 2012).

There is compelling scientific evidence that in developing countries, optimal breastfeeding during the first year of life can prevent around a million deaths of children under the age of five. Exclusive breastfeeding is

therefore seen as the optimal source of nutrition for the first 6 months of life (Rollins et al. 2016). The study reported here showed high initiation of breastfeeding after birth, and continued breastfeeding for the first year of life, whereas the international recommendation encourages breastfeeding for up to two years and beyond. There is therefore room for improvement in the duration of breastfeeding, which could be beneficial to optimise children's growth and development (Rollins et al. 2016). For improvements in the duration of breastfeeding to be realised, support for breastfeeding in the workplace is necessary (Daniels, Du Plessis & Mbhenyane 2020), as only around half of the mothers in the current study reported being able to continue breastfeeding once they returned to work.

The majority of ECD centres provided meals for the older children, although the lack of variety in the diet, as reported during interviews, was notably related to low fruit and vegetable consumption. The National Department of Health's Nutrition Guidelines for ECD Programmes (National Department of Health 2018) provide direction on infant and child feeding in the age categories 0–6 months and 6 months to 6 years. Although it was not the intent of this research to compare meal provisioning at ECD centres with these guidelines, it seems that the meals provided at surveyed ECD centres are starch-dominated and lack diversity. This observation is consistent with both international (Fookes, Hockridge & Quinn 2009; Frampton et al. 2014) and local studies (Nzama & Napier 2017; Pietersen et al. 2002) that describe meals provided at ECD centres as nutritionally inadequate in meeting macro- and micronutrient requirements of children, and not following nutritional guidelines.

The anthropometric status of children in this study indicated a lower prevalence of stunting (13%) and overweight and obesity (5%) compared to the national averages (27% and 14%) (SADHS 2016; Shisana et al. 2013). In contrast, according to a large study conducted in Worcester (Matlwa Mabaso et al. 2021) with 854 mother–infant pairs, stunting prevalence was 26% in children under five, while 11% of children were overweight and 5% were obese. These figures mirrored the national averages, which raised a question about the sampling strategy. The national surveys and the Matlwa Mabaso et al. (2021) study sampled from households, whereas our study sampled from ECD centres. This aligns with the Thrive by Five 2021 Index, which found that children attending early learning programmes had a lower stunting prevalence (5.7%) than national averages, reinforcing the importance of ECD enrolment (Giese et al. 2022). This finding has prompted the authors of the Thrive by Five Index to advocate for all children in SA to be enrolled in an ECD centre or programme (Giese et al. 2022).

Safety and security are fundamental to nurturing care. Our findings indicate that ECD staff prioritise supervision, ensuring children are

protected from neglect or harm. An important part of this care is to reduce adversities and to identify when intervention is needed for vulnerable children. To safeguard children at ECD centres, staff ensure that there is always supervision of children during play and mealtimes, and all staff are informed about dealing with neglect or abuse of a child. The interviews with many of the managers suggested that the ECD centre environment was often viewed as a place of safety for the children.

Responsive caregiving is another component of nurturing care, which was explored in the ECD setting. These ECD centres played an essential role in ensuring caregiver nurturance and continuity, as many of the managers explained that they support the development of children's emotions through communication and relationship building with the staff members and other children. This study shows that ECD centre managers understood the importance of their role in ensuring that a child is prepared for primary school. A systematic review prepared for the WHO (Jeong, Franchett & Yousafzai 2020) showed that interventions combining both features of caregiving (i.e. responsive care and support for early learning) had significant positive effects on cognitive, language and motor development, as well as caregiving knowledge, caregiver practices, and caregiver-child interactions.

The environment created by the caregiver, family and community was also explored, as it directly influences the quality of nurturing care that can be provided. Physical and mental health are both key aspects which affect the enabling environment for nurturing care. Reporting of physical and mental health in this study was reassuring, because poor maternal mental health is associated with negative outcomes on child growth and development, such as poor infant growth, as well as emotional and behavioural difficulties (Stein et al. 2014).

In the current study, most mothers had children before they got married, and marriage only occurred a few years after their first child's birth. This could indicate that many of these children may not have had a stable father figure for the first few years of life, which are crucial years for emotional and social development. Shared caregiving that includes fathers as well as other family members is beneficial for both child and mother (Singla, Kumbakumba & Aboud 2015).

Almost all mothers used supplements during pregnancy, with iron use being the highest, followed by folate and calcium. The *Strategic Plan for Maternal, New-born, Child and Women's Health and Nutrition in South Africa* (2012), describes the package of care for maternal health, which includes basic antenatal care. This policy document states that all pregnant women should receive supplementation with iron, folate and calcium. In the current study, not all mothers reported that they used these specific supplements

during pregnancy. The low use of folate and calcium could be problematic, as a folate deficiency can lead to birth defects in the foetus, while a calcium deficiency is linked to pre-eclampsia. The World Health Assembly's Global Nutrition Targets aim for a reduction in anaemia in women of reproductive age (WHO 2015). As 82% of mothers reported using iron during pregnancy, it can be seen as a step in the right direction towards achieving this goal.

Conclusions

The components of nurturing care seem largely in place for children attending ECD centres in the Breede Valley, Western Cape province. An enabling environment exists to support these components, with improvements recommended for certain components of care, to ensure that children are well on their way to reaching their developmental potential. Early childhood development centres can therefore be seen as key community assets and could serve as health and nutrition hubs for children.

Because mothers worked and had limited time in the morning and afternoon when children were dropped off and picked up from ECD centres, it was difficult to decide on a method to gather the required information. The self-administered questionnaire could have impacted the reliability of some of the responses. Details about parental employment were not gathered, which can be viewed as a limitation in describing socio-economic factors that impact child development outcomes. Furthermore, no observations were done, and data were self-reported and based on perceptions and opinions from mothers and ECD staff, which could be subjective.

Recommendations for future studies include an assessment or audit of food provisioning, in accordance with the National Department of Health's Nutrition Guidelines for ECD Programmes (National Department of Health 2018). Furthermore, ECD centre settings provide opportunities for training of staff, and for nutrition education to parents and caregivers for improved food provisioning and, ultimately, improved nutritional and health outcomes of young children. A thorough assessment of the social, economic, political, climate and cultural context, is recommended to provide more comprehensive insights into how stable the foundation of the life course conceptual framework of ECD is, in the broader study setting.

Declarations

Ethical considerations

This project was approved by the Health Research Ethics Committee of Stellenbosch University (Reference number: U17/09/042). The necessary permission to conduct the study was also obtained from the DSD.

Consent

Informed consent was obtained from all participants, and a copy of each consent form was delivered to the respective ECD centres for each participant's personal records. Child assent was not possible for this young age group, but children who showed or expressed fear, discomfort or any negative emotion (e.g. crying) were not forced or coerced to participate. Each participating ECD centre received a set of donated children's books to thank them for their participation.

Author contributions

Lisanne du Plessis: Conceptualisation, Formal analysis, Investigation, Methodology, Validation, Resources, Data curation, Funding acquisition, Project administration, Supervision, Visualisation, Writing – original draft preparation, Writing – review and editing.

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All authors reviewed the article, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

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Competing interests

The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this chapter.

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Data availability

The study dataset will be made available upon reasonable request.

Disclaimer

The views expressed in this chapter are the authors' own and not an official position of the institution, funder or the publisher.

Chapter 3

Advancing school readiness for children with disabilities in low- and middle-income countries

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Abstract

Background: Early childhood development (ECD) is critical for lifelong learning and well-being, yet children with disabilities remain at high risk of marginalisation.

Aim: This chapter aims to provide a global perspective on early child development and the rights and needs of children with disabilities.

Methods: A review of 10 papers from the Global Research on Developmental Disabilities Collaborators was conducted. These papers assess the prevalence of disabilities among children, school readiness, culturally sensitive parenting interventions and community-based early intervention programmes. Additionally, national programmes supporting ECD for children with disabilities were analysed to identify best practices and policy gaps.

Findings: Five key findings emerged: (1) a twin-track approach is necessary to meet the diverse needs of children with disabilities; (2) guidelines for early screening, diagnosis and referrals are essential; (3) national legislation must support ECD programmes; (4) sustainable funding mechanisms are required; and (5) effective multisectoral coordination and accountability at national and community levels are critical.

Conclusion: A global ECD strategy tailored for children with disabilities is needed to bridge existing gaps. Such a strategy should integrate health and education systems, ensure dedicated funding, and promote legislative support to achieve inclusive education.

Introduction

This chapter discusses the global vision for early childhood development (ECD), focusing on children under 5 years and their access to quality education, especially those with or at risk of disabilities. The United Nations (UN) Sustainable Development Goals (SDGs) (UN General Assembly 2015) aim to achieve universal access to quality ECD and pre-primary education for all children by 2030. While the Nurturing Care Framework was established in 2018 to promote early childhood development in low- and middle-income countries, it was not designed to promote school readiness for inclusive education for children with disabilities as envisioned by the SDGs. A global ECD strategy for children with disabilities is therefore essential to address the gaps and inequities in current ECD programmes. Having a unifying framework, action plan, political commitment and financial support from international partners is crucial. Such a strategy would contribute to fulfilling the SDG pledge of providing inclusive education for children with disabilities by 2030 and ensuring that no child is left behind.

Recent data reveal that approximately 145,000 babies are born yearly with or acquire lifelong disability in early childhood, making the issue of ECD even more pressing. To address this issue, we reviewed 10 papers published by 64 authors from around the world, as part of the Global Research on Developmental Disabilities Collaborators (Olusanya et al. 2023a). This chapter explores the prevalence, implications and early intervention strategies for children with disabilities among different contexts, with a particular focus on low- and middle-income countries (LMICs). The 10 papers included in this chapter address critical gaps in the literature on the prevalence of disabilities among children and adolescents, the concept and evaluation of school readiness and the critical role of culturally sensitive parenting interventions. The papers also explore the feasibility of community-based programmes for early care and support for young children with developmental disabilities and their caregivers. We examine the implications for policy, research and practice, and highlight the significance of addressing disabilities among children and adolescents, promoting early detection and intervention and implementing comprehensive strategies to ensure equal opportunities for all children, regardless of their abilities.

Prevalence of disabilities among children and adolescents

Children with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which, in interaction with various barriers, may hinder their full and effective participation in society on an equal basis with others (United Nations Children's Fund [UNICEF] 2021; United Nations 2006). Disabilities among children and adolescents have adverse consequences that affect their lives, education and employment prospects (Black et al. 2017; UNICEF 2021). Accurate estimation of disability prevalence is crucial for policy development, resource allocation and research prioritisation. This section explores three research papers that contribute to our understanding of the global and regional prevalence of disabilities among children and adolescents, focusing on different methodologies and data sources. We then discuss the implications for policy, research and practice, highlighting the need for comprehensive approaches to address disabilities among this population.

Global prevalence of disabilities among children and adolescents

Accurate collection of data on the prevalence of disability is essential to plan, initiate and develop national services. An analysis of findings from

global health databases (Olusanya et al. 2022a) therefore examined disability prevalence estimates reported by leading global health organisations. The study compared prevalence estimates from UNICEF, the World Health Organization (WHO), the World Bank and the Global Burden of Diseases study. By analysing the methodologies used and the latest available data, the researchers provide a comprehensive overview of disability prevalence globally and regionally. The UNICEF estimates indicate that globally, 10.1% of children aged 0–17 years, totalling 236.4 million, have moderate to severe disabilities (UNICEF 2021). Sub-Saharan Africa and South Asia together account for more than half of these children. In contrast, the Global Burden of Disease estimates suggest that globally 11.3% of all children under 20 years, totalling 291.3 million, have mild-to-severe disabilities (Olusanya et al. 2022a). Again, South Asia and sub-Saharan Africa contribute to over half of these cases. Children under 5 years with disabilities represent 12.2% according to UNICEF estimates, with developmental intellectual disability being the most prevalent (3.2%). The Global Burden of Disease study estimates for this age group differ, with South Asia showing a 6.7 percentage point difference, and the estimate being almost three times higher than UNICEF's. The statistical comparison between UNICEF and Global Burden of Disease estimates reveals significant differences only among children under 5 years, suggesting equivalence for other age groups. The paper emphasises the importance of accurate estimation to address the challenges faced by children with disabilities throughout their lives, such as limited educational opportunities and reduced employment prospects.

Global prevalence of developmental disabilities

These variations in disability prevalence estimates for children under 5 years highlight the need for a standardised approach in studying the epidemiology of developmental disabilities. Subsequently, an umbrella review (Olusanya et al. 2023b) compared prevalence estimates for developmental disabilities from systematic reviews and meta-analyses with data from global health databases, such as the WHO and the Global Burden of Disease study. The results demonstrated varying prevalence estimates across disabilities, with sensory impairments the most prevalent disabilities (13.1% for hearing loss and 12.7% for vision loss). Most of the global prevalence estimates were from primary studies conducted in high-income countries, and estimates for LMICs were reported for only three disabilities: Autism spectrum disorder, cerebral palsy and developmental dyslexia. When estimates from the systematic reviews were compared to the Global Burden of Disease study, discrepancies were also observed, which arose from data sources and modelling techniques. The limited data available for LMICs underscores the need for comprehensive studies in these settings.

Cerebral palsy and intellectual disability in children younger than 5 years

Building on the broader investigations into disability prevalence and subsequent focused inquiries into developmental disabilities, the prevalence of cerebral palsy and intellectual disability for children under 5 years old was also estimated (Olusanya et al. 2022b). The study used the Global Burden of Disease–World Health Organization Rehabilitation Database to estimate the prevalence and years lived with disability for cerebral palsy and intellectual disability. The findings reveal that globally, approximately 8.1 million children under 5 years old had cerebral palsy in 2019, with the highest prevalence observed in sub-Saharan Africa and South Asia. Moreover, intellectual disability affects around 16.1 million children in this age group globally. The study emphasises the need for primary prevention strategies and highlights the unmet rehabilitation needs in LMICs. Early detection and intervention are crucial for optimising outcomes and promoting inclusive education. However, the study acknowledges the limitations of the modelling approach and the need for further research to improve estimates and understanding of these conditions globally.

Implications for policy, research and practice

These three papers underscore the importance of accurate prevalence estimations for policy development, resource allocation and research prioritisation. The findings highlight the disparities across regions and disabilities. Comprehensive approaches to measuring disability, particularly in infants and young children, and promoting the inclusion of children with mild disabilities in prevalence estimates, are urgently needed.

In summary, this section highlights the importance of global and regional estimates of disabilities. Specifically, the estimated prevalence of developmental disabilities will be useful for the planning of services and to better estimate areas of need for country programmes. Early detection is important so that cases can be linked to early intervention and rehabilitation services, when this service is most effective. Scaling up these services for screening and intervention should be a priority to enhance the well-being and opportunities for children with disabilities.

Importance of early detection and intervention for school readiness

The development of the human brain during the early years of life is a critical period that lays the foundation for future cognitive, motor and

socioemotional abilities (Richter et al. 2019). However, many children in LMICs who are at risk of neurodevelopmental disorders face challenges in achieving school readiness (Lynch & Soni 2025). This part of the chapter focuses on papers that explore the importance of early detection and intervention in promoting school readiness for these children, highlighting the need to adapt methods to local situations and involve families.

The developing brain and neuroplasticity

Understanding the concept of neuroplasticity is essential, given the extensive brain development in the young human brain during the first two years of life, including the formation and subsequent disappearance of temporary structures and connections, such as the cortical subplate and the cerebellar external granular layer (Hadders-Algra 2022). Neuroplasticity allows for both positive and negative effects on brain development, enabling the brain to adapt and reorganise itself in response to new experiences, learning and environmental changes. The nature and timing of the stimuli during this period can either enhance cognitive function or result in maladaptive alterations.

Various methods for early detection of neurodevelopmental disorders in infants therefore play a crucial role in identifying potential issues. For example, caregiver questionnaires (e.g. Parents' Evaluations of Developmental Status) (Brothers, Glascoe & Robertshaw 2008), Ages and Stages Questionnaire (Squires, Bricker & Twombly 2009) and the Denver Developmental Screening Test (Frankenburg et al. 1996) are considered cost-effective options (Hadders-Algra 2022). Specific methods, such as magnetic resonance imaging and general movement assessment, show promise in detecting conditions such as cerebral palsy in infants (Novak et al. 2017). Additionally, the Hammersmith Infant Neurological Examination (Novak et al. 2017) and the Standardised Infant Neurodevelopmental Assessment (Hadders–Algra et al. 2020) are effective tools for detecting cerebral palsy and intellectual disability.

After early detection, the interventions for children at risk of neurodevelopmental disorders influence the developing brain and its inherent neuroplasticity. Early intervention programmes that promote sensitive parent–infant interaction and stimulate infant development play a critical role in shaping the developing brain. These interactions create a rich environment for learning and neural development, leveraging neuroplasticity to enhance cognitive function. Sensory experiences, social interactions and exposure to new stimuli can lead to the strengthening and refinement of neural connections. Furthermore, the importance of early intervention is underscored in promoting school readiness for children at

risk of neurodevelopmental disorders. Intervention programmes harness neuroplasticity by focusing on the child's activity domain and introducing assistive devices early. The brain's capacity to adapt and reorganise itself is employed to facilitate the integration of these tools into the child's daily life, improving their ability to engage with their environment and develop essential skills. In the case of caregiver-mediated social communication interventions, particularly for infants at increased risk of autism spectrum disorders, the emphasis is on fostering social interaction skills. These interventions are tailored to leverage neuroplasticity, promoting the development of neural pathways associated with communication and social engagement. By capitalising on the brain's ability to adapt and reorganise in response to new experiences, these interventions aim to enhance social and communication skills in infants at risk, ultimately supporting their neurodevelopment.

Challenges and opportunities in low- and middle-income countries

Limited resources, including equipment costs and access to health care, pose challenges to early detection and intervention compared to high-income countries. However, the use of cost-effective tools such as caregiver questionnaires, community health workers, and specific assessments, such as the Hammersmith Infant Neurological Examination and the Standardised Infant Neurodevelopmental Assessment, can help overcome some of these barriers. Adapting methods to local situations and integrating cultural beliefs and practices are crucial for successful early detection and intervention efforts in LMICs (Mwangi et al. 2022; Sapiets, Totsika & Hastings 2021).

Implications for policy, research and practice

Policymakers should prioritise the inclusion of children with disabilities in quality ECD and pre-primary education programmes, aligning with the UN's SDGs. This requires systematic changes in school functioning, attitudes and beliefs, as well as adequate training for teachers in inclusive education (Nair, Radhakrishnan & Olusanya 2023).

The role of parents and the community is important, and often forgotten, in fostering school readiness for children with disabilities. Parental involvement and empowerment are crucial, as parents serve as decision-makers and advocates for their children. However, parents in LMICs face challenges such as stigma, financial limitations, limited information and parental education and limited access to health care and educational facilities (Banks et al. 2022; Lynch & Soni 2025; Soni,

Reyes Soto & Lynch 2022). Therefore, it is essential to provide parental support, address community practices and beliefs and promote community enlightenment to support school readiness for children with disabilities.

Parent support programmes may enhance parents' knowledge, skills and support for early learning, thereby filling existing gaps in service availability (Smythe et al. 2022). However, implementing parenting interventions in low-resource settings presents challenges and ethical concerns. Culturally appropriate approaches that consider community practices and beliefs should be developed and implemented to ensure the effectiveness and sustainability of these interventions (Ohajunwa 2022).

In light of these findings, policymakers should prioritise the needs of children with disabilities and allocate adequate funding for inclusive education, health care and parent support programmes. The integration of inclusive education and disability-inclusive health services should be part of national strategies and plans. Additionally, further research is needed to develop and validate assessment tools for evaluating school readiness specifically designed for children with disabilities in LMICs. Longitudinal studies assessing the long-term outcomes of early detection and intervention programmes in LMICs would also provide valuable insights.

In summary, this section highlights the importance of early detection and intervention in promoting school readiness for children at risk of neurodevelopmental disorders in LMICs. It underscores the need to adapt methods to local situations, involve families, and address cultural beliefs and practices. Inclusive education, parental involvement and parenting interventions play crucial roles in optimising school readiness for children with disabilities. Policymakers, researchers and practitioners must collaborate to ensure that children with disabilities have equal opportunities to thrive and succeed in their educational journey.

Approaches to early intervention in low- and middle-income countries

In low- and middle-income settings, where resources may be constrained, early intervention plays a pivotal role in addressing the developmental needs of children. The significance of ECD is universally acknowledged; yet, the approaches to early intervention must be contextually tailored to effectively mitigate the challenges unique to these settings. In this section, we explore various strategies and methodologies employed in low- and middle-income contexts to provide timely and targeted interventions for children's developmental well-being. Early intervention programmes play

a crucial role in promoting the development and well-being of infants and young children with developmental disabilities. This section examines the potential of early intervention strategies in LMICs, drawing insights from two programmes piloted in Brazil and Uganda, as well as two policy papers from Chile and sub-Saharan Africa.

The coping with and caring for infants with special needs early intervention programme

The 'coping with and caring for infants with special needs' early intervention programme (COPCA) incorporates coaching as a major strategy (Akhbari Ziegler et al. 2023). The coaching goal is to empower family members to uncover their own strategies, capacities and competencies for engaging their child with special needs in everyday parenting situations. These coaching strategies were found to improve cognition, mobility, family empowerment and well-being in high-income countries. The COPCA programme has been piloted in Brazil and demonstrates the potential benefits of this approach in LMICs (Akhbari Ziegler et al. 2023), where access to early intervention services is limited. The COPCA approach may contribute to better outcomes and increased school readiness by empowering families and promoting their child's development. The home-based nature of COPCA and the potential for telecoaching may also reduce the burden on families and improve accessibility to intervention services.

Community-based programmes in Uganda

The Baby Ubuntu programme is a community-based, group, participatory, peer-led intervention for young children with developmental disabilities and their caregivers in Uganda (Nanyunja et al. 2022). The programme was found to be acceptable and feasible to deliver, with positive impacts on caregiver and child outcomes. Importantly, feasibility is facilitated by peer support, community engagement and integration with existing community health care systems. However, barriers such as stigma, poverty and limited access to specialised care services need to be addressed. Early engagement of male caregivers, community sensitisation and provision of social protection and livelihood support are crucial. Future plans include integrating the programme within government health care systems and conducting further evaluations.

In the accompanying policy reviews, critical evaluations and insights are provided on the efficacy and challenges of implementing early intervention strategies in LMICs, offering valuable perspectives for shaping effective policies and programmes.

Early childhood development policies in Chile

Chile's commitment to supporting children with developmental disabilities during early childhood is evident through investments in public health, social protection and education (Breinbauer et al. 2022). The focus encompasses early detection, prevention and services for children with developmental disabilities. Despite these efforts, challenges such as the lack of a national indicator for developmental delays, fragmented data collection and limited accessibility of information on benefits persist. It becomes imperative to address these gaps by involving the disability community in shaping services and evaluation. Rigorous studies on school readiness and educational outcomes, coupled with mental health support for children and families, are crucial elements for comprehensive intervention. Embracing inclusive approaches, fostering changes in perspectives towards disabilities and emphasising acceptance and strengths-based approaches are essential components that contribute to better outcomes and mental health for children with developmental disabilities.

Addressing gaps in sub-Saharan Africa

Integrated and comprehensive approaches are required in sub-Saharan Africa to reduce the occurrence and impact of developmental disabilities (Samia et al. 2022). The current state of schools in the region is marked by limited physical accommodations, insufficiently trained teachers and a lack of necessary services tailored for children with disabilities. To bridge these gaps, there is pressing demand for inclusive education frameworks, the provision of assistive technologies and the creation of environments that inherently accommodate diverse needs. Moreover, early diagnosis protocols, active involvement of parents, collaborative models involving various stakeholders and the development of supportive policies are crucial components in providing effective support for children with disabilities. The integration of peer support, fostering social interactions and the reduction of stigma through inclusive education are essential in improving the lives and opportunities of individuals with disabilities in Africa.

Implications for policy, practice and research

Implications for policy: Enhancing access to early intervention services is crucial. Governments should prioritise the development of community-based programmes that are home-based and may consider incorporating telecoaching and telehealth strategies to improve accessibility. Integrated policies and coordination are needed across sectors such as health, education and social protection to support children with developmental disabilities. Establishing coordination mechanisms can

streamline services, enhance early detection and provide comprehensive support. Inclusive education should be a policy priority, focusing on improving school accessibility, providing accommodations and training teachers to support children with developmental disabilities effectively.

Implications for practice: Practitioners should adopt family-centred approaches, involving families in decision-making and designing intervention plans. Supporting and empowering families enhances intervention effectiveness. Peer support and community engagement play a vital role. Practitioners should foster support networks, involve community members in programme delivery and engage leaders to reduce stigma and create a supportive environment.

Implications for research: Research is needed to assess the cost-effectiveness and scalability of early intervention programmes. Evaluations can determine long-term impacts and integration with existing health and social service systems. Long-term outcomes, including school readiness, educational achievements, social integration and mental health, should be assessed to understand the broader impact of interventions. Culturally appropriate assessment tools should be developed and validated to accurately identify children in need of early intervention services.

In summary, policymakers should prioritise enhancing access, implementing integrated policies and promoting inclusive education. Practitioners should adopt family-centred approaches and engage communities. Research should focus on cost-effectiveness, long-term outcomes and culturally appropriate assessment tools to strengthen early intervention efforts.

Overview of global commitments on children with disabilities

As we explore the implications for policy, practice and research, it becomes clear that these considerations are closely intertwined with the overarching global commitments to children with disabilities.

A focal point of the second global summit during the UN General Assembly in 2023 to assess progress on the 2015–2030 Agenda for Sustainable Development was the commitment to ECD for children under 5 years old, encompassing SDG 4.2 – ensuring inclusive and quality education. Sustainable Development Goal 4 is the first global pledge for ECD in LMICs (Figure 3.1). In this figure we highlight the most relevant global policies towards children with disabilities, and provide a historical overview of key global pledges and resolutions dedicated to advancing the rights and well-being of children with disabilities.

1946: UNICEF Mission Statement

'UNICEF is non-partisan, and its cooperation is free of discrimination. In everything it does, the most disadvantaged children and the countries in greatest need have priority.'

1990: The UN Convention on the Rights of the Child

'Recognizing the special needs of a disabled child, assistance shall be provided free of charge, whenever possible, taking into account the financial resources of the parents or others caring for the child and shall be designed to ensure that the disabled child has effective access to and receives education, training, health care services, rehabilitation services, preparation for employment and recreation opportunities in a manner conducive to the child's achieving the fullest possible social integration and individual development, including his or her cultural and spiritual development.' [Article 23.3]

2002: Special UN Resolution on A World Fit for Children

'We will take all measures to ensure the full and equal enjoyment of all human rights and fundamental freedoms, including equal access to health, education and recreational services, by children with disabilities and children with special needs; to ensure the recognition of their dignity; to promote their self-reliance; and to facilitate their active participation in the community.' [Plan of Action, A:21]

2006: The UN Convention on the Rights of Persons with Disabilities

'Provide those health services needed by persons with disabilities specifically because of their disabilities, including early identification and intervention as appropriate, and services designed to minimize and prevent further disabilities, including among children and older persons.' [Article 25b.]

2011: The WHO World Report on Disability

'Where there are none, or only limited, services introduce minimum services within existing health and social service provision [...] include: [*d*]eveloping basic rehabilitation services within the existing health infrastructure [...*s*]trengthening rehabilitation service provision through community-based rehabilitation [...*p*]rioritizing early identification and intervention strategies using community workers and health personnel [...]' [Service Delivery pp. 122–123]

2013: The Resolution of the World Health Assembly on Disability

Request WHO to provide technical assistance to Member States '[...] to promote habilitation and rehabilitation across the life course and for a wide range of health conditions through: early intervention; integrated and decentralized rehabilitation services, including mental health services; improved provision of wheelchairs, hearing aids, low vision devices and other assistive technologies; and training to ensure that there is a sufficient supply of rehabilitation professionals to enable people with disabilities to achieve their potential and have the same opportunities to participate fully in society [...]' [WHA66.9 Disability, Resolution 2(6)]

2013: The UNICEF State of the World's Children

'[...*R*]eliable and objective data are important to assist in planning and resource allocation, and to place children with disabilities more clearly on the development agenda. The necessary statistical work will take time but would be given vital impetus were international donors to promote a concerted global research agenda on disability. In the meanwhile, planning and programming will have to continue; denying or delaying services to children with disabilities because more data are needed would be unacceptable. Rather, plans, programmes and budgets can be designed to allow for modifications as additional information is made available.' [Global promise, local test p. 85].

2015: UN SDG

'Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

- Target 4.2: By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education.
- Indicator 4.2.1: Proportion of children under 5 years of age [revised in 2021 as "aged 24–59 months"] who are developmentally on track in health, learning and psychosocial well-being, by sex.'

FIGURE 3.1: Highlights from global pledges and resolutions for children with disabilities (Olusanya et al. 2023c).

Despite the historical advancements highlighted in Figure 3.1 and the emergence of initiatives like the Nurturing Care Framework, which focuses primarily on health-related issues during the early stages of life, a critical gap persists. A more comprehensive approach is needed, with global leadership, effective governance and increased investments to extend beyond health interventions. To bridge this gap, there is a need for routine screening, diagnostics and family-centred rehabilitation specifically tailored for children with developmental disabilities in LMICs. By shifting the emphasis from singular health-related interventions to a more holistic strategy encompassing various aspects of development, including education, social integration and overall well-being, such an approach would align with the broader spectrum of global pledges and resolutions highlighted in Figure 3.1. Addressing these multifaceted needs requires strategic planning, collaborative efforts and sustained investments to ensure a comprehensive and inclusive framework that leaves no child behind in the pursuit of optimal early childhood development.

Examples of national early childhood development programmes for children with disabilities

In the context of the global commitment to equitable and inclusive education, it is crucial to delve into the ways various nations have designed and implemented ECD programmes specifically catering to children with disabilities. Examining national ECD programmes reveals diverse approaches. Key lessons include the need for disability-focused ECD initiatives alongside general programmes, early detection and intervention, supportive legislation, funding mechanisms and guidelines (Olusanya et al. 2024) (Figure 3.2). A global ECD strategy for children with disabilities should incorporate these elements and leverage lessons from existing national programmes.

Head Start and Early Head Start (USA): Supports school readiness for low-income families, including children with disabilities, serving over 38 million children.

IDEA Early Intervention and Preschool Education (USA): Provides education and early intervention for children aged zero to five with disabilities, emphasising inclusive education.

Rashtriya Bal Swasthya Karyakram (India): Identifies and intervenes early for children with various conditions, with over 1.2 billion children served.

Early Childhood Commission (Jamaica): Establishes standards for early childhood institutions and promotes inclusive education, addressing barriers like stigma.

National ECD Policy Framework (Kenya): Encompasses children from conception to age eight, but challenges exist in implementation and funding.

FIGURE 3.2: Highlights from National ECD programmes (Olusanya et al. 2024).

Way forward: A global strategy for inclusion of children with disabilities

Although there is recognition that early childhood development is vital for optimal lifelong learning and the well-being of children, and children with disabilities are at a higher risk of marginalisation and exclusion (UNICEF 2021), there is currently no comprehensive global plan for promoting school readiness and inclusive education for children with disabilities in LMICs. Dedicated funding, legislation, early detection and intervention services are required to ensure the inclusive education of children with disabilities (Olusanya 2023d).

However, evidence shows that one size fits all policies often neglect and underfund services for these children (Pence et al. 2023). Children with disabilities differ in impairments and required services, necessitating an incremental approach. Health care systems serve as entry points for service delivery and need adequate resources. Early detection and intervention services are crucial, requiring collaboration between the health and education sectors. Effective multisectoral coordination and accountability at national and community levels are therefore vital for progress. Dedicated ECD programmes supported by legislation, such as the *Individuals with Disabilities Education Act* in the USA (Lipkin et al. 2015) and the Rashtriya Bal Swasthya Karyakram in India (Ministry of Health and Family Welfare, Government of India 2013), can be effective in ensuring school readiness from birth. Early childhood development programmes for children with disabilities should be backed by national legislation or executive orders, outlining eligibility, service entry points and family involvement. Parental rights and choices are supported and align with the UN conventions. This call for multisectoral coordination reflects existing but underdeveloped frameworks that require stronger collaboration between health and education policy and sectors to effectively implement inclusive ECD programmes.

A global ECD strategy for children with disabilities can be developed through high-level consultations with established ECD programmes. Implementing a country-led agenda allows for adaptation and ownership. Without such a strategy, the global commitment to inclusive education for children under five may remain unmet for millions of children with disabilities in LMICs. A review of country programmes revealed five key findings, crucial for shaping a comprehensive global strategy (Olusanya et al. 2024). Firstly, a twin-track approach is essential to address the unique needs of children with disabilities, emphasising a dual focus on their specific requirements. Secondly, establishing guidelines for early screening, diagnosis and referral processes is crucial to ensure timely and effective interventions. Thirdly, implementing national legislation that supports ECD programmes for children with disabilities is necessary to establish a legal

framework for inclusive initiatives. Fourthly, funding mechanisms, including global funds, are important to support LMICs in sustainable and widespread implementation. Lastly, effective multisectoral coordination, monitoring and accountability at both national and community levels are key components to ensure the strategy's success.

Conclusion

In conclusion, this chapter highlights the crucial importance of addressing childhood disabilities on a global scale, revealing persistent gaps in existing programmes and initiatives. The historical overview presented in Figure 3.1 and the findings from national programmes emphasise the progress made in recognising the rights and needs of children with disabilities. However, there remains a pressing need for a more holistic and inclusive approach to early childhood development. The identified gaps include a historical focus on health-related issues, limited data, fragmented services and insufficient attention to the broader spectrum of developmental needs. The proposed way forward involves crafting a global ECD strategy specifically tailored for children with disabilities. This strategy aims to implement a twin-track approach, establish guidelines for early screening and diagnosis, enact supportive national legislation, secure funding mechanisms and ensure effective multisectoral coordination and accountability. By bridging these gaps and embracing a comprehensive global strategy, we can aspire to fulfil the SDG pledge of inclusive education for children with disabilities by 2030, ensuring that no child is left behind in their journey towards optimal development and well-being.

Declarations

Author contributions

Tracey Smythe: Conceptualisation, Data curation, Methodology, Validation, Writing – original draft preparation, Writing – review and editing.

Bolajoko Olusanya: Conceptualisation, Data curation, Methodology, Validation, Writing – original draft preparation, Writing – review and editing.

Both authors reviewed the article, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

Competing interests

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Data availability

No additional data are available.

Disclaimer

The views expressed in this chapter are the authors' own and not an official position of the institution or the publisher.

Chapter 4

Playground impact on motor skill development in preschool children in a low-resourced area

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Abstract

Background: A prevalence study conducted among preschool children on the West Coast of South Africa identified several factors associated with motor skill impairment. The high prevalence of motor skill impairment (14.5%) raised concerns about the impact on the general development and school readiness of these children. This highlighted the need for further research and early involvement to provide opportunities for children to enhance their physical development.

Aims: This secondary analysis considers the factors and their weighting as influencing motor skill development of preschool children in a low-resourced area. By determining the most influential factor(s), it would be possible to prioritise and recommend strategies to address these.

Methods: We conducted a secondary analysis of the prevalence study data through cross-tabulation. The data include the standard scores of the *Movement Assessment Battery for Children* (second edition) and demographic data of participants and schools.

Findings: The analysis indicates that playground status outweighed the other factors, namely, age, weight, height and gender. The fee-paying status of a school, combined with the playground status in a linear regression, is the overall most significant factor. Analysis revealed that only fee-paying schools had extensive playgrounds.

Conclusion: A good playground is an environmental modification that may have long-term benefits for many children. Recommendations are made for developing playgrounds to benefit all preschool children, but in particular, children in low-resourced areas. The small sample size of the prevalence study (N = 129) and the small number of schools (n = 6) may affect the generalisability of findings.

Background

The background section describes the framework of thought processes from which the study evolved. The main concepts of physical development in young children and aspects of policy, development and environment that impact development are described.

Physical development and motor skills

Physical development refers to the achievement of physical developmental milestones, to reaching a level of advanced age-appropriate fundamental movement skills (Preedy, Duncombe & Gorely 2022). A preschool child at Grade R level (5–7 years), typically has reached all early milestones and is ready to perform more skilled and coordinated functional actions (Haywood & Getchell 2014; Sheridan 1997). Physical development includes the acquisition of gross and fine motor skills. Gross motor skills encompass postural skills, including strength and agility; static and dynamic balance and coordination, while fine motor skills refer to manual dexterity and components thereof, including hand strength, grasps, the isolation of finger movement and tactile discrimination (Wang 2004). These competencies enable agility on the playground and skilful participation in craft and pre-academic activities.

Participation in physical play is affected by a child's level of physical development. Children who experience a delay in physical development are likely to experience further developmental challenges concerning independence, social skills, pre-academic and academic skills and behaviour. If not addressed early, these challenges are likely to affect a child's school readiness and difficulties may continue throughout the school years into adulthood (Harrowell et al. 2018; Tal-Saban et al. 2012).

Policy around physical development and activity

The World Health Organization (WHO) promotes physical activity to improve health globally across all age groups and abilities (World Health Organization 2023). According to the 2023 WHO guidelines, children aged 5–17 years, including children with disabilities, should engage in physical activity for an average of 60 minutes daily. The many benefits of physical activity in children include physical fitness, general health, improved cognitive outcomes and reduced mental health concerns (World Health Organization 2023). Policies to increase physical fitness are recommended; for children, these include safe spaces in which to be freely active (physically playing), quality physical education in schools, and community- and school-based sports programmes.

We need to consider that the United Nations Convention on the Rights of the Child (UNCRC) was signed by former President Nelson Mandela in 1993, and the government ratified it in 1995 (UNCRC 2023). Occupational therapists and physiotherapists in South Africa are affiliated with the United Nations through the World Federation for Occupational Therapy and World Physiotherapy. As such, we are obliged to protect and support human rights, moreover, children's rights. According to Article 31 of the convention, play is signified as a human right recognised by the international community

and protected by international law. Thus, the government is compelled to report on progress regarding the implementation of the Convention. Play, including physical active play, is indispensable to children's development, health and wellness (Lester & Russell 2010; Navidi 2016). Therefore, protecting and supporting children's right to play cannot be addressed after other rights, as it is linked with all other rights (Lester & Russell 2010).

During the coronavirus disease 2019 (COVID-19) pandemic, a policy brief was published by the African Physical Activity Network (AFPAN) and the Academic Consortium, promoting physical activity for health in Africa (AFPAN and Academic Consortium 2020). This led to the development and gradual roll-out of the KaziKidz programme and the KaziPlay project (KaziBantu 2023). These projects set out to promote physical activity and a healthy lifestyle for school children (Grades 1 to 7), while also improving playgrounds in low-resourced settings in the Eastern Cape province. This progress is encouraging; however, it is currently limited to one province and, for now, excludes preschool children.

Factors and barriers impacting physical development

A child's physical development can be influenced by the complex interaction between genetic, environmental and medical factors. Certain neurological conditions, such as cerebral palsy, significantly impact motor and mobility skills, while other factors, such as prematurity, genetic conditions or acquired injuries, can also affect physical development. Children living in low socio-economic areas in South Africa (Du Plessis et al. 2020), but also around the globe (Delgado-Lobete et al. 2019; Deshmukh, Sahu & Deshpande 2021; Valentini, Clark & Whitall 2015), are known to be at a greater risk of experiencing developmental challenges, such as motor skill impairment. Other risk factors include gender, with more boys affected than girls (Morley et al. 2015), and obesity with general inactivity (De Waal & Pienaar 2021). Prevalent conditions on the West Coast of South Africa, such as foetal alcohol spectrum disorders (FASD) (Olivier, Curfs & Viljoen 2016), and human immunodeficiency virus (HIV) or acquired immunodeficiency syndrome (AIDS) (Ferguson & Jelsma 2009), add to the complexity of developmental delays experienced in children. Unfortunately, the provision of essential therapy services is often challenging in rural areas of South Africa (Bateman 2012; Prowse et al. 2022; Roots et al. 2014; Sonday et al. 2012).

Several studies, however, report on resource-effective interventions such as group programmes, aiming to improve motor skills in children in South African settings (De Milander, Coetzee & Venter 2015; Erasmus et al. 2016; Van Jaarsveld et al. 2021). Van Jaarsveld et al.'s (2021) study described

positive results following sensory-motor intervention using custom-designed low-cost playgrounds in areas where children did not previously have access to a playground. This correlates with findings from a European study by Delidou, Matsouka and Nikolaidis (2015), indicating that access to playgrounds with adequate space and play equipment improved physical activity in primary school children in Greece (Delidou et al. 2015). Another European study of preschool children in Italy found that the motor skills of children in the experimental group significantly improved with weekly access to a custom-designed motor skill playground. The PRIMO Sport 0246 playground had 35 pieces of equipment focusing on mobility, manual skills and balance and, as in Delidou et al.'s study, was spacious, stretching over 2,500 m^2 (Tortella et al. 2016).

The environment influences both the opportunities children have to play, and their motivations to play (Skard & Bundy 2008). This makes the government's commitment to provide conditions and spaces conducive to play critical for children from low-resourced communities, as their right to play should not be dependent on where they live. However, government commitment is questionable in its funding priorities. For example, the *Foundation Phase Curriculum and Assessment Policy Statement (CAPS) for Life Skills* (Department of Basic Education 2011) states that standard material for life skills development for preschoolers should include outdoor play equipment such as tyres, climbing ropes and jungle gyms. Unfortunately, few schools in rural or low-resourced areas have outdoor playground equipment available (Van der Walt, Plastow & Unger 2020). Furthermore, government therapy resources such as occupational therapy and physiotherapy are thinly spread in rural areas (Narain & Mathye 2019; Ned et al. 2020), and delayed development is often not detected before children start formal schooling.

The lack of basic outdoor play equipment for children in South Africa is concerning when compared to global research trends with a more advanced focus on the inclusivity of playgrounds or 'playgrounds for all' (Stanton-Chapman & Smith 2021; Sungur Ergenoğlu 2018). Jeon and Jun (2021), however, argue that the main focus shifts to social integration when considering inclusive playgrounds. Their Delphi study in South Korea, therefore, considered mainly fundamental movement skills and perceptual-motor abilities to suggest design criteria for outdoor playgrounds in South Korea, where the focus in recent years was on academic excellence in schools, while neglecting outdoor activities and play opportunities (Jeon & Jun 2021). The Delphi panel, consisting of child development specialists and play infrastructure experts, concluded that the following aspects need to be considered: Most importantly, the effectiveness of the playground to provide for motor learning and practising of fundamental movement skills, followed by the aspects of innovation, diversity, interest, efficiency, complexity, stability, relationship and connectivity.

This chapter reports on the effects that environmental constraints of a specific low-resourced setting in South Africa – the West Coast region – have on preschool children's healthy physical development as a consequence of the lack of, or poorly equipped, playgrounds. Thus, by not consequently implementing global and national policies, these children's right to play is denied. For this study, a low-resourced setting is defined as a predominantly low socio-economic area with many rural areas and with limited therapy resources. In the West Coast region of South Africa, 47.4% of the inhabitants live in poverty, with challenges such as high levels of drug and alcohol abuse, unemployment and school drop-out rates (Western Cape Government 2019).

Aim

This study aimed to determine the factors and their relative weights influencing physical development in preschool children (ages 5–7 years) in government schools in low-resource settings.

Research question

What factors influenced physical development outcomes in preschool children (ages 5–7 years) attending government schools in a low-resourced setting?

Methodology

A descriptive cross-sectional study with multistage cluster sampling was conducted. The original prevalence study determined the incidence of motor skill impairment in Grade R children living on South Africa's West Coast. The outcomes and full methodology of the prevalence study have been published in the *South African Journal of Education* (Van der Walt et al. 2020).

Setting

The prevalence study was conducted in the West Coast district of South Africa in government schools with a Grade R class. Schools were located in both urban and rural areas across five municipal areas. Consent was obtained from the Western Cape Education Department (WCED) and all six schools, after which data collection took place in May and June of 2015.

Participants

Multistage cluster sampling was completed with the help of a biostatistician. To allow for stratification of location (urban main place, urban area and rural area), the fee-paying status of schools and municipal area, six government primary schools in the West Coast education district in

South Africa was included in the sample. These schools were randomly selected from a list of all government schools in the district with Grade R classes of 30 or fewer children. All Grade R children at the selected schools were invited to participate. Children with a known neurological condition, physical disability or deteriorating muscular condition were excluded from the prevalence study, as there is extensive evidence that these conditions have a significant and negative impact on the motor skill development of children. However, no exclusions occurred because no children in the six schools were diagnosed with these conditions.

Variables, data sources and measurement

The *Movement Assessment Battery for Children* (second edition) (MABC-2) was used as the primary outcome measure (Henderson, Sugden & Barnett 2007). This is a standardised performance test, divided into three categories, namely manual dexterity (fine motor skills), balance and aiming and catching (ball skills). The raw scores of each category and the total score are converted to standard scores and percentiles.

Children's characteristics that were measured by the researcher included weight (kilogram [kg]) and height (millimetres [mm]). Gender (male or female) and age (date of birth) were reported by the parents.

School-related variables included the number of children participating in the study, fee-paying status, playground quality and setting. Urban versus rural setting, and the fee-paying status of schools, were determined by the classification as provided by the WCED. The quality of playgrounds was assessed by observation and categorised according to the extent to which the playground met the minimum standards of the *Foundation Phase CAPS document for Life Skills* (Department of Basic Education 2011). The standard outdoor equipment named in that document includes jungle gyms, climbing ropes and tyres.

The researcher took photographs of the outside space available for play to the Grade R children at each participating school. Initially, schools were classified as having extensive playgrounds that met the minimum standards, a limited playground with minimum standards not met or no playground equipment. Extensive playground equipment was defined as a range of playground equipment, including swings, slides, jungle gyms, etc. Schools with limited or no playground equipment had few or no large items for play, or equipment in a state of disrepair that was not usable or safe for play. Schools with no playground had an outside space, but no equipment for play. It was noted that some children in these schools had access to a ball. These three categories were collapsed to a two-category variable for the linear regression, 'meets minimum standards', and 'does not meet minimum standards (limited or no outdoor equipment)'.

Bias

The random sample is believed to be an accurate representation of the general population of school children in the West Coast area of South Africa because of the stratification by the key features of socio-economics (fee-paying status), rurality and geographical area. The MABC-2 is a standardised assessment with specific guidelines for administration, scoring and interpretation; thus, it was presented and administered in a consistent way to all children. Scoring and interpretation for all test sheets were double-checked, and where there was uncertainty, a co-researcher was consulted. Qualitative observations about playground status were made in consideration of the standard guidelines prescribed in the CAPS document.

Data analysis

The demographic characteristics of children were analysed using descriptive statistics appropriate to the type of data (Van der Walt et al. 2020). We also analysed the characteristics of each of the six schools using descriptive methods.

The MABC-2 guidelines were used to identify the presence of motor skill impairment. The total standard score (TSS) and percentile for each child were calculated, with a lower score indicating a higher risk of impairment. Total standard scores at or below five indicated that the child fell at or below the fifth percentile, with evidence of motor skill impairment. Scores of six indicated an amber zone, with a risk of motor skill impairment that needs to be monitored (6th–15th percentile). Scores above seven (above the 15th percentile) indicated sufficient motor skill development. The same categories were applied for the standard scores obtained for each child for the subcategories of manual dexterity, aiming and catching and balance.

Linear regression is a statistical method that expresses the relationship between two variables in the form of an equation. This enables researchers to understand how a change in one variable is affected by the other variable(s) of interest (Pandey 2020). In our study, we wanted to understand which factors (variables) would influence physical development. Linear regression also enables researchers to distinguish between the independent variable and the dependent variable (Pandey 2020). Consequently, we can understand which factors or variable(s) predict physical development, which was our outcome of interest.

Before conducting linear regression, it is essential to determine which independent variables have a relationship with the dependent variable. Only the variables with a significant relationship are included in the model. The relationship between the TSS and the categorical variables of gender, type of playground and fee status of the school was measured using

parametric tests (Pearson $\chi 2$ tests). The relationship between the TSS and continuous variables of age was measured using Pearson's correlation coefficient, and for weight and height, a non-parametric test (Kruskal-Wallis). These tests were repeated for each of the MABC-2 domains.

Correlation statistics provide information about the strength and direction of a relationship between a pair of variables. Although we knew from the prevalence study that there was a positive relationship between height, weight, playground status, fee-paying school and physical development outcomes (Van der Walt et al. 2020), correlation statistics do not provide information about the interaction between these variables, or which variables influence the other variables (Pandey 2020).

Because of the small sample size of the prevalence study, an explorative model was applied to investigate the factors influencing physical development through the use of linear regression. When we looked at the cross-tabulation of playground status by fee status, it was evident that there were no-fee-paying schools without any playground equipment. Both factors cannot be used in the same model. To address this problem, we created two new dummy variables. The three categories of playground status were collapsed to two categories: Well-equipped playground, and no outdoor equipment. The second dummy variable (play_school) had four categories: Well-equipped playground at a fee-paying school, no playground at a fee-paying school, well-equipped playground at a no-fee school and no playground at a no-fee school. A linear regression was conducted with TSS as the dependent variable, and the following independent variables: Age, weight, height, gender and the playschool variable. This was repeated for manual dexterity and balance.

Ethical considerations

For the prevalence study, consent was obtained from the local education department, individual schools and parents of participating children. Assent from the children was considered by attending to their willingness to participate on the day of the assessment. All data were handled as anonymous, and only the primary investigator and biostatistician had access to the data.

Results

Characteristics of schools and participants

The characteristics of the six schools and related MABC-2 prevalence results are presented in Table 4.1. All municipal areas on the West Coast of South Africa were represented by at least one school in both urban and

TABLE 4.1: Characteristics of participating schools.

School	*Grade R children (n)*	Gender Male	Gender Female	Impaired development < 15th percentile Total score		Impaired development < 15th percentile Balance		Impaired development < 15th percentile Ball skills		Impaired development < 15th percentile Manual dexterity		Typical development > 15th percentile Total score		Fee status	Type of playground
				n	%	*n*	%	*n*	%	*n*	%	*n*	%		
1	***15***	5	10	0	0.00	1	6.70	0	0.00	2	13.33	15	100.00	Pay	Extensive
2	***26***	15	11	3	11.53	2	7.69	1	3.85	1	3.85	23	88.46	Pay	Extensive
3	***28***	17	11	3	10.71	3	10.71	2	7.14	7	25.00	25	89.29	Pay	Limited
4	***24***	14	10	4	16.67	4	16.67	1	4.17	10	41.67	20	83.33	No-fee	Limited
5	***30***	13	17	7	23.33	8	26.67	0	0.00	8	26.67	23	76.67	No-fee	None
6	***15***	8	7	3	20.00	3	20.00	0	0.00	6	40.00	12	80.00	No-fee	None
Total	***138***	**72**	**66**	**20**	**14.49**	**23**	**16.67**	**4**	**2.90**	**34**	**24.63**	**118**	**85.51**		

Source: Authors' own work.

rural regions for the prevalence study. Across the six schools, 138 children were included with parental consent. Ages varied from 5 to 7 years, with a mean age of 5 years and 6 months. It was found that only fee-paying schools had extensive playgrounds that met the CAPS minimum requirements for outdoor equipment. Two schools had limited playgrounds, one a fee-paying and one a no-fee school. Both schools with no outdoor equipment were no-fee schools.

Movement Assessment Battery for Children (second edition) scores indicate a high prevalence of manual dexterity and balance impairment for schools with limited or no playgrounds when compared to schools with extensive playgrounds. A higher prevalence of general motor skill impairment on the total score percentiles was noticed in no-fee schools.

Factors influencing physical development

Table 4.2 shows the results of the analysis of the influencing factors of fee-paying status, extent of playground, height and weight for the original prevalence study. Attendance to a no-fee school was associated with manual dexterity and balance. Limited and no playgrounds were associated with manual dexterity, and short stature and low weight were associated with manual dexterity.

Through further analysis, the cross-tabulation of the playground status by no-fee schools resulted in a structural zero, thus indicating that only fee-paying schools had extensive playgrounds. Subsequently, only playground status was included in the first linear regression model (Table 4.3) for fine motor skills standard scores, and not the fee status of the schools. This model indicates that playground facilities (also when combining limited playground and no playground scores) were the most important factor in the model when considering age, weight, height, gender and playground facilities ($p = 0.0002$). The coefficients for the limited playground and the no playground were not significant ($p = 0.255$).

The combined information of playground status and fee-paying status provided more differentiation than either playground or fee-paying status alone: When the fee-paying status of a school was combined with the playground status in a linear regression, it was found to be the overall most significant factor for fine motor skills ($p = 0.0002$), for balance ($p = 0.009$) and for the total score ($p < 0.001$). A fee-paying school with a playground had a significantly higher fine motor standard score than all combinations of fee-paying and/or playground options, namely, a fee-paying school, without a playground ($p < 0.001$); a fee school with playgrounds ($p = 0.001$); and a no-fee school without a playground ($p < 0.001$), with the biggest contrast being that of a fee-paying school with a playground against a no-fee school without a playground.

TABLE 4.2: Effect of the influencing factors on the total scores and subtest scores of the *Movement Assessment Battery for Children* (second edition).

Score	Factor	Analysis	< 5th percentile	5th–15th percentile	> 15th percentile	*p-value*
Total score	No-fee	Pearson χ^2	13%	7.2%	79.7%	0.132
	Fee		4.3%	4.3%	91.3%	
	Extensive playground		2.4%	4.9%	92.7%	0.216
	Limited playground		11.3%	6.2%	82.5%	
	Weight	Kruskal-Wallis	-	-	-	0.118
	Height		-	-	-	0.220
Manual dexterity	No-fee	Pearson χ^2	21%	13%	65.2%	0.018
	Fee		7.2%	7.2%	85.5%	
	Extensive playground		4.9%	2.4%	92.7%	0.009
	Limited playground		18.6%	13.4%	68.0%	
	Weight	Kruskal-Wallis	-	-	-	0.002
	Height		-	-	-	0.005
Aiming and catching	No-fee	Pearson χ^2	1.4%	0%	98.6%	0.178
	Fee		2.9%	4.3%	92.8%	
	Extensive playground		2.4%	4.9%	92.7%	0.362
	Limited playground		2.1%	1.0%	96.9%	
	Weight	Kruskal-Wallis	-	-	-	0.278
	Height		-	-	-	0.372
Balance	No-fee	Pearson χ^2	18.8%	2.9%	78.3%	0.03
	Fee		5.8%	8.7%	85.5%	
	Extensive playground		7.3%	9.8%	82.9%	0.25
	Limited playground		14.4%	4.1%	81.4%	
	Weight	Kruskal-Wallis	-	-	-	0.954
	Height		-	-	-	0.971

Source: Authors' own work.

TABLE 4.3: Linear regression model for fine motor standard scores.

Factor	Coefficient	Standard error	*t*	*p*-value	95% confidence interval	
Age (years, months)	−0.436	0.683	−0.64	0.552	−2.191	1.319
Weight (kg)	0.001	0.035	−0.26	0.808	−0.081	0.0985
Height (cm)	0.076	0.029	2.56	0.051	−0.000449	0.153
Gender (male/female)	0.325	0.172	1.88	0.118	−0.119	0.769
Playground						
2	−2.596	0.194	−13.42	0.000	−3.094	−2.099
3	−2.239	0.334	−6.70	0.001	−3.098	−1.381
Constant	4.231	4.328	0.98	0.373	−6.897	15.359

Source: Authors' own work.
Key: %, percentage; kg, kilogram; cm, centimetre; 2, limited playground; 3, no playground.

There was also a significant difference between the fine motor skill standard scores of a fee-paying school with no playground and a no-fee school with no playground (p = 0.03). This was repeated in the balance standard score (p = 0.005) and the total standard score (p = 0.003).

Thus, to summarise, analysis using linear regression found that the interaction of playground equipment and fee-paying status significantly influenced the overall physical development of the children, F (3,5) = 131.38, p < 0.001. Children attending fee-paying schools with extensive playgrounds had the highest level of physical development, followed by children at fee-paying schools with a limited playground. However, no personal factors significantly predicted overall physical development, including age, weight, height and gender.

Discussion

The high prevalence of motor skill impairment in preschool children in the West Coast region of South Africa raises concerns about academic progress and future independence within their communities. While follow-up studies of complex intervention development are underway to address the therapeutic needs of children on South Africa's West Coast, the associated identified factors offer a prospect for further research and early involvement to provide the best opportunity for young children to develop motor skills in the first instance, and to prevent long-term consequences.

Analysis results indicate that access to a good playground is critical for the physical development of young children. The extensive playgrounds situated at two of the fee-paying schools had a wide variety of apparatus, including slides, swings and climbing frames. All equipment was in working order and well-maintained, so it complied with the standard equipment requirements as stipulated in the CAPS curriculum guidelines. A study by Delidou et al. similarly found that a variety of play equipment led to more active physical play and activity during recess in 12-year-olds (Delidou et al. 2015). For their study, playgrounds were labelled by size and equipment level, using guidelines as stipulated in the Hellenic Organization of School Buildings. Where our prevalence study only considered the extent and working state of the playground equipment, the Delidou et al. study included the categories of facilities (including playground equipment), green areas, recreation areas and surface materials. Similar to the guidelines of the Hellenic Organization of School Buildings, the Western Cape Government issued safety guidelines for playgrounds at public schools, including playground surfaces, safe and suitable plants and selection of playground equipment (Western Cape Education Department 2014); however, the focus here is on playground safety in schools rather than the promotion of physical development.

Focusing on younger children, a systematic review on the value of preschool playgrounds (Broekhuizen, Scholten & De Vries 2014) concluded that there was moderate evidence to suggest that playground equipment, rather than the use of playground markings, play space and multicomponent interventions, promotes physical activity, as well as social and cognitive development. Although the children in the study were all preschool age, as in the West Coast study, all included studies were conducted in high socio-economic countries, thus limiting the comparability to South Africa.

The mere presence of a good playground in the neighbourhood will, however, not guarantee access for all children. The safety of children during play needs to be considered, and in South Africa, children's participation in physical activity outside of school is significantly influenced by high levels of crime rates and traffic-related risks (Uys et al. 2016). In Soweto, for example, only 34% of the 2,309 preschool children in a study looking at correlates between screen time and outdoor playtime had access to a safe outdoor space to play (Prioreschi & Norris 2022). A New Zealand study found that for the participating primary school children in their study in Dunedin, only 2% of their total daily physical activity occurred on playgrounds in neighbourhood parks (Quigg et al. 2010), partially because of safety concerns in the area and lack of maintenance. The maintenance and sustainability of playgrounds are also important, as described by Jiménez & Gómez, to ensure safety and accessibility. Public spaces in vulnerable communities in Santiago, Chile, were recovered and developed into playgrounds, and the follow-up study concluded that the involvement of communities and families from the beginning stages was crucial for the sustainability and maintenance of the playgrounds (Jiménez & Gómez 2020).

In the South African context, a good place to start for improving the current situation may be the construction of playgrounds within school grounds, as these are generally considered safe spaces and have staff who can contribute to maintaining these playgrounds. Stakeholders such as local municipalities and businesses, education departments and community members should have the opportunity and responsibility to work together, take part and fund-share play projects in their local communities. An example is the KaziPlay project (KaziBantu 2023); however, long-term effects and sustainability are yet to be determined. In the Free State province of South Africa, research has been done on cost-effective playgrounds in rural communities (Van Jaarsveld et al. 2021), created from recycled materials, with positive results in motor skill improvements in children who participated in play on these playgrounds. Other examples from around the globe include the Sydney Play project, where easily accessible recycled objects, such as milk crates and cardboard boxes, were placed on the playground, increasing children's participation in physical play (Bundy et al. 2017). These are just two examples of cost-effective

physical play projects for children. A good playground within a school environment further provides opportunity to serve as a therapeutic apparatus in motor skill intervention programmes, which may make intervention more accessible in low socio-economic and rural communities (Bundy et al. 2017).

Low socio-economic status (no-fee schools), together with no playground access, was significantly more associated with motor skill impairment than areas with fee-paying schools without sufficient playgrounds. One related aspect may partially be explained by a study by Gil-Madrona et al. (2019), who found that adults with a higher education level had a more positive perception of the impact of playgrounds on a child's development and would thus be in a better position to advocate for playgrounds and to motivate children to play. On the West Coast of South Africa, there are high levels of unemployment and low education levels (Western Cape Government 2019) associated with low socio-economic areas with no-fee status schools.

Children in low socio-economic areas, with limited resources, will continue to find ways to play and are creative in substituting for what they do not have (Bartie et al. 2016). This perhaps provides them with opportunities for social skill development and development of areas of executive skills such as planning and organising, but there are many studies indicating that low socio-economic status in itself is linked to motor skill deficits (Delgado-Lobete et al. 2019; Deshmukh et al. 2021; Du Plessis et al. 2020). The lack of safe physical play opportunities compounds motor development.

No-fee schools, situated in low socio-economic areas, are typically accompanied by high unemployment rates, low income and low literacy rates in the community (Sayed & Motala 2012). These schools rely heavily on government provision of standard material and equipment, and where not funded, schools remain insufficiently equipped. While the WCED budget was increased substantially for the 2022/23 fiscal year, funds were prioritised for new schools and/or infrastructures, more teachers and teaching assistants, more no-fee schools and to address learning losses experienced in the foundation phase during the COVID-19 pandemic. Further funds were allocated to transfer early child development (ECD) management from the Department of Social Development to the WCED (Western Cape Education Department 2022). Although these are all valid priorities, our data analysis suggests that the upgrading of playgrounds, especially in low-resourced areas, is crucial for the acquisition of motor skills, which contribute to school readiness and academic progress, while helping to promote physical development. With the added responsibility of ECD services, it is argued that early opportunities for active physical play in a safe environment, by providing good playgrounds, should be a budget priority.

Other factors identified in the prevalence study as significantly impacting fine motor skill development were gender (fine motor skill difficulties were associated with boys), and low weight and height. While other studies have similarly found an association between fine motor skill difficulties and male subjects (Morley et al. 2015), most recent studies, in contrast, focus on childhood obesity as a factor associated with motor skill impairment (Zacks et al. 2021). It is important to consider that small stature and motor skill challenges are also associated with FASD (O'Leary 2004). While only one child who took part in the prevalence study had a diagnosis of FASD, in this area, which has a reported high incidence of FASD (Olivier et al. 2013), it is likely there were also more FASD children (undiagnosed) included in the prevalence study, which may account for the association found. Whatever the reason for the small stature and low weight, the importance of good nutrition and feeding programmes is well documented (Nahar et al. 2020).

It is important to recognise that the data used in this study came from a prevalence study that only included six schools. However, the sample can be generalised to other low socioeconomic and rural areas in South Africa because of the purposeful sampling to include fee-paying and no-fee schools, rural and urban schools and different municipal areas.

Recommendations

Considering the outcomes of this study, it is recommended that every government school with Grade R classes be provided with playground equipment in a safe, spacious area, while adhering to the Western Cape Government's guidelines on playground safety. The playground should provide opportunities for a variety of active play experiences to develop gross and fine motor skills, while also promoting a physically active lifestyle, in accordance with the WHO guidelines.

Future randomised control trials and longitudinal studies are recommended to investigate the effect of more and improved playgrounds on the motor skill competence and physical development of children, but also on the prevalence of motor delays in the West Coast area of South Africa.

Per the playground safety guidelines, the role of supervisors is explained with regard to safety aspects; however, it is recommended to also consider and evaluate guided play in comparison to free play when utilising playgrounds.

Teachers and parents should be empowered to promote the understanding of the importance of play and playground equipment and to encourage community collaboration to build and support these playgrounds.

Conclusion

This study confirms that preschool children who have access to a well-equipped school playground are less likely to experience motor delays. While many schools in low-resourced areas lack outdoor play equipment, caregivers, school management, and local education department education and empowerment initiatives can assist in collaborative, well-planned, safe play zones to help all children fulfil their right to play, develop and improve their future. Improved opportunities for children to develop their motor skills by playing on a playground that meets the minimum requirements of the education department can prevent the long-term effects of motor skill impairment. Continued research to explore accessible therapy input for children who have significant motor skill challenges is recommended.

Declarations

Ethical considerations

Ethical approval for the study was granted by the Health and Research Ethics Committee at Stellenbosch University for the prevalence study (N14/08/109) and for the present analysis, as a sub-study of the prevalence study (N23/08/109).

Consent

Consent for the prevalence study was obtained from the Western Cape Education Department, participating schools and parents of participating children.

Author contributions

Janke van der Walt: Conceptualisation, Data curation, Investigation, Methodology, Project administration, Validation, Visualisation, Writing – original draft preparation, Writing – review and editing.

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Nicola Plastow: Conceptualisation, Data curation, Formal analysis, Methodology, Resources, Software, Supervision, Validation, Visualisation, Writing – original draft preparation.

Arifa Ismail: Methodology, Validation, Visualisation, Writing – original draft preparation.

All authors reviewed the article, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

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Competing interests

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Data availability

Data are available from the authors upon reasonable request.

Disclaimer

The views expressed in this chapter are the authors' own and not an official position of the institution, funder or the publisher.

Chapter 5

A framework for the co-development of preschool teacher training through the World Café

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Abstract

Background: Occupational therapists can use a solution-focused approach to school readiness to provide children from disadvantaged backgrounds a better foundation for learning. Access to contextually relevant knowledge and training is one of the commonly reported needs of early childhood development (ECD) teachers in low-resource settings. Learning on a mobile device (mLearning) presents an opportunity for co-development of accessible, affordable and contextually relevant teacher training through participatory research methods.

Aim: To evaluate the World Café as a method to co-create culture-centred content for a teacher training curriculum.

Methods: Six experts in early childhood development and 35 participants providing ECD services to children from disadvantaged backgrounds participated in a World Café. Participants discussed their understanding of the concept of school readiness, activities they use to promote physical development, and the competencies they thought teachers could develop through mLearning. Framework synthesis of all transcribed data was completed. Video format preference was determined through ranked results, and a nominal group technique was used to determine the top eight teacher competencies promoted through culture-centred mLearning content.

Findings: The World Café method is an effective way of developing culture-centred mLearning content, and leads to mutual learning outcomes when the research to practice (RTP) process includes concept analysis, development of plain language summaries, multilingualism and skilled facilitation.

Conclusion: Applying these unique findings in future World Cafés is likely to lead to the development of culture-centred teacher training mLearning content that covers the full spectrum of school readiness.

Background

There is an urgent need for qualified preschool and early childhood development (ECD) teachers in low- and middle-income countries (LMICs)

(United Nations Children's Fund [UNICEF] 2019). In this chapter, an ECD teacher is defined as an individual employed at an ECD centre, with either formal or informal training, responsible for offering services to children 3–6 years of age. This is an all-encompassing term for caregivers, teaching assistants, and preschool teachers working within this context. In South Africa alone, there are currently more than 20,000 unqualified or underqualified teachers in Grade R classrooms (Hannaway et al. 2019). Smit et al. (2021) concluded that the most reported needs of early childhood teachers in a low-resource area in the Western Cape province, South Africa, are access to training and further knowledge. These teachers need adequate support in the critical role they are playing in individual lives within the classroom, as well as within low-resource communities. Spier et al. (2019) further emphasised the importance of human resources to achieve quality education and suggested mobile learning as a possible solution for teacher training in low-resource communities. We believe that an interdisciplinary and collaborative approach between ECD professionals is needed to develop mobile learning (mLearning) for this group of teachers.

Although there are guidelines for the development of mLearning (Kumar, Goundar & Chand 2019), and evidence of its effectiveness for teacher education globally (Ahmadi et al. 2023; Kang & van Es 2019; Seppälä, Alamäki & Radiolinja Ab 2002), there is a surprising lack of evidence for the use and effectiveness of mobile application (app) teacher training for ECD teachers within Africa.

As a first step, two authors of this chapter (Monique de Wit and Nicola Plastow) conducted a scoping review to identify recommendations that could improve the usability of mLearning for preschool teachers in Africa. De Wit and Plastow (2021) found that schoolteachers in Africa emphasised the importance of contextual relevance when using mLearning. This included the need to adapt training applications to specific contexts and regions, and modify content (e.g. videos) to ensure their value in classrooms. Additionally, teachers expressed the importance of contextual relevance in terms of the sustainability of training and the potential impact it has on classroom practices. De Wit and Plastow (2021) suggested that contextual relevance be included as an attribute of usability when mobile teacher training content is designed, especially within the African context. De Wit and Plastow's (2021) study also revealed that teachers prefer mLearning compared to computer-based learning. They are driven to enhance their proficiency in using cell phones by transitioning from personal use to using their phone as professional tools, collaborative devices and teaching aids. This finding aligns with Baran (2014), who emphasised that mobile learning offers significant potential for collaborative, contextualised, customised and personalised learning opportunities, particularly for student teachers.

There is growing evidence in South Africa for the need to incorporate indigenous knowledge into early childhood teacher education (Republic of South Africa 2004). Chinsamy and Koitsiwe (2016) offer a definition of indigenous knowledge systems that includes local skills, practices, technologies and innovations from within communities. Keane, Khupe and Muza (2016) agree that indigenous knowledge includes understandings and skills developed by communities, that are transferred from generation to generation, but caution that it continues to be dynamic as communities change. In this publication, we use the term indigenous knowledge, with consideration to ever-evolving definitions that encompass traditional, cultural and contextual knowledge.

In ECD teacher education, indigenous knowledge can be incorporated by considering context, cultural background and community input when developing teacher training content (Botha 2010). Culture-centred education is a space where knowledge is created and stays within the community, by combining indigenous knowledge systems with 'Western' frameworks of learning (Botha 2010). Rather than using the term 'Western Learning', as evident in Botha (2010), we have chosen professional knowledge as a term that reflects the knowledge ECD practitioners gain in higher education (Bryant, Fieldhouse & Plastow 2022). Combining indigenous and professional knowledge provides an opportunity to learn from each other, rather than learning from each other. Cocreation of knowledge is thus a collaborative process where stakeholders play a role in data collection and data analysis, which potentially speeds up the discovery and application of new knowledge into practice. In this context, it challenges the binary view of researchers as creators of knowledge and teachers as the passive recipients thereof (Pearce et al. 2020).

Moreover, Maistry and Du Preez (2024) emphasised the continuing need for decolonisation of curriculum in childhood education and, by extension, teacher education. This is also confirmed by Shaik (2024), as they feel that there is still a need for a transformative pedagogy in the early childhood education sector, even after 30 years into a democratic South Africa.

The promotion of indigenous knowledge and culture-centred education requires the facilitation of knowledge cocreation and mutual learning in stakeholders through participatory methodologies such as consensus workshops and the World Café method (Botha 2010; De Wit & Plastow 2021). The World Café method was introduced by Brown and Isaacs in 1995. It fosters inclusive discussions in diverse groups or within a larger community, and ensures the ideas and opinions of all stakeholders are heard (Brown & Isaacs 2005). It is a widely used participatory method with the potential to benefit participants through the facilitation of dialogue and mutual learning. For researchers, it may produce valuable qualitative data.

The method draws inspiration from the ambience of a café, creating a relaxed and informal environment, conducive to conversation. It represents a neutral public space where participants feel comfortable, engage in open dialogue and exchange diverse perspectives. This process leads to collective insights and creates potential solutions to community challenges. World Café participants are not recipients of knowledge that has been created elsewhere. Instead, they are stakeholders who contribute to the knowledge production process, while benefiting from it. World Café meetings are thus a useful way to cocreate culture-centred teacher education content for mobile learning (Löhr, Weinhardt & Sieber 2020).

Methodology

Study aims and research question

The aim of this study was to use the World Café to co-create content for a teacher training curriculum, using culture-centred education design methods. The research question was: 'What principles guide the design of culture-centred education content of a mobile application for teacher training to promote motor skills in young children in low-resource areas?'

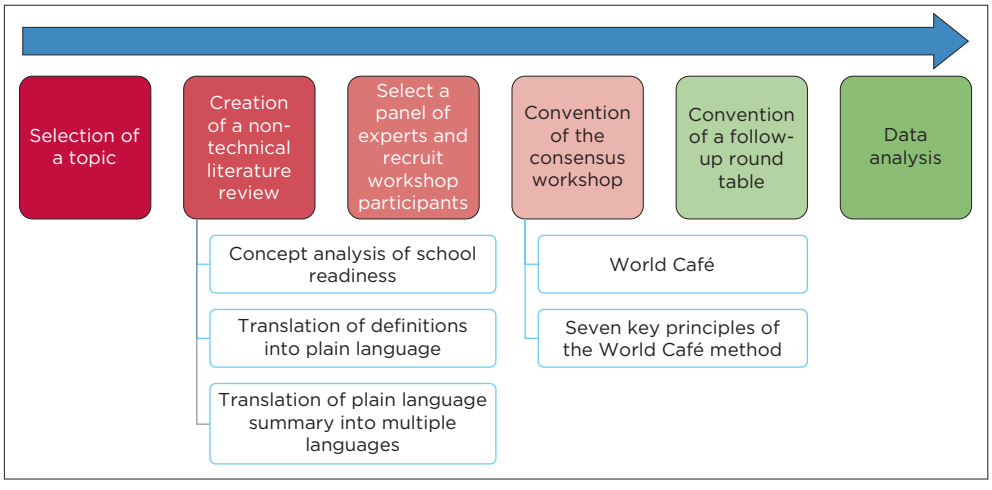
Methods

The co-development of the content for the teacher training app was guided by the Cornell Research to Practice Consensus Workshop model (RTP model), evidence-based consensus workshop approaches (Wethington et al. 2018), and Botha's (2010) culture-centred education framework. The RTP model is a strategy for bridging practice and research through the integration of the traditional consensus conference with community-based participatory research. The RTP model, illustrated in Figure 5.1, emphasises gathering and reporting qualitative data when completing a consensus workshop. Phase IV, the convention of the workshop itself, used the World Café method (Löhr et al. 2020).

The preselected topics for the consensus World Café were school readiness and motor development.

Preparation of a non-technical literature review

A non-technical literature review was completed through a concept analysis of school readiness within the South African context (De Wit et al. 2023). A plain language summary (PLS) of the findings was then developed according to the seven-step process suggested by Dormer et al. (2022). A PLS is typically used for stakeholders in consensus methods to make



Source: Based on Trevino et al. (2020) and Löhr et al. (2020).

FIGURE 5.1: Cornel research to practice model (Trevino et al. 2020) with World Café (Löhr et al. 2020) as the consensus workshop.

brief, jargon-free information available to a non-expert audience (Edgell & Rosenberg 2022; Kerwer et al. 2021; Löhr et al. 2020). The PLS was also translated into multiple languages for the workshop. The PLS of school readiness read as follows (De Wit et al. 2023, Box 5, p. 8):

> Children who are fully prepared for school can engage in meaningful learning, because they have developed the necessary behavioural, intellectual, language, literacy, numeracy, physical, socio-emotional and classroom skills for formal schooling.

Selection of a panel of experts and recruitment of workshop participants

Convenience methods were used to recruit six professional experts for the World Café. Professional experts were occupational therapists with experience in early childhood development (n = 5), or qualified teachers with ECD lecturing experience (n = 1). Teachers with experience in promoting school readiness were recruited as workshop participants. They had to provide childcare in low-resource settings within the Cape Town Metropole, South Africa. Multistage random sampling was used to select 10 ECD centres in the City of Cape Town, South Africa, and then purposive sampling was used to recruit 24 workshop participants. This was seen as an adequate number to achieve the outcome of the phase, as guidelines for sample sizes for World Café's range from 12 to 70 participants (Trevino et al. 2020; Wethington et al. 2018). Inclusion criteria for the participants included being an ECD teacher or Grade R teacher with or without a formal teaching

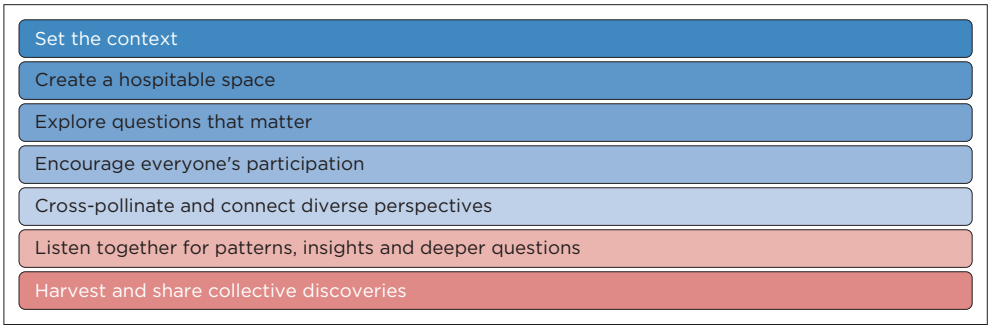
qualification, having a minimum of two years' experience, and being able to communicate in English, Afrikaans or isiXhosa. We invited 35 participants to the workshop to ensure a minimum of 24. All 35 participants attended the World Café workshop, along with the six professional experts.

Convention of the consensus workshop: World Café

A three-hour workshop was scheduled with a series of small and large group discussions. The first author was the lead facilitator, with each of the six small groups facilitated by one of the professional experts. Mutual learning and understanding of a concept are both fostered through the consideration of the seven principles of a World Café (Brown, Isaacs & World Café Community 2005), presented in Figure 5.2. These principles were therefore applied during the workshop.

The physical space was set up like a small café, with coffee and snacks and six round tables. This created a multiple small-group feeling that aided in the facilitation of constructive dialogue around the prepared questions. We acknowledged the collective expertise of school readiness within the room and included everyone's opinion. The facilitator used phrases such as 'there is no right or wrong answer', and continually asked 'what activities do you use in your classroom?, We made use of an icebreaker where participants were asked to demonstrate games from their own preschool memories.

The prepared questions were developed as technical questions and then translated into plain language to ensure clear communication (Table 5.1). They were also ranked by importance, to keep to the time limit. Questions were prioritised so that less important questions could be skipped if there was insufficient time, without having to interrupt the flow of conversations. Each small-group facilitator made an audio recording of conversations.



Source: Brown et al. (2005).

FIGURE 5.2: Seven principles of the World Café.

TABLE 5.1: Technical questions, plain language and priority of questions.

Round	Priority	Technical question	Plain language question
1	High	1. What is school readiness?	What does a school-ready child look like? What can you see in a child who is ready for school?
	Low	2. What are motor skills?	What are motor and/or movement skills?
	High	3. What are the most important motor and/or movement skills a child needs to develop before going to school?	What are the most important motor and/or movement skills a child needs to develop before going to school?
2	High	4. How do YOU promote motor and/or movement skills in young children?	What can you do to help a child develop movement skills?
	High	5. What do you USE to promote motor or movement skills in young children?	What do you need in your classroom to do these activities (from the previous question)?
3	Low	6. Do you consider promoting motor and/or movement skills as part of the role of a teacher of young children?	Do you think it is part of your role or tasks as a teacher to help a child develop movement skills?
	High	7. How do you develop your skills as a teacher?	What do you do to become a better teacher?
	High	8. Which teacher competencies are developed through engaging with this kind of information?	How will using an app with this information help you become a better teacher?
	High	9. Which video design format do you prefer when you learn new information?	Indicate which kind of video you like most, second and least, by adding a 1, 2, or 3 next to each option.

Source: Authors' own work.

These recordings were paused after each of the three rounds of discussions when participants were asked to change tables. Each discussion round lasted about 20–30 minutes.

As there was not sufficient time, low-priority questions were not included in the session. After question seven, the facilitator presented the non-technical definition of school readiness and its attributes in two of the represented languages. Question eight was facilitated through a consensus method, a nominal group technique known as card sorting, while question nine was determined through completion of a preference questionnaire with three options for video format.

Convention of a follow-up round table

Fourteen workshop participants who were active during the consensus workshop and two facilitators were invited to participate in a follow-up roundtable meeting. The objective of this two-hour meeting was to collaboratively review and refine the lists of recommendations from the initial workshop, to create a final list of activity suggestions and materials to include in the teacher training content. This was also a form of member checking. The seven competencies promoted in teachers through the

teacher training prototype were revisited. No new information was generated, but the information generated during the World Café was confirmed as being representative of the knowledge created during the workshop.

Data analysis

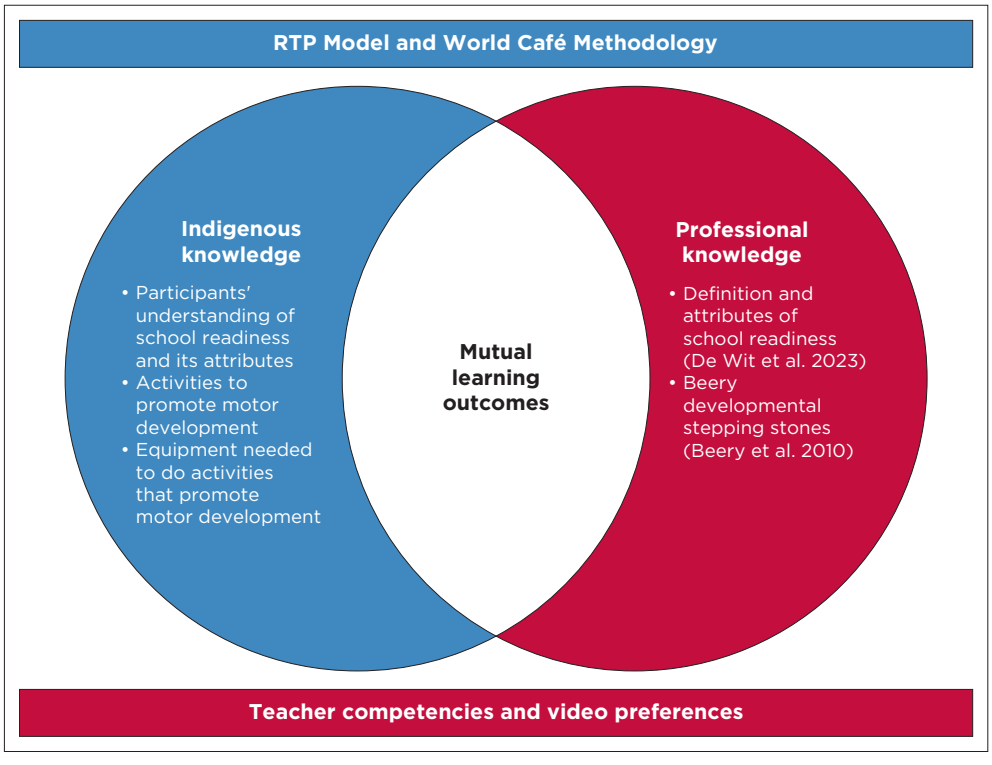
Data were collected through demographic information questionnaires, video design preference rankings, card sorting for teacher competencies, and transcribed audio recordings from the World Café and follow-up round table. All data were securely stored to adhere to ethical standards and privacy policies.

Thirty-five participants attended the workshop, and we received signed consent forms from all. However, some participants did not complete all sociodemographic questions. Demographic and video preference data were captured using a Microsoft Form and analysed using descriptive statistics. The card sorting results for teacher competencies, with all comments sorted and labelled, were entered into an Excel spreadsheet. Transcriptions were saved in six Word documents (one per discussion table) and uploaded to Atlas.ti software version 23 (ATLAS.ti Scientific Software Development GmbH, 2023).

All other documents, including the online meeting with the facilitators, the programme for the World Café, and the card sorting results that formed part of the data set, were uploaded to form the complete data set for analysis in Atlas.ti.

Framework synthesis is a systematic approach that allows for data to be organised, analysed and compared to existing frameworks. Framework synthesis requires an a priori framework that includes key themes, concepts and potential relationships, to extract and synthesise findings (Barnett-Page & Thomas 2009). The process of framework synthesis involves several steps, such as those suggested by Braun, Clarke and Terry (2015), and Barnett-Page and Thomas (2009).

Our framework (see Figure 5.3) included three themes: Facilitating a World Café, indigenous knowledge and professional knowledge. The categories in the World Café theme were based on the RTP process and the seven World Café principles (Löhr et al. 2020). The indigenous knowledge theme included the following categories: (1) participants' understanding of school readiness and its attributes, (2) activities to promote motor development and (3) equipment needed for activities that promote motor development. The professional knowledge theme included the categories of (1) definition and attributes of school readiness,



Source: Authors' own work.
Key: RTP, research to practice.

FIGURE 5.3: Framework for analysis of co-developed teacher training content.

developed through a concept analysis completed by De Wit et al. (2023), and (2) a developmental frame of reference represented by the Beery developmental stepping stones (Beery, Buktenica & Beery 2010). This includes 600 age-normed skills developed through a content analysis of the term 'milestones' in the developmental areas of gross motor skills, fine motor skills and visual-motor integration skills.

We familiarised ourselves with the collected data. By using a deductive approach, we systematically identified and labelled specific phrases, sentences or paragraphs that represent meaningful units of information using the pre-existing themes, categories and codes in our framework. Where a unit of information (words, phrases or sentences) did not fit the existing framework, we created a new code. We considered whether new codes fell within existing categories or themes, or whether new themes were emerging inductively from the data.

The framework with extracted data was then refined through an iterative process of continual comparisons to previous versions and to existing

frameworks to refine the codes, categories and themes. Data were compared within and across cases to ensure that the framework accurately represented the data and captured the diversity of perspectives. The step of re-coding and mapping required that we then revisited and re-coded the data based on the refined framework, after which, we mapped the data onto the framework, placing relevant evidence from the transcribed data under the appropriate themes and categories. Finally, we interpreted the data within the context of the framework to identify connections, patterns and relationships between themes.

The second-last question of the World Café, to identify teacher competencies that could be developed through mobile learning, was answered using a card-sorting technique (Zimmerman & Akerelrea 2002). Firstly, a brief explanation of the project was given by showing examples of a teacher training app using short videos for knowledge translation. Secondly, an example of how card sorting works was provided by using a deck of cards to illustrate the grouping of labels. Blank cards were provided to each group, and they were encouraged to write their own ideas of how a learning app could help them become a better teacher on the cards.

Sixty-four cards were made by the participants under the guidance of their table facilitator. In the large group, participants were then asked to stick their cards on a wall, matching their cards with other participants' cards that had a similar idea written on them. Two of the facilitators then read the statements back to the participants and suggested labels for each group of similar statements. These labels reflected the content of the statements and the group consensus that had emerged about which competencies were similar. Through this inductive process, the participants agreed with the labels that developed.

In the final question, participants were asked to rank their preferences for three video design options for training content: Live action videos, animation, and whiteboard or Doodly videos. Preference was ranked by writing the number '1' next to the most preferred format, '2' next to the second-most preferred format and '3' next to the least preferred format. We then entered the ranked data using IBM SPSS Statistics (IBM Corp. 2023) and completed the analysis using Friedman's Test.

Informed consent

This research was approved on 20 February 2023 by the Stellenbosch University Health Research Ethics Committee (Reference number S22/08/151). Informed consent was established through consent forms available in three languages: English, Afrikaans and isiXhosa, with translators present.

Results

Sociodemographic information

The World Café participants were women, with a mean age of 39. The majority (58%) were married or living with a partner and indicated their population group as coloured (91%). All were living within the Cape Town Metropole area of the Western Cape province, South Africa. At least 50% of the participants reported Afrikaans as their first language or speaking Afrikaans only at home, while almost half reported Afrikaans and English being spoken at work. Nine per cent reported isiXhosa being their first language and the language spoken at work, while only 3% reported speaking English, Afrikaans and isiXhosa at work.

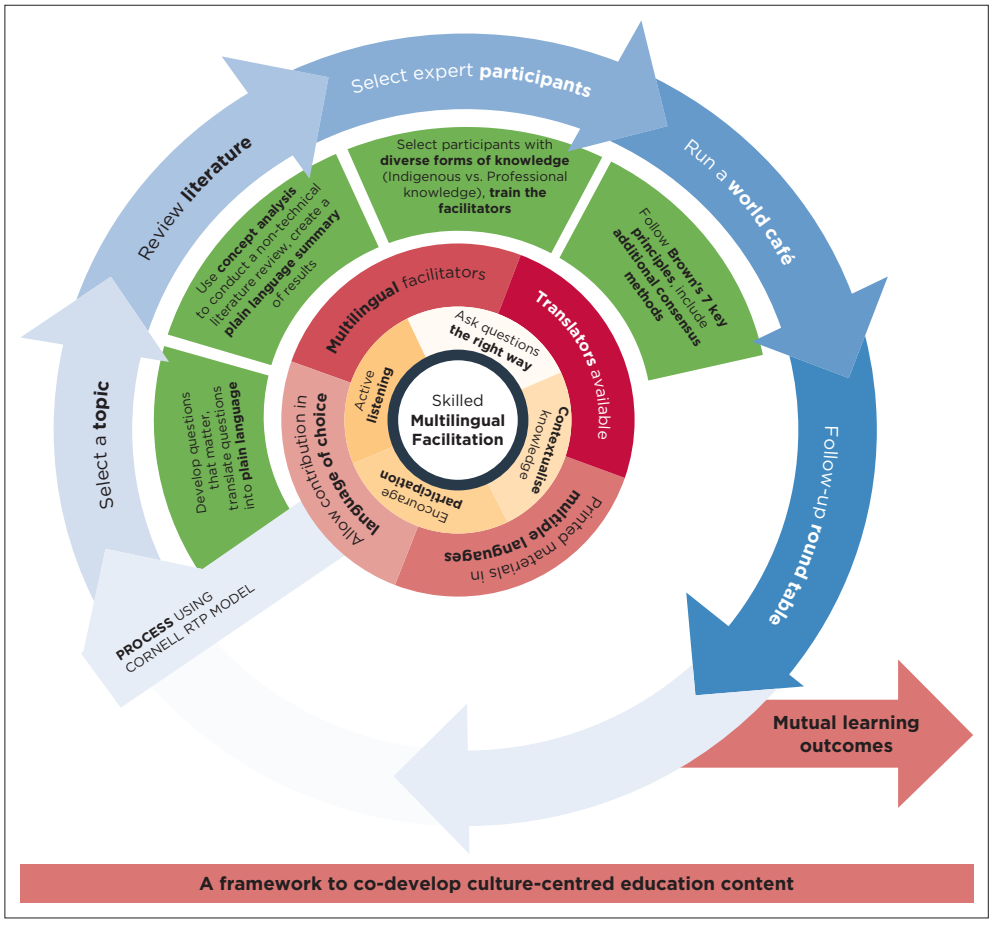
Framework synthesis

Analysis of the qualitative data from the World Café suggested that this method could be used successfully to generate culture-centred content for a teacher training app, as illustrated by the framework presented in Figure 5.4. Two key themes were evident throughout the analysis: The World Café process, and mutual learning outcomes. Four key categories emerged from the World Café process, and, within the theme of mutual learning outcomes, six categories summarised the different aspects of mutual learning that occurred while developing culture-centred content through the World Café and other consensus methods.

World Café process

Principles that were unique to this analysis, and enhanced steps of the RTP Model (Trevino et al. 2020) and components of Brown et al. (2005) World Café principles, include creating a PLS following the non-technical literature review, translating questions and printed information into plain language, multilingualism, and the use of additional consensus methods within the structure of the World Café. Multilingualism was evident across multiple steps, including having translators available in the venue, preparing printed materials in more than one language, which included the consent forms and the plain language summary of school readiness, allowing contributions in the language of choice, and having multilingual facilitators.

A critical success factor for the use of the World Café was the way in which the facilitators followed Brown et al. (2005) steps for running a World Café to facilitate dialogue and mutual learning. Twenty-one principles of facilitation were observed during the World Café. Four categories were developed from the analysis of these observed facilitation skills: Asking the questions the right way, Contextualisation, Encouraging participation, and Active listening. These 21 principles for facilitation are presented in



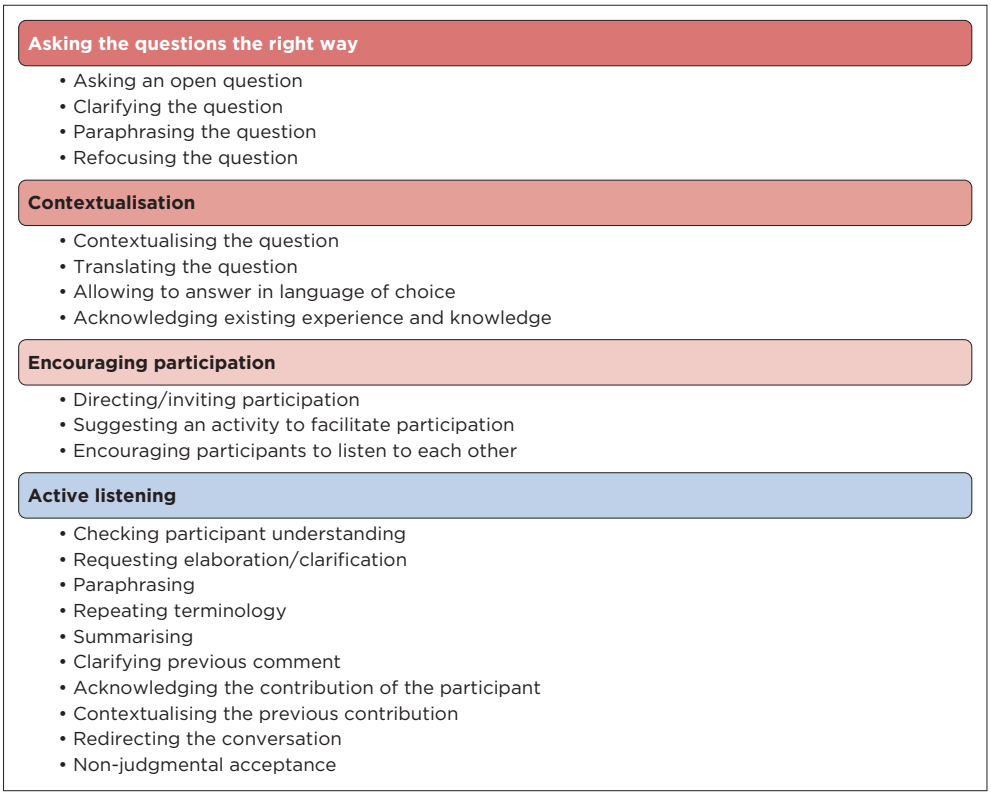
Source: Authors' own work.

FIGURE 5.4: A framework for the co-development of culture-centred education content.

Figure 5.5 and represent the facilitation skills needed for successful facilitation of dialogue in a World Café. The additional consensus methods used included card sorting and preference voting.

Mutual learning

Indigenous knowledge and professional knowledge were demonstrated and integrated throughout the World Café. The level of mutual learning achieved meant that it was almost impossible to differentiate between purely indigenous knowledge and exclusively professional knowledge. Within the framework for developing culture-centred content (Figure 5.4), it was evident that participants were able to express their knowledge of school readiness. Much of this knowledge was consistent with professional definitions and the attributes of school readiness identified in the literature. Participants mentioned all eight attributes of school readiness identified by



Source: Authors' own work.

FIGURE 5.5: Twenty-one observed facilitation skills.

De Wit et al. (2023), either by naming the attribute (e.g. physical development), or describing components of that characteristic (e.g. being able to run and jump). For example, one participant said, 'we as ECD practitioners are there to create an environment in which the child grows physically strong', while another mentioned '[...], so you are also teaching them to jump'. Dissenting views about school readiness were also evident, with one participant commenting, 'The child itself needs to be able to speak to go to school, before anything else', and another saying, 'I would not say the one (skill) is more important (than another)'.

Participants named or demonstrated 108 unique activities to promote motor development, as well as the rules, resources needed, and origins of these activities. For example, one participant said, 'So I will maybe put two red and one blue or blue and green like that so they can jump', while another talked about midline crossing when they said, 'taking your right hand and putting it on your left foot and taking your left hand and touching your right foot'.

Activities such as obstacle courses were mentioned 12 times in the conversations, and skipping six times, as activities used to promote motor development. They also named 84 unique pieces of equipment needed to promote motor development, including scoops, sand, milk containers and chairs; as well as ways in which the equipment could be used (e.g. building obstacle courses).

Another aspect of indigenous knowledge that was evident through the analysis was the connection between learning and play, as well as the importance of having fun and enjoying an activity, so that learning can take place. Examples are comments such as 'making it fun for the children', and 'the children had fun, not knowing that they were actually learning something'.

Simultaneously, the incorporation of professional learning into the World Café was evident in the programme developed to run the World Café, the reading materials prepared for participants, and the contribution of the facilitators to the conversations within the groups. For example, facilitators used their professional knowledge of early childhood developmental stepping stones (Beery et al. 2010) to ask the pre-planned, follow-up and probing questions to participants. This was evident when one facilitator said, 'Your job today is to do the gross motor skills. How do you do it at your school?' At another table, another facilitator asked, 'What do you associate with midline crossing?'

Information that was highlighted and confirmed during the follow-up roundtable was the fact that school readiness attributes cannot be prioritised. This was evident with participants' comments such as 'Because you see the focus is actually on the gross motor, I see, but for me it is the child as a whole', and 'I don't think there is a thing that you say school ready is more gross or fine motor'. Another aspect that was highlighted was the fact that you cannot promote a skill in isolation; activities are complex and require motor skills and other skills, such as following instructions, memory, and turn-taking, all at the same time. This was evident by comments such as 'and when you think of that we can't separate gross motor skills development as something on its own'.

Eight teacher competencies that participants believed could be developed through a learning app emerged from the card-sorting activity, as indicated in Figure 5.6. Teachers wrote comments such as, 'It will help me to learn different ways of teaching and it will make things easier for me because it demonstrates what I want them to do'. Another comment said, 'This app will help me with planning and sparking ideas'. The first seven labels are teacher competencies, such as improving knowledge, skills, and level of creativity within lesson planning, and the eighth label is about using your smartphone and the app as a professional tool and a teaching aid.



Source: Authors' own work.

FIGURE 5.6: Teacher competencies developed through card sorting.

Results of the video design preference questionnaire were analysed using the Friedman Test to determine whether there was a preference for video type between three options of video format. There was a statistically significant difference in video preference when comparing participants' preferences for learning using live action videos, animation, or whiteboard or Doodly videos, $\chi 2(2) = 14.547$, $p < 0.001$, $n = 35$. Participants' first preference was for live action videos (mean rank = 1.51) compared to animation (mean rank = 2.07) or whiteboard or Doodly video (mean rank = 2.41).

Discussion

School readiness is a complex concept, and the meaning behind it varies depending on the context and from whose perspective it is used (Jahreie 2023). To address school readiness within a specific context, a contextual working definition was needed as a starting point for discussions around the development of ECD teacher training content. From the data, the stakeholders' contribution to the content creation appears to be consistent with a social policy pedagogical tradition, which is distinguished by a comprehensive child-centred approach, broad guidelines, no formal assessment and play-based learning (Bennett 2005). Bennett emphasises that understanding the pedagogical tradition helps to clarify the role and importance of well-trained teachers in quality early childhood programmes.

De Wit and Plastow (2021) reiterated the significance of contextual relevance in the content of ECD teacher training programmes and the customisation of learning materials to suit the local context in which they would be used. By ensuring that the learning materials align with the specific context, there is a greater likelihood of successful transfer of mLearning to classroom practices.

A concept analysis of school readiness served as a thorough literature review, and provided a common definition of the attributes of school readiness to compare stakeholders' understanding of these attributes (De Wit et al. 2023). Completing a concept analysis was a way to deconstruct the term 'school readiness', to understand it better within our context, and to create a contextual definition that would also provide insight into the concept. Furthermore, a PLS of the technical definition was needed.

Translating these technical definitions into plain language assists in making these definitions accessible in jargon-free language. This was helpful, as the literacy of stakeholders could not be assumed. The ability to read in English also could not be assumed, and thus the translation of these definitions into at least one other language was helpful in making the definitions accessible to stakeholders. This was essential in keeping the discussions during the World Café focused on school readiness within the South African context, especially as it applies to low-resourced areas in the Western Cape province. Plain language summaries were used again to present findings to stakeholders during the follow-up roundtable.

Multilingualism was a factor that was addressed through the translation of all material and consent forms. According to a study done by Fang and Liu (2020) about learning in multiple languages in a tertiary setting and making use of multiple languages for discussions of content, was useful to deepen understanding, create rapport and promote learning, especially for the students with lower proficiency in the primary language of instruction. McGrath et al. (2023) also stressed the importance of the use of translators during World Café's for understanding research agendas in primary care with stakeholders from underserved communities. Similarly, Ravneberg (2024) used bilingual assistants and multilingual resources during her World Café as a prerequisite to co-creating and co-producing positive changes in their learning environment. Multilingualism – making use of translators – can thus be used to ensure mutual learning during the World Café.

For the development of culture-centred teacher training content, we valued the involvement of stakeholders in every step of the process. As with all participatory methods, stakeholder involvement is costly in terms of planning and recruitment time, participant reimbursement and administrative resources. However, the purpose of the World Café is cross-pollination of ideas and learning from each other. Inviting participants from different communities and hosting the World Café at a central location facilitated reaching this outcome. The World Café is thus a resource-intensive but effective way of co-developing culture-centred teacher training content. Compared to other methods of enquiry, Schiele et al.

(2022) argue that a World Café only requires one day of stakeholder involvement and significantly reduces the cost and time spent on data collection, which benefits both the researcher and the stakeholders. Results are shared and wrapped up in such a way that stakeholders leave with knowledge on the selected topic on the same day. This was evident by the mutual learning and results of the World Café of school readiness knowledge, motor activities, equipment lists, teacher competencies and video design preference.

Training of facilitators was a critical step in the success of the World Café. When Freeman, Wright and Lindqvist (2010) examined the facilitator skills required of educators involved in interprofessional learning, which also included aspects of active listening and encouraging participation. They acknowledged the importance of effective facilitation in the success of their interprofessional learning course. However, to address the gap in the literature on how to prepare facilitators for interprofessional learning, they described the facilitator training programme they used. Bylund et al. (2008) concluded in their study on facilitation skills training that preparing the facilitator to adhere to a set of facilitation guidelines was an important step in being able to evaluate the effectiveness of the training programmes they would then facilitate. The training also provides the background and practice opportunity necessary to become effective facilitators. Thus, recruiting experts as facilitators, as well as training these experts in the use of facilitation skills, were critical to our success.

To define the levels and dimensions of quality in ECD within the South African context, Excell (2016) argues that definitions should be contributed to and understood by stakeholders. Therefore, research must use participatory methodologies that involve all stakeholder groups to define quality in ECD. This was achieved through methods such as the RTP model and World Café, along with the use of other consensus methods within the World Café. The other methods, such as card sorting and preference voting, must thus be included to ensure meeting the objectives of the World Café, and collectively, these consensus methods are one way to ensure the quality of ECD teacher training within the South African context.

By following the careful preparation steps as suggested by the RTP model (Trevino et al. 2020), and skilled facilitation evident in the 21 facilitation principles applied during the World Café, we were able to co-develop teacher training content for an mLearning app focused on school readiness and motor development. This is evident through the collective knowledge of school readiness that the participants contributed during the discussions, and the mutual learning outcomes evident in our analysis. It also became apparent through the abundance of activity ideas for motor

skill development participants described, and the creative list of accessible materials and equipment they discussed. Fonseca Peso, Caro González and Milosevic (2020) reported that participatory methods such as the World Café led to mutual learning and a deeper appreciation of perspectives from a diverse group of stakeholders.

The suggested framework (Figure 5.4) represents the steps that should be taken to plan and prepare for the co-development of culture-centred content. This follows the five steps of the Cornell Research to Practice Model (Trevino et al. 2020) specifically including the training of facilitators before the World Café and the translation of all materials and information into plain language, as well as multiple languages. Facilitation of dialogue during the World Café happens through facilitator skills and the World Café principles and process. There are 21 facilitator skills needed by the experts, and the seven key principles can be expanded on by considering multilingualism and other consensus methods. The suggested framework could also potentially be used for the co-development of culture-centred mLearning modules for teachers of older age groups, as well as for other professions, such as social workers and community workers.

New findings that emerged from this study, to guide the development of culture-centred education content for teacher training:

- Complete a concept analysis and literature review and convert this into a PLS. Summarise findings in plain language again, to use in a follow-up round table to confirm the findings.
- All workshop materials should be prepared in multiple languages, and the workshop should be facilitated in multiple languages.
- Recruit and train skilled facilitators who can apply a range of facilitation techniques and are multilingual.
- World Cafés that use multiple consensus methods are a place where mutual learning can effectively occur.

Limitations and challenges

Although the World Café was successful in achieving the pre-determined objectives, the recruitment strategy was time-intensive without a great response rate. Snowballing was much more effective, while still reaching the intended participants. The management of large amounts of transcribed data was also time-consuming and extended the time between the World Café and follow-up round table to more than the suggested timeline of two to four weeks. Keeping to the suggested timeline between the data collection (World Café) and stakeholder confirmation of the analysed results is recommended.

Transcription time was exponentially increased by low-quality recordings on one of the devices. Although data saturation was achieved after the analysis of four transcripts (representing the conversations at four tables), having more than 24 participants ensured the quality and rigour of the data collection process.

Conclusion

Although school readiness is a Western concept, how it is promoted within the South African context is influenced and enhanced by indigenous knowledge. Stakeholders' own understanding and knowledge of school readiness within the South African context can be used to develop mLearning teacher training content to potentially promote teacher competencies such as developmental knowledge, skills in promoting school readiness, understanding what children should be able to do before they go to school, skills in identifying and helping the children who are struggling, lesson planning, planning of fun activities, and stimulating new and creative lesson ideas. The purpose of the World Café is cross-pollination of ideas and learning with each other, and through skilled facilitation within the World Café, culture-centred content can be co-developed, thus enhancing teacher training in early childhood education.

While the term 'indigenous knowledge' serves as a useful umbrella term, it is essential to approach it critically, acknowledging the diversity and complexity of indigenous knowledge as one develops culture-centred content. Recognising the role of language is a crucial step towards respectful collaboration in the co-development of culture-centred teacher training mLearning content.

Declarations

Ethical considerations

The Human Research Ethics Committee at Stellenbosch University approved the study with study number S22/08/151 (PhD).

Consent

Written informed consent was obtained from all participants.

Author contributions

Monique de Wit: Conceptualisation, Data analysis, Data collection, Data curation, Methodology, Writing – original draft, Writing – review and editing.

Sylnita Swartz-Filies: Data collection, Data curation, Writing – original draft, Writing – review and editing.

Darelle van Greunen: Conceptualisation, Data curation, Writing – review and editing.

Nicola Plastow: Conceptualisation, Data analysis, Data collection, Data curation, Methodology, Writing – review and editing.

All authors reviewed the article, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

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Competing interests

The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this chapter.

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Data availability

The data that support the findings of this study are available upon reasonable request submitted to the first author (Monique de Wit).

Disclaimer

The views expressed in this chapter are the authors' own and not an official position of the institution or the publisher.

Chapter 6

Leveraging occupational therapy in early childhood development: Achieving population impact

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Abstract

Background: Occupational therapists face challenges in providing equal health care access to children, particularly in rural areas. An opportunity for occupational therapists to provide support and training, especially in play, to early childhood development (ECD) practitioners in the non-governmental setting is emerging. Occupational therapists in South Africa

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are largely employed in the private sector, with no population-based programmes to support children. Non-governmental organisations (NGOs) providing support for children are crucial for ECD services, including training and support of ECD practitioners. The NGO space is thus an area for investing and strengthening services to train and support ECD practitioners. A primary responsibility of ECD practitioners is to incorporate organised play-based activities at ECD facilities through a structured daily programme. Play, however, is not prioritised by ECD practitioners in their daily programme.

Aim: This qualitative study thus aimed to explore and describe the knowledge of ECD practitioners in low socio-economic areas on the value of play for children under 3 years.

Method: A case example was used to illuminate challenges in ECD, assuming an occupational therapist's perspectives and experiences in working in ECD.

Conclusion: Occupational therapists who practise in similar settings, and occupational therapy students in their capacity as future practitioners, might benefit from the insights presented in this chapter. This chapter may furthermore enhance advocacy initiatives and policymakers working in the education department and civil society on the importance of and challenges experienced in the ECD sector.

Background

Education for all – how far have we come in early childhood development?

While South Africa is classified by the World Bank (2023) as having an upper-middle-income economy, it is a country where young children are exposed to risk factors that have an impact on their early childhood development (ECD). The South African National Integrated Early Childhood Development (NIECD) Policy (Department of Social Development 2015) identifies poverty, malnutrition and environmental toxins as risk factors affecting ECD. More than six in 10 children (62.1%) in South Africa are classified as multidimensionally poor. Compared to children in urban areas, children in rural areas have a higher multidimensional poverty rate. These children experience deprivation across seven dimensions, which include water, sanitation and hygiene; housing; nutrition; protection; health; information; and child development (United Nations Children's Fund [UNICEF] 2020). Children in poorer areas in South Africa face substantial obstacles before they start schooling, as a result of such deprivation during the first five years of their lives (Giese et al. 2022).

By 2030, it is intended that all children have access to high-quality early learning to help them reach their potential (United Nations 2015). An estimated 250 million children in low- and middle-income countries will not reach their developmental potential because of poverty (Black et al. 2017). Children born in sub-Saharan Africa are expected to be only 58% as productive as they could potentially be when they reach adulthood, compared to children born in Europe and Central Asia (World Bank 2020). Poverty in earlier life is found to affect human capital in terms of 'levels of education, population health, unemployed youth, criminal behaviour and incomplete schooling' (Lim et al. 2018, p. 1217; Naicker et al. 2022). South Africa faces challenges in transforming human capital and addressing the 2030 agenda for sustainable development, ensuring quality care and ECD for more children (National Planning Commission 2013, pp. 299–300; United Nations 2015, p. 17).

Developments in ECD in South Africa have increasingly been orchestrated to respond to the global as well as national ECD objectives. These objectives steer the changes for positive outcomes and initiatives in ECD, and drive the goal of universal access for all children to early learning programmes. Changes in the ECD space are well informed by policy, legislation and literature, and are guided by the National Integrated Plan for early childhood development in South Africa (UNICEF 2005), the National Development Plan (National Planning Commission 2013), the South African NIECD Policy (Department of Social Development 2015) and the Early Childhood Development Subsector Skills Plan (2020–2021) (Department of Higher Education and Training 2020). South Africa has prioritised the expansion of ECD programmes to ensure that every child, from birth to 5 years old, can access and participate in high-quality early learning programmes by 2030. With additional funding, it is envisaged that by 2030, around two million more 2.5-year-olds can potentially participate in quality early learning (Labantwana & Bana 2018).

The Nurturing Care Framework was launched in 2018 to promote the latest research on ECD, and it outlines strategies and initiatives to nurture care for infants and young children. It highlights the role of sectors, including government, private, academic and educational institutions, in fostering healthy child development. Nurturing care during the first three years of life is crucial for optimal child development, as it helps mitigate the impact of risk factors affecting development. Relationships, whether familial or with other caregivers, are fundamental to 'nurturing care'. Since the launch of the Nurturing Care Framework, noticeable progress has been made in leading, investing and supporting families and communities. Existing services from health, education and protection have also been strengthened. The next step is to strengthen and increase investment in strategic action and to ensure an 'enabling environment' through informed

policy and intentional action, to support parents and caregivers in understanding nurturing care (World Health Organization, United Nations Children's Fund & World Bank Group 2018, p. 5). Biersteker et al. (2016), however, note that when compared to the standards of older children, the quality of early learning programmes in South Africa for infants and toddlers is lacking. The quality of a programme is affected by poor planning of daily programme activities and inadequate positive interactions with children. Early childhood development centres in less affluent areas often lack quality in language stimulation, access to educational resources and support for learning through scaffolding. Moreover, limited funding and centre management further exacerbate the poor developmental outcomes for children under the age of 5 years (Department of Basic Education 2022; Giese et al. 2022).

Positioning early childhood development practitioners in the non-governmental sector

While poverty significantly impacts early learning, the support from various staff members at the ECD centre, especially the ECD practitioners, also impacts children's development in their early years. The ECD practitioner is crucial for advancing the change needed so that more children have access to high-quality early learning programmes. However, there is a shortage of qualified ECD practitioners throughout the sector to foster a setting that provides the prerequisite opportunities for children's early learning. The latest estimate on the number of ECD practitioners in South Africa is 30,000 (Labantwana & Bana 2018). Of this group of ECD practitioners, 15,000 are unqualified. Despite the pivotal role of ECD practitioners in driving the ECD agenda in South Africa, this occupation has been identified as 'hard to fill'. Factors limiting the number of ECD practitioners are a dearth of appropriately qualified practitioners as per the minimum standards set out by the Department of Social Development (2006).

Qualifications in South Africa are based on the National Qualifications Framework (NQF) by the South African Qualification Authority (Department of Higher Education and Training 2020). The National Development Agency of the Department of Social Development (2020) outlines that ECD qualifications are primarily provided at Further Education and Training colleges and ECD non-profit organisations. The minimum requirement for ECD practitioners is training in ECD, including managing programmes and ECD sites for young children. Early childhood development practitioners must also complete ongoing training in these areas. They are expected to be physically and mentally healthy and be capable of caring for a child. According to the South African Qualification Authority, the minimum level of qualification for an ECD practitioner is an NQF Level 1. For senior positions

such as an ECD centre supervisor, the qualification requirement is an NQF Level 4. The NQF Level 1 allows access for further studies so that ECD practitioners can achieve an NQF Level 4 certification (Department of Higher Education and Training 2017; Department of Social Development 2006).

For more than 20 years, it has been advocated and documented that strengthening human capital through the training and support of ECD practitioners is crucial for bringing about the changes needed so that more children from birth to age five receive high-quality early learning. In 2001, the ECD audit reported (Williams et al. 2001) that most ECD practitioners were unqualified or received training from an NGO that was not accredited by the Department of Basic Education. In the 2013 audit, 75% of ECD staff had not completed Grade 12 (Department of Social Development 2013). The current data suggest that there have been improvements in qualifications, as 52% of teaching staff now have NQF 4–9 qualifications (Department of Basic Education 2022). To achieve the target of trained and supported ECD practitioners, it is envisaged that by 2030, an added 210,000 ECD practitioners will have been trained, including 'playgroup facilitators' and childminders, as well as staff working in ECD centres. Additionally, 140,000 assistants will be trained to reach universal coverage of early learning (Labantwana & Bana 2018, p. 6). The South African NIECD Policy (Department of Social Development 2015) supports that a primary responsibility of ECD practitioners should include play-based activities at ECD facilities that are planned and structured through an organised daily programme to promote young children's development. Such planned activities should cater to children's ages and developmental needs, ensuring practitioners understand their interests and provide a variety of activities for children to choose from (Department of Social Development 2006, 2015).

Creating a play milieu within the diverse ECD spaces is aimed at harnessing the child's natural inclination and curiosity to explore, be innovative, solve problems and learn while having fun (Department of Basic Education 2019). The 2022 ECD Census makes it clear that South African children are not given enough opportunities for play to support the intended play environment. Play is not given priority, and in the daily contacts that ECD practitioners have with children, learning through play continues to be elusive (Department of Basic Education 2022).

Early childhood development practitioners can be trained through partnerships with the Sectoral Education and Training Authority, provincial and national education departments, ECD organisations, and Technical and Vocational Education and Training Colleges and Higher Education Institutions (Department of Higher Education and Training 2020). Non-governmental organisations are regarded as key players in working collaboratively with governmental departments. In South Africa, ECD

practitioners are largely employed either as owners of an ECD centre or at an ECD facility managed privately or under the auspices of an NGO. Early childhood development practitioners are also employed in the Department of Basic Education, as the department establishes Grade R classes for which ECD practitioners need to be employed (Department of Higher Education and Training 2020). Early childhood development services are further provided by private organisations, NGOs, non-profit organisations, preschool centres, crèches and other role players within communities (Aubrey 2017). While ECD services are mostly publicly funded, NGOs or microenterprises are key in providing these services (Labantwana & Bana 2018). Furthermore, ECD centres that depend on or plan to apply for funding from donors must register as an NGO (Biersteker et al. 2016). The NGO space is thus a key setting for investing and strengthening services to train and support ECD practitioners.

Occupational therapy focus within early childhood development

Understanding the latest advances in occupational therapy services that illustrate occupational therapy's position in the ECD space is crucial. A study by Naidoo, Van Wyk and Joubert (2016) examined the perspectives of Department of Health stakeholders, including Community Health Care Workers, nurses, and experienced and newly qualified occupational therapists, on the function of occupational therapists in primary health care. The authors noted that occupational therapy intervention in paediatrics is 'predominantly individualised with limited group (paediatric intervention) and no population based programmes' (Naidoo et al. 2016, p. 6) and needing to strengthen collaboration with other sectors. Most South African occupational therapists are employed in the private sector (74.8%), while the remaining 25.2% provide services to 84% of the population. Occupational therapy services are limited, and are not equitably distributed nor easily accessible, particularly in rural areas (Ned et al. 2020). Philpott (2018) encourages occupational therapists to gain an understanding of and develop relationships in working with local NGOs and contribute to 'inclusive practices' within the ECD sector through knowledge and skills to promote universal access for children to early learning in the ECD space. There is an emerging opportunity for occupational therapy services in the provision of training and support for ECD practitioners in the NGO setting.

One of this chapter's authors works for an NGO as an occupational therapist and is responsible for managing the training and support of ECD practitioners. In addition, the occupational therapist creates content for the infant and toddler early learning programme. This management role also entails supervising a team of Support Teachers who are responsible

for assisting ECD practitioners at ECD centres. This section details the occupational therapy landscape in the ECD sector, focusing on the experiences of the occupational therapist in her role. Table 6.1 describes a group of practitioners from the research study conducted by the author. These practitioners receive training and support from a local NGO. This group formed part of 70 ECD practitioners employed at 24 ECD centres in rural and semi-rural agricultural communities. None of these ECD practitioners obtained a formal ECD qualification and therefore relied solely on the NGO for the provision of resources, training and support.

Case example

Gill* began her career as an occupational therapist within the education system more than two decades ago. Besides the traditional individual and group therapy sessions, tasks included planning and organising as well as management of a therapy team. The education system at that time was experiencing much change, and therapy services were in demand in terms of assessment, treatment and supporting learners in an inclusive class environment. Within the education and school setting, it is a common practice for occupational therapy to focus on individual and group sessions.

Gill accepted a position as a programme manager at an NGO eight years ago. Her experiences and expertise gained while working as an education therapist within the public school system aided her understanding of challenges experienced with the referral system and the infrastructure of the school setting. Although a medical model focus remained relevant, she realised that the use of this model was not practical for use in her current setting. Gill's job description now needed her to not only support

TABLE 6.1: Research participants: Early childhood development practitioners.

Pseudonym*	Age	Gender	Home language	Area	Highest grade passed	Years as an ECD practitioner	Years training with the NGO	Ages of children in class (months)
Theresa	40	Female	Afrikaans	Citrusdal	7	6	3	18–24
Anna	41	Female	Afrikaans	Citrusdal	10	2	2	36
Ursula	48	Female	Afrikaans	Citrusdal	10	14	3	12–24
Ilene	49	Female	Afrikaans	Citrusdal	8	18	3	24–36
Wendy	31	Female	Afrikaans	Stellenbosch	10	5	5	18–36
Geraldine	39	Female	Afrikaans	Stellenbosch	12	3	3	24–40
Nika	38	Female	Afrikaans	Stellenbosch	11	4	4	14–36
Zelda	26	Female	Afrikaans	Stellenbosch	11	2	2	12–36
Rhoda	29	Female	Afrikaans	Wellington	12	13	3	30–42

Source: Authors' own compilation.
Key: ECD, early childhood development; NGO, non-governmental organisation.
To further illuminate the occupational therapist's experience, a case example was used to describe the experiences of the occupational therapist, named Gill* (pseudonym). The case example shed light on knowledge that was acquired, which expanded the occupational therapist's understanding and execution of her role.

learners and parents at several ECD centres but also train and support ECD practitioners. She soon realised that supporting children across various locations presented with many challenges in terms of coordinating the services at all these sites. Thus, to reach the 700 children enrolled in the ECD centres working under the auspices of the community-based NGO, Gill needed to adopt a different approach to intervention.

In addition to effectively addressing the opportunities and needs of the NGO as far as the children were concerned, Gill also addressed broader key issues that ECD practitioners and children faced. Embarking on a postgraduate research study in occupational therapy aided with evidence-based practice. This study illustrated how research helped Gill's journey of not knowing to knowing and how it aided Gill in discovering how key issues in ECD contributed to redefining her role in providing intervention, shifting from the traditional role of an occupational therapist working in the public school system.

Gill's postgraduate studies were inspired by her working in and gaining experience in ECD services from 2015 to 2018. Her research study explored the use of play for children under 3 years of age who attend ECD centres. The study aimed to develop an evidence-based occupational therapy training curriculum for ECD practitioners.

This study explores and describes ECD practitioners' knowledge of and their perceptions on the value of play with children under the age of three attending ECD centres from lower socio-economic areas in the Western Cape province.

Research question

What knowledge and perceptions do ECD practitioners working with children under the age of three from a low socio-economic area have on the value of play?

Objectives

The study objectives were as follows:

- To describe ECD practitioners' knowledge of play with children under 3 years of age who come from a low socio-economic area
- To describe the perceptions that ECD practitioners have of play of children under 3 years of age in the ECD centres where they are employed
- To explore the play opportunities that ECD practitioners create for children under 3 years of age from a low socio-economic background, and what challenges they experience.

Methods

This study utilised a qualitative descriptive design within a constructivist paradigm. A qualitative design approach is characterised by its ease of use and flexibility, and it is commonly employed within the health care field (Doyle et al. 2020) and when time and resources are limited (Bradshaw, Atkinson & Doody 2017). This research design enables primary investigators to explore and understand a phenomenon through participant experiences in their natural environment (Bradshaw et al. 2017) and could be used to understand ECD practitioners' experiences with play in a low socio-economic setting. Sampling within the qualitative descriptive design is characterised, among others, by purposive sampling (Palinkas et al. 2015). Purposive sampling selects readily accessible subjects having the requisite experiences and qualities to address the research question (Doyle et al 2020; Palinkas et al. 2015). This sampling method was suited as the primary investigator had access to ECD practitioners who had experience in play with children in lower socio-economic areas.

Study population

The study drew its population from a broader group of approximately 30,000 ECD practitioners employed in South Africa (Department of Higher Education and Training 2020). Participants were recruited from approximately 70 practitioners from ECD centres in agricultural communities in the Western Cape province, receiving resources, support and training from the NGO involved during the study period. These ECD centres were in three municipal areas, namely, the Drakenstein and Stellenbosch Municipalities of the Cape Winelands district, and the Cederberg Municipality of the Western Coast district.

Selection criteria

Early childhood development practitioners working for one to four years with children under 3 years of age and receiving training monthly from the host organisation, Cobblestones (pseudonym), for at least one year were eligible for the study. Participants had to have access to an internet-enabled device.

Sampling

The study excluded practitioners with ECD qualifications to ensure an exact reflection of participants' views based on their relevant experiences (Bradshaw et al. 2017). Once all potential participants had responded and

showed their interest in taking part in the study, Cobblestones completed a form provided by the primary investigator for personal details of potential participants. A third party, who was a Cobblestones staff member, verified if a practitioner met the selection criteria and helped practitioners who struggled with completing forms for their personal details. The third party helped the ECD practitioners to access an internet-enabled device.

The study methodology was revised because of the coronavirus disease 2019 (COVID-19) pandemic, considering the University's Ethics Committee's response and the declaration of a national state of disaster. Face-to-face contact with study participants was not allowed. Recruitment was conducted using a bulk short message service (SMS) web application and telephone calls (Speirs et al. 2016). The focus group discussions were conducted using Zoom video conferencing and telephone conference calls (Allen 2014; Archibald et al. 2019; Irani 2019). The in-depth semi-structured interviews were conducted telephonically (Farooq & De Villiers 2017).

Recruitment

The primary investigator used anonymous bulk SMS to recruit participants to the study, with participants responding 'yes' or 'no' to the request for participation. If potential participants indicated that they could be contacted, they were invited to take part in the research study. Three SMSs were sent to non-responders, after which a telephone call was made by a third party to check that participants had received the SMS as well as to remind them to respond via SMS so that the primary investigator could record their responses.

Ethics and approvals

Ethics approval was granted by the Health Research Ethics Committee from Stellenbosch University, while Cobblestones approved that the research could be conducted at the organisation. The primary investigator met with staff from Cobblestones to discuss the methodology and address questions they had about the study. Ethical issues, autonomy, confidentiality and anonymity were discussed, and methods to support these were discussed with Cobblestones as well as ensured throughout the study (Department of Health 2015). As the primary investigator was employed at Cobblestones, the two roles of primary investigator and occupational therapist had to be carefully managed. Communication with potential participants and information access were delegated to a third party, the Support Teacher. The primary investigator ensured anonymity

by sending all communication to practitioners via the third party to prevent undue pressure on participants. Participants were given an opportunity to share their experiences during the study at the last data collection session.

Informed consent

Practitioners were enrolled in the study by means of a WhatsApp voice note and direct message, and they received electronic copies of the informed consent document and informed declaration form. Participants consented by sending a direct message of a 'thumbs up' emoji and their full name to the third party from Cobblestones. The 'thumbs up' emoji served as a substitute to a signature on a hard copy of the informed consent form. The primary investigator recruited 15 participants from seven ECD centres for a study, but as a result of COVID-19, not all centres reopened and recruitment attempts were unsuccessful (Manji et al. 2021).

Pilot study

The pilot study involved five project practitioners who were not ECD qualified, working with older children at supported centres. The aim was to evaluate the research process, improve communication and amend the topic and interview guide. The pilot study found that participants had challenges with Wi-Fi connectivity at the sites. A technical troubleshooting segment was thus included in the focus group discussion sessions. The third party assisted participants in downloading Zoom for the focus group discussions. The bulk SMS web application was easy to use, cost-effective and ensured anonymous communication. The pilot participants reported experiencing anxiety during the pilot but were more comfortable with familiar individuals. The third party was thus a familiar staff member. The primary investigator reassured participants during data collection sessions by explaining their roles and reminding them that they could withdraw at any time. An undergraduate student assisted with transcription, which was found to be a time-consuming task.

Data collection

The primary investigator conducted in-depth, semi-structured interviews and focus groups with 11 practitioners, including two who could not attend because of the data collection duration. Data were collected over two months, including three online focus group discussions, nine telephone

TABLE 6.2: Data collection duration.

Data collection session	Duration in minutes
Focus group discussions	407
Telephone interviews	330
Member checking	160
Total hours' data collection	897 (14 hours 57 minutes)

Source: Authors' own compilation.

in-depth semi-structured interviews and three mobile conference calls focus group discussions. The primary investigator utilised a topic or interview guide to facilitate discussions and interviews, allowing for further exploration of the findings (Moser & Korstjens 2018). The sessions were recorded and saved as audio recordings, with each focus group discussion lasting about 60 minutes. The total hours of data collection are presented in Table 6.2.

Data analysis

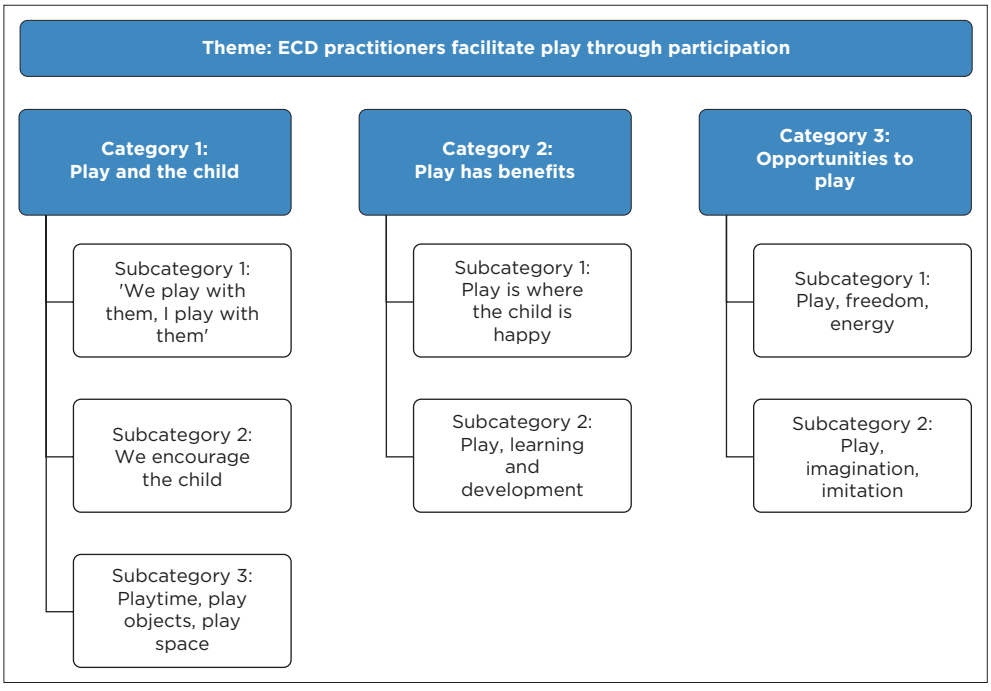
Following the first focus group discussion, data analysis commenced. Data were transcribed verbatim and organised (Sutton & Austin 2015). The primary investigator added comments and reflections and identified similar words or phrases. Patterns in words and phrases were used to formulate themes (Doyle et al. 2020). Two themes and eight subcategories were initially identified, and these were further organised.

Data management

The audio recordings of data collected from the focus group discussions, and telephone interviews once transcribed were stored on a device used exclusively for the research study, and no other persons had access to this device. Participants' contact details and personal information were saved in an Excel spreadsheet and stored on the same laptop. All subsequent research documentation generated through the analysis process was kept secure in this way on the primary investigator's laptop. Additionally, data were stored using a cloud-based online system. Following the final research report, the audiotaped data were erased from all devices. Hard copies of telephonic interviews and any other written work that had been generated were securely stored in an archive filing system. Data were deleted after analysis (Sutton & Austin 2015).

Study findings

The study's findings identified a single theme, with three categories and seven subcategories, as depicted in Figure 6.1.



Source: Authors' own work.
Key: ECD, early childhood development.

FIGURE 6.1: Themes and categories.

The theme explains three components and their contribution to facilitating participation in play. Category 1 illustrates how the practitioners' experiences highlighted that they facilitated their learners' participation in play either by participating in play with the children or by encouraging the children in play. Additionally, time, space and play objects were important to facilitate play participation. Category 2 describes the perceptions that practitioners had regarding the benefits of play and includes benefits related to feelings or emotions, and learning and development. Category 3 links play to creating a sense of freedom and imagination. Table 6.3 provides excerpts of participant responses relating to the theme. The study found that ECD practitioners, despite lacking accredited formal training or appropriate qualifications, facilitated play by assuming multiple roles, including that of participant, encourager, organiser, observer or overseer, and teacher. This aligns with existing literature on how teachers promote play to benefit children's development in ECD. Through these roles, they created a play milieu and encouraged children, provided organised play opportunities, fostered freedom in play, promoted happiness and stimulated learning and development (Altun 2018; Shin & Partyka 2017; Yogman et al. 2018).

TABLE 6.3: Participant excerpts.

Category	Subcategory	Illustrative quote
Play and the child	We play with them; I play with them	'[…] they enjoy it when I play along and so forth.' (Anna)
Play and the child	We encourage the child	'[…] when you give him a nudge, when you give him that nudge and tell him "teacher will do this with you then we see if you can do it and do it".' (Geraldine)
Play and the child	Playtime, play objects, play space	'[…] and when we have free play then we have hm, there is a grass patch outside hm, we play with a ball, or they run around a bit and so forth.' (Anna)
Play has benefits	Play is where the child is happy	'They are so happy, and I can usually see on their faces that they are busy playing.' (Rhoda)
Play has benefits	Play, learning and development	'[…] for example, construction is also part of what can be played with the building blocks. It helps with problem-solving. And creative skills.' (Ursula)
Opportunities to play	Play, freedom, energy	'They wake up teacher Marge and they have much more energy when they play' (Zelda) 'Often when it comes to story time then I read a short story, but then I observe there's one or two who are not listening. They do not want to sit quietly. Or there is one who is tired, then I keep the story short and then think to myself, before the one goes to sleep, I go to my phone and switch it on. Then the one says to the other, "Oh, teacher [name omitted] is again Freeze Dance, Freeze Dance!" Then I play Freeze Dance for them […] and then suddenly they are alert and awake.' (Ilene)
Opportunities to play	Play, imagination, imitation	'She plays with the tea set then she imagines she is making coffee or tea, she pours and then she gives me a cup, a cup of tea to drink, hm, you know their imagination goes wild and as they imagine so they do much more.' (Ilene) 'I think, wait, wait! What are they busy doing? Then I see, hmm, they are using their imagination; they started diving, beginning with swimming in the pool because now it looks as if there is water in it and the balls are there now and they have started swimming.' (Nika)

Source: Authors' own work.

Discussion

This chapter explicates the process of the researcher in redefining her role and approaches to intervention as an occupational therapist practising in the ECD sector. Inequalities in early childhood for many children perpetuate poor long-term health (Lim et al. 2018). The chapter highlights persistent inequalities in early life, including a lack of skilled ECD practitioners, which contribute to young children's vulnerability to poor health and economic success. While policy and partnerships have begun to give impetus to the needed changes, how such change is exacted may not be as explicit. Similarly, the occupational therapist's role in ECD may not be clearly defined, affecting equitable access to support for many young children. The chapter highlights the potential disadvantages of inequitable occupational therapy service distribution, particularly for children from lower socio-economic backgrounds, in the ECD sector.

The case example provided a snapshot into the ECD space and the experiences of an occupational therapist working in the setting. The study lists and describes four important points that can be linked to two key challenges experienced in the ECD space, namely, ECD practitioner qualification and the role of occupational therapists in the ECD sector. Firstly, ECD practitioners use play naturally, but they do not have sufficient knowledge about this innate play and the multiple roles which they naturally assume when they play with children. Secondly, despite their lack of an ECD qualification, ECD practitioners are aware of and have some knowledge of how to employ play to advance learning and development. Finally, occupational therapy requires an understanding of its role in ECD in rural areas where occupational therapy services are limited and not equitably distributed, and where an emerging opportunity exists for occupational therapy services to provide support and training to ECD practitioners in the NGO setting.

Play is mentioned in this discussion to illustrate how it shaped Gill's understanding of her role, given that play is prioritised in ECD. Play is well grounded in the discipline of occupational therapy, and occupational therapists believe that children's primary occupation is play (Boop et al. 2020). The discipline of occupational therapy requires a fundamental understanding of human development and occupation (World Federation of Occupational Therapists 2023). The scope of practice for occupational therapists is not limited to play but encompasses a range of areas in which occupational therapists are employed, as outlined by the Department of Health (2023). Occupational therapists and ECD practitioners can work together to support young children's learning and development.

The case example demonstrated how an occupational therapist in a community-based setting faced challenges in assessing, supporting and referring children, educating parents and ECD practitioners, advocating for children's rights and establishing partnerships with various stakeholders. An additional challenge was the existing infrastructure within the education and health sectors to provide coordinated responses to the developmental needs of children. While different sectors should work together to bring about change in the ECD sector, a limited number, as well as the inequitable distribution of occupational therapy services, impact such intentions. Occupational therapists are thus required to approach the existing resources and systems with creativity and innovation to facilitate a coordinated and comprehensive response. This would entail strengthening of an intersectoral approach, which is crucial for achieving quality education of children in areas where access to early learning programmes and services is limited.

Limitations

The study findings apply specifically to ECD practitioners in rural, under-resourced settings and cannot be generalised. A pilot study and a process flow diagram were used to refine the methodology because of a lack of previous literature. The primary researcher was employed as an occupational therapist at the host organisation. To address potential bias, the primary researcher used reflexivity throughout data collection and analysis, and member checking was used to ensure findings reflected participants' experiences. Restrictions related to COVID-19 required online and telephonic data collection, impacting face-to-face engagement. The pilot study informed refinements to mitigate problems with data collection, and decisions regarding data collection were made in the best interest of the participants. Despite five participants withdrawing, data collection continued until saturation was reached, to potentially collect richer data. Wi-Fi connectivity challenges were addressed using insights from the pilot study by testing online and telephonic methods of data collection.

Conclusion

In South Africa, numerous children in under-resourced communities lack access to quality early learning programmes, which drives poor developmental outcomes before they have even entered the formal schooling system. Equitable distribution of occupational therapy services is a challenge impacting the provision of health care to children, especially in rural areas (Ned et al. 2020). The NGO space is essential for ECD services, to ensure that more children from birth to 5 years old can be reached through high-quality early learning programmes by 2030 (Labantwana & Bana 2018). Investing in ECD practitioners through training and support is imperative. Early childhood development practitioners demonstrate an innate ability to facilitate play. Occupational therapists, with their knowledge of play as an important childhood occupation, components of function and activity analysis (Boop et al. 2020), can contribute to the ECD sector by providing training and support to ECD practitioners.

A significant leap in knowledge resulting from the postgraduate study contributed towards conceptualising the process of support of children in the ECD setting, as well as ECD practitioners. This process made it possible to construct a theoretical basis for how occupational therapy services and support can be provided, while considering the complexities of how occupational therapists work with young children in under-resourced areas in the ECD space. Progressing towards role clarification in the ECD setting requires occupational therapists to consider community-based approaches and the inherent knowledge and skills of these communities. The study highlighted occupational therapy's role in training and supporting ECD

practitioners within agricultural communities. While ECD practitioners demonstrate an innate ability to play with children, the question remains of how play is promoted within the broader ECD context. Occupational therapists are equipped to facilitate participation in the occupation of play. The education department's stance on play may restrict the view of play as it is experienced by the communities that require support. Occupational therapists are skilled in facilitating play participation of children in homes and pre-schools, providing training and support to ECD practitioners, and advancing policy to promote play, learning and development. To ensure universal access that promotes learning and development, especially through play, the skills and knowledge of communities must be considered. This provides a platform for unrepresented voices because of power dynamics that hinder the representation of such communities.

Declarations

Ethical considerations

Ethical approval for this study was granted by the Health Research Ethics Committee of Stellenbosch University (HREC Reference number S20/02/035).

Consent

Informed consent was obtained from all participants, and a total of 15 individuals were recruited for inclusion in the study.

Author contributions

Liezl Worship: Conceptualisation, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Visualisation, Writing – original draft preparation, Writing – review and editing.

Lizahn Cloete: Conceptualisation, Formal analysis, Investigation, Methodology, Resources, Supervision, Validation, Visualisation, Writing – review and editing.

Both authors reviewed the chapter, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

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Chapter 7

Predictive validity of HINE versus GMA with MOS-R on motor outcomes in high-risk infants at 12–15 months

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Abstract

Background: Evidence supports the predictive value of Prechtl's General Movement Assessment (GMA) with the Motor Optimality Score–Revised (MOS-R) and the Hammersmith Infant Neurological Examination (HINE) for predicting if infants have cerebral palsy (CP) before 5 months corrected age, but less is known about the usefulness of these measures to predict non-CP gross motor outcomes.

Aim: This study aims to compare the predictive validity of the HINE versus Prechtl's GMA with MOS-R (at 11–16 weeks corrected age) for gross motor outcomes in high-risk infants at 12–15 months corrected age, as measured by the Alberta Infant Motor Scale (AIMS).

Methods: A longitudinal descriptive study was conducted at Tygerberg Hospital, Cape Town, South Africa. High-risk infants assessed at 11–16 weeks corrected age using Prechtl's GMA with MOS-R and HINE were re-evaluated using the AIMS to determine gross motor outcome at 12–15 months corrected age. Data were analysed using STATA version 16 and IBM SPSS software. Receiver operating characteristic curve analysis was utilised to determine sensitivity and specificity values.

Results: The study enrolled 100 infants with a mean birth weight of 1,525.6 g and gestational age of 31.1 weeks. The HINE and Prechtl's GMA with MOS-R had an area under the curve of 0.867 and 0.713, respectively, to predict gross motor delay. The HINE was more sensitive (87%) than Prechtl's GMA with MOS-R (47%). Negative predictive values (NPVs) and specificity for both measures were similar and very high. Both the HINE and Prechtl's GMA with MOS-R were predictive of later CP diagnosis.

Conclusion: Both the HINE and Prechtl's GMA with MOS-R are valid measures for predicting gross motor delay in high-risk infants. A longitudinal study in a larger sample of infants with specific perinatal risk factors is recommended.

Introduction

Worldwide, there is an increase in the survival rate of high-risk infants, primarily as a result of advancements in maternal and neonatal care (De Kleine et al. 2007; Pascal et al. 2018). Infants categorised as 'high risk' face elevated chances of morbidity and mortality, including preterm born infants, very low birth weight (VLBW) (< 1,500 g) and extremely low birth weight (ELBW) (< 1,000 g) infants, as well as infants suffering from hypoxic-ischaemic encephalopathy (HIE), intraventricular haemorrhage, severe jaundice or sepsis (Chattopadhyay & Mitra 2015).

Cerebral palsy (CP) represents the most prevalent physical disability affecting children (Novak et al. 2017). Medical experts define CP as a collection of disorders that impact movement and postural development, resulting in activity restrictions attributed to non-progressive disturbances in the developing brain of foetuses or infants (Bax et al. 2005). While CP diagnosis traditionally occurred between 12 and 24 months of age, specialists now suggest accurate prediction is possible before 6 months corrected age (Novak et al. 2017). Cerebral palsy prevalence in Africa (10 per 1,000 live births) significantly exceeds rates reported in high-income countries (1.6 per 1,000 live births) (McIntyre et al. 2022). However, diagnostic delays commonly occur throughout Africa as a result of inadequate basic health care infrastructure (Donald et al. 2014; Katangwe et al. 2024).

Few reliable assessment methods exist for identifying severe neurological disorders in infants during early development. During the 1990s, Heinz Prechtl and colleagues established a methodology for evaluating the developing nervous system through observational assessment of spontaneous movement patterns, known as Prechtl's General Movement Assessment (GMA) (Einspieler & Prechtl 2005). The remarkable predictive capability of Prechtl's GMA primarily stems from fidgety movements (FMs), which emerge approximately nine weeks post-term and persist until 20 weeks post-term age, when intentional movements against gravity become predominant. Prechtl's GMA framework has evolved to incorporate the Motor Optimality Score–Revised (MOS-R), enabling evaluation of postural configurations and developmentally appropriate movements (Einspieler et al. 2019). The MOS-R employs optimality-based scoring and effectively identifies subtle movement

abnormalities or atypical motor development (Einspieler et al. 2019; Salavati et al. 2017). While Prechtl's GMA is widely acknowledged as a valid predictive tool for severe neurodevelopmental outcomes such as CP, less research exists regarding the predictive validity of Prechtl's GMA with MOS-R for non-CP gross motor outcomes in infants.

The Hammersmith Infant Neurological Examination (HINE) was developed in 1981 by Drs. Lilly and Victor Dubowitz and their colleagues at London's Hammersmith Hospital (Novak et al. 2017). This user-friendly neurological assessment tool is designed for infants between two and 24 months of age (Romeo et al. 2009). The HINE underwent standardisation in terms of infant populations and demonstrated strong prognostic capability for predicting walking ability at age two in very preterm infants (Romeo et al. 2009). Research highlights numerous advantages of implementing the HINE across clinical settings, particularly its ease of use, free availability and documented strong inter-observer reliability, even in examiners with limited experience (Romeo et al. 2016).

High-quality evidence demonstrates the predictive accuracy of both Prechtl's and the HINE for identifying cerebral palsy in infants categorised as high risk prior to 5 months corrected age (Adigüzel et al. 2025; Novak et al. 2017). Not all high-risk infants will develop CP; however, an increase in non-CP motor impairments has been reported in ELBW and/or preterm survivors over the last three decades (Cheong et al. 2020; Spittle et al. 2018). A meta-analysis reported the prevalence of non-CP motor impairments in preterm infants to be three to four times greater than in the general population (Williams, Lee & Anderson 2010). Therefore, the timely identification of non-CP motor delay is warranted, and accurate neurological assessments are pivotal for timeous identification of infants at risk for severe neurodevelopmental outcomes, such as CP, as well as mild to moderate motor impairments to ensure early referral for intervention.

Currently, both the HINE and Prechtl's GMA with MOS-R are utilised for evaluating high-risk infants at Tygerberg Hospital's neonatal high-risk outpatient clinic, one of South Africa's largest tertiary medical facilities. To the best of the researchers' knowledge, no published studies have compared these two neurological assessment tools' capabilities to predict gross motor developmental delays (beyond CP diagnosis) in any at-risk infant population. This research sought to determine which neurological assessment, Prechtl's GMA with MOS-R or the HINE, when administered at 11–16 weeks corrected age, more accurately predicts gross motor development at 12–15 months corrected age as measured by the Alberta Infant Motor Scale (AIMS) in at-risk infants born at Tygerberg Hospital.

Methods

Study design and participants

The researchers employed a longitudinal correlational descriptive design with successive sampling to enrol high-risk infants who received both Prechtl's GMA with MOS-R and HINE evaluations at 11–16 weeks corrected age and subsequently attended follow-up assessments at 12–15 months corrected age at the neonatal high-risk clinic of Tygerberg Hospital between 01 February and 31 August 2021. Inclusion criteria encompassed infants with birth weight below 1,500 g, preterm and/or full-term infants with moderate to severe HIE, infants with congenital cytomegalovirus infection, those with Grade III or IV intraventricular haemorrhage, infants with cystic periventricular leukomalacia, preterm and/or full-term infants with severe neonatal jaundice requiring exchange transfusion, and infants with neonatal bacterial meningitis (acquired within the first 28 days of life).

The study excluded infants diagnosed with known chromosomal abnormalities or syndromes (such as foetal alcohol syndrome or Down syndrome), those with known congenital disorders or malformations of the central nervous system, and infants who contracted diseases during or after the neonatal period that could potentially influence neurological outcomes (such as meningitis or tuberculosis meningitis). Parents or legal guardians of all participating infants provided written informed consent. The Health Research Ethics Committee at Stellenbosch University granted ethical approval (S20/07/163), with additional authorisation from Tygerberg Hospital and the Western Cape Department of Health, South Africa.

Procedure for the neurodevelopmental assessment using the Hammersmith Infant Neurological Examination and Prechtl's General Movement Assessment with the Motor Optimality Score–Revised at 11–16 weeks corrected age

The HINE was conducted by an experienced developmental specialist with many years of practice using this assessment tool. Each infant received scores ranging from 0–3 for individual test items. While the complete HINE score ranges from 0–78, for infants younger than 6 months, the range is limited to 0–75, as forward parachute reactions are not yet evaluated. Individual item scores were tallied to calculate a total optimality score. Research literature indicates that a HINE score below 40 at 3 months corrected age demonstrates 100% predictive accuracy for CP diagnosis (Romeo et al. 2016).

General movement patterns were recorded on video following the standardised protocol outlined by Einspieler et al. (2004). These video recordings underwent independent evaluation by three experienced assessors with advanced certification in Prechtl's GMA with MOS-R. When scoring discrepancies occurred, a senior certified Prechtl GMA instructor provided resolution. With one exception, all assessors evaluated the infants without knowledge of their medical histories or developmental outcomes.

The MOS-R comprises five subcategories that yield a comprehensive score ranging from a minimum of five to a maximum of 28 points (Einspieler et al. 2019). Infants' MOS-R results were classified according to the following categories: Optimal (25–28 points), mildly reduced (20–24 points), moderately reduced (9–19 points) and severely reduced (8 points or fewer) (Örtqvist, Einspieler & Ådén 2021).

Neurodevelopmental assessment protocol at 12–15 months corrected age

The AIMS assessments were conducted by the primary investigator at 12–15 months corrected age. Assessment involved observing the infant from a distance with minimal prompting to achieve necessary positions. The investigator observed the infant's performance across prone (21 items), supine (9 items), sitting (12 items) and standing positions (16 items), noting the range from least to most mature gross motor skills demonstrated. This established a 'window of movement repertoire' between these observed boundaries. Total AIMS scores were calculated by assigning one point to each item below the least mature observed item, plus all items observed within the established window. The maximum possible score was 58 points (Darrah, Piper & Watt 1998). The investigator referenced standardised AIMS percentile rank tables (with percentile ranks averaged across entire age months) to determine each infant's percentile ranking based on their total score (Piper & Darrah 1994, p. 48). An AIMS total score of 35 or below placed an infant at or below the 1st percentile on the AIMS reference table, while achieving the maximum score of 58, indicated performance above the 77th percentile (Piper & Darrah 1994, p. 204). Within this study, infants scoring below the 5th percentile on the AIMS were classified as having severe or atypical gross motor delay. The principal investigator remained blinded to both HINE and GMA/MOS-R scores prior to conducting the AIMS assessments. During routine follow-up evaluations at 12–15 months, the study consultant administered a comprehensive neurological examination, categorising infants as normal, suspect or atypical. For infants classified as atypical, the severity of motor impairment was further assessed using the Gross Motor Function Classification System (GMFCS) developed for children with CP (Palisano et al. 1997).

Statistical analyses

STATA version 16 software (StataCorp LLC, College Station, Texas, USA) was utilised for data analysis. The outcomes of interest with regard to the MOS-R and HINE were analysed both as continuous and categorical variables. Linear regression and correlation were considered for the continuous version of the variables, while ordinal logistic regression and the chi-square test of association were used for the categorical version of the outcomes. The level of significance to interpret chi-square test results was set at $p < 0.05$. Exact two-sided significance was used to interpret *p*-values, where appropriate. Categorical variables were summarised and are presented using frequencies and percentages. Continuous variables are presented using means and standard deviations or median with interquartile range, when not distributed normally. The receiver operating characteristic (ROC) curves were generated to determine sensitivity and specificity values, and the area under the curve (AUC) was statistically generated. The AUC is a statistical measurement defined as the average value of sensitivity for all the possible values of specificity. It provides an overview of the diagnostic accuracy of a test. An optimal AUC = 1.00; thus, the closer the AUC value generated is to 1.00, the more accurate the diagnostic probability of the test (Hajian-Tilaki 2013). An initial total HINE cut-off score of 40 and a Prechtl's GMA with MOS-R score of 8 to predict later gross motor delay on the AIMS were utilised to generate a ROC curve, whereafter data were re-analysed to obtain a sample-specific HINE total cut-off score for this study.

Results

Demographic profile and characteristics of the study population

One hundred (*N* = 100) infants fitting our inclusion criteria attended their 12–15-months scheduled follow-up appointment at the neonatal high-risk clinic during the data collection period. There were more female (*n* = 55) than male participants (*n* = 45) in the study sample. The mean birth weight was 1,525.55 g (standard deviation [SD] = 833.18). Mean gestational age was 31.14 weeks (SD = 4.274). The demographic profile and characteristics of the study population are demonstrated in Table 7.1.

Most infants were diagnosed with respiratory distress syndrome post-birth (95%). Other perinatal risk factors included jaundice (55%), sepsis (28%), HIE (17%), anaemia (13%), seizures (12%) and patent ductus arteriosus (2%).

TABLE 7.1: Demographic profile and characteristics of the study population.

Variable		Count	%
Gender	Female	55	55
	Male	45	45
Birth weight	ELBW (< 1,000 g)	21	21
	VLBW (< 1,500 g)	60	60
	> 1,500 g	19	19
Gestational age	Extremely preterm (< 28 weeks of gestation)	17	17
	Very preterm (28 to < 32 weeks of gestation)	57	57
	Late/moderate preterm (32–37 weeks of gestation)	9	9
	Full-term (38–42 weeks of gestation)	17	17

Source: Authors' own work.
Key: %, percentage; ELBW, extremely low birth weight; VLBW, very low birth weight; g, gram.

Gross motor outcomes according to the Alberta Infant Motor Scale at 12–15 months corrected age

The mean total AIMS score (out of a total of 58) was 49.05, and the AIMS percentile ranking at 12–15 months corrected age was 33.83. Total AIMS scores ranged from 7 to 58, while AIMS percentile rankings ranged from one to ≥ 77th percentile. An AIMS percentile ranking of < 5th percentile is equated to severe or atypical gross motor development. Fifteen infants in our study scored below the 5th percentile on the AIMS, while three infants scored between the 5th and the 10th percentile.

Seven of the 15 infants with an AIMS percentile ranking of < 5th percentile were diagnosed with CP. Table 7.2 provides a description of the infants in our study who were provisionally diagnosed with CP at 12–15 months corrected age. Five infants were classified as Level V on the GMFCS, thus indicating that they are severely limited in gross motor and functional ability, while two infants were classified as Level III.

Outcomes and predictive validity of the Hammersmith Infant Neurological Examination

The mean total HINE score of the sample was 63.18 (SD = 6.71). The mean total HINE score of infants scoring < 5th percentile on the AIMS was 54.20 (SD = 12.68). Table 7.3 provides an overview of outcomes on the HINE in infants scoring < 5th percentile on the AIMS.

Utilising a HINE cut-off score of 40, the HINE was a good predictor of gross motor outcome on the AIMS, with an AUC of 0.867. Although the HINE had good specificity (100%), it had poor sensitivity (13%) to predict later gross motor delay on the AIMS. The positive predictive value (PPV)

was 100%, and the negative predictive value (NPV) was 87%. Utilising the ROC curve analysis, a proposed HINE cut-off score of 62.25 was identified with a sensitivity of 87% and specificity of 81%, with PPV = 54% and NPV = 97% to identify infants scoring less than the 5th percentile on the AIMS (Figure 7.1).

TABLE 7.2: Description of infants diagnosed with cerebral palsy at 12–15 months corrected age.

Proposed CP diagnosis at 12–15 months CA	GMFCS at 12–15 months CA	FMs at 11–16 weeks CA	Gender	BW (g)	Gestation (weeks)	MOS-R score	HINE score	Neonatal risk factors
Spastic diplegia	III	Absent	Female	2,830	40	14	54	HIE
Spastic right hemiplegia	III	Normal	Male	1,380	29	25	61	VLBW
Spastic quadriplegia	V	Absent	Female	3,255	40	5	21	HIE
Spastic quadriplegia	V	Absent	Male	1,225	30	10	49	VLBW
Spastic quadriplegia	V	Absent	Female	1,290	29	12	59	VLBW
Spastic quadriplegia	V	Absent	Female	3,100	40	6	47	HIE
Spastic quadriplegia	V	Absent	Male	2,020	38	6	32	HIE

Source: Authors' own work.
Key: CP, cerebral palsy; CA, corrected age; GMFCS, Gross Motor Function Classification System; FMs, fidgety movements; BW, birth weight; MOS-R, Motor Optimality Score–Revised; HINE, Hammersmith Infant Neurological Examination; HIE, hypoxic-ischaemic encephalopathy; VLBW, very low birth weight.

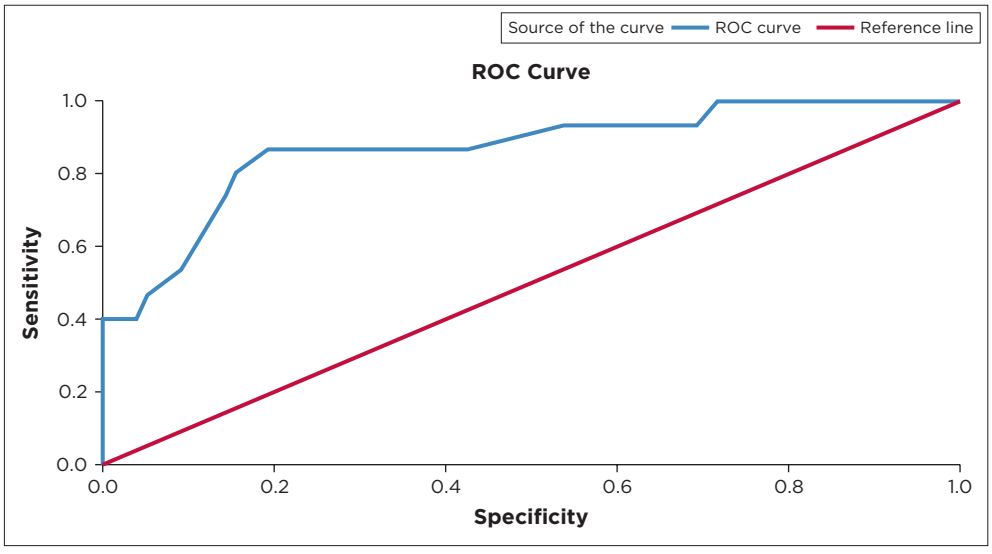
TABLE 7.3: Outcomes on the Hammersmith Infant Neurological Examination of infants scoring < 5th percentile on the Alberta Infant Motor Scale (*n* = 15).

Variable	HINE Total	Cranial nerves	Posture	Movement	Tone	Reflex and reactions
Mean	54.20	12.80	12.10	4.93	18.70	5.66
Median	60.00	13.00	12.00	6.00	22.00	6.00
Standard deviation	12.68	2.04	2.23	2.21	5.12	2.76
Range	21–71	8–15	7–16	0–6	4–24	0–12

Source: Authors' own work.
Key: HINE, Hammersmith Infant Neurological Examination.

Outcomes and predictive validity of Prechtl's General Movement Assessment with Motor Optimality Scale–Revised of gross motor outcomes on the Alberta Infant Motor Scale at 12–15 months corrected age

The mean MOS-R total score of the whole study sample was 25.05 (SD = 4.57). In the subgroup of infants that scored less than the 5th



Source: Authors' own work.
Key: ROC, receiver operating characteristic, *n*, number.

FIGURE 7.1: Predictive validity of the Hammersmith Infant Neurological Examination to determine gross motor outcome on the Alberta Infant Motor Scale at 12–15 months corrected age (*N* = 100).

percentile on the AIMS (*n* = 15), the mean MOS-R total score was 19.00 (SD = 9.07). Table 7.4 provides an overview of outcomes of infants scoring in the < 5th percentile on MOS-R.

Prechtl's GMA with MOS-R had a sensitivity of 20% and specificity of 100%, and a PPV of 100% and NPV of 88% when utilising a MOS-R cut-off score of 8 to predict gross motor delay on the AIMS (≤ 5th percentile), while the AUC was 0.713.

Utilising ROC curve analysis, a new MOS-R cut-off score of 20.5 was proposed. The rationale was to establish if a customised cut-off score specific to our sample would better predict gross motor outcomes alone and not only severe neurological deficit such as CP. A cut-off MOS-R score of 20.5 had a sensitivity of 47% and specificity of 100%, with PPV = 100% and NPV = 91% (Figure 7.2).

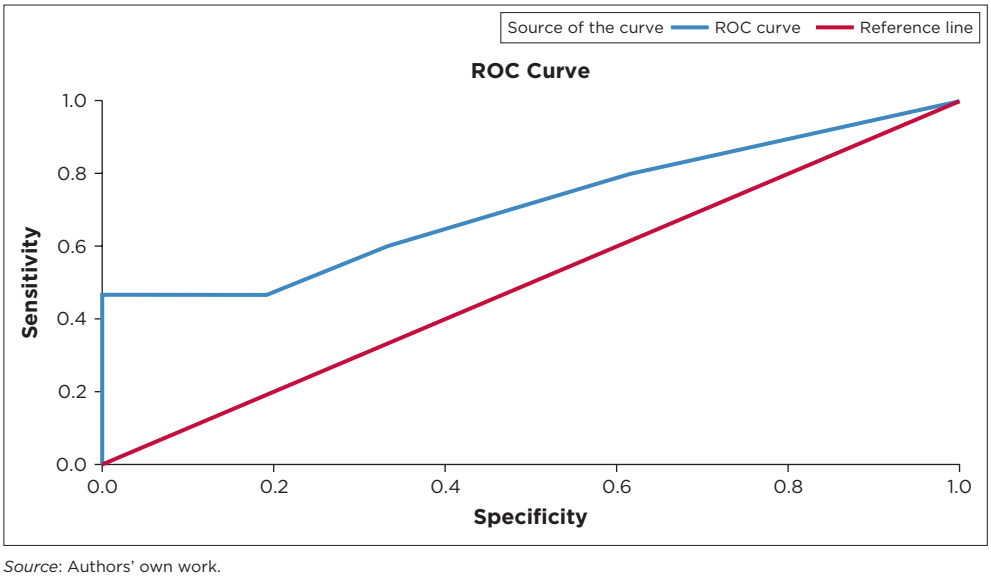
Predictive validity of the Hammersmith Infant Neurological Examination and Prechtl's General Movement Assessment with the Motor Optimality Scale–Revised of infants with cerebral palsy

Figure 7.3 illustrates the sensitivity and specificity of the HINE to predict the outcome of CP in our sample of infants. The HINE total score at 11–16 weeks corrected age was very predictive of later CP diagnosis at 12–15

TABLE 7.4: Outcomes of infants on Prechtl's General Movement Assessment with Motor Optimality Scale–Revised that scored < 5th percentile on the Alberta Infant Motor Scale (*n* = 15).

Variable	MOS-R total score	FMs	Observed movement patterns	Age-adequate movement repertoire	Observed postural patterns	Movement character
Mean	19.00	7.6	4.40	2.20	2.53	3.26
Median	25.00	12.00	4.00	2.00	2.00	4.00
Standard deviation	9.07	5.57	1.24	1.37	1.45	1.09
Range	5–28	1–12	1–4	0–4	1–4	1–4

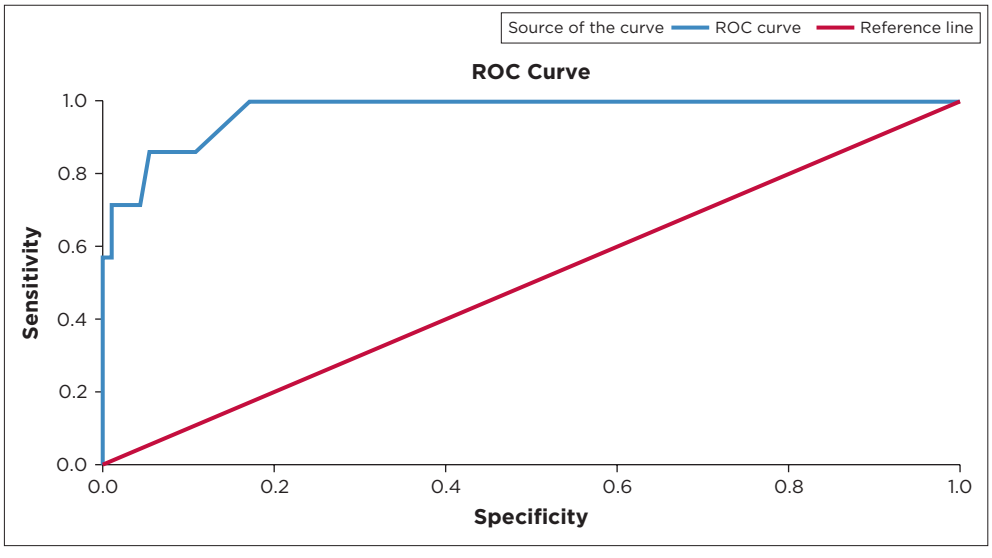
Source: Authors' own work.
Key: MOS-R: Motor Optimality Score–Revised; FMs: fidgety movements.



Source: Authors' own work.
Key: ROC, receiver operating characteristic, *n*, number.
FIGURE 7.2: Predictive validity of Prechtl's General Movement Assessment with Motor Optimality Scale–Revised of gross motor outcomes on the Alberta Infant Motor Scale (*N* = 100).

months corrected age, with an AUC = 0.927. The HINE (cut-off score of 40) had a sensitivity of 29% and a specificity of 100% to identify infants with CP, with PPV = 100% and NPV = 95%.

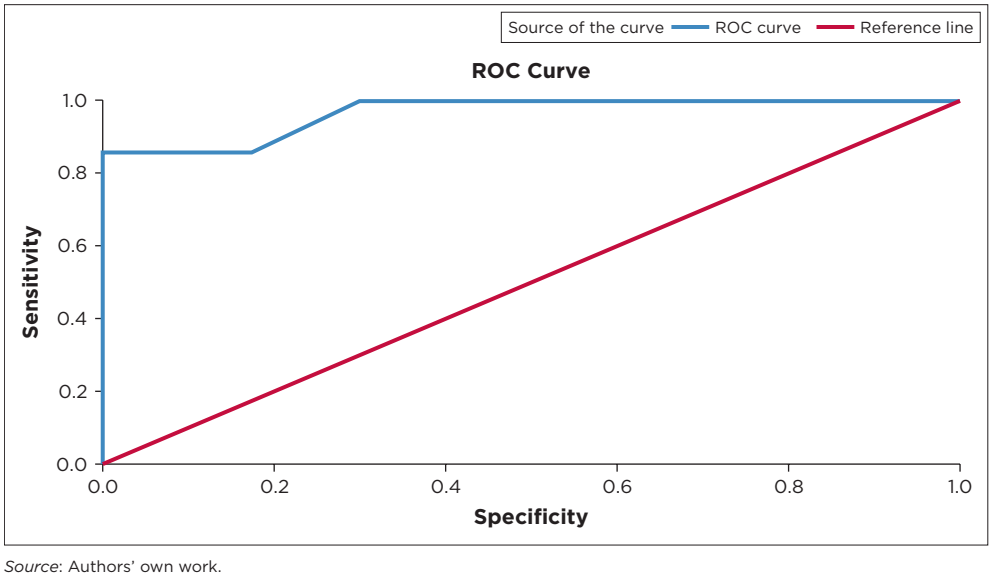
Figure 7.4 depicts a ROC curve demonstrating the sensitivity and specificity of Prechtl's GMA with the MOS-R (cut-off MOS-R score of 8) assessment at 11–16 weeks corrected age to predict later CP diagnosis in our sample of high-risk infants. As was the case with the HINE, the MOS-R total score was also very predictive of later CP outcome, with an AUC = 0.966. The MOS-R had a sensitivity of 43% and specificity of 100% to predict CP, with PPV = 100% and NPV = 96%.



Source: Authors' own work.

Key: ROC, receiver operating characteristic.

FIGURE 7.3: Predictive validity of Hammersmith Infant Neurological Examination total scores for cerebral palsy.



Source: Authors' own work.

Key: ROC, receiver operating characteristic.

FIGURE 7.4: Predictive validity of Motor Optimality Scale–Revised total scores of later cerebral palsy outcome in high-risk infants.

Discussion

The HINE and Prechtl's GMA with the MOS-R have both been recognised to be a gold standard in the prediction of CP in at-risk infants (Novak et al. 2017). While extensively researched with regard to predicting CP diagnosis, literature supporting the use of the HINE and Prechtl's GMA with the MOS-R to determine delayed or atypical gross motor outcomes other than CP in high-risk infants is lacking. The results of this study have shown that the HINE had a higher sensitivity than Prechtl's GMA with the MOS-R when utilising sample-specific cut-off scores to predict severe or atypical gross motor delay on the AIMS at 12–15 months corrected age. Prechtl's GMA with the MOS-R had a higher specificity and PPV to predict gross motor outcome than the HINE, but the NPV was similar for both assessment tools.

Compared with term infants, preterm infants are at higher risk for neurodevelopmental delay and morbidity (Allotey et al. 2018). A systematic review by Pascal et al. (2018) found that very preterm birth and VLBW were the main contributing factors to later poor developmental outcomes. Although most of the infants that presented with gross motor delay at 12–15 months corrected age were indeed born preterm, 73% of all the preterm infants included in this study had a typical gross motor outcome on the AIMS.

In this study, only 15% of the 100 infants assessed scored lower than the 5th percentile on the AIMS. Higher rates of infants with a significant gross motor delay on the AIMS were reported by Burger, Frieg and Louw (2011), Spittle et al. (2015) and Wang et al. (2010), where 36%, 19% and 16.1% of their infants scored below the 5th percentile on the AIMS, respectively. These differences can be explained by the fact that previous authors only included preterm-born infants in their studies, whereas high-risk term-born infants were also included in our study. The AIMS total scores of the participants in our study ranged from 7 to 58, and a score of $\leq$ 46 was always associated with the occurrence of gross motor delay at 12–15 months corrected age. This correlates to the study findings of Su et al. (2017), as they found that AIMS total scores of > 52.8 (28th percentile on the AIMS at 12 months corrected age) were associated with normal gross motor outcomes and those < 33.1 (< 1st percentile on the AIMS at 12 months corrected age) with delayed gross motor outcomes. Their study, however, only included VLBW (Su et al. 2017).

Allocating appropriate HINE and GMA with the MOS-R cut-off scores to predict gross motor outcomes in our study proved to be problematic, as previous cut-off scores proposed in the literature were developed with the intent to identify those infants at risk of severe neurological deviations

such as CP. An initial HINE cut-off score of ≤ 40 and a GMA with MOS-R cut-off score of ≤ 8 were chosen to run analyses, as this is regarded in the literature to be 100% predictive of later CP diagnosis (Novak et al. 2017; Pizzardi et al. 2008; Romeo et al. 2009, 2016). However, these cut-off scores resulted in low sensitivity – 13% for the HINE and 20% for the GMA with MOS-R. A need for a cut-off score that was more sensitive and specific, to predict not only CP but also atypical gross motor delay in our study sample, was identified. We proposed that a new cut-off HINE score of 62.25 and a new GMA with MOS-R score of 20.5 would be more appropriate to predict gross motor delay in our included sample of infants, as ROC curve analysis showed improved sensitivity measures for both assessment tools. It is, however, important to note that our study sample of infants that scored in less than the 5th percentile on the AIMS also included infants diagnosed with CP and that infants with CP were not excluded from data analysis.

Recent publications have proposed new cut-off scores for the GMA with the MOS-R derived from ROC analysis to predict neurodevelopmental delay. Örtqvist et al. (2021) proposed a revised cut-off value of a < 21 after ROC curve analysis on the MOS-R (sensitivity 77%; specificity 63%; PPV 77%; NPV 63%) while investigating a sample of 42 extremely preterm infants for neurodevelopmental delay at 12 years according to the *Touwen Infant Neurological Examination* and the *Movement Assessment Battery for Children-II*. Kwong et al. (2022), however, found that MOS-R scores ≤ 23 were predictive (sensitivity 78%; specificity 63%; PPV 77%; NPV 85%) of gross and fine motor development according to the Bayley Scales of Infant Development-III at 2 years of age in a large cohort of very preterm infants. A cut-off score with higher sensitivity is important if a screening tool is being evaluated as a public health measure, as this results in more at-risk infants being identified for follow-up to monitor future development. This could cause fewer infants to fall through the cracks and not be identified for regular screening and follow-up when they truly need it, bearing in mind that a higher sensitivity may also include a higher number of false positive results.

The latter may result in over-surveillance and overuse of resources (especially in resource-restricted and over-burdened health care settings such as Tygerberg Hospital). It is the authors' opinion that evaluating the cut-off scores for valid prediction of motor delay in infants when using any assessment tool depends on the purpose of the research: Whether the purpose is to ascertain how well a test performs in a population (for example as a screening tool) or whether you want to predict a single infant's risk for developing motor delay at a specific point in time. Higher values of sensitivity and specificity are more important when researchers want to ascertain how well a test performs in a population compared to

a reference standard (Trevethan 2017). On the other hand, in practical application in a clinical setting, when evaluating a patient at a specific point in time, clinicians may place more value on interpreting PPV and NPV values, as these values demonstrate the ability of the test to differentiate successfully between people who have a condition and those who do not (Trevethan 2017).

Our study showed that both the HINE and Prechtl's GMA with the MOS-R were predictive of later gross motor delay in a subgroup of high-risk infants. However, the HINE had a higher sensitivity than Prechtl's GMA with the MOS-R to predict severe or atypical gross motor delay on the AIMS at 12–15 months corrected age. It has been suggested that the high predictive value of HINE during the first year of life can be attributed to the effective combination of distinct groups of items for each key period of age (Romeo et al. 2009). Romeo et al. predicted that the HINE had good predictive power at 3 months corrected age to predict locomotor function at 2 years of age, and reported high sensitivity (93%) and specificity (100%) values. Various studies have reported on the high predictive validity of the HINE to predict later CP diagnosis with sensitivity and specificity values ranging from 59.18% to 100% across different studies (Bosanquet et al. 2013; Kwong et al. 2018; Morgan et al. 2019; Novak et al. 2017; Romeo et al. 2016). Interestingly, the results of our study showed that the MOS-R had a higher specificity in predicting CP compared to Prechtl's GMA alone, as reported by Bosanquet et al. (2013), Kwong et al. (2018) and Novak et al. (2017). This poses an interesting question to be evaluated in further studies, and further research is warranted before a valid conclusion can be made.

Although the focus of this study was not to ascertain the predictive validity of the HINE and Prechtl's GMA with the MOS-R for later CP diagnosis, it is worthwhile noting that our study findings concur with the large body of evidence available in the literature. Six infants who were later diagnosed with CP had a total MOS-R of ≤ 14, while one infant diagnosed with hemiplegia had a MOS-R of 25. Our study findings again support the findings that the absence of FMs and a MOS-R score of ≤ 14 is highly predictive of infants at risk for neurodevelopmental and functional abnormalities and that these infants warrant early referral for intervention (Burger et al. 2011; Einspieler et al. 2019).

The results of our research suggest that the timely identification of non-CP motor delay is warranted. Accurate neurological assessments are pivotal to timeously identify infants at risk for severe neurodevelopmental outcomes such as CP, as well as mild to moderate motor impairments, and should be part of standard practice at health care facilities. Early identification will ensure early referral for intervention in a timeframe where neuroplasticity of the brain is at its most optimal, and outcomes can be optimised.

Study limitations

A limitation of this study is that high-risk infants were only assessed on a singular occasion at 12–15 months corrected age and that subsequent evaluations were not performed to establish a trajectory of gross motor development.

During gross motor evaluations using the AIMS, it was noted that a subset of study participants utilised an infant walking ring (baby walker) at some stage during early infancy. The use of infant walking rings often stems from the belief of caregivers that it will assist in accelerating gait acquisition and help to strengthen their infants' legs (Chagas et al. 2020). Some studies suggest a correlation between walking ring use in infancy and poorer gross motor outcomes, with some studies also reporting gait deviations with infant walking ring use (Chagas et al. 2020). Infant caregivers were, however, inconsistent at reporting infant walking ring use and were also often unable to recall at what age infants started using the device and for how long. The impact that infant walking ring use could have had on gross motor outcomes in the infants in our study could therefore not be statistically analysed and reported.

In this study, we were able to provide a specific cut-off score on both the HINE and the MOS-R, based on the best predictive value for determining gross motor delay at 12–15 months corrected age in our specific cohort of high-risk infants. We are, however, at present unable to establish whether these proposed values can be reliably applied to other high-risk populations at risk of gross motor delay. We recommend that further longitudinal studies on large cohorts of low risk as well as high-risk infants with specific perinatal risk factors, such as HIE, would be needed.

Conclusion

The results of this study indicated that both the HINE and Prechtl's GMA with MOS-R had good predictive validity, with the aim of predicting later gross motor outcomes of high-risk infants on the AIMS. Both neurological assessments were able to distinguish between those infants who would require possible future intervention and regular follow-up and those for whom this is not needed. The HINE had higher sensitivity to predict later gross motor delay than the MOS-R. The HINE had a lower PPV to predict gross motor delay compared to the MOS-R, but the NPV for both assessments was very similar and very high. The results of our study support that there may be value in interpreting both HINE and MOS-R total scores to predict gross motor outcomes. A longitudinal study in a

larger sample of infants with specific perinatal risk factors is recommended.

Declarations

Ethical considerations

Ethical approval was obtained from the Health Research Ethics Committee (HREC) of the University of Stellenbosch in order to conduct this study (reference number S20/07/163). Permission was obtained from the Western Cape Department of Health, superintendent of Tygerberg Hospital and departmental chairperson and/or head of Paediatrics at Tygerberg Children's Hospital for the study to be conducted.

Consent

Informed, written consent was obtained from the parents or legal guardians of all participants included in this study.

Author contributions

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All authors reviewed the chapter, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

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Chapter 8

Feeding difficulties and neurodevelopment in children with HIV at a Western Cape hospital

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Abstract

Background: Neurodevelopmental delays are one of the concerns in children living with human immunodeficiency virus (HIV). Neurodevelopmental delays and HIV had previously been associated with feeding difficulties in children.

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A bidirectional interplay exists between HIV infection, neurodevelopmental delays and feeding difficulties in paediatric patients, emphasising the need for a comprehensive understanding of these intertwined factors to optimise the care and quality of life for children with HIV.

Aim: The primary objectives of this study were to determine the prevalence of feeding difficulties and the association between neurodevelopment status in children with HIV and feeding difficulties.

Methods: An analytical cross-sectional study was done at a tertiary hospital in the Western Cape province. Participants were legal caregivers (*N* = 70) who completed the feeding and swallowing questionnaire about the feeding of their children under the age of 5 years with HIV. Neurodevelopmental status was determined by the results of the Molteno Adapted Scale obtained from the children's medical records. Data were analysed quantitatively.

Findings: Data from 70 children were included. The prevalence of feeding difficulties was 22%. An increased prevalence of feeding difficulties was observed in the group of children with neurodevelopmental delay (33%) versus the group of children with normal development (18%). Developmental status (OR 2.22, 95%CI [confidence interval] 0.7–7.09), severity of developmental delay (OR 6.66, 95%CI 0.97–45.92) and timing of antiretroviral therapy initiation (OR 0.62, 95%CI 0.2–1.91) were not associated with feeding difficulties.

Conclusion: Reported feeding difficulties are high among children with HIV. An increase in feeding difficulties was noticed in children with neurodevelopmental delays versus those with typical developmental status. Children with neurodevelopmental delay and HIV do not have a statistically significant increase in risk of developing feeding difficulties. The timing of antiretroviral therapy initiation did not influence the prevalence of feeding difficulties.

Introduction

In 2022, there were over 39.0 million (33.1 million–45.7 million) people living with human immunodeficiency virus (HIV); of these, 1.5 million (1.2 million–2.1 million) are children (0–14 years) (Joint United Nations Programme on HIV and AIDS [UNAIDS] 2023). Morbidity and mortality are exceptionally higher in infants and children with HIV. The unavailability or absence of appropriate management will lead to the death of about 52% of children aged 2 years, and 75% aged 5 years (Biyazin et al. 2022). Despite broadened access to much-needed antiretroviral therapy (ART), clinicians in low- and middle-income countries where the disease burden is excessively high continue to face difficulties in managing paediatric HIV infection (Nalwanga & Musiime 2022).

The ART Clinical Guidelines (Buthelezi 2023) indicate that ART should be started for all children irrespective of the World Health Organization (WHO) clinical stage or CD4 cell count. However, in 2021, globally, only 52% of all children aged 0–14 years living with HIV had access to treatment (Biyazin et al. 2022). In 2019, it was projected that just 47% of the 340,000 HIV-positive children under 15 years of age residing in South Africa were getting ART. Thus, despite universal access to ART, more than half of the HIV-positive children in South Africa were still not receiving ART (Dunlop et al. 2022).

Following an HIV diagnosis, the newborn should be connected to ART with same day ART initiation as a suggested approach (Dunlop et al. 2022). Evidence from the South African Children with HIV Early Antiretroviral (CHER) randomised clinical trial and other observational studies suggests that starting ART early in life lowers morbidity and death in HIV-infected children (Cotton et al. 2013). These findings have influenced treatment guidelines, which currently recommend starting ART in all HIV-infected infants and children regardless of clinical or immunological status (Consolidated Guidelines, WHO 2021). It has been found that children who start with ART before the age of 6 months have fewer difficulties than their counterparts who started ART after 6 months of age (Laughton et al. 2013). The virological benefits of early treatment (< 6 months), in addition to reduction of mortality and morbidity, improved growth and better neurological outcomes, have also been indicated in a study by Shiau et al. (2017).

Another notable finding arising from a subanalysis within the CHER trial revealed that children who commenced with ART at an early stage exhibited better gross motor skills and neurodevelopmental traits compared to those who commenced treatment at a later stage (Cotton et al. 2013). Within a cohort of Thai children with HIV, who commenced ART within the first three months of life, the prevalence of global developmental impairment stood at 22% (with a 95% confidence interval ranging from 11 to 27%). This prevalence soared to 44% (with a 95% confidence interval spanning from 23% to 66%) among the children for whom ART was initiated between 3 months and 12 months of age (Jantarabenjakul et al. 2019). In a study involving South African infants with perinatal HIV infection, the initiation of ART within 21 days of birth, with a median onset at six days, yielded neurodevelopmental scores within the normal range at 11 months (Laughton et al. 2019).

Although the introduction of ART reduces the prevalence of HIV encephalopathy, neurodevelopmental delays and cognitive impairments are still present in children with HIV (Blokhuis et al. 2016). A review conducted by Laughton et al. (2013) found that neurodevelopmental outcomes in children with HIV were much poorer when compared to

uninfected children. In both high- and low-resource settings, the neurodevelopmental delays in children with HIV span a range of domains, including motor, language and cognitive aspects of development.

Neurodevelopmental delay is found in 6% to 40% of children with HIV in low-resource countries, and this was in a sample of children who were ART-naïve (Laughton et al. 2013). Another study conducted in South Africa noted that although significant improvement in markers of neurodevelopmental function was achieved through viral suppression with ART, potential delays persisted in a considerable portion of the paediatric population (Strehlau et al. 2016). The high rate of neurodevelopmental delay in low- and middle-income countries can be attributed to resource limitations, the orphan status of children, living conditions and poor nutrition (Le Doare, Bland & Newell 2012). The development of each child is shaped by numerous unique factors, making it difficult to determine the precise impact of these influences on the neurodevelopmental outcomes of adolescents with perinatally acquired HIV.

In a resource-constrained setting, where the direct impact of HIV on neurocognitive development coexists with many other factors such as poverty, quality of the home environment, genetic predisposition, opportunistic infections and accessibility to health care, it becomes evident that the effects of these multifaceted circumstances may overshadow the direct influence of HIV (Laughton et al. 2019). Poverty stands as one of the primary risks for adverse developmental outcomes during early childhood (Hair et al. 2015). It is noteworthy that within the South African context, approximately 30% of young children fall below the food and poverty threshold. This translates into approximately 4 million children under the age of 6 years, living in the poorest 40% of households (Hall et al. 2019). The altered structural brain development present in infants living in homes affected by HIV is because of a lack of appropriate environmental stimulation, which is potentially worsened by undernutrition (Hair et al. 2015). The interaction between the biological risk, potential contributing environmental factors and prenatal exposure has been shown to influence not only the health but also the development of children exposed to HIV (Hair et al. 2015).

Risk factors that increase the probability of low birth weight include prenatal exposure to HIV and contributing environmental factors. In 2020, about 19.8 million infants were born with a low birth weight (LBW), globally. South Asia, eastern and southern Africa, and West and Central Africa accounted for more than 70% of all infants born with LBW (United Nations Children's Fund [UNICEF] 2023). Low birth weight is defined as an infant weighing less than 2,500 g at birth. Low birth weight in infants exposed to HIV is an indicator of poor maternal–infant nutrition and could lead to both long- and short-term consequences. Infants with LBW

present with poorer immune systems and possibly cognitive and neurological diseases (Zenebe, Eshetu & Gebremedhin 2020). Infants with LBW are therefore at increased risk for poor growth, neurodevelopmental delays and the possibility of developing non-communicable diseases later in life (Koenraads et al. 2017). A possible consequence of the neurodevelopmental concerns associated with preterm birth and LBW is that they can cause swallowing and respiration incoordination that result in feeding difficulties (Ramokolo et al. 2019).

LaMantia et al. (2016) reported that as many as 80% of infants and children with neurodevelopmental delays have feeding and/or swallowing difficulties. A mutually influential connection between neurodevelopmental delays and feeding difficulties is proposed by recent studies, as it can play a role in the emergence of oral-motor deficiencies, swallowing complications and heightened sensory sensitivities (Crapnell et al. 2015; Patra & Greene 2019). These issues, in turn, can further compound the feeding difficulties. Recognised concerns such as delayed gross motor development, sensory processing difficulties, and organic and behavioural factors have been established to disrupt the progression of feeding skills. Consequently, these challenges significantly impact the overall success of the child's feeding process (Ramos et al. 2017). Ramos et al. (2017) indicated that the most prevalent feeding difficulty in the child with a neurodevelopment delay was picky eating. Other frequently mentioned concerns included prolonged bottle feeding, transition to solid foods that occur at later stages and poor self-feeding behaviour. Conversely, chronic malnutrition resulting from feeding difficulties can adversely impact brain development and cognitive function.

The early stages of life, specifically infancy and early childhood, play a pivotal role in the proper development of feeding and swallowing capabilities (Arvedson 2008). During the initial year of life, there is a significant and essential progression in the capacity for feeding and swallowing, which relies on the successful maturation of the central nervous system. The process of developing feeding skills is greatly influenced by and reliant on effective neuromotor control (Arvedson & Brodsky 2002) and could potentially be impacted in infants who have been exposed to HIV. This is because developmental challenges can have a ripple effect on various aspects of growth and development. Consequently, infants infected with HIV often experience notable delays and challenges in their oral-motor and swallowing development (Narayanan & Kalappa 2017; Nel & Ellis 2012; Pressman 2010; Rabie et al. 2007). Feeding difficulties are prevalent in children with HIV and can stem from various factors such as oral manifestations of the virus, medication-related side effects, oral aversion and compromised immune function. HIV may affect all phases of swallowing, as oral thrush,

odynophagia and gastro-oesophageal reflux disorder can result in failure-to-thrive (Rabie et al. 2007). The occurrence of swallowing complications and gastro-oesophageal reflux disorder in HIV-infected children remains inadequately assessed; however, it is commonly observed in clinical settings. Weakening of the immune system can have repercussions on gastrointestinal function, elevating the susceptibility to fungal infections such as *Candida* spp. These infections, as suggested by Field, Garland and Williams (2003) and Hoffmann and Green (2014), could potentially be one of the factors underlying feeding challenges. The feeding behaviour in HIV-exposed children is influenced by altered and delayed oral-motor function, especially during the period of transitional feeding, when oral-motor demands are higher (Lalbahadur 2018). These difficulties can lead to inadequate nutrition, growth faltering and increased susceptibility to infections. Feeding and swallowing difficulties might substantially add to the health challenges experienced by HIV-infected infants (Rabie et al. 2007).

The prevalence of feeding difficulties in children with typical development is estimated at 25%–45% and up as high as 80% in children with health conditions and/or developmental disabilities (Arvedson 2008). There is a scarcity of global research dedicated to assessing the prevalence of feeding difficulties among paediatric patients with HIV and acquired immunodeficiency syndrome (AIDS). Studies conducted in South Africa have shed light on this issue, revealing a concerning trend. In the research by Nel and Ellis (2012), it was discovered that 45% of children living with HIV experienced some form of feeding difficulty. Similarly, Jeena et al. (2011) reported that 24% of caregivers noted feeding difficulties in their children who were diagnosed with HIV.

Because of the limited information available, this study aims to add to the body of knowledge regarding the prevalence of feeding difficulties and the association between feeding difficulties and neurodevelopmental status within the paediatric HIV population. The information will enable clinicians to identify at-risk children and improve the quality of care of patients in resource-restrained settings through early referrals and regular follow-ups to prevent possible malnutrition. Therefore, the main objective of the study was to determine the prevalence of feeding difficulties in children with HIV, and to determine whether feeding difficulties were more common in children with HIV and developmental delays than in those with typical development. The secondary objectives were to describe the association between feeding difficulties and mean birth weight, mean age at the time of the study, initiation of ART, sex and severity of developmental delay, and to determine the strength of the association between children with HIV and neurodevelopmental status and feeding difficulties.

Methods

Study design and setting

An analytical, cross-sectional study was used to determine the association between developmental statuses and reported feeding difficulties in children with HIV. The research was conducted at Tygerberg Hospital, a tertiary care facility in the Western Cape province. It is the second largest hospital in South Africa and is located in the Tygerberg Eastern Health district of the Metro Region. Data collection included both the outpatient clinic and the ward to which children with HIV are admitted for care. The outpatient clinic manages children on ART, with the primary goal of monitoring their health and development. This clinic manages approximately 40 patients per week, while the ward admits approximately five new patients per week for HIV-related illnesses.

Sampling and eligibility criteria

Participant recruitment was conducted between June 2012 and June 2014 and followed purposive sampling. Children between 6 weeks and 5 years old with a confirmed diagnosis of HIV were included in the study. Children need to be at least 6 weeks old to allow both caregiver and child to establish a feeding method and a feeding routine. Children were either seen at their outpatient clinic appointment or in the ward. Children who had comorbidities, such as cerebral palsy, that could be the cause of their feeding problems were not included in the study. Children who attended the clinic without their legal caregivers or those who did not receive a paediatric neurologist assessment were also not included in the study. Children were also excluded if their hospital files did not have all the necessary information.

Data collection

The neurodevelopmental status and possible feeding and swallowing difficulties of the children with HIV were determined using the following two screening tools:

Feeding and swallowing questionnaire (FSQ): To determine the nature and extent of the children's feeding problems, the caregivers completed a questionnaire about feeding and swallowing, with the help of the research assistant. The questionnaire was compiled by speech-language therapists with expertise in dysphagia, and a paediatric gastroenterologist, as part of a larger study that focuses on feeding and swallowing difficulties in HIV. As part of the development of the FSQ, paediatric dysphagia literature and experts in the field of paediatric dysphagia were consulted. Subsequently, the

FSQ was validated in a study by Vermeulen (2015), which found that the questionnaire had both face-to-face and content validity. Criterion validity was established with a sensitivity of 92% and specificity of 59%. The FSQ was therefore regarded as a valid and reliable tool for the identification of feeding difficulties as reported by caregivers of children in the HIV population. The questionnaire consists of 20 items. The 20 items included gathering information regarding oral feeding, difficulties in the pharyngeal phase of swallowing and behavioural feeding difficulties.

Neurodevelopmental screening: The developmental quotient (DQ) of the children was assessed individually by a paediatric developmental specialist. Neurodevelopmental screening was performed using the Molteno Adapted Scale (Molteno 1989). It showed reliable diagnostic accuracy when compared to the Griffiths Mental Development Scale-Extended-Revised, and therefore, it is encouraged to be used in toddlers within the South African population (Honeth et al. 2019). The Molteno Adapted Scale is frequently used in children under the age of five to determine a neurodevelopmental quotient (Laughton 2010). The DQ is determined by adding the age-equivalent scores of each subsection, which include gross motor, fine motor, personal–social and communication. The added score is divided by four to achieve a developmental age. The developmental age is divided by chronological age to achieve a DQ. Neurodevelopmental delay was diagnosed when the DQ is below 80, with borderline DQ between 70 and 80, mild DQ between 50 and 70, moderate DQ between 30 and 50, severe DQ between 20 and 30, and profound DQ below 20. The quotient allowed the researcher to divide the children into two groups (i.e. those with or without a developmental delay).

Procedures

Ethical clearance was obtained from both the University of Stellenbosch (N11/05/149) and Tygerberg Hospital. The necessary consent forms and the FSQ were translated into Afrikaans and isiXhosa. A health professional in the ward, a first language isiXhosa speaker, was trained to assist the isiXhosa-speaking participants. The research assistant and health professional in the ward were trained regarding the objectives, gaining informed consent, data collection tools and procedures of the study.

Participants who consented to participate in the study were recruited from the outpatient clinic and relevant ward at Tygerberg Hospital. Data were collected by the researcher and the research assistant. The participants' demographic and medical history information was collected via an interviewer-administered structured questionnaire with the participant and medical data collected from the hospital folder. The DQ, using the Molteno Adapted Scale, was determined by a paediatric developmental specialist for

each participant. The specialist's raw data and results were inserted in the research folder of the participant. The feeding questionnaire was completed with the participants on the day they visited the outpatient clinic, and thus, they incurred no additional patient costs to participate in the study.

Statistical analysis

Data were captured and placed into a data collection form in Microsoft Excel developed after discussions with the biostatistician. The data collection form was kept on a password-protected computer in a locked office. The backup of data was done after every session and stored on an external hard drive that was kept in a separate location in a locked cabinet. When all the data were captured, the data were transferred to STATA version 17.0 (StataCorp, LLC., College Station, Texas, USA).

The prevalence of feeding difficulties reported by caregivers was determined for the two groups, with and without neurodevelopmental delay. Descriptive statistics included means, proportions, frequencies and standard deviations. The association between neurodevelopmental quotient and feeding difficulties was determined through the calculation, which was done using logistic regression values of odds ratios, with accompanying confidence intervals and *p*-values, using the univariate chi-square test for categorical variables and Student's *t*-test for continuous variables. Data were stratified according to the time of ART initiation, developmental delay and sex to eliminate possible confounding.

Results

A total of 70 children from a potential study population of 200 children with HIV and AIDS met the inclusion criteria and were included in this study. Children who were excluded were above the age of five and had had a different neurodevelopmental assessment done or had incomplete data. Of the 70 children, 44 (68%) were boys and 26 (37%) were girls.

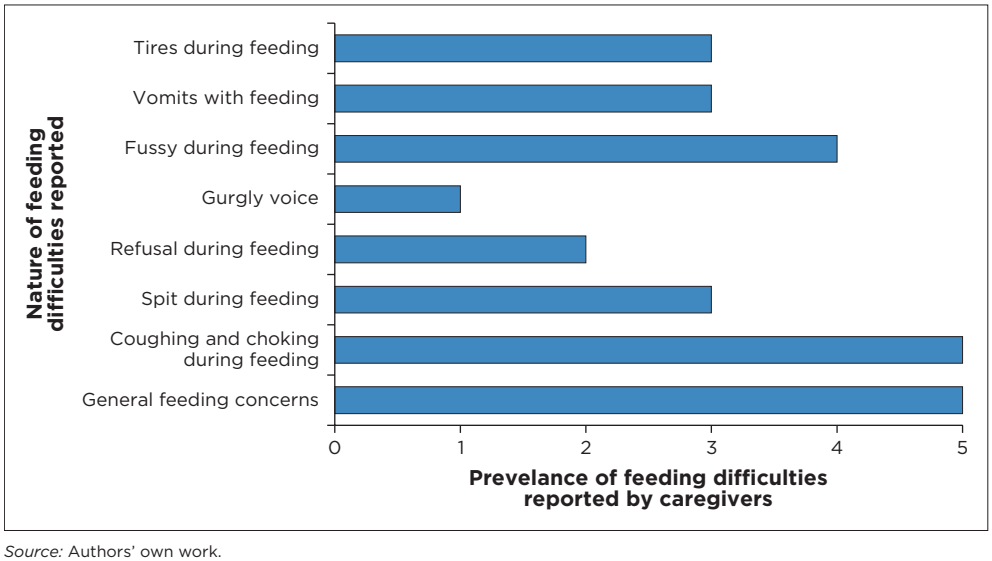
Sixteen (22.86%) of the 70 children with HIV experienced feeding difficulties. Figure 8.1 outlines the 26 feeding difficulty concerns reported by the 16 caregivers, which included oral, pharyngeal and behavioural feeding difficulties. Some caregivers provided more than one feeding difficulty.

Various challenges related to feeding and swallowing encompassed a spectrum of issues. Caregivers commonly reported general feeding difficulties, such as poor weight gain and challenges in feeding children, along with coughing and choking during meals, accounting for 38% of the 26 identified issues. These prevalent concerns underscore significant signs

and symptoms in paediatric care. Fussiness during mealtimes made up approximately 15% of the 26 reported difficulties. Vomiting while feeding, spitting up during feeding, and experiencing fatigue during feeding, which included taking more than 30 minutes to feed or struggling to finish feeds, were each reported three times. Additional feeding and swallowing concerns included a gurgled voice during or after feeding, and instances of refusal to feed. These findings highlight the diverse range of issues faced by caregivers, shedding light on the multifaceted nature of feeding and swallowing difficulties in children.

One of the objectives of the study was to determine the prevalence of feeding difficulties in the specific study population by comparing the groups with feeding difficulties and no feeding difficulties. In the group with feeding difficulties, the mean age (standard deviation [SD]) was 25 (16.14) months, while the group without feeding difficulties was older with a mean age of 32.68 (18.95) months. Table 8.1 indicates the number of children with feeding difficulties within specific age ranges, related to their ART initiation.

As indicated in Table 8.1, feeding and swallowing difficulties were indicated across the age range, with no specific association with ART initiation. Table 8.2 presents the data of the 70 children with HIV and the prevalence of feeding difficulties in terms of birth weight, sex, neurodevelopmental status and timing of ART initiation.



Source: Authors' own work.

FIGURE 8.1: The feeding concerns reported by caregivers.

TABLE 8.1: Age range of feeding and swallowing difficulties.

Age range	Children with feeding and swallowing difficulties (*N* = 16)	ART initiation < 6 months	ART initiation > 6 months
0–12 months	5	3	2
12–24 months	3	2	1
24–36 months	4	2	2
36–48 months	4	2	2

Source: Authors' own work.
Key: *n*, number; ART, antiretroviral therapy.

TABLE 8.2: Summary of the prevalence of feeding difficulties stratified according to birth weight, sex, developmental status and antiretroviral therapy initiation (*N* = 70).

Variable	Birth weight	Sex				Neurodevelopmental status				Timing of antiretroviral therapy initiation			
	Mean (g)	Male (*n* = 44)		Female (*n* = 26)		Typical (*n* = 49)		Delay (*n* = 21)		< 6 months (*n* = 33)		> 6 months (*n* = 37)	
		n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
With feeding difficulties (*n* = 16)	2675.8	12	27	4	15	9	18	7	33	9	27	7	19
Without feeding difficulties (*n* = 54)	2678.8	32	73	22	85	40	82	14	67	24	73%	30	81

Source: Authors' own work.
Key: *n*, number, g, gram.

Table 8.2 provides insights into the prevalence of feeding difficulties based on sex, neurodevelopmental status and timing of ART initiation. No difference was observed in birth weight between the group with feeding difficulties versus the group without, with the mean birth weight being below 3,000 g for both groups. There appears to be a trend that the prevalence of feeding difficulties is higher in boys (27%) compared to girls (15%). The timing of ART initiation does not seem to show a clear pattern of association with feeding difficulties. Therefore, an unexpected result of the study indicated children who started ART before the age of 6 months had a higher prevalence of feeding difficulties (27%) versus those children who only started their ART after 6 months (19%). Individuals with delayed neurodevelopmental status tend to have a higher prevalence of feeding difficulties compared to those with typical neurodevelopment. Feeding difficulties were almost double in the neurodevelopmental delayed group (33%) than the 18% in the group with typical neurodevelopment.

Forty-nine (70%) of the children presented with typical developmental status and 21 (30%) with varying degrees of developmental delays, ranging from borderline to profound developmental delays. Eight children each had a diagnosis of a borderline or mild developmental delay. One child had a moderate developmental delay, one had a severe delay, and three children were diagnosed with a profound delay. Table 8.3 summarises the possible association between feeding difficulties and developmental status, developmental delay, timing of ART initiation, sex, mean age and birth weight.

TABLE 8.3: Association between feeding difficulties and developmental status, antiretroviral therapy initiation and gender.

Outcome measure	Odds ratio	95% confidence interval	*p*-value
Feeding difficulties associated with developmental status	2.22	0.7–7.09	0.177
Feeding difficulties associated with the timing of antiretroviral therapy initiation	0.62	0.2–1.91	0.408
Feeding difficulties associated with borderline to mild developmental delay	1.48	0.39–5.67	0.566
Feeding difficulties associated with moderate to profound developmental delay	6.66	0.97–45.92	0.054
Feeding difficulties associated with sex	2.06	0.58–7.24	0.258

Source: Authors' own work.
Key: %, percentage.
As shown in Table 8.3, the findings show a variety of associations between feeding difficulties and possible confounding factors. While one association exhibited a trend, none of the associations were statistically significant. Notably, there is a possibility of a relationship (ρ = 0.054) between feeding difficulties and moderate to profound developmental delay; however, this result warrants further examination. Birth weight and age were not associated with the presence of feeding difficulties.

Discussion

To frame the discussion, it is recognised that the data set was collected a decade ago. These findings have, however, not previously been published in the context of HIV, neurodevelopmental delay, and possible feeding and swallowing difficulties. The mutually influential nature between these aspects made the analysis of the data relevant and a critical area of concern. Because of the noticeable paucity of research and the limited evidence on the effect of early ART on neurocognitive functioning in HIV-infected children in Africa (Debeaudrap et al. 2018), it was deemed that the current data set could still contribute to the body of knowledge. The focus of the research study is therefore still applicable to current clinical practice and possible future research.

Feeding and swallowing are complex skills that can be influenced by medical, psychological and behavioural factors. The multifactorial nature of feeding and swallowing difficulties therefore highlights the interplay between HIV, feeding, neurodevelopmental delay and the possibility of feeding difficulties. Therefore, the research aimed to determine the prevalence of feeding difficulties, to describe the association between feeding difficulties and the severity of developmental delay, and possible confounding factors.

The study included data from 70 HIV-positive children and yielded a prevalence of feeding difficulties of 22.86%. The results are similar to the prevalence described by Jeena et al. (2011) in their sample of 70 participants, but much lower than the prevalence of 80% described by Nel and Ellis (2012), who had a sample of 25 participants. However, in the present study, most children were attending an outpatient clinic in contrast with Nel and

Ellis (2012) and Jeena et al. (2011), who focused on the inpatient setting. Masoza et al. (2022) indicated that children with HIV are at higher risk for hospitalisation. The reason for increased risk can be attributed to common childhood infections and possible malnutrition that is associated with the chronic state of illness caused by HIV (Masoza et al. 2022). Dicko et al. (2014) indicated that even though children are initiated on ART during their early years, they still have an increased admission rate when compared to their HIV-negative counterparts because of possible co-morbidities and HIV encephalopathy. Increased feeding and swallowing difficulties are associated with children with chronic illnesses. Sdravou et al. (2021) indicated that feeding problems are an interplay between organic and environmental influences. The unfavourable mealtime environment in the hospital setting as well as negative parental feeding practices could also influence the development and maintenance of feeding and swallowing difficulties (Sdravou et al. 2021).

The type of feeding difficulties, as reported by caregivers in the current study, is similar to those reported by Melvin, Wright and Goddard (1997), who indicate that most of the feeding difficulties in children with HIV reported in their study were poor weight gain and behavioural issues. Behavioural feeding and swallowing difficulties may include signs of being fussy during mealtimes, refusing and spitting on foods and difficulty feeding children. Children with HIV also have an increased risk for oral disease, including soft tissue lesions and salivary gland dysfunction. Long-term oral disease in children with HIV contributes to feeding and swallowing difficulties (Narayanan & Kalappa 2017). Possible bulbar dysfunction can occur over time, which will affect chewing, sucking and swallowing. The detrimental effects of feeding and swallowing difficulties, and their associated health complications on an infant's general well-being, growth and quality of life, underscore the importance of early detection and customised intervention. When developmental challenges are recognised and addressed promptly, infants exposed to HIV show promise in achieving typical developmental milestones (Rajan et al. 2017).

Another finding in this study was that feeding difficulties were also more prevalent in younger children, possibly because of the shorter duration of ART treatment. Melvin et al. (1997) found similar results where children with HIV above the age of 30 months were functioning better, as these children have more time to develop, normalise or promote their neurodevelopment and feeding and swallowing skills. In a study done by Laughton et al. (2012), children starting ART at approximately 7 months of age were already presenting with neurodevelopmental delays. These delays were associated with poorer outcomes for the child with HIV, which could include feeding and swallowing difficulties.

Feeding difficulties are, therefore, independently associated with both being infected with HIV and neurodevelopmental delay. Therefore, the risk for feeding difficulties of a developmentally delayed, HIV-infected child is potentially double that of the typical developing population (Ramokolo et al. 2019). These results confirm the increased prevalence of feeding difficulties in the developmentally delayed, HIV-infected paediatric population. However, in this study, no statistically significant association was found between neurodevelopmental delays or the timing of ART initiation and feeding difficulties. The associations might, however, be obscured by the small sample size. Furthermore, the Molteno Adapted Scale has been shown to have strong positive correlations with the Griffiths Mental Developmental Scales in predicting neurodevelopmental outcomes in children older than 7 months with very low birth weight (Laughton 2010). The Molteno Adapted Scale might therefore not be the best test to predict developmental status in infants up to 7 months post-term age.

Le Doare et al. (2012) confirmed that children born to mothers with HIV have a lower birth weight, which is associated with increased mortality and developmental delay. In this study, even though birth weight was not associated with the presence of feeding difficulties, low birth weight (< 3,000 g) was associated with neurodevelopmental delay. Gender differences in the areas of health and development have been reported for medically at-risk infants (Cho, Holditch & Miles 2010), which was also evident in this study, with boys having a higher prevalence of feeding problems than girls.

The timing of ART initiation could influence developmental status, which in turn influence the risk of having feeding difficulties. Timing of ART could therefore be a possible negative confounder, as timing of ART attenuates the apparent effect. In a study done by Lowick, Sawry and Meyers (2012), it was found that children starting with ART before the age of 12 months have better neurodevelopmental outcomes. This study found that feeding difficulties were more prevalent in children starting ART before the age of 6 months. Possible reasons could be that a higher prevalence of feeding difficulties is associated with younger children (Melvin et al. 1997). Eight of the 16 children who presented with feeding problems were younger than 24 months, and five of them commenced with ART before the age of 6 months. The children starting ART under the age of 6 months could therefore be representative of the younger population in this study. Levin, Horak and Nuttall (2021) reported that the evolving mother-to-child transmission guidelines in South Africa have decreased HIV diagnosis in children by 84% between 2009 and 2015. However, children with an HIV diagnosis still lack access and provision of ARTs, as a result of poverty, stigma, and alcohol and drug abuse. This could potentially increase the possibility of neurodevelopmental delays and subsequent feeding and swallowing difficulties.

Understanding the association between feeding difficulties and neurodevelopmental status has important clinical implications. Comprehensive care for children with HIV should consider both of these factors. Multi-disciplinary approaches involving paediatricians, speech-language therapists, dieticians, physiotherapists, occupation therapists and developmental specialists are vital to addressing these challenges holistically. Early identification of feeding difficulties and neurodevelopmental delays is crucial for initiating timely interventions.

Children with HIV and neurodevelopmental delays should be screened by a specialist in dysphagia to determine possible feeding difficulties to prevent further adverse events. The children who are found to be at risk should receive rehabilitation and support as early as possible. Early initiation of intervention strategies to optimise development in children with HIV, especially in resource-constrained areas, is therefore of utmost importance (Laughton et al. 2019). It is suggested that early initiation of ART and early start of rehabilitation could decrease feeding difficulties in children with HIV and neurodevelopmental delay (Laughton et al. 2012).

Limitations of the study

Limitations of the study included a relatively small sample size of 49 participants in the group with typical neurodevelopmental status and 21 participants in the group presenting with a neurodevelopmental delay, resulting in the achievement of 24% power to detect a difference between the group proportions of 0.1500. Furthermore, the small sample size led to mostly statistically insignificant results ($p > 0.05$), which resulted in a Type II error, even though clinical significance was expected. As the results were statistically insignificant, logistic regression could not be performed to determine predictor variables for feeding difficulties.

Another limitation to consider is the use of a screening tool to determine developmental status. Screening tools serve as quick evaluations to determine if a child may be at risk for developmental delays across various domains. Yet, their ability to detect more nuanced delays is somewhat restricted (Sabanathan, Wills & Gladstone 2015). A more comprehensive neurodevelopmental evaluation is recommended in the future, as the screener could affect the true associations between neurodevelopmental status and feeding. A formal and comprehensive diagnostic test will be recommended for future studies to increase the reliability and validity of results. It is recommended that in future studies, other confounders associated with developmental delay should be assessed as well as including aspects such as maternal substance abuse, poverty, malnutrition and mother–infant attachment. Poor weight gain was classified as feeding difficulty, but this could be problematic because of poor weight

gain also being associated with food security, recurrent hospitalisations and HIV disease in itself (Oluma et al. 2020). Lastly, the exposure and outcome data were collected simultaneously, and therefore, it was not possible to determine whether the exposure preceded or followed the outcome (Wang & Cheng 2020).

Finally, once again, it is acknowledged that although the data are a decade old, the discussion was formulated in relation to the most recent research available.

Conclusion

Reported feeding difficulties are high among children with HIV. An increase in feeding difficulties was noticed in children with neurodevelopmental delays in comparison to those with typical developmental status. Children with neurodevelopmental delay and HIV do not have a statistically significant increase in risk of developing feeding difficulties but this study was not sufficiently powered to detect this difference. The timing of ART versus ART initiation had no influence on the prevalence of feeding difficulties.

The association between neurodevelopmental delay and feeding difficulties in children with HIV underscores the complexity of their health challenges. The alignment of the results with more recent research suggests that challenges are ongoing and possibly underscore the need for proactive management in children with HIV. Additionally, ongoing studies should consider longitudinal assessments to track developmental progress and intervention outcomes over time. A comprehensive approach to monitoring feeding and swallowing difficulties in HIV-positive children remains crucial for the health outcomes and quality of life in this vulnerable population.

Declarations

Ethical considerations

Ethical approval for this study was obtained from the Health Research Ethics Committee of Stellenbosch University (reference number N11/05/149) and from Tygerberg Hospital. All procedures followed the relevant institutional guidelines and regulations.

Consent

All participants completed a separate informed consent form prior to participation.

Author contributions

Alida de Beer: Conceptualisation, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Writing – original draft, Writing – review and editing.

Faeza Bardien: Validation, Writing – review and editing.

Both authors reviewed the chapter, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

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Competing interests

The authors declare that they have no competing interests.

Data availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Disclaimer

The views and opinions expressed in this study are those of the authors and do not necessarily reflect the official policy or position of any affiliated institutions.

Chapter 9

A decade of childhood hearing loss at a public hospital in the Western Cape: A retrospective study

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Abstract

Background: Most children with permanent disabling hearing loss live in developing countries. In South Africa, approximately 16–17 babies are born with hearing loss daily. Limited newborn hearing screening programmes and inadequate data management contribute to the lack of systematic data on the causes of congenital and early-onset hearing loss in the country.

Aim: This study aims to investigate paediatric hearing loss at a tertiary hospital in the Western Cape province over a 10-year period, focusing on prevalence, degree of hearing loss, age at initial consultation and diagnosis, and factors influencing timing and associated risk factors.

Methods: A total of 537 paediatric cases were identified for the retrospective file review, with 381 cases included after excluding those with incomplete or inconclusive data. Data were analysed using descriptive and inferential statistics.

Results: Of the cases included, 66% had hearing loss, with 60% experiencing bilateral hearing loss. Profound hearing loss was prevalent. The average age of diagnosis was 31 months, with parental concern being the most common risk factor. Factors such as severe neonatal jaundice, craniofacial abnormalities and extended stays in the neonatal intensive care unit were associated with earlier diagnosis, while parental concern was associated with later diagnosis.

Conclusion: The study highlights the high prevalence and severity of hearing loss in children referred to tertiary hospitals, with diagnosis occurring later than national and international benchmarks. Children with specific medical diagnoses or birth complications were diagnosed at a younger age, possibly because of their engagement with the hospital system. Notably, parental concern regarding hearing was associated with older ages at initial consultation and diagnosis, suggesting challenges in

identifying hearing loss at primary health care clinics. These findings emphasise the need for early intervention and improved strategies for identifying hearing impairments in children, particularly in resource-constrained settings.

Background

Permanent disabling hearing loss is reported to affect 3–6 per 1,000 children worldwide, of which the vast majority (at least 85%) live in developing countries (Olusanya 2017). An estimated 16–17 babies are born with hearing loss daily in South Africa (Swanepoel, Störbeck & Friedland 2009). The first few months of life are a critical time for the development of the brain's auditory centres, and the initial three years form the critical period for speech and language development (Yoshinaga-Itano et al. 1998). The impact is thus greatest for individuals who are born with hearing loss or who experience hearing loss shortly after birth.

The individual and societal impact of permanent congenital or early-onset hearing loss has been widely reported. Language, cognitive, motor and socioemotional development may be negatively affected, resulting in academic underachievement, social isolation, higher risk of injury and increased poverty (Bezuidenhout et al. 2018; Olusanya 2017; World Health Organization 2016). The positive outcomes associated with the timeous and appropriate management of permanent congenital or early-onset hearing loss are equally well documented. Research suggests that children born deaf or who acquire a hearing loss very early in life and who are enrolled in intervention programmes early can achieve language development levels similar to their hearing peers by the age of five, assuming there are no additional impairments (Moeller 2000). The earlier a hearing loss is diagnosed and intervention is initiated, the more optimal the potential outcome.

Early Hearing Detection and Intervention (EHDI) describes a three-stage pathway from infant screening for hearing loss to the subsequent processes of diagnosis and intervention. In virtually all developed countries, universal newborn hearing screening programmes are well established and mandatory, so that EHDI services meet the internationally benchmarked indicators of screening by age 1 month, diagnostic testing by age 3 months and early intervention by age 6 months. For established programmes, earlier goals of screening by age 1 month, diagnosis by age 2 months, and early intervention by age 3 months are proposed (Joint Committee on Infant Hearing 2019).

In developing countries such as South Africa, newborn hearing screening programmes are sparse and not supported by legislation. Olusanya (2015)

discusses challenges to providing newborn hearing screening in low-to middle-income countries, including failure to recognise hearing loss as an important condition, lack of or inadequate financial resources, lack of appropriate risk-based screening, unsuitable environment and conditions for hearing tests, and cost of intervention services. These challenges are also applicable within the South African context. The Health Professions Council of South Africa Early Hearing Detection and Intervention Position Statement 2018 (Health Professions Council of South Africa 2018) provides modified recommended timeframes for hearing screening, given these contextual challenges. Initial screening should take place before age 1 month and no later than 6 weeks for programmes linked to immunisation visits. Diagnostic evaluations should be in process before age 3 months, and the diagnosis confirmed no later than 4 months of age. Infants with diagnosed hearing loss should receive intervention before age 4 months and no later than age 8 months.

There has been slow progress in the implementation of EHDI in South Africa (Naidoo & Khan 2022), with efforts to roll out newborn hearing screening services across different levels of public health care, including primary care clinics, birthing units and district, secondary and tertiary hospitals. However, screening programmes continue to be limited and fragmented, with the effective EHDI implementation in South Africa being counterbalanced by financial, human and infrastructure resource constraints (Bezuidenhout et al. 2018; Naidoo & Khan 2022). Public health care facilities have a limited budget and a lack of funding. This directly impacts the employment of staff and the provision of equipment. In the absence of trained screeners, audiologists are expected to perform both hearing screening and diagnostic tests. Furthermore, there is no national data management programme for newborn hearing screening. This makes the tracking of infants with 'refer' results on their screening test difficult and may contribute to poor follow-up rates.

Even where newborn hearing screening services do exist, this does not ensure a timely and smooth transition to the next critical stages of EHDI, namely diagnostic assessment and subsequent intervention. Access to diagnostic testing for babies who fail their hearing screening is challenging in the South African state health care system. Auditory brainstem response (ABR) testing is considered a specialist paediatric test procedure requiring costly equipment. In the Western Cape province, for example, this service is offered at only two tertiary-level state hospitals. Human and physical resource constraints result in unacceptably long waiting times, which are contrary to EHDI principles. Financial and logistical challenges also play a role, particularly for the rural population relying on health care system transport to diagnostic centres. Furthermore, there are delays in referral as a result of poorly coordinated upward referral pathways, as well as limited

knowledge in health care workers regarding the importance of EHDI. These factors cause a delay in the diagnostic process, which in turn affects both long- and short-term management options and outcomes for children with hearing loss. Subsequently, the age of diagnosis of congenital paediatric hearing loss in South Africa, as well as the age of entry into an intervention programme, exceeds national and international benchmarks. Several retrospective studies in this regard have been conducted, with the reported average age of diagnosis ranging from 26 to 44 months (Butler et al. 2013; Khoza-Shangase & Michal 2014; Kuschke et al. 2020; Störbeck & Young 2016; Swanepoel, Johl & Pienaar 2013). Kuschke et al. (2020) reported outcomes for 240 children under the age of 6 years with confirmed hearing loss at a Children's Hospital in the Western Cape province. A mean delay of 9 months from the time hearing loss was suspected to when it was diagnosed was reported. The mean age at which permanent congenital or early-onset hearing loss was diagnosed was 31.4 months.

Because of a lack of newborn hearing screening programmes, late diagnosis and inadequate data management, there are limited systematic data regarding the causes and characteristics of permanent congenital and early-onset hearing loss in South Africa. In the study conducted by Kuschke et al. (2020), it was observed that more than two-thirds (68.3%) of the identified cases involved bilateral hearing loss. Most of these cases were found to present with conductive hearing loss (64.6%), then sensorineural hearing loss (28.7%) and, finally, mixed hearing loss (3.3%), along with auditory neuropathy spectrum disorder (3.3%). Over half (51.8%) of the cases with bilateral sensorineural hearing loss were classified as profound. Additionally, Swanepoel et al. (2013) and Kuschke et al. (2020) noted that having a family history of hearing loss was the most common risk factor associated with sensorineural hearing loss.

According to the World Health Organization (WHO) (2016), approximately 60% of hearing loss in children can be prevented, with 40% of hearing loss being non-preventable. Preventable causes include infections and birth complications. Infections such as cytomegalovirus, chronic ear infections, measles, meningitis, mumps and rubella cause more than 30% of childhood hearing loss, with meningitis and rubella accounting for more than 19% of childhood hearing loss. Furthermore, birth complications, such as lack of oxygen, low birth weight, prematurity and jaundice, account for 17% of childhood hearing loss (WHO 2016).

Preventable causes account for a significantly higher proportion (75%) of hearing loss in middle- and lower-middle-income countries than in high-income areas (49%) (Neumann et al. 2019). This disparity is most likely because of higher infection rates in poorer countries and better maternal and child health care in wealthier ones. However, data for the South African

context are either underreported or not reported at all, making it difficult to assess the extent of the problem in this region.

This study aims to describe paediatric hearing loss at the Tygerberg Academic Hospital over 10 years in terms of:

- prevalence and nature (unilateral and/or bilateral and degree) of hearing loss
- age at initial consultation, diagnosis and first follow-up
- time between initial consultation, diagnosis and intervention
- risk factors associated with hearing loss
- risk factors affecting the age of initial consultation and the age of diagnosis.

Methods

The study was approved by the Health Research Ethics Committee of the Faculty of Medicine and Health Sciences, Stellenbosch University (N17/10/108), and permission to conduct the study was obtained from the hospital.

Study context

The Tygerberg Academic Hospital represents one of two tertiary-level state health institutions in the Western Cape province equipped to perform objective electrophysiological testing to diagnose paediatric hearing loss. Referrals are received from community health clinics, neonatal screening programmes, general practitioners and medical specialists. After diagnosis, children with hearing loss are followed up at the hospital's Audiology Department to ensure that an appropriate management plan is implemented.

Study population

A total of 381 cases, aged 6 years and younger, tested between July 2007 and June 2017, were included in the study.

Procedures

A retrospective review of clinical records from children under 6 years of age diagnosed with confirmed hearing loss between July 2007 and June 2017 was conducted. A total of 537 cases were identified from the Audera database, and available audiological data were collected from the database. Cases with incomplete, inconclusive or unavailable data were excluded, leaving a sample of 381 cases.

Information that was not available on the database was collected from the cases' hospital folders. This included demographic information, nature

of hearing loss and age at consultation, diagnosis and follow-up, as well as risk factors.

The audiological test battery included otoscopy, tympanometry, acoustic reflex testing, otoacoustic emissions, frequency-specific air- and bone-conduction ABR testing and auditory steady-state response testing. Behavioural testing (Visual Reinforcement Audiometry or Play Conditioned Audiometry) was included where appropriate.

Statistical analysis

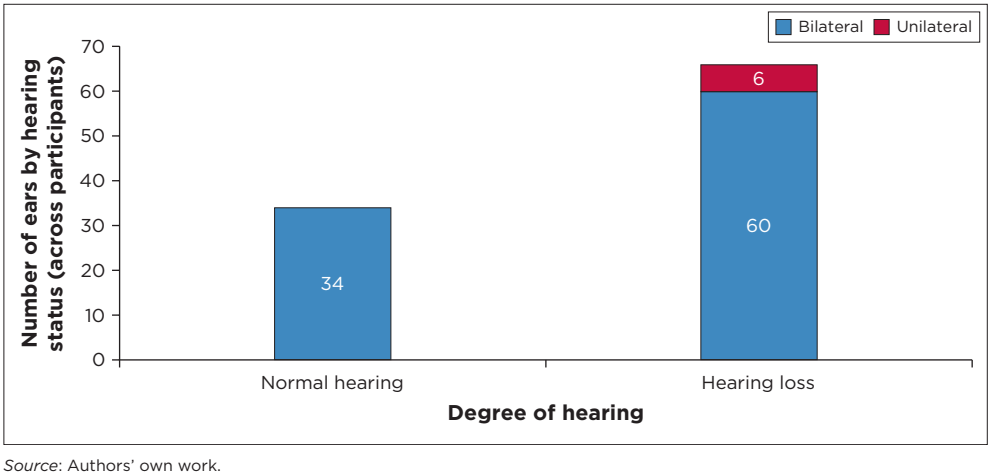
Microsoft Excel (2016) was used to capture the data. IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp. 2019, Armonk, New York) was used for descriptive and inferential statistics. An analysis of variance (ANOVA) test was used, which allowed for the comparison of multiple means.

Results

Prevalence and nature of hearing loss

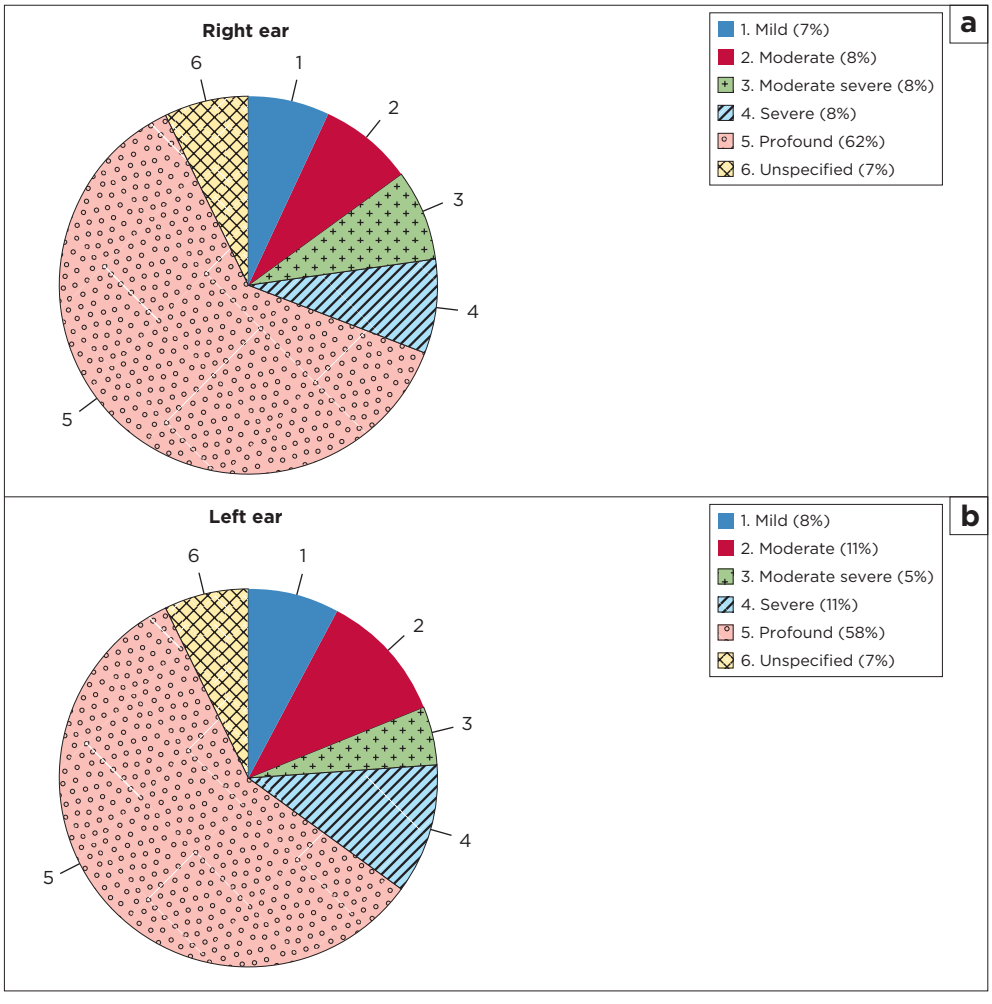
Sixty-six per cent of the cases presented with hearing loss. Of these, 60% presented with bilateral hearing loss, with the remaining 6% presenting with unilateral hearing loss (Figure 9.1).

Hearing loss was predominantly profound, with 70% of cases presenting with severe or profound hearing loss in the right ear and 69% in the left ear. Mild to moderately severe hearing loss was identified in 23% of cases for the right ear and in 24% of cases for the left ear. The degree of hearing loss was unspecified in 7% of cases (Figure 9.2). The type of hearing loss was not reported.



Source: Authors' own work.

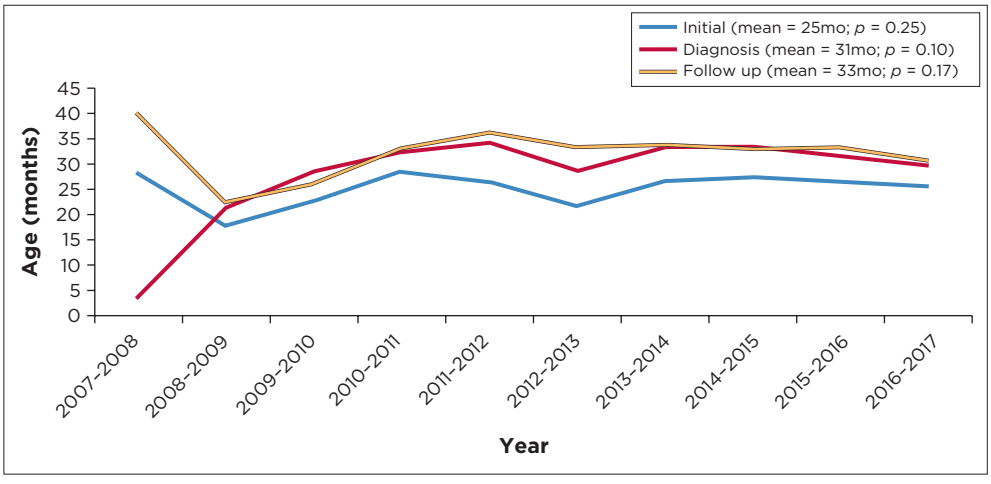
FIGURE 9.1: Nature of hearing loss – ear affected.



Source: Authors' own work.
Key: %, percentage.
FIGURE 9.2: Nature of hearing loss – degree.

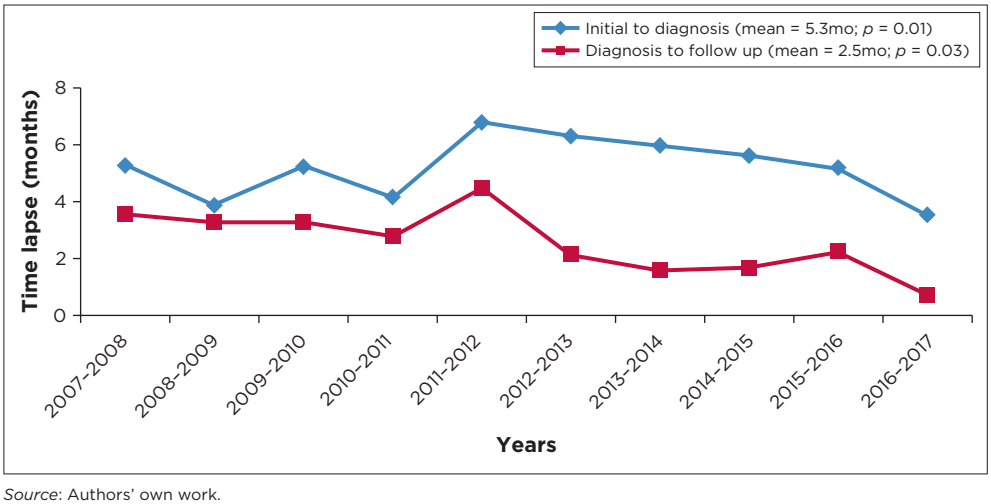
Age at initial consultation, diagnosis and follow-up

The mean age over the 10-year period at which the cases were seen for the initial consultation was 25 months (ANOVA p = 0.25), with diagnosis at 31 months (ANOVA p = 0.10), and the first follow-up at 33 months (ANOVA p = 0.17) (Figure 9.3).



Source: Authors' own work.

FIGURE 9.3: Age at Early Hearing Detection and Intervention appointments.



Source: Authors' own work.

FIGURE 9.4: Time lapse from initial consultation to first follow-up.

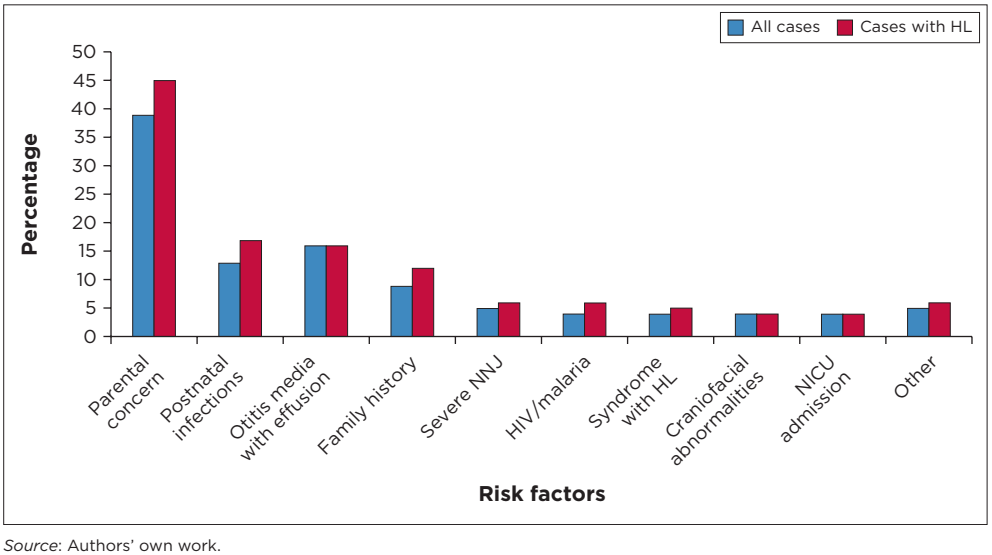
Waiting times ranged from 3.5 to 7 months between initial consultation and diagnosis, and from 0.5 to 4.5 months between diagnosis and first follow-up (Figure 9.4).

The mean time lapse over the 10 years between initial consultation and diagnosis was 5.3 months ($p = 0.01$), with the time lapse between diagnosis and first follow-up being 2.5 months ($p = 0.03$). A significant improvement in waiting time between initial consultation and diagnosis, as well as diagnosis and first follow-up, was identified over the 10-year period.

Risk factors associated with hearing loss

Risk factors were identified in 75% of the total sample and 84% of the cases with hearing loss (Figure 9.5). The most frequently occurring risk factors in those identified with hearing loss were parental concern (45%), postnatal infections including bacterial meningitis (17%), otitis media with effusion exceeding three months (16%) and family history of hearing loss (12%). Less frequently occurring risk factors in those identified with hearing loss included hyperbilirubinaemia exceeding exchange values (6%), human immunodeficiency virus (HIV) and/or malaria (6%), syndromes associated with hearing loss (5%), craniofacial abnormalities (4%), neonatal intensive care unit (NICU) admission for longer than 48 hours (4%) and other risk factors, such as cytomegalovirus (6%).

Cases with risk factors associated with medical conditions were seen for the initial consultation and diagnosed at a younger age than the mean average, while parental concern was associated with older mean ages at initial consultation and diagnosis. The time lapse between initial consultation and diagnosis was 3.7 months longer when otitis media with effusion was present for three months or longer (p = < 0.01) (Table 9.1).



Source: Authors' own work.
Key: %, percentage; NNJ, neonatal jaundice; HIV, human immunodeficiency virus; HL, hearing loss; NICU, neonatal intensive care unit

FIGURE 9.5: Occurrence of risk factors associated with hearing loss.

TABLE 9.1: Risk factors affecting age of initial consultation and diagnosis relative to the mean age.

Risk factor	Initial consultation	Diagnosis
Craniofacial anomalies	14.3 months younger ($p < 0.01$)	15.9 months younger ($p < 0.01$)
Hyperbilirubinaemia exceeding exchange values	17.6 months younger ($p < 0.01$)	14.1 months younger ($p < 0.01$)
NICU admission > 24 hours	15.1 months younger ($p < 0.01$)	14.6 months younger ($p < 0.01$)
Parental concern	8.4 months older	Seven months older

Source: Authors' own work.
Key: NICU, neonatal intensive care unit.

Discussion

The majority of cases reviewed in this study were diagnosed with hearing loss, possibly as most cases referred for ABR or auditory steady-state response testing at Tygerberg Hospital present with suspected hearing loss and/or associated risk factors.

Bilateral hearing loss, with a severe or profound degree in at least one ear, was the most prevalent hearing loss. Hearing loss ranging from mild to moderate in severity was identified less frequently. Unilateral hearing loss was in the minority. These findings are consistent with the findings of Kuschke et al.'s (2020) study, where both bilateral and profound hearing loss were most frequent. In the absence of universal screening programmes, it is possible that milder hearing losses and/or unilateral losses may not be detected until a much later age, as presenting symptoms are less obvious. In a study by Eksteen et al. (2022), it was found that mild and moderate hearing loss was most prevalent in preschool children from low-income South African communities, although bilateral hearing loss remained more prevalent than unilateral hearing loss in this age group. Findings for South Africa are aligned with the broader global context. In a systematic review of 88 studies across 39 countries, Wang et al. (2019) reported a high prevalence of slight or worse hearing loss, with 13.1% of children having bilateral hearing loss of at least 15 decibel hearing loss (dBHL) within the speech frequencies. There was a significant rise in prevalence over two decades (1990–2010) for hearing loss of greater than 15 dBHL in one or both ears.

Mean ages of initial consultation, diagnosis and follow-up exceeded international (and national) benchmarks, which recommend screening by age 1 month (no later than 6 weeks), diagnostic testing by age 3 months

(no later than 4 months) and early intervention by age 6 months (and no later than 8 months). There was no improvement over the 10-year period. This supports the need for universal newborn hearing screening as opposed to risk-based screening. This will allow for the identification of potential hearing loss in infants who do not present with the medically related risk factors which typically alert health professionals to the need for a potential referral. Universal hearing screening will also potentially allow for the earlier identification of mild and moderate hearing losses, where symptoms are less obvious and less likely to trigger concern in parents or health care workers.

The average age of diagnosis (31 months) correlates with the reported average age of diagnosis ranging from 26 to 44 months in retrospective studies conducted in the South African context (Butler et al. 2013; Khoza-Shangase & Michal 2014; Kuschke et al. 2020; Störbeck & Young 2016; Swanepoel et al. 2013). In the study by Kuschke et al. (2020), also conducted at a tertiary hospital in the Western Cape province, the mean age of diagnosis of permanent congenital or early-onset hearing loss was 31.4 months.

Waiting times between consultations also remain unacceptably high, despite a significant improvement over 10 years. Average waiting times of 5.3 months between initial consultation and diagnosis, and 2.5 months between diagnosis and first follow-up, were identified. Similarly, Kuschke et al. (2020) reported a mean delay of nine months between the age of suspicion and the age of diagnosis of hearing loss. These delays have significant implications for management outcomes. In addition to high patient numbers, several factors may have contributed to these delays, including the presence of middle ear effusion, which affects accurate and timely diagnosis. Otitis media was identified as a risk factor in 16% of the cases with hearing impairment in this study. In addition, socio-economic and logistical factors, such as the availability of transport, may have affected access to a tertiary-level hospital (Olusanya 2015).

Children with risk factors relating to certain medical diagnoses and/or early birth complications were referred and diagnosed at a younger age. A possible reason for the earlier referral and diagnosis was that these children were already being managed within the hospital system, and in some cases, they were considered high risk for hearing loss. They were, therefore, referred earlier by a medical health professional. However, patients in this category were in the minority relative to those with more frequently occurring risk factors such as parental concern, otitis media, postnatal infections, and family history of hearing loss.

While parental concern regarding hearing was the most frequently occurring risk factor in those children identified with hearing loss, this factor was also found to be associated with older mean ages of initial

consultation and diagnosis. As hearing loss typically presents as an 'invisible disability' without physical symptoms, concerns from parents may be ignored or overlooked at primary health care clinics in favour of a 'wait and see' approach (Olusanya 2015). While Naidoo and Khan (2020) emphasise that parents should be made more aware and knowledgeable of the risk factors for infant hearing loss, it is equally important that health care workers are knowledgeable and aware of the importance of early referral of all cases where parental concern or other risk factors are present. Primary-level health care workers are the initial point of contact for most parents and/or caregivers accessing health care and thus play a pivotal role in the referral process (Olusanya 2015).

Limitations of the study

As this was a retrospective study, complete data were not available for all cases tested during the time frame of the study. The exclusion of incomplete data resulted in a reduced sample size, which may affect the generalisability of the findings and result in conservative predictions of prevalence in this study.

Hearing loss was not classified according to type (conductive, sensorineural or mixed), as bone-conduction thresholds were not always available.

The socio-economic status of participants could not be accurately determined from the available data.

Conclusion

The most prevalent hearing loss was bilateral and severe in nature, while the most common associated risk factors were parental concern and postnatal infections. The age at initial consultation, diagnosis, and follow-up was delayed, which has implications for enrolment in early intervention services and subsequent language outcomes.

The relationship between certain risk factors and different types of hearing deficits should be investigated. Additionally, further investigation is needed to understand the reasons behind delayed referrals and long waiting times across various levels of health care, from primary to tertiary. Possible related factors, such as medical history and current health status, socio-economic factors, and awareness and knowledge of EHDI in parents, caregivers and health care professionals, should be considered. Health care workers at all levels should be educated regarding the importance of EHDI as essential to ensuring timely referrals. A family-centred approach that values and addresses parental concerns is recommended over a purely

medical model of assessment and intervention. Pathways and criteria for referral from the primary health care level upwards should be clarified and communicated to relevant stakeholders.

The roll-out of universal newborn hearing screening programmes, with simultaneous expansion and upgrading of paediatric audiological diagnostic and intervention centres, should be prioritised. Additionally, a national data management system should be established to monitor and evaluate the number of children who have been screened, diagnosed and managed. This system will help to ensure that children receive coordinated services and are not lost in the system as they progress through their developmental trajectory.

Declarations

Ethical considerations

Ethical approval for this study was granted by the Health Research Ethics Committee of Stellenbosch University (reference number N17/10/108). The study was conducted in accordance with the International Declaration of Helsinki (2017), the South African Guidelines for Good Clinical Practice (2006) and the Department of Health Ethics in Health Research: Principles, Processes and Studies (2015).

Consent

Permission to access patient records for this retrospective file review was granted by Tygerberg Hospital. Because of the retrospective nature of the research and the use of de-identified clinical data, informed consent from participants was not required.

Author contributions

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All authors reviewed the chapter, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

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Competing interests

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Disclaimer

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Chapter 10

Vocabulary size of young Afrikaans-speaking children: Influence of known risk factors across socio-economic status

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Abstract

Background: Various measures of socio-economic status (SES) have been shown to correlate with child language skills in high-income countries. It is not yet known if this is the case in South Africa.

Aim: In this chapter, the aim was to look beyond SES as a main predictor, rather than asking whether known risk factors for language development patterns differ across mid-SES and low-SES backgrounds. The hypothesis was that financial and education-related resources associated with mid-SES mitigate the negative effects of health-related and household-related risks for language development problems.

Methods: Questionnaire data on health-related and household-related factors were collected from caregivers of Afrikaans-speaking 8–32-month-olds (n = 241) from rural and urban settings across South Africa. Caregivers also completed the preliminary Afrikaans version of the *MacArthur-Bates Communicative Development Inventory* as a measure of vocabulary size. Afrikaans speakers were targeted to address the lack of knowledge on language development in what is the country's third-largest home language.

Findings: A Mann-Whitney U test and Pearson correlations showed (1) no significant vocabulary size difference between mid- and low-SES groups for infants or toddlers, (2) a negative correlation between family history of language impairment and vocabulary size for the low-SES toddlers and (3) a negative correlation between vocabulary and concern about the child's language development for both low-SES and mid-SES toddler groups.

Conclusion: These findings render little evidence that mid-SES mitigates the potential negative effect of risk factors for language development. Larger-scale studies of this nature in under-researched contexts are needed to understand how these factors interact with SES.

Background

The focus of this chapter is vocabulary development in infants and toddlers and the factors that affect it. Early vocabulary development is one of the foundations for later academic success and is a robust predictor of later language development (Mahr & Edwards 2018). Toddlers' vocabulary size correlates with their linguistic and cognitive skills at 8 years old (Marchman & Fernald 2008), and preschool expressive vocabulary predicts literacy development (Scarborough 2009).

Child language development in general is understudied in South Africa, especially in children younger than 3 years. In terms of Afrikaans, the language under study in this chapter, traceable studies include those of Gonasillan, Bornman and Harty (2013), Bornman et al. (2018) and Brink (2020). Gonasillan et al. (2013) adapted the *Language Development Survey* (Rescorla 1989) for use with South African children and administered it to an ethnolinguistically diverse group of 40 parents of 2-year-olds, 10 of whom spoke Afrikaans. The *Language Development Survey* tool is a questionnaire about expressive language skills. It was found that, in keeping with results reported in the USA, the 40 parents' 2-year-olds mostly used nouns. Similarly, Bornman et al. (2018) adapted the *Mullen Scales of Early Learning* (Mullen 1995) for Afrikaans. These scales form a battery with which children aged 0 to 68 months are assessed, among others, on their language comprehension (33 items) and production (22 items). The 57 children from whom Bornman et al. (2018) collected data were 21 months and older, and it was found that their language skills typically increase from one age band to the next. This was a methodological study, not primarily aimed at collecting data on how language acquisition unfolds in young Afrikaans-speaking children. Brink (2018) set up a data set by using parental diaries to study the early form-meaning mappings of 21 Afrikaans-speaking children over a period of five months, with the youngest participant being 6 months when data collection commenced and the oldest participant being 23 months when it ended. The data of 20 of these children were included by Brink (2020) in a study of the holophrases and communicative intentions of young Afrikaans-speaking children, which found that these concur with what Tomasello (2003) reported for children of other languages in contexts around the world.

Given the comparative lack of research on child language development in South Africa, there is an accompanying lack of developmental norms, which complicates accurate child language assessment. In other research contexts (e.g. the USA), and for better studied languages (such as English), various measures of socio-economic status (SES) – many of which are discussed below – have been shown to correlate with child language skills; for instance, children from lower-income households have been found to

have smaller vocabulary sizes (Fernald, Marchman & Weisleder 2013; Hoff 2003). However, there is an increasing awareness of the possibility for 'diverse pathways for language development' (Wang et al. 2021, p. 1) and the need for caution in the interpretation of findings relating to differences in early vocabulary development between different SES groups. As most research on child language acquisition has been conducted in monolingual, white, middle-class communities and on only 1.5% of the world's languages (Kidd & Garcia 2022), this creates the risk of inadvertently applying a so-called deficit framework, within which the skills and language abilities of the majority culture are upheld as the norm (MacLeod & Demers 2023).

This chapter considers the relationship between SES and vocabulary size, but looks beyond SES as a predictive factor, rather investigating whether known risk factors for child language development pattern differently across low-SES and mid-SES groups. Low-SES is often seen as a risk factor in itself, but it is also related to a range of health-related and household-related risk factors, some of which are discussed below.

Known risk and protective factors for language development

Socio-economic status

Socio-economic status is widely regarded as a measure of an individual's relative social and economic position in society. It also presents one way of operationalising children's experience of disadvantage. However, as Binos, Papastefanou and Psillas (2023, p. 152) point out, SES is not a 'narrow and simple factor, but a reflection of the economic and social background of a household'. Although different studies employ different, sometimes composite, measures of SES, often involving factors such as maternal or parental level of education, household affluence, parental occupation and indices of deprivation (Binos et al. 2023, p. 153), it has been found that children from low-SES backgrounds may present with poorer language skills than their mid-SES peers (Fernald et al. 2013; Reilly et al. 2010).

Singh et al. (2022, p. 2) emphasise that past investigations involving the relationship between SES and child language development indicate that the effects within high-SES contexts are often mediated by factors that correlate with SES, such as children from high-SES families receiving richer linguistic input, the parents being more knowledgeable about child development and therefore providing support early on, and the children receiving more practice with conversational routines. Singh et al. (2022) state that it is not having higher SES per se that improves language outcomes, but rather that improvement is attributed to certain parental behaviours prevalent in higher SES families.

As is the case for child language studies in general, most studies investigating SES have been conducted in minority-world contexts (e.g. Hoff 2003; McNally et al. 2019; Reilly et al. 2010). Minority-world countries comprise the minority of the world's population, while majority-world countries comprise the majority (Khan et al. 2022). *Minority and majority world countries* are recently introduced terms for what was previously referred to as 'Western, educated, industrialised, rich and democratic' (WEIRD) and non-WEIRD countries (Henrich, Heine & Norenzayan 2010).

Studies are emerging of which the results do not point to children from low-SES households necessarily having poorer language skills than their mid-SES peers, and where maternal level of education does not necessarily have an impact on vocabulary development (see Southwood et al. 2021; Sperry, Sperry & Miller 2019). It is therefore important to expand studies on the influence of a variety of SES factors on language development, especially in majority world societies, to fully assess this impact.

Studying the influence of low-SES factors on language development is of particular relevance in South Africa. Some sobering statistics in this regard include an estimated adult illiteracy rate of 10.5% in 2021, resulting in approximately four million adults who have not completed Grade 7 (Khuluvhe 2023). These illiteracy levels are somewhat higher for women than men (11.3% vs 9.6% in 2021) (Khuluvhe 2023). Furthermore, the 2023 unemployment rate in South Africa was 32.6% (Statistics South Africa 2023a), and a 2020 report on child poverty in South Africa released by Statistics South Africa (Statistics South Africa 2020) indicated that 62.1% of South African children are identified as multidimensionally poor. Poverty is therefore common in South Africa, especially in female-headed households, with 33% of children in 2018 living below the food poverty line, which allows only enough money for basic nutrition and no other essentials (Hall 2023). Through the measurement of SES, researchers can access valuable information about relative disadvantage or advantage in terms of access to financial, educational, health and other related resources.

☐ Health-related risk factors

Socio-economic conditions are associated with various health-related factors that have been identified as predictors of children's long- and short-term developmental outcomes, for instance, middle ear infection, which during early childhood is associated with a reduced rate of receptive vocabulary growth in later childhood (Brennan-Jones et al. 2020). This impact on language development may occur through an interaction of reduced hearing sensitivity resulting from temporary conductive hearing loss, reduced attention to sound, and the experience of illness itself (Louw et al. 2002), especially when the infection is recurrent (which it is typically

deemed to be if effusion, i.e. discharge, is present for more than three months). Middle ear infections are significantly more prevalent among preschool children than among other age groups, particularly in low-income countries in sub-Saharan Africa (Biago et al. 2014; Choffor-Nchinda, Bola Siafa & Nansseu 2020). Similarly, vision impairment may also disrupt the typical course of language development and has a high prevalence in sub-Saharan Africa, with children under the age of five having the highest risk of blindness (Borrel et al. 2013; Eksteen et al. 2022).

A family history of language impairment as well as the child's gestational age and weight at birth have also been identified as key predictors of long- and short-term language outcomes (Barre et al. 2011; Pruitt, Garrity & Oetting 2010). Risks to child development that arise because of prematurity (i.e. infants born before 37 weeks of gestation) relate closely to birth weight (where low birth weight is 2,500 g or less at birth), and to a myriad of additional risk factors related to the pre- and postnatal period (such as respiratory distress) (World Health Organization 2014).

Other health-related factors, including chronic illness (for example, being human immunodeficiency virus [HIV] positive) or being born to a mother who is HIV positive (Wedderburn et al. 2019), can also influence language development.

Risk factors in terms of family composition

Some risk factors for language development are related to the composition of the household in which the child grows up. For instance, if a child has older siblings living in the same home as them, these siblings might serve as language models and have a positive influence on the child's language development. This has been shown to be the case for children from immigrant backgrounds who need to learn a community language which is not their home language (see Gurgand et al. 2022). Conversely, according to the resource dilution model, the quality and quantity of language input to every subsequent child after the firstborn could be reduced, given that the caregiver's input is shared between the siblings (Havron et al. 2019). Based on this model, siblings compete for their parents' finite resources (e.g. their financial resources and time, which would include the time the parents have to converse with the child), and therefore, as the number of children in the family increases, the resources assigned to any one child necessarily decrease.

Considering birth order of the children in the household and their language skills, Bornstein, Leach and Haynes (2004) found a vocabulary size advantage for firstborns over secondborns at the age of 20 months. In contrast, Oshima-Takane, Goodz and Derevensky (1996) found that, although firstborns and secondborns at 21 months use the same number

of utterances and words and have the same mean length of utterance, secondborns fared significantly better in the production of first-person personal pronouns at both ages. Research on the influence of birth order on language development has thus rendered mixed results.

A final household composition factor to consider is maternal age. Higher maternal age is often regarded to be a health-related risk factor for infants; for example, the infants of women aged 40 or older have an increased risk for distress and poor growth during pregnancy (Cavazos-Rehg et al. 2015) and for major chromosomal abnormalities (Hook 1981; Hook, Cross & Schreinemachers 1983). However, there are indications that children of older mothers have better language skills, i.e., that higher maternal age might be a protective factor for language development. Sutcliffe et al. (2012) in their large-sample UK-based study found that for both 3- and 5-year-olds, expressive vocabulary scores increased with an increase in maternal age. Three-year-olds of mothers aged 20 years had vocabulary scores of 0.22 standard deviations below those of mothers aged 40, whereas the scores of 5-year-olds with mothers aged 20 were 0.21 standard deviations below those with mothers aged 40.

The discussed socioe-conomic, health-related and household-related factors are not the only factors that could place a child at risk for delayed language development. In the next section, we indicate which factors are considered in this chapter. Of note is that these factors are treated as interdependent instead of unrelated.

Research questions

This study investigated how, if at all, known risk factors for language development impact the vocabulary development of young Afrikaans-speaking children from mid- and low-SES backgrounds. There were two research questions (RQ):

RQ1: What is the effect of SES on the total vocabulary size of infants and toddlers?

Based on most previous research findings, we hypothesise that infants and toddlers from mid-SES backgrounds will have a larger total vocabulary.

RQ2: What is the relationship between health- and household-related factors and vocabulary development of infants and toddlers from mid- and low-SES backgrounds?

We hypothesise that where a known risk factor for language development is present, (1) the children from mid-SES backgrounds (associated with more financial and education-related resources than low-SES backgrounds)

will have vocabulary sizes comparable to those of their peers for which said risk factor is not present, whereas (2) the vocabulary size of children from low-SES backgrounds will be smaller than their peers for which the risk factor is not present.

Methods

Research design

The study followed a quantitative, descriptive, cross-sectional research design. Questionnaire data on several household-related and health-related factors (referred to as the background questionnaire) were collected from caregivers of young Afrikaans-speaking children (8–32 months; *n* = 241). A parent-report language development instrument, namely the preliminary Afrikaans adaptation (see Brookes et al. 2025) of the MacArthur-Bates Communicative Development Inventory (CDI; see Fenson et al. 1993), was also completed as a measure of vocabulary size (see further below). Participation was per informed consent, and all data were collected anonymously, treated confidentially and stored securely.

Participants

Afrikaans speakers were targeted because of the lack of knowledge on child language development in what is the third-largest mother tongue of the population of South Africa (at 10.6%; Statistics South Africa 2023b). Non-mainstream dialect speakers were purposefully recruited to increase the generalisability of the results. Through their personal and professional networks, the authors recruited caregivers of 8–32-month-olds to participate. Participants were from five of South Africa's nine provinces, namely Northern Cape and Western Cape provinces, the Free State province, North West province and Gauteng province. All data were anonymous and confidential, and caregivers of participants were told that they could withdraw from the study at any point. All caregivers of participants gave informed consent.

Table 10.1 contains an overview of the characteristics of the children about whom data were collected in this study. A *t*-test showed that there were no significant differences between the low- and mid-SES infant groups for age ($t(118) = 0.08$, $p = 0.914$) or sex ($t(118) = 1.37$, $p = 0.718$). No significant difference was found between toddler SES groups for age ($t(119) = -2.53$, $p = 0.273$), but there was a significant difference for sex ($t(119) = 1.86$, $p = 0.009$), with there being more boys in the low-SES group than the mid-SES group.

TABLE 10.1: Demographics of the children on whose vocabulary size the participants reported.

Variable		Infants		Toddlers	
		Low-SES	Mid-SES	Low-SES	Mid-SES
n		75	45	75	46
Age	Mean	13.63	13.88	25.77	23.73
	Range	8.10–18.97	8.00–19.11	16.9–32.57	16.31–32.57
	SD	3.18	3.38	4.46	4.91
Sex	Female	31	25	36	30
	Male	43	20	39	16

Source: Authors' own work.
Key: SES, socio-economic status; SD, standard deviation.

Data collection instruments

Caregivers' responses on the background questionnaire yielded information on household composition, income and food expenditure, parental education level, as well as the development and health of the child. Caregivers of the 8–18-month-olds completed the infant version of the CDI, on which they indicated which early gestures the infants could make and which words they know. The caregivers of the children aged 16–32 months completed the toddler version of the CDI, on which caregivers indicated which words and early grammar constructions their child produces. The age overlap between the two versions of the CDI was deliberate to allow caregivers of 16–18-month-olds with small vocabulary sizes who were not yet producing utterances of two or more words to complete the somewhat shorter infant version instead of the toddler version.

Socio-economic status and vocabulary calculations

The infant and toddler datasets were divided into two groups based on their SES, mid-SES and low-SES. These groups were based on participants' combined household income, which was self-reported on the background questionnaire. Where the combined household income was less than R20,000 a month, the household was considered low-SES, and above R20,000, mid-SES. Where the question on household income was not answered, we considered the maternal level of education to be indicative of mid-SES where the mother studied beyond high school.

The infant and toddler forms of the CDI ask about vocabulary in different ways. The infant form has two separate columns where the caregiver can indicate whether the infant *understands* the word or *understands and says* the word. Responses to *understands* were summed and referred to as receptive vocabulary, while responses to *understands and says* were

summed and referred to as expressive vocabulary. The sum of the infant's receptive and expressive vocabulary is their total vocabulary. The toddler form only has the option for *understands and says*; therefore, all responses were summed and referred to as total vocabulary. Because the number of items included in the infant and toddler forms differs, the vocabulary sizes of infants and toddlers were not directly comparable to one another.

Data analysis

All analyses were conducted in R version 2023.03 (R Core Team 2023). A Mann-Whitney *U* test was run to determine whether there was a statistically significant difference (where $p < 0.05$) between SES groups for both the infant and the toddler vocabulary data. Thereafter, the following health-related factors were included in a correlation analysis with vocabulary scores: (1) child gestational age, (2) birth weight, (3) recurrent ear infection, (4) presence of developmental disability, (5) presence of vision impairment, (6) caregiver concern about the child's language and communication development and (7) family history of language disorder. Household-related factors were also considered: (8) maternal age, (9) whether the child was the firstborn of their mother and (10) number of child's older siblings. Pearson correlations between these variables and total vocabulary were computed separately for each SES group for both the infant and toddler data.

Results

Table 10.2 indicates the number of low-SES and mid-SES infant and toddler participants per variable, as well as the mean score per participant group, the range and the standard deviation. Figure 10.1 shows the percentage of data points per variable and illustrates that there were three infants with a family history of language disorder in the mid-SES group, whereas there were none in the low-SES group. Furthermore, only one infant in the low-SES group had experienced recurrent ear infections, in contrast to the mid-SES group which had no such cases.

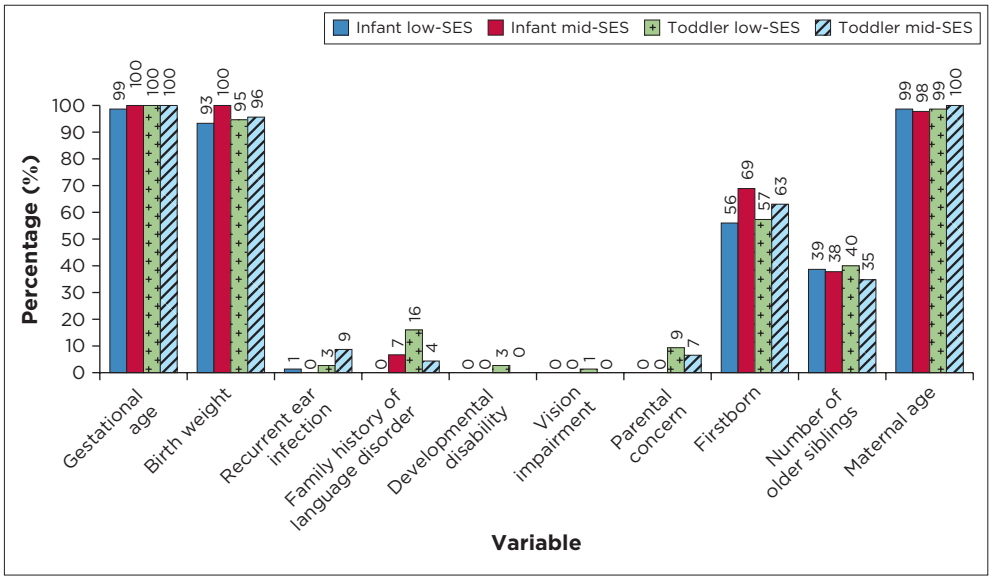
The results of the Mann-Whitney *U* test showed that there was no significant difference for vocabulary size between mid- and low-SES groups for infant ($U = 1{,}641$, $p = 0.801$) or for toddler ($U = 1{,}620$, $p = 0.575$). This indicates that total vocabulary size was comparable, regardless of SES.
For the infants, no correlations were found between total vocabulary and any of the health or household factors, neither for the low- nor the mid-SES group. Table 10.3 provides the infant correlation results.

TABLE 10.2: Descriptive statistics for infant and toddler by socio-economic status group.

Variable	Infant low-SES				Infant mid-SES			
	n	**Range**	**Mean**	**SD**	***n***	**Range**	**Mean**	**SD**
Gestational age[*]	74	1–3	2.19	0.90	45	1–3	1.98	0.89
Birth weight[‡]	70	1–2	1.76	0.43	45	1–2	1.89	0.32
Recurrent ear infection	1	n/a	n/a	n/a	0	-	-	-
Family history of language disorder	0	-	-	-	3	n/a	n/a	n/a
Developmental disability	0	-	-	-	0	-	-	-
Vision impairment	0	-	-	-	0	-	-	-
Caregiver concern	0	-	-	-	0	-	-	-
Firstborn	42	n/a	n/a	n/a	31	n/a	n/a	n/a
Number of older siblings	29	0–5	1.15	1.19	17	0–4	0.96	0.94
Maternal age[§]	74	0–6	2.47	1.25	44	3–6	4.05	0.83
Receptive vocabulary	75	0–718	168.85	178.83	45	0–431	144.98	123.26
Expressive vocabulary	75	0–176	16.23	31.77	45	0–307	19.87	46.57
Total vocabulary	75	0–768	185.08	181.77	45	0–567	164.84	144.54
Variable	**Toddler low-SES**				**Toddler mid-SES**			
	n	**Range**	**Mean**	**SD**	***n***	**Range**	**Mean**	**SD**
Gestational age[*]	75	2–3	2.83	0.38	46	1–3	2.76	0.48
Birth weight[‡]	71	1–2	1.83	0.38	44	1–2	1.89	0.32
Recurrent ear infection	2	n/a	n/a	n/a	4	n/a	n/a	n/a
Family history of language disorder	12	n/a	n/a	n/a	2	n/a	n/a	n/a
Developmental disability	2	n/a	n/a	n/a	0	-	-	-
Vision impairment	1	n/a	n/a	n/a	0	-	-	-
Caregiver concern	7	n/a	n/a	n/a	3	n/a	n/a	n/a
Firstborn	43	n/a	n/a	n/a	29	n/a	n/a	n/a
Number of older siblings	30	0–4	0.76	1.08	16	0–3	0.43	0.69
Maternal age[§]	74	1–6	2.68	1.42	46	1–6	3.89	0.95
Total vocabulary	75	30–544	252.28	163.47	46	0–604	242.17	186.27

Source: Authors' own work.
Note. '-' indicates missing data; 'n/a' indicates it cannot be computed.
[*] Gestational age: 1 = less than 8 months (less than 33 weeks); 2 = 8 months instead of 9 months (34–37 weeks); 3 = full 9 months (38+ weeks).
[‡] Birth weight: 1 = less than 2.5 kg; 2 = 2.5 kg or more.
[§] Maternal age: 1 = 20 years old or younger; 2 = 21–25 years old; 3 = 26–30 years old; 4 = 31–35 years old; 5 = 36–39 years old; 6 = 40+ years old.
Key: *n*, number of; SES, socio-economic status; SD, standard deviation.

Table 10.4 shows the toddler results, where cells containing significant correlations are highlighted. The low-SES toddler group showed significant negative correlations for total vocabulary with a family history of language disorder (r = −0.349, p = 0.002) and caregiver concern about the child's language and communication development (r = −0.322, p = 0.005). Regarding the mid-SES toddler group, only caregiver concern about the child's language and communication development correlated negatively with total vocabulary (r = −0.326, p = 0.027).



Source: Authors' own work.
Key: SES, socio-economic status.

FIGURE 10.1: Percentage of data points per health- and household-related variable for infant and toddler per socio-economic status group.

TABLE 10.3: Correlations between health- and household-related factors and vocabulary measures: Infants.

Infant low-SES correlations				Infant mid-SES correlations			
	Total voc	**Receptive voc**	**Expressive voc**		**Total voc**	**Receptive voc**	**Expressive voc**
Gestational age	0.095	0.095	0.006	Gestational age	−0.040	0.022	−0.183
Birth weight	−0.094	−0.127	0.175	Birth weight	−0.232	−0.281	0.024
Recurrent ear infection	−0.268	−0.266	−0.015	Recurrent ear infection	-	-	-
Family history of language disorder	-	-	-	Family history of language disorder	0.032	0.059	−0.057
Developmental disability	-	-	-	Developmental disability	-	-	-
Vision impairment	-	-	-	Vision impairment	-	-	-
Caregiver concern	-	-	-	Caregiver concern	−0.126	−0.134	−0.039
Firstborn	−0.146	−0.135	−0.075	Firstborn	0.068	−0.008	0.233
Number of older siblings	−0.207	−0.197	−0.110	Number of older siblings	−0.14	−0.178	−0.001
Maternal age	−0.075	−0.075	−0.010	Maternal age	−0.111	−0.127	−0.012

Source: Authors' own work.
Note. '-' indicates missing data.
Key: voc, vocabulary; SES, socio-economic status.

TABLE 10.4: Correlations between health- and household-related factors and vocabulary measures: Toddlers.

Toddler low-SES correlations		Toddler mid-SES correlations	
	Total vocabulary		**Total vocabulary**
Gestational age	0.012	Gestational age	0.180
Birth weight	−0.017	Birth weight	0.081
Recurrent ear infection	0.179	Recurrent ear infection	0.147
Family history of language disorder	**−0.349****	Family history of language disorder	−0.199
Developmental disability	−0.173	Developmental disability	-
Vision impairment	0.200	Vision impairment	-
Caregiver concern	**−0.322****	Caregiver concern	**−0.326***
Firstborn	−0.045	Firstborn	0.101
Number of older siblings	0.002	Number of older siblings	−0.174
Maternal age	0.045	Maternal age	**−0.345***

Source: Authors' own work.
Note. *Correlation significant at the 0.05 level.
**Correlation significant at the 0.01 level.
'-' indicates missing data.
Key: voc, vocabulary; SES, socio-economic status.

Discussion

This study investigated whether commonly researched risk factors for language development, in terms of young children's health and household, patterned differently between children from different SES backgrounds. Specifically, we had two research questions: *What is the effect of SES on the total vocabulary size of infants and toddlers?* and *What is the relationship between health- and household-related factors and vocabulary development of infants and toddlers from mid- and low-SES backgrounds?*

Regarding our first research question, we found no significant difference between SES groups on vocabulary size, for neither infants nor toddlers. This is contrary to the findings of previous studies, namely that children from low-SES backgrounds have smaller vocabularies than their mid-SES peers (e.g. Fernald et al. 2013). Recently, however, some studies have begun to contest this long-established claim (Sperry et al. 2019) by unveiling the minority-world biases that are present in this research. For instance, Dailey and Bergelson (2021) conducted a meta-analysis of SES differences on language input and found that some methodologies are biased; large SES differences were found in those studies that considered only child-directed speech, but studies that measured all speech that a child is exposed to in their environment found no effect of SES. This finding would suggest that researchers are likely to underestimate – simply on the basis of imposing minority-world norms on diverse households – the amount of input a child is exposed to when they (1) operationalise child language input as only the language directed to the child and (2) exclude households with

compositions that are typical in majority-world contexts, for example, those in which several adults and other family members co-reside.

To address our second research question, we considered 11 health- and household-related factors and their relationship with vocabulary in low- and mid-SES groups of both infants and toddlers. However, for some factors, correlations could not be computed because of the absence of data. There were only five of the 11 factors for which the relationship with vocabulary could be calculated for all four groups of participants: gestational age, birth weight, being firstborn, number of older siblings and maternal age. Whereas there were data for all variables in the low-SES toddler group, the mid-SES toddler group had no instances of developmental disability or vision impairment. This lack of data is understandable as infants and toddlers who were typically developing, according to their caregivers, were specifically targeted for inclusion in this study. In the infant data, no participants presented with a developmental disability or vision impairment, and no caregivers were concerned about their infant's language and communication development. The lack of caregiver concern was not unexpected, given that language delays typically come to the attention of caregivers when children are noticed to be lagging behind in comparison to their peers, which often arises when they begin preschool (e.g. Glascoe 1991). Consider that a child's first words typically emerge around 12 months, and a delay in the emergence of these first words may be the first overt indication of a language delay; however, children are only considered to be 'late talkers' if their expressive and receptive vocabulary is limited at 18 months (Rescorla 2011; see also Hawa & Spanoudis 2014). For a review of studies pertaining to the age range in which a language disorder can be identified in children by using psychometric tests, see Sansavini et al. (2021).

In the mid-SES infant group, there were three infants with a reported family history of language disorder, whereas there were none in the low-SES group. Moreover, there was only one infant in the low-SES group who had a recurrent ear infection, but none in the mid-SES group; while two toddlers in the low-SES and four in the mid-SES group had had recurrent ear infections, no correlation with vocabulary size was found in these groups. A potential limitation here is that we relied on caregivers' understanding of what constitutes a recurrent ear infection, which could not be confirmed by a medical diagnosis, given that caregivers were reporting on past infections. Parent-report data might be less reliable for this factor than objective data, considering that otitis media without effusion may not be accompanied by signs or symptoms of inflammation (i.e. caregivers might be unaware that their child has an ear infection, leading to ear infections being underreported).

Caregiver concern about the toddler's language and communication occurred only seven times in the low-SES group and three times in the mid-SES group. The negative correlation with total vocabulary was significant in both these groups and showed, in line with previous research (e.g. Chung et al. 2011), that language measures often reflect the intuition of caregivers who have concerns about their child's language development. It is worth noting that, based on our results, this intuition is not affected by SES.

A low number of toddlers had a family history of language disorder, specifically 12 low-SES and two mid-SES, but the correlation was in the expected negative direction and was significant in the low-SES group. For the mid-SES toddler group, no correlation was found. There were also no correlations between being firstborn or the number of older siblings, on the one hand, and vocabulary size, on the other. The latter findings were partly expected, given that mixed findings have been reported on the effect of these two factors on child language development (e.g. Havron et al. 2019; Oshima-Takane et al. 1996). For the mid-SES toddlers only, there was a negative correlation between maternal age and vocabulary size. That higher maternal age is associated with a smaller vocabulary size is contrary to the findings of Sutcliffe et al. (2012), and the reason for this negative correlation in only the mid-SES toddlers warrants further investigation.

Strengths and limitations

As stated further above, our hypothesis was that protective factors, in the form of financial and education-related resources (associated with mid-SES groups), may provide a buffer against health-related and household-related risk factors for language development. Limited data points in several of the categories impeded our ability to draw firm conclusions. However, looking at the incidence of the known risk factors occurring in each of the four participant groups, we see that low-SES toddlers are represented more than the other groups. In other words, there were more low-SES toddlers with a family history of language disorder, developmental disability, vision impairment and caregiver concern than any other group. This group also had more participants with older siblings. Although our sample is small, we can speculate that despite risk factors being more prevalent in the low-SES group, the protective factors that we assume come with the increased resources of mid-SES are not at play here. Considering that vocabulary size is the same for low- and mid-SES groups, there are mechanisms that mitigate the effect of these risk factors in children from low-SES backgrounds, resulting in vocabulary development

on par with mid-SES peers. This necessitates further research that considers low-SES not as a deficit but as an alternative to the minority-world norms, and that investigates language development with suitable methodologies and considerations.

Conclusion

The overarching question that this study aimed to answer was how previously reported risk factors for language development impact the vocabulary size of young Afrikaans-speaking children from mid- and low-SES backgrounds. Better knowledge of health conditions, adequate financial resources for (early) intervention and access to high-quality child care are more commonly linked to mid-SES than to low-SES (Flood et al. 2022 for quality of childcare; Gordon, Booysen & Mbonigaba 2020 for access to health care in South Africa; Svendsen et al. 2020 for health literacy) – could these mitigate the reported negative effect that certain health- and household-related factors have on child language development? Are children from mid-SES backgrounds more protected from the reported risk for delayed language development brought about by these factors?

Our data showed that the vocabulary development of young children from mid-SES backgrounds did not differ from that of their low-SES peers. There were no significant vocabulary size differences, for neither infants nor toddlers, between SES groups, contrary to the findings of many of the studies on SES and language development conducted in minority-world contexts. In this regard, the results of this study concur with those of a small but growing number of others that have found no significant SES-related differences in children's language skills. Only in terms of having a family history of language impairment did the mid-SES toddlers appear more 'protected' than their peers from low-SES backgrounds, given that such a history for the mid-SES toddlers did not show the expected correlation with smaller vocabulary size.

Little is still known about child language development in South African languages. Larger-scale studies in non-mainstream research contexts are needed for gaining a better understanding of how these factors affect the language development of very young children. Hoff (2009, p. 1) states that language acquisition is 'one of the more remarkable achievements of early childhood'. Considering the range of factors that are purported to negatively affect language development, and the high prevalence of some of these factors in South African contexts, gaining a deeper insight into how they interact with early language development will assist in identifying those children who need additional support to reach this remarkable achievement.

Declarations

Ethical considerations

Ethical clearance for the study was obtained from the Research Ethics Committee: Social, Behavioural and Education Research of Stellenbosch University (#19139).

Consent

Caregivers of all participants gave their written informed consent.

Author contributions

Michelle White: Conceptualisation, Data collection, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Visualisation, Writing – original draft preparation, Writing – review and editing.

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All authors reviewed the chapter, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

Competing interests

The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this chapter.

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Data availability

Data on the toddlers, analysis code and research materials will be made available at https://repo.sadilar.org/handle/20.500.12185/7. This study's design and its analysis were not preregistered.

Disclaimer

Any opinions, views, findings, conclusions or recommendations expressed in this material are those of the authors and not an official position of the institution, funders or publisher.

Chapter 11

Single-leg standing balance in foetal alcohol spectrum disorders: An observational study

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Abstract

Background: Controversial evidence exists on the balance patterns of children with foetal alcohol spectrum disorders (FASD).

Aim: This study aimed to (1) present a comprehensive description of single-leg standing (SLS) task performance and balance quality of South African children with FASD, (2) explore differences in balance outcomes compared to a typically developed (TD) group of children and (3) describe the relationship between balance quality outcomes.

Methods: Schoolchildren aged 9–10 years and previously screened for alcohol-related neurological deficits (ARND), partial foetal acohol syndrome (PFAS), foetal alcohol syndrome (FAS) or no prenatal alcohol exposure were recruited. Participants performed SLS with eyes open and closed on both legs. Task duration was measured up to 20 seconds (task performance). Balance quality outcomes were extracted from centre of pressure measurements. Outcomes were described using medians and ranges. Group differences were tested using linear regression analysis, and Spearman correlations described associations.

Findings: Ninety-seven (N = 97) children participated (TD = 33; FAS = 20; ARND = 24; PFAS = 19), of which 40 were boys and 57 were girls. With eyes open, no significant differences were observed; however, children with more severe FASD diagnoses displayed a significant decrease in task performance when vision was perturbed. Significant differences between the TD and FASD subgroups were observed for balance quality outcomes when the task was performed on the dominant leg for either eyes open or closed.

Conclusion: In this participant sample, balance impairment may manifest in severe FASD cases, during more demanding balance tasks such as SLS with eyes closed.

Background

Foetal alcohol spectrum disorders (FASDs), caused by prenatal alcohol exposure (PAE), are often associated with cognitive and physical development deficits in children, including motor control deficits such as poor balance and postural stability (Mattson, Bernes & Doyle 2019; May et al. 2021). These deficits can hinder daily activities and cause misinterpretation of behaviour and emotional distress in environments requiring sustained postural stability, such as classrooms (Hen-Herbst et al. 2020; Mattson et al. 2019; Peadon & Elliott 2010). South Africa has the world's highest FASD prevalence (16%–31%) (May et al. 2021). Research on FASD balance deficits is limited,

especially in South African children, who may have different opportunities for motor learning during childhood development compared to FASD children from high-income countries (Adnams et al. 2001; Brink et al. 2018). Moreover, no data are available that distinguish between balance impairments across the FASD continuum, such as alcohol-related neurodevelopmental disorder (ARND), partial foetal alcohol syndrome (PFAS) and foetal alcohol syndrome (FAS). A deeper understanding of these impairments is for targeted and tailored interventions.

The psychometric properties of traditional balance assessment methods, such as the *Movement Assessment Battery for Children* (second edition) (MABC-2), have low cross-cultural validity in low- and middle-income countries such as South Africa, where age-normative mean values are not applicable to South African children (Smits-Engelsman et al. 2022). This necessitates novel assessment methods for static balance. The MABC-2 includes single-leg standing (SLS) as a standardised task to assess static balance (Henderson, Sugden & Barnett 2007). Single-leg standing duration can be supplemented with stabilometry, a quantitative method that assesses postural control through force-instrumented platforms, offering detailed insights into motor control patterns during postural sway (Postolache & Postolache 2017). Stabilometry during SLS has been used in various child populations to describe postural stability, for example, autism (Lidstone et al. 2020), intellectual disabilities (Giagazoglou et al. 2013), hearing impairment (De Kegel et al. 2011) and typically developed (TD) children (Condon & Cremin 2012). However, the application of stabilometric techniques in FASD is limited, with small sample-sized studies (Brink et al. 2018; Kooistra et al. 2009; Lidstone et al. 2020; Roebuck et al. 1998).

Postural stability relies on the integration of somatosensory, vestibular and visual subsystems to achieve proper balance while performing tasks (McCoy et al. 2015). Not assessing SLS with eyes closed in children with PAE masks balance differences between FASD and TD children because of tasks not challenging the sensory subsystems (Humphriss, Hall & Macleod 2010). Sensory perturbations, to examine perceptual-motor adaptations in children with FASD, found either no difference to TD children (Kooistra et al. 2009) or poor sensorimotor performance in children with FASD (Jirikowic et al. 2013; Roebuck et al. 1998). Furthermore, while leg dominance impacts clinical SLS testing because of asymmetric limb conditioning and coordination, FASD literature lacks information on this aspect (Paillard & Noé 2020). Collecting larger stabilometric datasets with expanded protocols (including sensory perturbation and limb dominance) is indicated.

Cost and transport to laboratories hinder stabilometry research and natural environments (field assessment) (Larsen et al. 2014). Portable pressure measurement platforms offer a feasible alternative for large-scale field testing, providing comprehensive data such as the centre of pressure (COP) and the base of support contours (Richmond et al. 2021). It is also possible to extract time-to-boundary outcomes to quantify the temporal proximity to falling during a balance task (Hertel, Olmsted-Kramer & Challis 2006).

The purpose of this study was to present a novel dataset on postural stability during SLS in South African children with FASD, analysing stabilometric measurements for FASD subgroups and leg dominance. It also introduced a modern stabilometric time-to-boundary analysis for FASD. This study aimed to (1) present a comprehensive description of SLS task performance and balance quality of South African children with FASD, (2) explore differences in balance outcomes compared to a group of children without FASD and (3) describe the relationship between balance quality outcomes. This research contributes to understanding FASD balance impairments, aiding future interventions and rehabilitation strategies.

Methods

Study design

An observational cross-sectional study with an analytical component was conducted over a four-year period.

Setting and population

The study was conducted in two geographical areas (areas 1 and 2) of the Cape Winelands district of the Western Cape province, South Africa, between 2016 and 2019. The rural town settings were selected because of the high prevalence of FASD in these areas and because school-attending learners from these two areas were previously screened for ARND, PFAS and FAS (May et al. 2021). The FASD diagnosis for this study was based on the diagnostic procedures of May et al. (2021), where they screened 6–7-year-old Grade 1 school learners in research area 1 during 2014 and in area 2 during 2016. The study population comprised learners living in rural areas, aged 9–10 years old and diagnosed with FASD, as well as learners from the same schools, similar in age and gender, with no PAE (TD group).

Participants

Boys and girls aged 9–10 years old, who participated in the prevalence study and gave assent to be contacted and agreed to the usage of their

data (obtained through the screening process of the prevalence study) and with confirmed diagnoses of ARND, PFAS, FAS or no PAE, were invited to participate in the study (May et al. 2021). Learners who attended the chosen primary schools and had both parental and/or guardian written informed consent and child assent were eligible to participate. However, learners diagnosed with neurological, musculoskeletal or movement disorders not related to PAE were excluded.

Sampling method

As the three-tier screening procedure for diagnosing FASD and confirming no PAE took approximately 18 months, the school learners from research areas 1 and 2 were enrolled in the study at the age of 9–10 years old. The names of all 9–10-year-old boys and girls who were eligible to participate were obtained from the prevalence study. The Western Cape Education Department gave permission to conduct the study during school hours. Twelve primary schools with the most eligible participants from the two geographical research areas were identified (five from area 1 and seven from area 2). Once the study was explained to the school principals, they granted permission for their learners to participate. All eligible school learners were invited to participate in the study. Written informed consent was obtained from the parent and/or guardian, and written assent was obtained from the participants. The research team was blind to the diagnosis of each participant at the time of data collection.

Data collection procedure

Single leg standing with eyes open and eyes closed were performed barefoot on both legs, creating four different conditions: Dominant eyes open (DEO), non-dominant eyes open (NEO), dominant eyes closed (DEC) and non-dominant eyes closed (NEC). For DEO and NEO trials, the participants were instructed as follows by the principal researcher (Yolandi Brink): (1) to balance on one leg on the mat for as long and as steadily as possible (maximum 20 seconds), (2) the non-weight-bearing leg must not make contact with the weight-bearing leg or the floor, (3) the trial should start begin with the non-weight-bearing hip in a neutral position and the knee bent at a 90° angle, (4) to direct their gaze at a picture mounted on the wall about 3 metres away at eye-level and (5) to place their hands on their hips for the duration of the trial. It was randomly allocated whether the dominant or non-dominant side would be tested first. Each participant was allowed a practice trial, followed by up to three (if the first trial did not reach 20 seconds) formal trial attempts.

A portable instrumented platform (FDM S; Zebris Medical GmbH, Munich) was used to measure foot pressure distribution during the SLS task. The pressure data were acquired in a commercial biomechanical software package (MyoResearch 3.16, Noraxon, Scottsdale, Arizona, USA) together with a 30Hz, 720p video stream using a webcam (C920, Logitech). The pressure and video data were accurately time synchronised using a hardware-generated pulse signal, measured simultaneously by the pressure platform via a cable and by the video via a light-emitting diode flash bulb. The acquisition software then aligned the timelines of the two devices automatically post hoc.

Outcomes

The study outcomes are described in terms of balance performance (Table 11.1) and balance quality (Hertel et al. 2006).

Three primary outcomes were chosen to describe what the authors considered to be the three fundamental features of balance quality: COP_{sway} and its components provide a proxy measure of how much postural sway (centre of mass displacement) there was over the interval – higher values are seen as indicative of weaker postural control (Kooistra et al. 2009); COP_{speed} and its components are used as a proxy measure for the speed or intensity of postural sway – higher values may indicate faster postural control responses to outward sway but could also imply greater outward sway intensity (Lidstone et al. 2020); and time-to-boundary $(TTB)_{mean}$ is a proxy measure of temporal proximity to a fall event (how much time remained

TABLE 11.1: Description of balance performance outcomes.

Outcome	Definition	Units
SLS_{time}	Duration of single-leg standing	s
COP_{sway}	COP sway area; area of the ellipse that covers 95% of the COP trace	mm^2
COP_{speed}	Average instantaneous sway speed	mm/s
$AP_{excursion}$	Anteroposterior components of sway displacement range	mm
$ML_{excursion}$	Mediolateral components of sway displacement range	mm
$AP_{variability}$	Standard deviation in anteroposterior component of sway displacement	mm
$ML_{variability}$	Standard deviation in mediolateral component of sway displacement	mm
AP_{speed}	Anteroposterior component of sway speed	mm/s
ML_{speed}	Mediolateral component of sway speed	mm/s
TTB_{mean}	Mean of the TTB minima calculated from the COP and the foot pressure data	S

Source: Authors' own work.
Key: SLS, single-leg standing; s, seconds; COP, centre of pressure; mm^2, square millimetre; mm/s, millimetre per second; AP, anteroposterior; mm, millimetre; ML, mediolateral; TTB, time-to-boundary.

before completely losing balance) on average, at the different points during the task where balance was recovered – higher values indicate that outward sway was corrected earlier, reducing the risk of falling (Hertel et al. 2006).

Data analysis

To isolate the SLS data required for analysis within the broader recorded data, SLS interval markers were manually inserted post hoc into the timeline of each SLS trial within the data acquisition software. The balance quality outcomes were first calculated for the entire SLS interval ($Interval_{full}$). The start event (beginning of $Interval_{full}$) was identified through visual inspection of the recorded video and the plantar pressure distribution to ascertain when the participant had first assumed the target posture described in the SLS task description. The end of $Interval_{full}$ was defined either as 20 seconds after the start marker if no task failure had occurred or at the video frame before a visible loss of balance occurred leading to task failure. Next, a single trial was selected for analysis per participant for each of the four SLS conditions. The data set was described and/or analysed separately for NEO, DEO, NEC and DEC. Where repeated task attempts were made by a participant, the trial with the longest SLS duration was chosen (Giagazoglou et al. 2013). If there was more than one successful trial adhering to all criteria, the first trial was selected for analysis. If there was no successful trial for a particular condition, none was selected. Outcomes were then calculated for the selected trials using a custom script (Matlab R2019b, The MathWorks Inc., Natick, Massachusetts, USA).

Analysis and interpretation of these outcomes are confounded by inter-participant variation in SLS_{time}, as the task duration is variable for trials where there was a task failure before 20 seconds was reached. To evaluate the balance quality for standardised time intervals of analysis, the balance quality outcomes were also calculated per participant using one of four fixed time intervals: 0–5 ($Interval_{0\text{-}5}$), 0–10 ($Interval_{0\text{-}10}$), 0–15 ($Interval_{0\text{-}15}$) and 0–20 ($Interval_{0\text{-}20}$) seconds. The longest valid interval for the participant's task performance was chosen, for example, the $Interval_{0\text{-}15}$ interval for an SLS_{time} of 16 seconds or $Interval_{0\text{-}5}$ for an SLS_{time} of 9 seconds. For completeness, participants who could not reach the minimum fixed time interval of 5 seconds were grouped into a fifth variable-time interval ($Interval_{less5}$), and balance quality outcomes were also calculated for this interval. This time-normalisation approach was used to investigate if balance quality outcomes differed for different levels of task performance: very poor ($Interval_{less5}$), poor ($Interval_{0\text{-}5}$), average ($Interval_{0\text{-}10}$), good ($Interval_{0\text{-}15}$) and excellent ($Interval_{0\text{-}20}$). The number of participants per time-normalised interval subgroup differed per task, whereas the analysis of $Interval_{0\text{-}end}$ included all participants.

Study sample size

A minimum sample size of 81 participants was required to achieve 90% power with a significance level of α = 0.05 (PASS 2021, v21.0.8; NCSS LLC., Kaysville, Utah, USA).

Statistical analysis

Descriptive statistics (median, ranges, quartiles) were reported for all outcomes for each analysis interval. Linear regression analysis was performed for $Interval_{full}$ outcomes to determine any significant differences between the TD, FASD and FASD subgroups adjusting for age, sex, height and weight. Statistical significance was set at 5%. Spearman Rank correlation coefficients were used to determine the associations between outcomes. Correlations of below 0.3, 0.3–0.59, 0.6–0.79 and 0.8 and above were seen as poor, fair, moderate and very strong, respectively, with significance at p = 0.004 (Akoglu 2018).

Results

Sample description

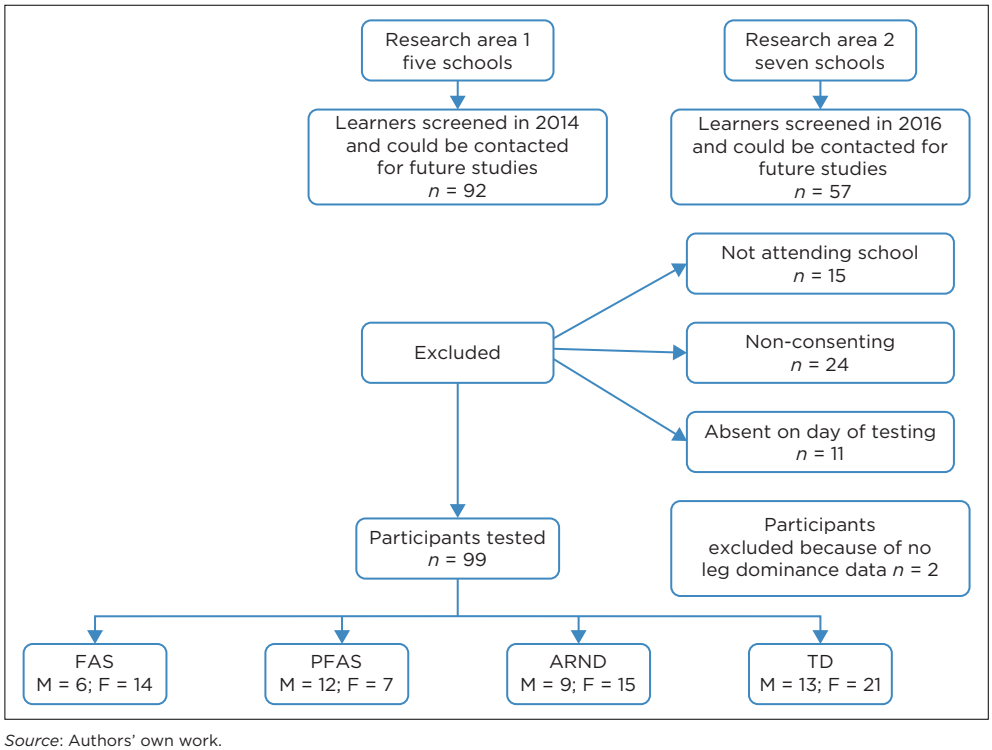
Twelve schools participated in the study and 149 learners were eligible for inclusion (Figure 11.1). Fifteen learners did not attend the selected schools anymore and were excluded. The remaining 134 learners were invited to participate and received written informed assent and consent letters.

Thirty-five (non-consenting or absent) learners were excluded, and 99 (66%) were tested, with a larger number with FASD (n = 63) than TD (n = 34). The FASD group consisted of three subgroups: FAS, PFAS and ARND. All groups were comparable in age and height, although there was a significant difference between the FASD and TD groups for weight (p = 0.0015). Table 11.2 presents the participant demographic data.

Task performance

Eyes open tasks

No significant differences were found in SLS_{time} between TD and any FASD groups for DEO and NEO (p-values: 0.074–0.763). For both tasks, the median SLS_{time} for all groups was 20 seconds, as most of the participants successfully completed the eyes open tasks on both legs ($Interval_{0\text{-}20}$ in Figure 11.2a and Figure 11.2b). All participants balanced for at least 5 seconds with open eyes on both legs, and only five failed to reach 10 seconds ($Interval_{0\text{-}5}$). Therefore, for DEO, 85.3% of TD and 74.6% of FASD participants



Source: Authors' own work.
Key: FAS, foetal alcohol syndrome; PFAS, partial foetal alcohol syndrome; ARND, alcohol-related neurodevelopmental disorder; TD, typically developed; M, male; F, female.

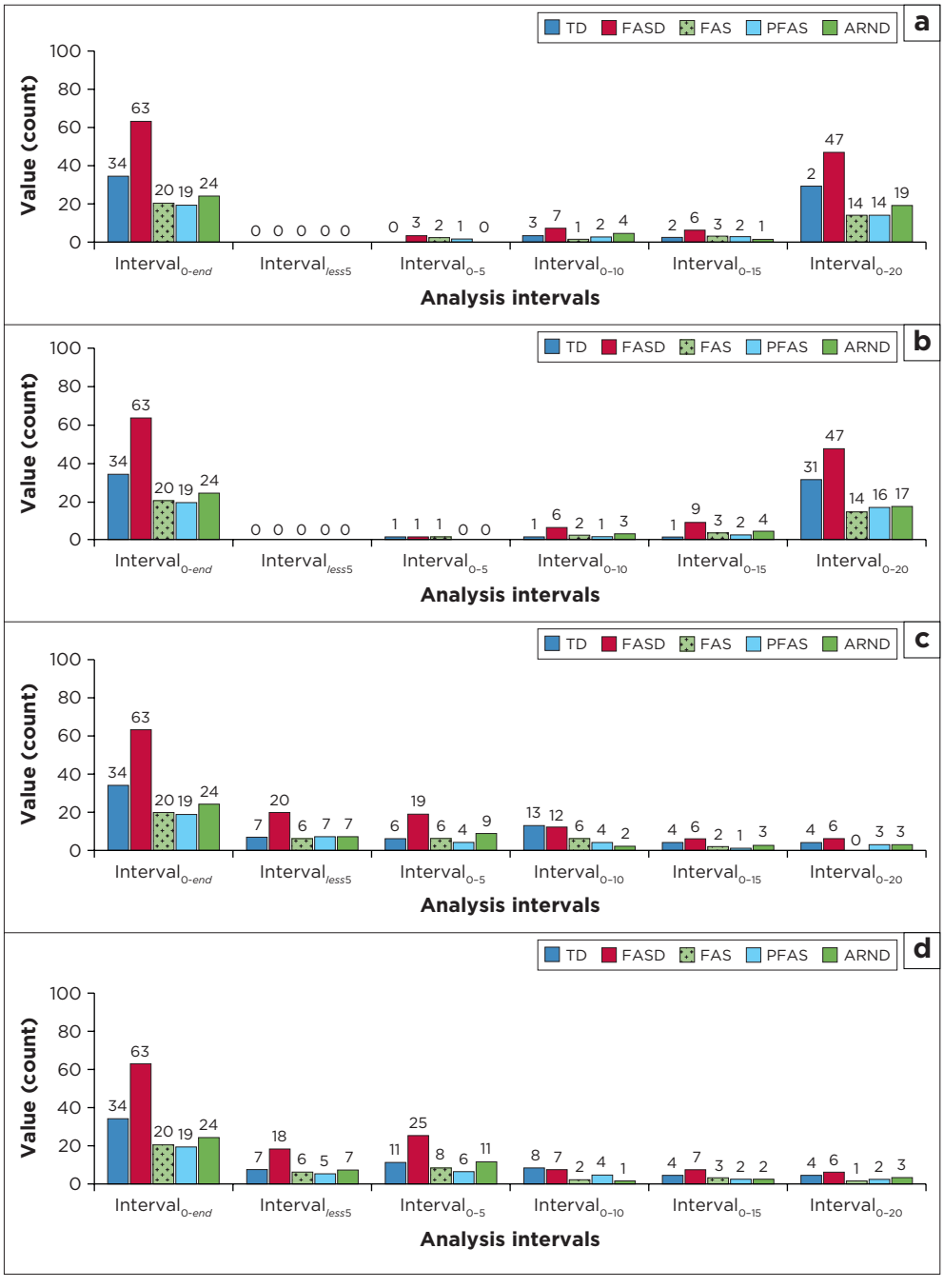
FIGURE 11.1: Overview of participant selection process and the diagnostic distribution of participants with and without foetal alcohol syndrome disorders.

TABLE 11.2: Description of participant demographics.

Variable	Age (years)		Weight (kg)		Height (cm)	
	FASD	TD	FASD	TD	FASD	TD
median	9.8	9.7	24.0	28.0	132.0	131.9
min	9.2	9.2	16.4	20.2	115.0	120.0
max	11.0	10.8	45.6	38.5	163.1	158.5
Q1	9.6	9.6	22.6	25.3	126.0	128.4
Q2	10.1	9.8	26.9	30.7	140.5	135.0

Source: Authors' own work.
Key: kg, kilogram; cm, centimetre; FASD, foetal alcohol spectrum disorders; TD, typically developed; min, minimum; max, maximum; Q1, first quartile; Q2, second quartile.

successfully completed the task. For NEO, the FASD success rate was identical to DEO (74.6%), whereas the TD success rate was slightly higher (91.2%). The failure rate of FASD participants was almost three times higher for DEO (25.4% vs 8.8%) and almost two times higher (24.7% vs 14.3%) for NEO compared to the TD group. When considering FASD subgroups, success rates for DEO declined with increasing severity of FASD diagnosis



Source: Authors' own work.
Key: TD, typically developed; FASD, foetal alcohol spectrum disorders; FAS, foetal alcohol syndrome; PFAS, partial foetal alcohol syndrome; ARND, alcohol-related neurodevelopmental disorder; DEO, dominant eyes open; NEO, non-dominant eyes open; DEC, dominant eyes closed; NEC, non-dominant eyes closed.

FIGURE 11.2: Number of participants binned into the analysis intervals for (a) DEO, (b) NEO, (c) DEC and (d) NEC tasks.

(ARND: 79.2%; PFAS: 73.7%; FAS: 70%). This trend was not observed for NEO, although FAS participants still produced the lowest success rate (ARND: 70.8%; PFAS: 84.2%; FAS: 70%).

Eyes closed tasks

Most participants did not successfully complete either of the eyes closed tasks (Figure 11.2c and Figure 11.2d). The distribution of SLS_{time} for both DEC and NEC was widely and relatively evenly spread. Median SLS_{time} for TD participants in the DEC task (11.69 seconds; interquartile range [IQR]: 7.07–14.45) was higher than for the FASD group (7.12 seconds; IQR: 4.03–11.97). The SLS_{time} value for TD participants in the NEC task was lower than on the dominant leg (9.34 seconds; IQR: 6.21–14.01), but still higher compared to the FASD group (7.40 seconds; IQR: 4.6–13.82). Subgroup analysis revealed that the FAS participants had significantly lower SLS_{time} than TD during both the DEC (8.29 seconds; IQR: 4.17–11.91; p = 0.045) and NEC (6.60 seconds; IQR: 4.82–11.71; p = 0.032) tasks. Task success rates were identical in DEC and NEC tasks for both TD and FASD groups; only 11.8% of TD and 9.5% of FASD participants reached 20 seconds SLS_{time}. However, when considering FASD subgroups, success rates for DEC were marginally higher for ARND (12.5%) and PFAS (15.8%) than for TD. In contrast, all FAS participants failed the DEC task and only one FAS participant reached 20 seconds in the NEC task. The NEC success rates declined with increasing severity of FASD diagnosis (ARND: 12.5%; PFAS: 10.5%; FAS: 5%).

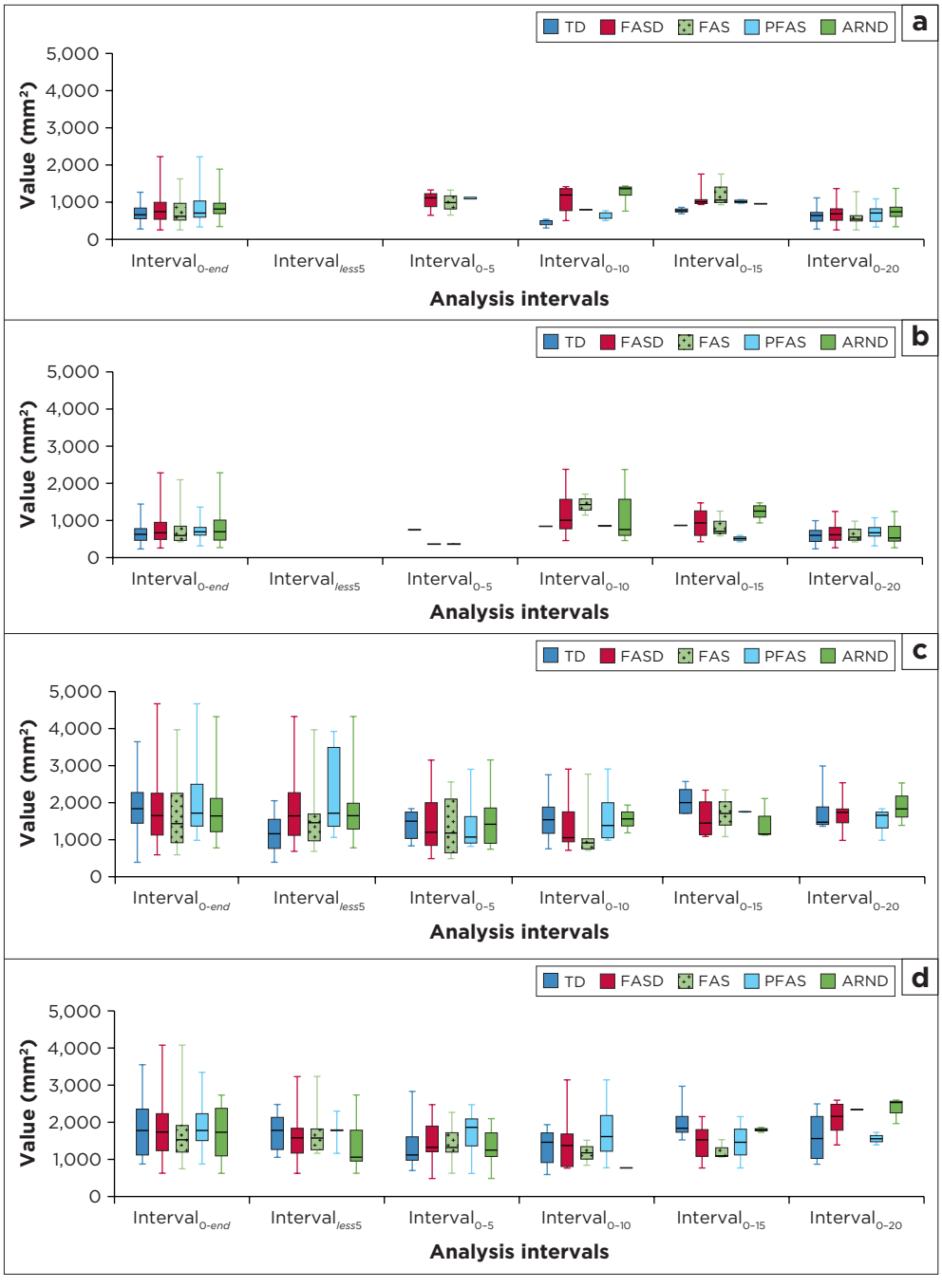
A notable proportion of participants could not reach 5 seconds SLS_{time} ($Interval_{less5}$) for DEC (TD: 20.6%; FASD: 31.7%; ARND: 29.2%; PFAS: 36.8%; FAS: 30.0%) and NEC (TD: 20.6%; FASD: 28.6%; ARND: 29.2%; PFAS: 26.3%; FAS: 30.0%). Slightly more than half the TD (52.9%) and two-thirds of FASD participants (68.3%) were unable to reach 10 seconds SLS_{time} ($Interval_{less5}$ or $Interval_{5}$) for NEC. These proportions were lower for DEC (TD: 38.2%; FASD: 61.9%).

Balance quality

Postural sway

Eyes open tasks

Lower and more consistent COP_{sway} was observed for the TD group (653.97 mm^2; IQR: 557.65–836.72) than the FASD group (748.98 mm^2; IQR: 547.87–990.20) for DEO in $Interval_{0\text{-}end}$ (Figure 11.3a), as well as for NEO with the TD group (623.70 mm^2; IQR: 463.49–771.28) compared to the FASD group (669.57 mm^2; IQR: 492.70–942.60) (Figure 11.3b). However,



Source: Authors' own work.
Key: COP, centre of pressure; TD, typically developed; FASD, foetal alcohol spectrum disorders; FAS, foetal alcohol syndrome; PFAS, partial foetal alcohol syndrome; ARND, alcohol-related neurodevelopmental disorder; DEO, dominant eyes open; NEO, non-dominant eyes open; DEC, dominant eyes closed; NEC, non-dominant eyes closed.

FIGURE 11.3: Postural sway [COP_{sway}] for the four tasks during the various analysis intervals for (a) DEO, (b) NEO, (c) DEC and (d) NEC tasks.

the FAS group demonstrated the lowest median COP_{sway} of all groups for this interval ($Interval_{0\text{-}end}$) in both tasks (DEO: 622.10 mm^2; IQR 519.32–965.70; NEO: 595.70 mm^2; IQR 472.37–841.89). This trend persisted when excluding task failures. Successful FAS participants (see $Interval_{0\text{-}20}$) had notably lower COP_{sway} for DEO and NEO in comparison to other groups and less variability for the NEO trials. The minimum COP_{sway} values for DEO were similarly low across groups; however, this was not observed for the NEO task, in which the FAS group did not produce any low minimum postural sway values. Despite the low participant numbers in $Interval_{0\text{-}5}$, $Interval_{0\text{-}10}$ and $Interval_{0\text{-}15}$ (Figure 11.2a and Figure 11.2b), COP_{sway} was generally different and highly non-uniform for the unsuccessful participants (especially for FASD). There was also a marked reduction in COP_{sway} variability between $Interval_{0\text{-}end}$ and $Interval_{0\text{-}20}$ for all groups.

For the NEO trials, there were no significant differences between the TD and the FASD groups, or between the TD group and any of the FASD subgroups for any postural sway outcomes (*p*-values ranging from 0.100 to 0.953). For DEO, there was a significant difference between the TD group and the FASD group for mediolateral $(ML)_{variability}$ ($p = 0.020$). The subgroup analysis showed significant differences between the TD group and the ARND and FAS subgroups, with $p = 0.019$ and $p = 0.003$, respectively. The subgroup analysis also indicated significant differences between the TD and the ARND groups ($p = 0.037$) for $ML_{excursion}$ and between the TD and the PFAS groups ($p = 0.042$) for COP_{sway}. The postural sway difference seen in DEO appears to be driven by the increased distance (excursion) and amount of variation of postural sway in the ML direction for the FASD participants compared to the TD group.

Eyes closed tasks

COP_{sway} were two to three times greater with eyes closed than with eyes open for all groups, and similarly higher IQRs and general variability (Figure 11.3c and Figure 11.3d) were seen. In contrast to the eyes open task, the TD group demonstrated the highest median COP_{sway} with eyes closed during $Interval_{0\text{-}end}$ (DEC: 1,829.59 mm^2; IQR 1,445.75–2,274.92; NEC: 1,779.70 mm^2; IQR 1,112.83–2,347.94) compared to the FASD group (DEC: 1,644.67 mm^2; IQR 1,123.03–2,248.55; NEC: 1,732.23 mm^2; IQR 1,229.57–2,225.63). However, as with the eyes open tasks, the FAS group again produced the lowest postural sway with eyes closed (DEC: 1,425.50 mm^2; IQR 917.12–2,242.69; NEC: 1,516.74 mm^2; IQR 1,195.05–1,905.07). The same trend did not emerge when excluding task failures, as the successful TD participants had notably lower postural sway compared to all other FASD groups for DEC and NEC. In contrast, the TD group showed consistently higher COP_{sway} on both legs when there was a late task failure ($Interval_{0\text{-}15}$),

being just short of task success. The FASD group and particularly the FAS subgroup showed decreased postural sway and less variability for the fixed time intervals $Interval_{less5}$, $Interval_{0\text{-}5}$ and $Interval_{0\text{-}10}$, after which they increased again towards $Interval_{0\text{-}20}$ for DEC. However, the TD group displayed a steady increase in postural sway from $Interval_{less5}$ to $Interval_{0\text{-}15}$, with less variability for DEC, but no pattern emerged for NEC.

For the NEC trials, there were no significant differences between the TD and the FASD groups, or between the TD group and any of the FASD subgroups for any postural sway outcomes (*p*-values ranging from 0.072 to 0.952). For DEC trials, there were significant differences between the TD and the FASD groups for $AP_{excursion}$ ($p = 0.025$). With further subgroup analysis, there were significant differences between the TD and the FAS subgroups for $AP_{excursion}$ ($p = 0.003$), $ML_{excursion}$ ($p = 0.040$) and $AP_{variability}$ ($p = 0.020$). The postural sway difference seen in DEC appears to be driven by the increased distance (excursion) and amount of variation of postural sway in the AP direction for the TD participants compared to the FASD group.

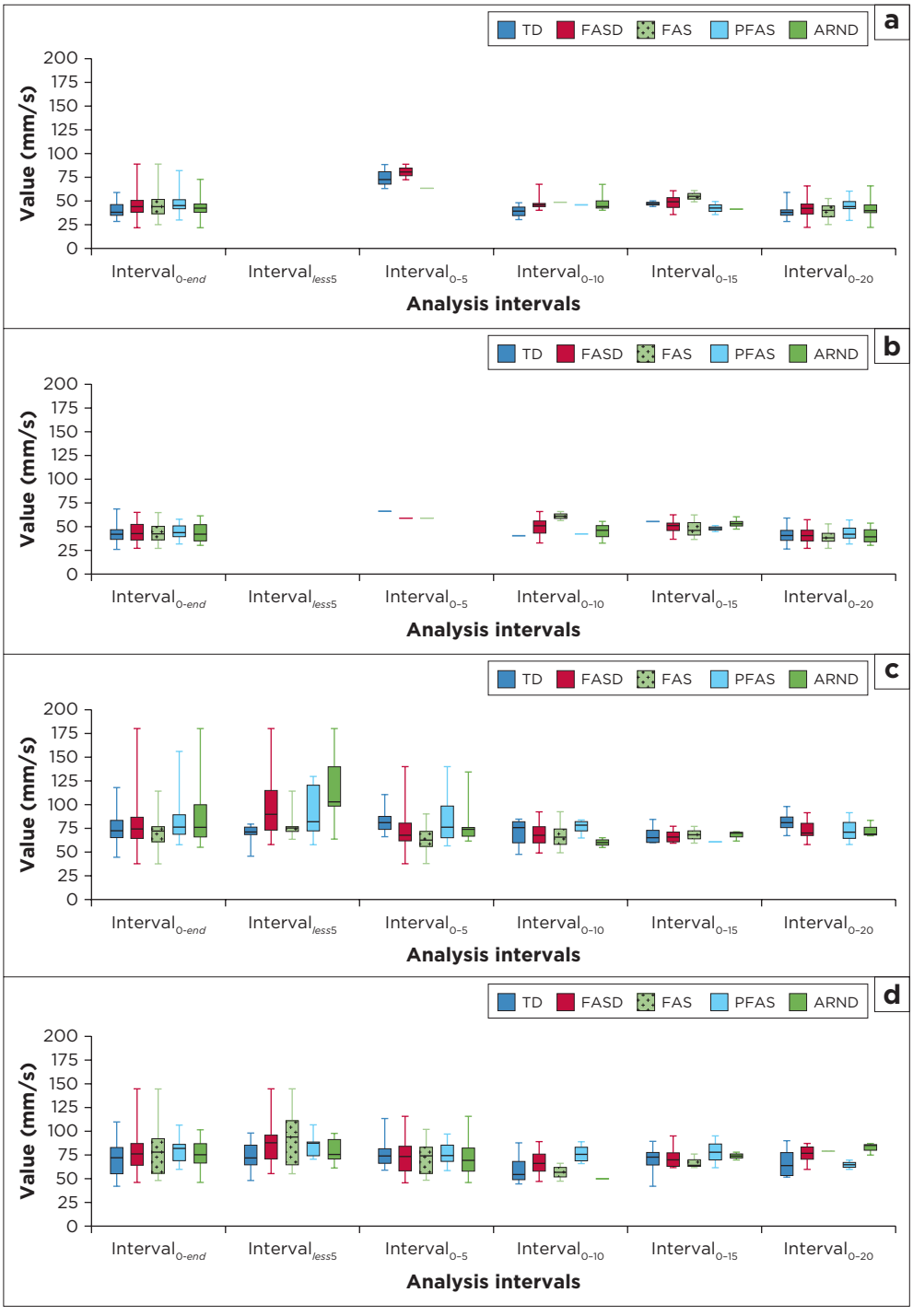
Postural sway intensity

Eyes open tasks

The COP_{speed} was uniform across the groups, irrespective of leg dominance (Figure 11.4a and Figure 11.4b) for $Interval_{0\text{-}end}$. The TD group demonstrated lower and more consistent COP_{speed} values for DEO (38.04 mm/s; IQR 34.75–46.01) in comparison to the FASD group (44.11 mm/s; IQR 37.96–50.52), but very similar COP_{speed} for NEO. In DEO, the TD group demonstrated lower postural sway speed compared to other groups when task failures were excluded (see $Interval_{0\text{-}20}$). For DEO, the FASD COP_{speed} was also higher for $Interval_{0\text{-}5}$ compared to $Interval_{0\text{-}10}$ and $Interval_{0\text{-}15}$. This suggests that only the early task failures contributed to the difference in COP_{speed} variability for the FASD group between $Interval_{0\text{-}end}$ and $Interval_{0\text{-}20}$ (FASD subgroups considerably less variable COP_{speed} when considering only successful trials). During the NEO trials, COP_{speed} values were very similar across groups and intervals, also demonstrating less variability in COP_{speed} for $Interval_{0\text{-}20}$ compared to $Interval_{0\text{-}end}$. For both DEO and NEO, there were no significant differences between the TD group and the FASD group for any COP_{speed} parameters (*p*-values ranging from 0.348 to 0.870) or between the TD group and any of the FASD subgroups (*p*-values ranging from 0.087 to 0.820).

Eyes closed tasks

The COP_{speed} was almost twice as high and twice as variable with eyes closed than with eyes open for all groups (Figure 11.4c and Figure 11.4d).



Source: Authors' own work.
Key: TD, typically developed; FASD, foetal alcohol spectrum disorders; FAS, foetal alcohol syndrome; PFAS, partial foetal alcohol syndrome; ARND, alcohol-related neurodevelopmental disorder; DEO, dominant eyes open; NEO, non-dominant eyes open; DEC, dominant eyes closed; NEC, non-dominant eyes closed.

FIGURE 11.4: Postural sway intensity [COP_{speed}] for the four tasks during the various analysis intervals for (a) DEO, (b) NEO, (c) DEC and (d) NEC tasks.

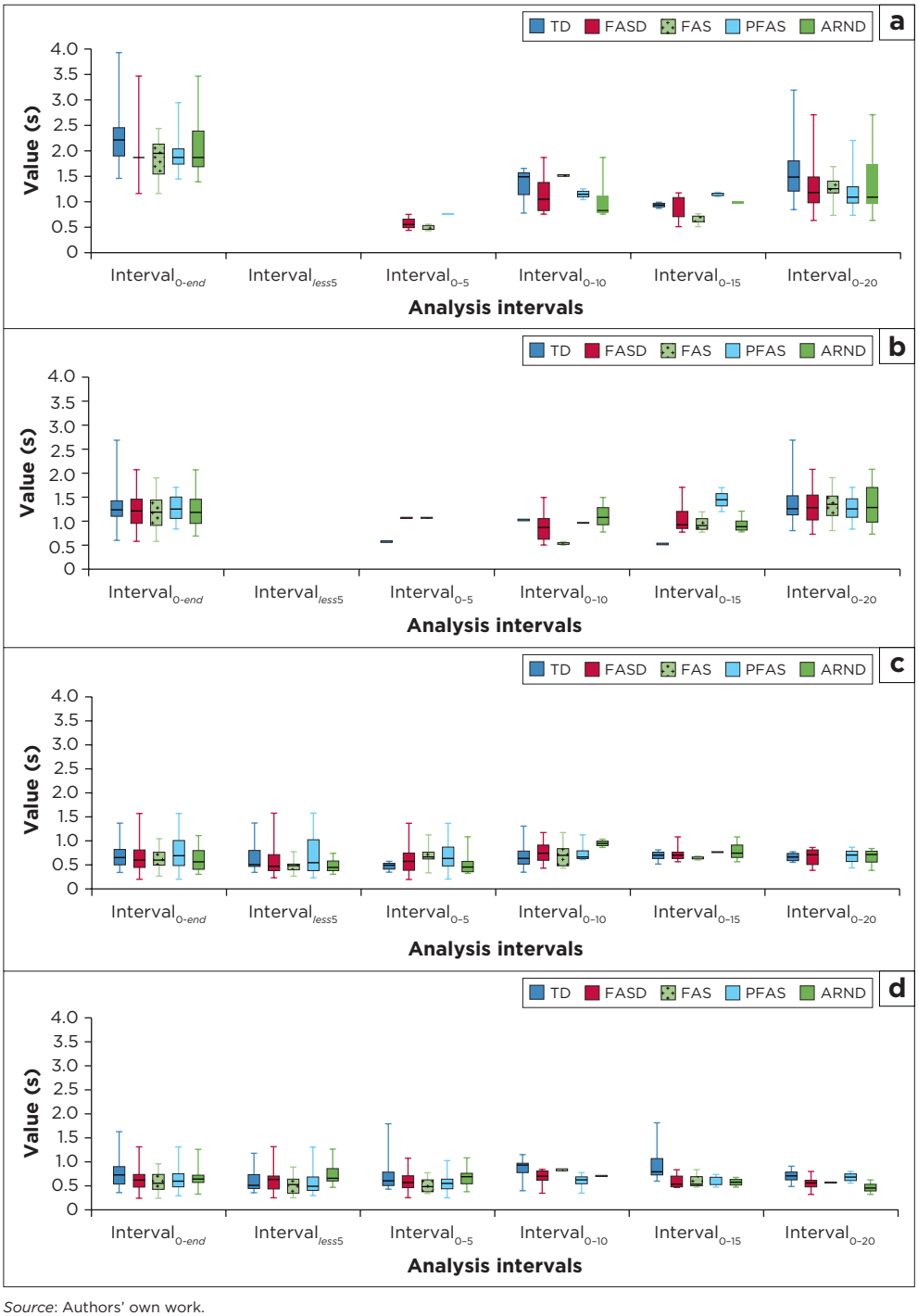
The COP_{speed} was significantly (p = 0.038) lower for TD (72.60 mm/s; IQR 65.10–83.58) compared to FASD (74.17 mm/s; IQR 64.19–86.41) during DEC $Interval_{0\text{-}end}$ (Figure 11.4c). However, there was no difference between TD and FASD during NEC (p-values ranging from 0.403 to 0.811). There were also no significant differences found between TD and the FASD subgroups for either DEC or NEC (p-values ranging from 0.120 to 0.883). Nevertheless, PFAS median COP_{speed} was noticeably higher (81.80 mm/s; IQR 68.75–86.04) compared to TD (71.99 mm/s; IQR 54.81–82.50) and other FASD subgroups during $Interval_{0\text{-}end}$ for NEC (Figure 11.4d).

Generally, COP_{speed} variability decreased with increasing fixed interval duration on both legs, although this may simply reflect dwindling participant numbers in longer intervals (Figure 11.4c and Figure 11.4d). For DEC, FASD showed more extreme high-value outliers in $Interval_{0\text{-}end}$ that largely originated from the ARND and PFAS subgroups. For the NEC trials, the $Interval_{0\text{-}end}$ trend was reversed, with FAS being much less consistent than ARND and PFAS, producing more high-end outliers. There was higher variability in COP_{speed} in the early failure interval ($Interval_{less5}$) for FASD than for TD for both legs. However, as with the trend for $Interval_{0\text{-}end}$, this was largely driven by ARND and PFAS on the dominant leg but by FAS on the non-dominant leg. The TD and FASD groups displayed a steady decrease in postural sway speed for the fixed time intervals $Interval_{less5}$ to $Interval_{0\text{-}15}$, after which it increased again in $Interval_{0\text{-}20}$ for DEC. No similar pattern emerged for the NEC trials.

Time-to-boundary

Eyes open tasks

Significantly (p = 0.033) higher $Interval_{0\text{-}end}$ TTB_{mean} was observed for TD (1.461 seconds; IQR 1.144, 1.694) than for FAS (1.119 seconds; IQR 0.789–1.370) during DEO (Figure 11.5a). There was very little difference in TTB_{mean} between the TD (1.227 seconds; IQR 1.098–1.413) and FASD (1.202 seconds; IQR 0.939–1.445) groups for $Interval_{0\text{-}end}$ during NEO (Figure 11.5b). These trends persisted when excluding task failures for both DEO and NEO ($Interval_{0\text{-}20}$), with the TD group maintaining higher TTB_{mean} values for DEO and negligible differences for NEC. Unlike with postural sway and sway intensity, TTB_{mean} variability did not decrease when excluding task failures. However, the FAS group had noticeably reduced TTB_{mean} variability for DEO compared to other groups, with much lower high-end outliers, but this was not observed for NEO. The TD group performed better on the dominant leg compared to the non-dominant, whereas the PFAS and ARND groups were better when performing SLS on the non-dominant leg, and the FAS group performed similarly on both legs.



Source: Authors' own work.
Key: TD, typically developed; FASD, foetal alcohol spectrum disorders; FAS, foetal alcohol syndrome; PFAS, partial foetal alcohol syndrome; ARND, alcohol-related neurodevelopmental disorder; DEO, dominant eyes open; NEO, non-dominant eyes open; DEC, dominant eyes closed; NEC, non-dominant eyes closed.

FIGURE 11.5: Time-to-boundary [TTB_{mean}] outcome for the four tasks during the various analysis intervals for (a) DEO, (b) NEO, (c) DEC and (d) NEC tasks.

For DEO and NEO, there were no significant differences between the TD group and the FASD group (*p*-values ranging from 0.154 to 0.703) or between the TD group and any of the FASD subgroups (*p*-values ranging from 0.104 to 0.578), except between the TD and FAS group for DEO, as mentioned previously.

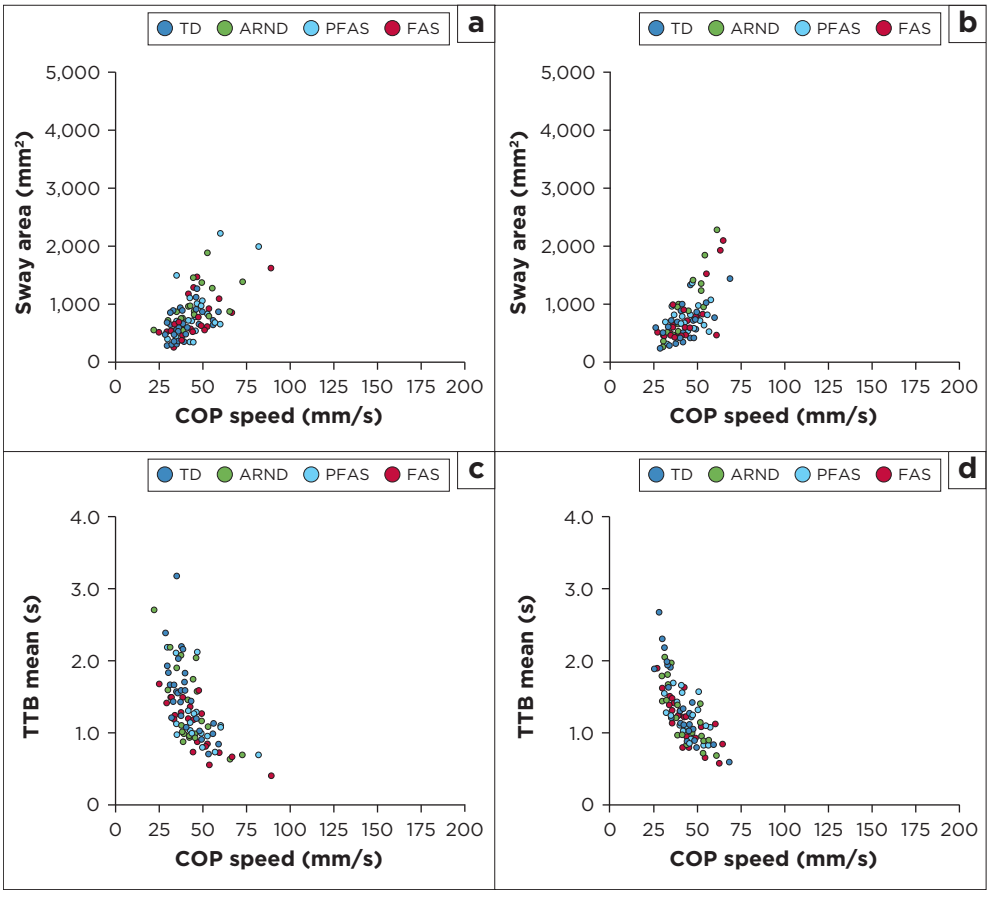
Eyes closed tasks

The TTB_{mean} was generally only half as high with eyes closed compared to eyes open for all groups, which would be expected for a more difficult balance task (Figure 11.5c and Figure 11.5d). Slightly higher TTB_{mean} values ($Interval_{0\text{-}end}$) were observed for the TD (0.646 seconds; IQR 0.492–0.812) than for FASD (0.595 seconds, IQR 0.447–0.801) groups during DEC (Figure 11.5c) and for NEC (TD: 0.723 seconds; IQR 0.530–0.894; FASD: 0.615 seconds; IQR 0.447–0.731) (Figure 11.5d). When excluding the task failures for DEC, the pattern changed, and the FASD subgroups performed better (except for FAS who had no participants who could successfully reach 20 seconds). Both TD and FASD subgroups steadily achieved higher TTB_{mean} values from $Interval_{less5}$ up to $Interval_{0\text{-}10}$, after which they plateaued towards $Interval_{0\text{-}20}$. For NEC, excluding task failures did not change what was observed for all participants, and the TD group still achieved higher TTB_{mean} median values compared to the FASD subgroups. A similar pattern to DEC emerged for all groups from $Interval_{less5}$ up to $Interval_{0\text{-}10}$, with increased TTB_{mean} median values; however, after the halfway mark (10 seconds), the TTB_{mean} median values decreased towards the end of the task. For eyes closed trails, there were no significant differences between the TD and the FASD groups or between the TD group and any of the FASD subgroups for time-to-boundary (*p*-values ranging from 0.252 to 0.984).

Relationship between balance quality outcomes

Eyes open tasks

Moderate significant positive correlations were found between COP_{speed} and COP_{sway} for the ARND (r_s = 0.705) and FAS (r_s = 0.665) groups for DEO (Figure 11.6a). Moderate significant negative correlations were found for DEO between COP_{speed} and TTB_{mean} for the ARND (r_s = -0.644), FAS (r_s = -0.767) and TD (r_s = -0.659) groups (Figure 11.6c). For NEO, a moderate significant positive correlation was found between COP_{speed} and COP_{sway} for the ARND (r_s = 0.781) group (Figure 11.6b), and moderate to strong significant negative correlations were found between COP_{speed} and TTB_{mean} for the ARND (r_s = -0.844), FAS (r_s = -0.733) and TD (r_s = -0.845) groups (Figure 11.6d). Other moderate significant negative correlations were seen between COP_{sway} and TTB_{mean} for groups ARND (r_s = -0.656) and FAS (r_s = -0.696). Statistical significance was $p < 0.004$.

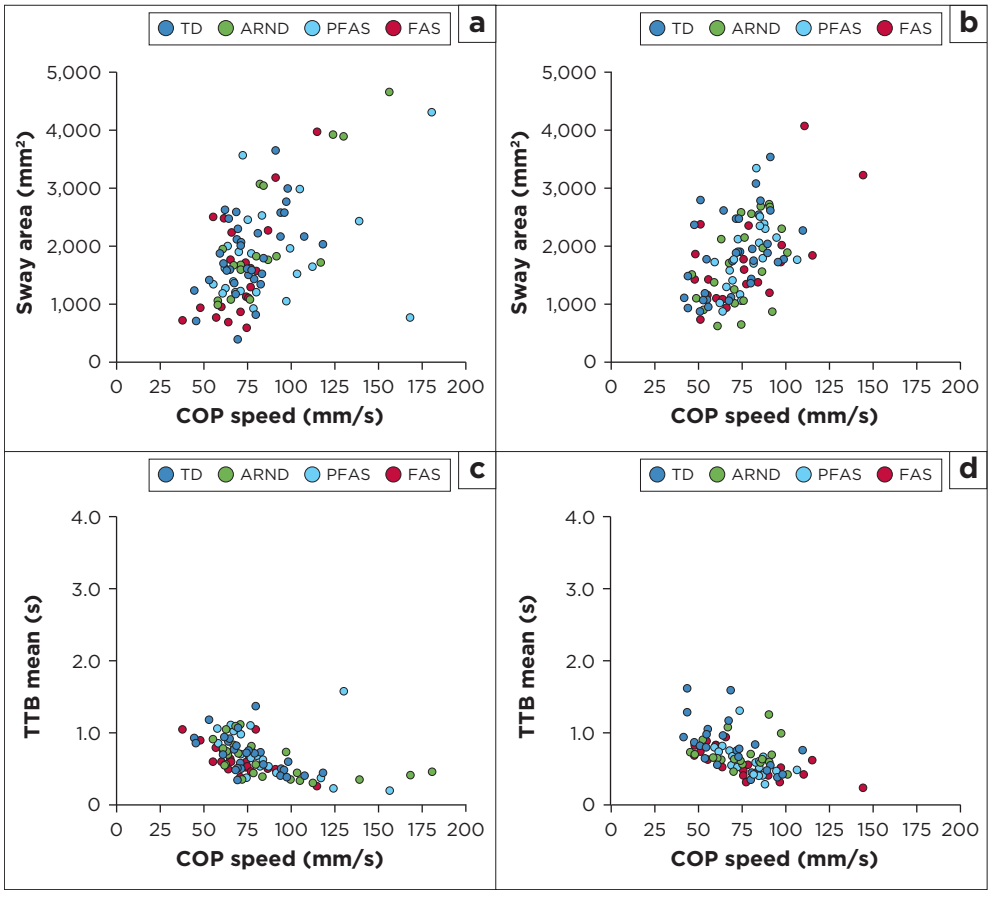


Source: Authors' own work.
Key: COP, centre of pressure; TTB, time-to-boundary; DEO, dominant eyes open; TD, typically developed; ARND, alcohol-related neurodevelopmental disorder; PFAS, partial foetal alcohol syndrome; FAS, foetal alcohol syndrome; mm/s, millimetre per second; NEO, non-dominant eyes open; DEC, dominant eyes closed; NEC, non-dominant eyes closed.

FIGURE 11.6: Association between postural sway intensity [COP_{speed}] and postural sway [COP_{sway}] area for (a) dominant eyes open and (b) non-dominant eyes open tasks, and between time-to-boundary and postural sway intensity [COP_{speed}] for the (c) dominant eyes open and (d) non-dominant eyes open tasks during the full single-leg standing interval ($Interval_{0\text{-}end}$).

Eyes closed tasks

A moderate significant positive correlation was found between COP_{speed} and COP_{sway} for the PFAS (r_s = 0.774) group (Figure 11.7a), and moderate significant negative correlations were found between COP_{speed} and TTB_{mean} for the ARND (r_s = -0.669) and TD (r_s = -0.649) groups for DEC (Figure 11.7c). For NEC, a moderate significant positive correlation was found between COP_{speed} and COP_{sway} for the PFAS (r_s = 0.684) group (Figure 11.7b), and moderate significant negative correlations were found between COP_{speed}



Source: Authors' own work.
Key: COP, centre of pressure; TTB, time-to-boundary; DEC, dominant eyes closed; DEO, dominant eyes open; TD, typically developed; ARND, alcohol-related neurodevelopmental disorder; PFAS, partial foetal alcohol syndrome; FAS, foetal alcohol syndrome; mm/s, millimetre per second; NEC, non-dominant eyes closed.

FIGURE 11.7: Association between postural sway intensity [COP_{speed}] and postural sway [COP_{sway}] area for (a) dominant eyes closed and (b) non-dominant eyes closed tasks, and between time-to-boundary and postural sway intensity [COP_{speed}] for (c) dominant eyes closed and (d) non-dominant eyes closed tasks during the full single-leg standing interval ($Interval_{0\text{-}end}$).

and TTB_{mean} for the FAS (r_s = -0.704) and TD (r_s = -0.686) groups (Figure 11.7d). Statistical significance was $p < 0.004$.

Descriptive and inferential statistics for performance and balance quality outcomes are available upon request.

Discussion

This is the first quantitative in-field investigation into balance of South African children, with and without FASD, performing SLS with and without

visual perturbation. No significant differences in task performance were observed with eyes open. However, children with severe FASD (FAS) displayed a significant decrease in task performance compared to TD children when vision was perturbed. Balance quality differences between TD and FASD subgroups were more apparent on the dominant leg (TD displayed better balance than FASD). Visual perturbation heightened group differences in postural sway patterns, but impacted sway intensity and time-to-boundary outcomes less.

Typically developed children (8–10 years old) typically average 29.0 ± 1.9s in SLS with eyes open (Mani et al. 2019). In this study, FASD children performed well, reaching 20 seconds as required by the MABC-2 testing battery; however, longer task duration might reveal subtler FASD-related balance deficits. A smaller study (*n* = 17) found significant differences in SLS duration between FASD and TD children, with the FASD group averaging 37.74 seconds in a 45-second task (Lidstone et al. 2020). That study's FASD group was more varied in age (7.4–17.6 years). Our findings align with a feasibility study reporting no significant SLS_{time} differences between FASD (*n* = 28) and TD (*n* = 28) children for the 20-second SLS task with and without visual perturbation (Brink et al. 2018). Brink et al. (2018) noted an SLS_{time} reduction in children with FASD when their eyes were closed, although this difference did not reach statistical significance, possibly because of sample limitations. The FASD median SLS_{time} (12.8 seconds) from the study by Brink et al. (2018) was notably higher than what was reported in this study.

Brink et al. (2018) observed significant reductions in postural sway speed (10%–30%) for FASD compared to TD children with and without visual perturbation. This study found no differences, except for a 2% significant reduction for TD children with eyes closed on the dominant leg compared to the FASD group. Brink et al. (2018) reported no differences in $AP_{excursion}$ or $ML_{excursion}$ between FASD and TD children. However, this study found significant differences between the groups in the ML direction – the FASD group displayed more postural sway for eyes open and in the AP direction the FASD group displayed less postural sway with eyes closed on the dominant leg. Although Lidstone et al. (2020) reported significant differences in FASD SLS_{time} with eyes open, they found no significant stabilometric differences to TD children (age group: 7–18 years old). They reported much higher values for COP_{sway} (mean: ~3,000 mm^2), similar values for $AP_{variability}$ (~7 mm), slightly lower values for $ML_{variability}$ (~3 mm) and significantly lower AP_{speed} (~9 mm/s) and ML_{speed} (~4 mm/s). This discrepancy may reflect age-related differences in foot size and balance ability, as well as methodological differences in measurement instruments and data filtering. The significant difference in TTB_{mean} found in this study for DEO

suggests that more sophisticated postural stability outcomes such as TTB may be required to detect postural stability deficits. However, no difference found for the non-dominant leg suggests balance strategy and/or ability may differ between legs.

No studies have reported stabilometric outcomes in terms of dominance for children with FASD. In this study, the dominant leg was defined as the preferred leg for kicking a ball, with the non-dominant leg supporting the body (Paillard & Noé 2020). The non-dominant leg often shows improved postural balance in sports such as soccer, likely played informally by study participants (Paillard & Noé 2020). The lack of differences between TD and FASD groups for the non-dominant side could be attributed to the non-dominant (supporting) leg's better postural stability compared to the dominant leg, leading to more similar balance outcomes between groups.

This study suggests that children with severe FASD (FAS) have balance deficits, while those with ARND and PFAS are less affected. Without visual perturbation, FASD participants, particularly the FAS group, were more likely to lose balance as a result of increased postural sway in the ML direction, suggestive of weaker postural control. Counterintuitively, with visual perturbation the FAS group displayed noticeable less postural sway in the AP direction compared to the TD group, despite worse task performance. Interestingly, the FAS group showed decreased postural sway and less variability for the first 10 seconds then increased towards the end of the task, indicating a possible inflection point around 10 seconds, where a different balance strategy might be employed because of continued visual perturbation. This suggests that the reason for the lower sway for the FAS group with eyes closed was that the onset of task failure was more rapid than for other groups and thus did not allow enough time for significant sway.

With eyes open, early in the 20 seconds task, the FASD group displayed greater COP_{speed} variability, likely attributing to earlier task failure compared to the TD group. This is corroborated by the significantly higher TTB_{mean} values in the TD group, indicating they were less likely to lose balance. Successful FAS participants (reaching 20 seconds) had greater COP_{speed} with less postural sway compared to the TD group, suggesting effective sway correction to maintain balance, especially on the dominant leg. Visual perturbation revealed different patterns for dominant and non-dominant legs. Increased COP_{speed} variability with early task failure was observed for participants with a less severe FASD diagnosis (ARND and PFAS) on the dominant leg, whereas FAS participants showed greater COP_{speed} variability with early task failure on the non-dominant leg.

This study included a novel fixed interval analysis revealing that task failures (where participants lost balance before the end of the SLS task)

significantly impact stabilometric outcomes, as larger and more rapid postural sway often occurs just before losing balance. For example, COP_{sway} variability notably reduced between $Interval_{0\text{-}end}$ and $Interval_{0\text{-}20}$ for all FASD groups in the eyes open tasks. The FASD group steadily decreased COP_{speed} from $Interval_{less5}$ to $Interval_{0\text{-}20}$, indicating slower responses to postural sway changes towards the halfway mark and kept decreasing speed, although postural sway increased towards 20 seconds for DEC. The COP_{speed} varied more with eyes closed in groups failing early ($Interval_{less5}$ and $Interval_{0\text{-}5}$), possibly because the duration of the loss of balance was more prominent – it took up a larger proportion of the interval used to average the speed. This points to the need for safeguards in handling task failure in stabilometric analysis, such as excluding the pre-fall subinterval. Nevertheless, the data also suggest that FASD participants may be prone to different movement strategies and/or longer periods of increased sway before falling than the TD group, particularly on the dominant leg during early task failures.

The significant negative correlation between increased COP_{speed} and decreased TTB_{mean} was consistent for the TD group regardless of dominance or visual perturbation. This suggests that increased speed is a strategy to correct outward sway early in response to increased sway but at the expense of increased risk of falling; a reactive rather than anticipatory strategy to maintain postural stability. The significant positive correlation between increased COP_{speed} and increased COP_{sway} was only detected for various FASD subgroups, which might imply that increased COP_{speed} is in response to increased COP_{sway} but does not necessarily equate to a lesser risk of falling.

Relevance to and impact of findings on clinical practice

The interpretation of the study findings indicates that balance strategy patterns for children with FASD, which are different from TD children, are emerging and warrants tailored interventions to address impaired balance in children with FASD. Clinicians should include the SLS task when developing tailored interventions that focus on retraining balance by improving postural control of the dominant leg (leg that learner prefers to kick the ball with) as the dominant leg might be more affected than the non-dominant leg. The tailored intervention should also incorporate the use of visual perturbation to challenge the motor system to improve unilateral static standing balance. If the SLS tasks are used as an outcome measure, clinicians should test SLS for longer than 20 seconds.

Strengths and weaknesses of study and recommendations for future study

This study reports in-field stabilometry measures within a sample of FASD children that is significantly larger (n = 67) than similar previous studies. Novel analytical approaches such as the 2D time-to-boundary and time-normalised interval analyses also provide new insights. The study reports postural sway outcomes for a similar TD group that was recruited at the same time from the same age group, geographic location and school population. Furthermore, it is the first study of FASD movement function that includes a subgroup analysis based on high-quality diagnostic criteria. However, these diagnostic subgroups are smaller in size, with reduced statistical power. The SLS task duration in this study, which was based on a standardised MABC-2 test, may have been too short to detect stance time differences for eyes open and should be lengthened in future studies. Another limitation of the analysis is that stabilometric outcomes only allow inferences of centre of mass kinematics and so do not provide any body posture surrogates such as segment and joint angles. Additional research could thus be conducted using motion capture outcomes to investigate FASD motor control patterns in greater detail. Lastly, it is unclear how consistent SLS performance and postural stability is for repeated measures in these populations and to what extent learning effects are present.

Conclusion

These findings suggest that motor control impairment may manifest notably in more severe FASD cases, particularly during more demanding balance tasks such as SLS with eyes closed. Postural control strategies during SLS tasks may also differ between dominant and non-dominant legs. A longer duration SLS task is needed to detect balance impairments with eyes open.

Declarations

Ethical considerations

The Human Research Ethics Committee at Stellenbosch University approved the study (N15/09/086).

Consent

Written informed consent was obtained from the parent or guardian, and written assent was obtained from the participants.

Author contributions

Yolandi Brink: Conceptualisation, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Validation, Visualisation, Writing – original draft preparation.

Quinette Louw: Conceptualisation, Writing – review and editing.

John Cockcroft: Conceptualisation, Data curation, Formal analysis, Investigation, Methodology, Resources, Software, Validation, Visualisation, Writing – original draft preparation.

All authors reviewed the chapter, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

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Competing interests

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Data availability

The research data cannot be made available as it includes confidential participant data.

Disclaimer

The views expressed in this chapter are the authors' own and not an official position of the institution, funder or the publisher.

APPENDICES

Single-leg standing balance of children with foetal alcohol spectrum disorders in South Africa

Authors: Yolandi Brink; Quinette Louw; John Cockcroft

Descriptive and inferential statistics for performance and balance quality outcomes are available upon request.

Additional file 1a

Descriptive statistics for task performance outcomes

DEO

	TD					FAS					PFAS					ARND				
	median	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**
SLS_{time}	20	11.745	20	20	20	20.00	7.57	20.00	19.33	20.00	20.00	5.65	20.00	19.74	20.00	20.00	11.63	20.00	20.00	20.00

NEO

	TD					FAS					PFAS					ARND				
	median	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**
SLS_{time}	20.00	7.82	20.00	20.00	20.00	20.00	8.70	20.00	17.28	20.00	20.00	14.87	20.00	20.00	20.00	20.00	10.60	20.00	19.01	20.00

DEC

	TD					FAS					PFAS					ARND				
	median	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**
SLS_{time}	11.69	0.78	20.00	7.07	14.45	8.29	1.90	19.29	4.17	11.91	7.81	1.33	20.00	3.92	10.92	6.71	1.47	20.00	4.64	14.40

NEC

	TD					FAS					PFAS					ARND				
	median	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**
SLS_{time}	9.34	1.75	20.00	6.21	14.01	6.60	2.29	20.00	4.82	11.71	8.74	2.22	20.00	4.87	14.33	7.42	1.70	20.00	4.40	10.18

Key: DEO, dominant eyes open; TD, typically developed; FAS, foetal alcohol syndrome; PFAS, partial foetal alcohol syndrome; ARND, alcohol-related neurodevelopmental disorder; min, minimum; max, maximum; Q1, first quartile; Q2, second quartile; NEO, non-dominant eyes open; DEC, dominant eyes closed; NEC, non-dominant eyes closed; SLS, single-leg standing.

Additional file 1b

Descriptive statistics for balance quality outcomes for eyes open

DEO																				
	TD					FAS					PFAS					ARND				
	median	min	max	Q1	Q2	median	min	max	Q1	Q2	median	min	max	Q1	Q2	median	min	max	Q1	Q2
$AP_{excursion}$	37.09	20.67	96.20	30.56	42.34	32.13	17.28	70.17	26.88	39.00	40.12	23.83	137.34	32.27	49.53	42.04	21.29	112.46	34.06	51.38
$ML_{excursion}$	25.34	17.46	33.84	21.08	27.78	27.81	18.54	34.26	24.90	28.96	28.31	18.51	40.03	23.67	31.41	28.21	19.76	36.55	25.01	30.85
$AP_{variability}$	7.24	4.09	11.99	6.17	8.21	6.42	3.27	11.96	5.25	7.81	7.79	4.45	16.14	5.60	8.50	8.02	4.05	15.12	6.79	9.06
$ML_{variability}$	5.06	3.28	6.85	4.40	5.87	5.66	4.11	8.00	5.00	6.81	5.34	3.96	7.33	4.75	6.71	5.87	3.71	7.81	5.1	6.51
AP_{speed}	28.56	21.87	40.98	24.24	30.83	31.30	18.39	68.64	25.37	37.19	32.80	22.68	69.79	29.54	36.63	29.38	16.85	54.93	28.35	35.77
ML_{speed}	20.05	13.52	34.11	17.77	25.83	24.91	13.14	42.81	20.03	27.53	22.65	13.81	38.99	21.50	28.00	22.38	10.50	39.91	20.25	25.60
COP_{speed}	38.04	28.33	58.93	34.75	46.01	44.43	24.90	88.83	36.48	51.41	45.08	29.57	81.82	41.94	51.27	41.95	21.93	72.63	38.09	47.64
COP_{sway}	653.9	279.4	1259.4	557.7	836.7	622.1	252.8	1621.1	519.3	965.7	716.5	339.7	2222.9	595.0	1032.2	815.7	340.9	1883.3	694.4	963.4
TTB_{mean}	1.46	0.70	3.18	1.14	1.69	1.19	0.40	1.68	0.79	1.37	1.11	0.69	2.19	0.98	1.27	1.09	0.63	2.70	0.93	1.60

NEO																				
	TD					FAS					PFAS					ARND				
	median	min	max	Q1	Q2	median	min	max	Q1	Q2	median	min	max	Q1	Q2	median	min	max	Q1	Q2
$AP_{excursion}$	32.88	16.23	65.22	27.5	40.37	35.05	20.99	62.87	27.68	41.49	35.85	22.94	121.33	31.82	41.86	35.08	19.31	90.03	29.80	49.96
$ML_{excursion}$	25.41	15.33	30.60	21.77	26.76	27.09	15.5	56.27	24.74	28.97	26.38	17.41	41.39	23.08	29.24	27.29	17.34	42.98	22.07	30.06
$AP_{variability}$	6.55	3.50	12.10	5.25	7.65	6.64	4.20	11.86	5.21	7.94	7.12	4.75	9.35	6.26	8.36	6.86	3.99	13.39	5.58	8.49
$ML_{variability}$	4.99	2.62	7.74	4.41	5.79	5.77	3.30	9.37	4.69	6.36	5.34	3.57	10.23	4.56	5.75	5.47	3.56	9.29	4.40	6.25
AP_{speed}	29.41	18.30	49.26	26.81	33.84	27.70	19.75	47.93	25.91	36.20	30.17	22.59	43.93	28.47	37.58	29.31	20.70	47.01	25.39	38.79
ML_{speed}	23.24	14.12	37.16	20.20	25.59	22.53	14.32	36.62	19.00	27.36	23.29	14.70	31.84	19.93	26.83	23.30	16.27	30.18	19.64	26.15
COP_{speed}	41.81	26.10	68.39	36.21	46.56	42.35	26.99	64.69	35.78	50.18	43.74	31.51	57.59	39.30	50.74	42.27	30.17	61.15	34.98	52.10
COP_{sway}	623.7	232.3	1430.9	463.5	771.3	595.7	424.7	2093.1	472.4	841.9	683.8	311.9	1351.9	605.2	808.9	689.4	262.12	2279.3	468.6	1017.4
TTB_{mean}	1.23	0.59	2.67	1.10	1.41	1.18	0.57	1.89	0.91	1.43	1.23	0.82	1.69	1.05	1.49	1.17	068	2.06	0.94	1.45

Key: DEO, dominant eyes open; TD, typically developed; FAS, foetal alcohol syndrome; PFAS, partial foetal alcohol syndrome; ARND, alcohol-related neurodevelopmental disorder; min, minimum; max, maximum; Q1, first quartile; Q2, second quartile; AP, anteroposterior; ML, mediolateral; COP, centre of pressure; TTB, time-to-boundary; NEO, non-dominant eyes open.

Additional file 1c

Descriptive statistics for balance quality outcomes for eyes closed

DEC																				
	TD					FAS					PFAS					ARND				
	median	min	max	Q1	Q2	median	min	max	Q1	Q2	median	min	max	Q1	Q2	median	min	max	Q1	Q2
$AP_{excursion}$	58.45	18.70	135.15	49.06	80.41	43.09	20.24	97.84	35.10	75.66	58.43	25.73	134.80	43.24	71.54	54.59	29.02	128.15	42.23	70.54
$ML_{excursion}$	35.31	17.05	55.21	30.84	39.58	31.67	21.31	47.61	27.09	34.87	35.71	22.27	51.20	31.04	41.78	35.61	23.40	50.34	33.15	39.88
$AP_{variability}$	11.95	6.19	17.77	10.18	14.16	9.95	4.13	20.81	6.57	13.51	11.67	6.40	17.35	8.32	14.50	11.09	5.99	25.58	8.39	12.99
$ML_{variability}$	8.75	4.73	10.96	7.75	9.67	8.20	5.25	12.21	7.21	9.23	8.85	6.19	14.54	7.95	10.65	9.01	4.69	12.67	7.78	10.00
AP_{speed}	52.6	33.19	98.30	45.55	64.58	48.22	28.16	85.05	41.42	55.75	58.11	38.51	116.39	47.06	68.34	53.21	39.15	161.66	46.60	73.22
ML_{speed}	39.34	21.83	60.92	33.62	44.76	38.61	18.18	56.37	32.11	46.37	39.74	29.15	75.17	35.23	49.04	41.00	30.70	70.59	35.72	46.59
COP_{speed}	72.60	44.13	118.02	65.10	83.58	72.17	37.44	114.31	60.73	76.39	76.32	57.52	156.05	68.70	88.93	75.92	54.93	180.38	65.80	100.02
COP_{sway}	1829.6	394.2	3648.7	1445.8	2274.9	1425.5	585.5	3966.6	917.1	2242.7	1713.6	980.0	4663.1	1365.1	2493.1	1633.2	769.5	4317.2	1220.4	2106.3
TTB_{mean}	0.65	0.34	1.37	0.49	0.81	0.60	0.26	1.04	0.49	0.75	0.68	0.20	1.57	0.48	1.00	0.55	0.30	1.11	0.40	0.79

NEC

	TD					FAS					PFAS					ARND				
	median	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**	**median**	**min**	**max**	**Q1**	**Q2**
$AP_{excursion}$	53.19	28.78	147.21	41.52	81.77	46.33	27.18	97.32	37.30	59.16	52.80	31.25	120.35	38.38	61.42	49.58	25.18	126.43	36.79	83.11
$ML_{excursion}$	32.49	24.59	46.88	31.04	39.65	35.55	22.37	46.92	31.91	39.02	36.56	23.42	50.99	32.47	41.69	35.47	20.81	48.32	31.47	39.26
$AP_{variability}$	10.43	6.19	17.40	8.23	13.36	9.57	5.81	18.99	7.98	11.15	11.00	6.52	17.55	9.57	12.28	10.41	6.01	17.02	8.44	13.43
$ML_{variability}$	8.66	6.16	12.01	7.43	9.98	9.53	6.30	11.81	7.91	10.19	8.60	6.86	14.24	7.66	10.36	8.99	4.94	10.61	8.23	9.83
AP_{speed}	50.23	27.50	84.75	39.33	62.34	51.06	32.69	111.26	40.72	67.21	54.39	40.63	73.62	49.54	62.66	52.84	32.42	82.37	45.87	64.65
ML_{speed}	36.53	20.45	52.99	30.62	42.60	40.86	21.51	68.99	27.86	46.56	41.00	19.91	62.43	37.05	49.51	39.09	25.96	51.57	33.65	44.86
COP_{speed}	71.99	42.02	109.77	54.81	82.50	75.99	47.92	144.55	55.49	92.03	81.80	59.48	106.48	68.75	86.04	75.04	45.85	101.18	66.26	86.65
COP_{sway}	1779.7	867.1	3542.6	1112.8	2347.9	1516.7	741.7	4077.0	1195.1	1905.1	1777.2	871.9	3340.3	1499.2	2224.4	1730.5	624.8	2728.5	1090.4	2366.1
TTB_{mean}	0.72	0.35	1.62	0.53	0.89	0.54	0.24	0.95	0.42	0.74	0.59	0.29	1.31	0.48	0.74	0.63	0.32	1.25	0.57	0.71

Key: DEC, dominant eyes closed; TD, typically developed; FAS, foetal alcohol syndrome; PFAS, partial foetal alcohol syndrome; ARND, alcohol-related neurodevelopmental disorder; min, minimum; max, maximum; Q1, first quartile; Q2, second quartile; AP, anteroposterior; ML, mediolateral; COP, centre of pressure; TTB, time-to-boundary; NEC, non-dominant eyes closed.

Additional file 2a

ANOVA indicating between group differences for TD and the FASD subgroups

Parameters	*p*-value	Subgroups	Coefficient	Std. err	*p*-value	95% CI
DEO						
$AP_{excursion}$	0.135	TD vs ARND	−5.119814	5.233442	0.331	−15.51855 – 5.278923
		TD vs FAS	3.80704	3.80704	0.528	−8.136263 – 15.75034
		TD vs PFAS	9.63559	5.683307	0.093	−1.657021 – 20.9282
$ML_{excursion}$	0.155	TD vs ARND	−2.743437	1.295174	0.037	−5.316921 – −0.169952
		TD vs FAS	−2.092747	1.406507	0.098	−5.048481 – 0.862987
		TD vs PFAS	2.352018	1.40650	0.098	−0.442682 – 5.146719
$AP_{variability}$	0.250	TD vs ARND	−0.896103	0.654762	0.175	−2.197101 – 0.404896
		TD vs FAS	−0.023908	0.752017	0.975	−1.518149 – 1.470333
		TD vs PFAS	1.137055	0.711045	0.113	−0.275777 – 2.549887
$ML_{variability}$	0.020	TD vs ARND	−0.702042	0.294810	0.019	−1.287825 – −0.116260
		TD vs FAS	−1.016508	0.338599	0.003	−1.689299 – −0.343717
		TD vs PFAS	0.519355	0.320152	0.108	−0.116780 – 1.155491
AP_{speed}	0.254	TD vs ARND	−1.622112	2.335977	0.489	−6.263648 – 3.019424
		TD vs FAS	−3.314005	2.682948	0.220	−8.644966 – 2.016957
		TD vs PFAS	4.960154	2.536777	0.054	−0.080367 – 10.00068
ML_{speed}	0.693	TD vs ARND	−0.9194949	1.703405	0.591	−4.304124 – 2.465134
		TD vs FAS	−1.80598	1.956419	0.358	−5.693342 – 2.081382
		TD vs PFAS	1.998042	1.849829	0.283	−1.67753 – 5.673614
COP_{speed}	0.348	TD vs ARND	−1.996234	2.997474	0.507	−7.952152 – 3.959683
		TD vs FAS	−4.094784	3.442701	0.237	−10.93536 – 2.74579
		TD vs PFAS	5.637895	3.255137	0.087	−0.829992 – 12.10578
COP_{sway}	0.146	TD vs ARND	−177.7134	95.56765	0.066	−367.6043 – 12.17746
		TD vs FAS	−132.46	109.7627	0.231	−350.5562 – 85.63611
		TD vs PFAS	214.027	103.7826	0.042	7.813157 – 420.2409
TTB_{mean}	0.154	TD vs ARND	0.155119	0.131774	0.242	−0.106713 – 0.416951
		TD vs FAS	0.327213	0.151347	0.033	0.026490 – 0.627937
		TD vs PFAS	−0.235279	0.143102	0.104	−0.519618 – 0.049061
SLS_{time}	0.298	TD vs ARND	0.753983	0.847748	0.376	−0.930473 – 2.438439
		TD vs FAS	1.75901	0.973667	0.074	−0.175645 – 3.693666
		TD vs PFAS	−1.247709	0.920620	0.179	−3.076961 –.5815432

Parameters	*p*-value	Subgroups	Coefficient	Std. err	*p*-value	95% CI
NEO						
$AP_{excursion}$	0.365	TD vs ARND	−7.271514	4.372231	0.100	−15.95904 – 1.416016
		TD vs FAS	−2.746148	5.021656	0.586	−12.72407 – 7.231776
		TD vs PFAS	5.565033	4.748067	0.244	−3.869276 – 14.99934
$ML_{excursion}$	0.526	TD vs ARND	−1.839182	1.667162	0.552	−5.151797 – 1.473433
		TD vs FAS	−2.673776	1.914792	0.166	−6.478427 – 1.130874
		TD vs PFAS	1.081283	1.810471	0.552	−2.516084 – 4.678649
$AP_{variability}$	0.480	TD vs ARND	−0.959726	0.616167	0.123	−2.184037 – 0.264584
		TD vs FAS	−0.653057	0.707689	0.359	−2.05922 – 0.7531061
		TD vs PFAS	0.506000	0.669133	0.452	−0.823552 – 1.835553
$ML_{variability}$	0.468	TD vs ARND	−0.343516	0.363536	0.953	−1.065854 – 0.378823
		TD vs FAS	−0.58735	0.417534	0.163	−1.41698 – 0.2422805
		TD vs PFAS	0.023339	0.394786	0.953	−0.761091 – 0.807769
AP_{speed}	0.693	TD vs ARND	−0.940664	1.870165	0.616	−4.656641 – 2.775313
		TD vs FAS	−1.946121	2.147948	0.367	6.214048 – 2.321805
		TD vs PFAS	2.212779	2.030924	0.279	−1.822624 – 6.248181
ML_{speed}	0.992	TD vs ARND	0.316149	1.419586	0.824	−2.504537 – 3.136836
		TD vs FAS	0.015792	1.630442	0.992	−3.223862 – 3.255446
		TD vs PFAS	0.144571	1.541613	0.925	−2.918581 – 3.207723
COP_{speed}	0.870	TD vs ARND	−0.554582	2.432162	0.820	−5.387236 – 4.278072
		TD vs FAS	−1.71224	2.793421	0.541	−7.262708 – 3.838227
		TD vs PFAS	1.968595	2.64123	0.458	−3.279473 – 7.216663
COP_{sway}	0.484	TD vs ARND	−143.6504	104.4054	0.172	−351.1017 – 63.80094
		TD vs FAS	−135.0651	119.9132	0.263	−373.33 – 103.1998
		TD vs PFAS	28.84958	113.3801	0.800	−196.4342 – 254.1334
TTB_{mean}	0.703	TD vs ARND	0.06071	0.124115	0.578	−0.155144 – 0.276563
		TD vs FAS	0.145873	0.124770	0.245	−0.102042 – 0.393788
		TD vs PFAS	−0.079426	0.117973	0.503	−0.313834 – 0.154982
SLS_{time}	0.373	TD vs ARND	0.496033	0.679783	0.467	−0.854680 – 1.846747
		TD vs FAS	1.127401	0.780753	0.152	−0.423939 – 2.678742
		TD vs PFAS	0.223681	0.738217	0.763	−1.24314 – 1.690501

Key: ANOVA, analysis of variance; TD, typically developed; FASD, foetal alcohol spectrum disorders; Std., standard; %,percentage; DEO, dominant eyes open; AP, anteroposterior; ARND, alcohol-related neurodevelopmental disorder; FAS, foetal alcohol syndrome; PFAS, partial foetal alcohol syndrome; ML, mediolateral; COP, centre of pressure; TTB, time-to-boundary; SLS, single-leg standing; NEO, non-dominant eyes open.

Additional file 2b

ANOVA indicating between group differences for TD and the FASD subgroups

Parameters	*p*-value	Subgroups	Coefficient	Std. err	*p*-value	95% CI
DEC						
$AP_{excursion}$	0.025	TD vs ARND	13.1034	6.89245	0.061	−0.591754 – 26.79855
		TD vs FAS	24.27809	7.916213	0.003	8.548746 – 40.00744
		TD vs PFAS	−10.99131	7.484924	0.146	−25.86369 – 3.881075
$ML_{excursion}$	0.083	TD vs ARND	−0.194746	2.041724	0.924	−4.251608 – 3.862117
		TD vs FAS	4.899666	2.34499	0.040	0.240222 – 9.559111
		TD vs PFAS	0.891805	2.21723	0.688	−3.513784 – 5.297395
$AP_{variability}$	0.137	TD vs ARND	0.999982	1.013567	0.327	−1.013953 – 3.013917
		TD vs FAS	2.755884	1.164116	0.020	0.442811 – 5.068957
		TD vs PFAS	−1.253884	1.100693	0.258	−3.440936 – 0.933169
$ML_{variability}$	0.441	TD vs ARND	−0.1522774	0.492928	0.758	−1.131714 – 0.827159
		TD vs FAS	0.229089	0.566144	0.687	−0.895827 – 1.354005
		TD vs PFAS	0.692850	0.535300	0.199	−0.370779 – 1.756479
AP_{speed}	0.055	TD vs ARND	−8.167925	6.013427	0.178	−20.11648 – 3.780627
		TD vs FAS	9.452521	6.906626	0.175	−4.270797 – 23.17584
		TD vs PFAS	6.051408	6.530341	0.357	0.926611 – 30.08125
ML_{speed}	0.126	TD vs ARND	−1.531644	2.711465	0.574	−6.919267 – 3.855979
		TD vs FAS	4.717552	3.11421	0.133	−1.470316 – 10.90542
		TD vs PFAS	2.523077	2.944542	0.394	−3.327665 – 8.373819
COP_{speed}	0.038	TD vs ARND	−8.21025	6.468611	0.208	−21.06324 – 4.642741
		TD vs FAS	11.6559	7.429419	0.120	−3.106197 – 26.418
		TD vs PFAS	6.831561	7.024651	0.333	−7.126271 – 20.78939
COP_{sway}	0.265	TD vs ARND	162.8564	229.4129	0.480	−292.9822 – 618.695
		TD vs FAS	450.384	263.4885	0.091	−73.16213 – 973.9301
		TD vs PFAS	62.06633	249.1332	0.804	−432.9561 – 557.0887
TTB_{mean}	0.529	TD vs ARND	0.001427	0.069266	0.984	−0.136203 – 0.139057
		TD vs FAS	−0.077964	0.079554	0.330	−0.236037 – 0.080109
		TD vs PFAS	0.086641	0.075220	0.252	−0.062820 – 0.236102
SLS_{time}	0.233	TD vs ARND	1.969702	1.592568	0.219	−1.194697 – 5.134102
		TD vs FAS	3.726505	1.829119	0.045	0.092085 – 7.360926
		TD vs PFAS	−1.987759	1.729465	0.253	−5.424169 – 1.448652

Parameters	*p*-value	Subgroups	Coefficient	Std. err	*p*-value	95% CI
NEC						
$AP_{excursion}$	0.220	TD vs ARND	9.678698	6.854556	0.161	−3.941159 – 23.29855
		TD vs FAS	14.34206	7.872691	0.072	−1.300809 – 29.98493
		TD vs PFAS	−12.33476	7.443773	0.101	−27.12538 – 2.455857
$ML_{excursion}$	0.816	TD vs ARND	0.681404	1.781232	0.703	−2.857867 – 4.220674
		TD vs FAS	0.594080	2.045806	0.772	−3.470892 – 4.659053
		TD vs PFAS	1.138046	1.934347	0.558	−2.705459 – 4.981552
$AP_{variability}$	0.798	TD vs ARND	0.589841	0.884406	0.507	−1.167455 – 2.347137
		TD vs FAS	0.87494	1.01577	0.391	−1.143375 – 2.893254
		TD vs PFAS	−0.057466	0.96043	0.952	−1.965819 – 1.850887
$ML_{variability}$	0.904	TD vs ARND	0.154800	0.465415	0.740	−0.7699692 – 1.07957
		TD vs FAS	−0.212823	0.534545	0.691	−1.274952 – 0.8493059
		TD vs PFAS	0.135681	0.505422	0.789	−0.8685812 – 1.139944
AP_{speed}	0.8078	TD vs ARND	−1.732332	4.098574	0.674	−9.876111 – 6.411447
		TD vs FAS	−4.603674	4.707352	0.331	−13.95708 – 4.749733
		TD vs PFAS	2.24113	4.450887	0.616	−6.602687 – 11.08495
ML_{speed}	0.403	TD vs ARND	0.3698565	2.513229	0.883	−4.623876 – 5.363589
		TD vs FAS	0.868832	2.886529	0.764	−4.866639 – 6.604303
		TD vs PFAS	3.72342	2.729266	0.176	−1.699572 – 9.146413
COP_{speed}	0.811	TD vs ARND	−1.274839	4.810139	0.792	−10.83248 – 8.282805
		TD vs FAS	−3.385587	5.524609	0.542	−14.36287 – 7.591693
		TD vs PFAS	4.790624	5.223618	0.362	−5.588594 – 15.16984
COP_{sway}	0.853	TD vs ARND	155.2628	190.0675	0.416	−222.3972 – 532.9227
		TD vs FAS	133.8035	218.2989	0.541	−299.9518 – 567.5588
		TD vs PFAS	−45.24429	206.4056	0.827	−455.3679 – 364.8793
TTB_{mean}	0.754	TD vs ARND	0.034897	0.066703	0.602	−0.0976413 – 0.167435
		TD vs FAS	0.080361	0.076611	0.297	−0.071863 – 0.232586
		TD vs PFAS	−0.051413	0.072437	0.480	−0.1953436 – 0.092518
SLS_{time}	0.174	TD vs ARND	2.293602	1.54126	0.140	−0.7688481 – 5.356052
		TD vs FAS	3.852577	1.770189	0.032	0.335249 – 7.369905
		TD vs PFAS	−1.565306	1.673746	0.352	−4.891004 – 1.760392

Key: ANOVA, analysis of variance; TD, typically developed; FASD, foetal alcohol spectrum disorders; Std., standard; %, percentage; DEC, dominant eyes closed; AP, anteroposterior; ARND, alcohol-related neurodevelopmental disorder; FAS, foetal alcohol syndrome; PFAS, partial foetal alcohol syndrome; ML, mediolateral; COP, centre of pressure; TTB, time-to-boundary; SLS, single-leg standing; NEC, non-dominant eyes closed.

Additional file 3

Spearman Rank correlation coefficients indicating associations between outcomes

		DEO					NEO		
		COP_{sway}	**COP_{speed}**	**TTB_{mean}**			**COP_{sway}**	**COP_{speed}**	**TTB_{mean}**
COP_{sway}	TD	**1**	0.4429	−0.3730	**COP_{sway}**	TD	**1**	0.4451	−0.4099
	ARND	**1**	0.7052*	−0.3652		ARND	**1**	0.7809*	−0.6557*
	PFAS	**1**	0.3825	−0.3965		PFAS	**1**	0.1789	0.0228
	FAS	**1**	0.6647*	−0.5414		FAS	**1**	0.5519	−0.6962*
COP_{speed}	TD	0.4429	**1**	−0.6587*	**COP_{speed}**	TD	0.4451	**1**	−0.8454*
	ARND	0.7052*	**1**	−0.6443*		ARND	0.7809*	**1**	−0.8443*
	PFAS	0.3825	**1**	−0.5702		PFAS	0.1789	**1**	−0.5246
	FAS	0.6647*	**1**	−0.7669*		FAS	0.5519	**1**	−0.7325*
TTB_{mean}	TD	−0.3730	−0.6587*	**1**	**TTB_{mean}**	TD	−0.4099	−0.8454*	**1**
	ARND	−0.3652	−0.6443*	**1**		ARND	−0.6557*	−0.8443*	**1**
	PFAS	−0.3965	−0.5702	**1**		PFAS	0.0228	−0.5246	**1**
	FAS	−0.5414	−0.7669*	**1**		FAS	−0.6962*	−0.7325*	**1**
		DEC					**NEC**		
		COP_{sway}	**COP_{speed}**	**TTB_{mean}**			**COP_{sway}**	**COP_{speed}**	**TTB_{mean}**
COP_{sway}	TD	**1**	0.4215	−0.2348	**COP_{sway}**	TD	**1**	0.4677	−0.2791
	ARND	**1**	0.2113	−0.4026		ARND	**1**	0.4861	−0.0530
	PFAS	**1**	0.7738*	−0.4632		PFAS	**1**	0.6842*	−0.5281
	FAS	**1**	0.4241	−0.2662		FAS	**1**	0.4391	−0.3489
COP_{speed}	TD	0.4215	**1**	−0.6486*	**COP_{speed}**	TD	0.4677	**1**	−0.6856*
	ARND	0.2113	**1**	−0.6687*		ARND	0.4861	**1**	−0.3078
	PFAS	0.7738*	**1**	−0.5754		PFAS	0.6842*	**1**	−0.7035
	FAS	0.4241	**1**	−0.4406		FAS	0.4391	**1**	−0.7038*
TTB_{mean}	TD	−0.2348	−0.6486*	**1**	**TTB_{mean}**	TD	−0.2791	−0.6856*	**1**
	ARND	−0.4026	−0.6687*	**1**		ARND	−0.0530	−0.3078	**1**
	PFAS	−0.4632	−0.5754	**1**		PFAS	−0.5281	−0.7035	**1**
	FAS	−0.2662	−0.4406	**1**		FAS	−0.3489	−0.7038*	**1**

*Significant associations $p < 0.004$
Key: DEO, dominant eyes open; NEO, non-dominant eyes open; COP, centre of pressure; TTB, time-to-boundary; ANOVA, analysis of variance; TD, typically developed; ARND, alcohol-related neurodevelopmental disorder; PFAS, partial foetal alcohol syndrome; FAS, foetal alcohol syndrome.

Chapter 12

At-risk primary caregivers' perspectives on the importance of play

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Abstract

Background: Literature relating to at-risk women's viewpoints on the nature of a nurturing environment in which play, for the sake of play, can take place is limited. As a vulnerable group, at-risk women may live in conditions with food insecurities, homelessness, unemployment, violence and low educational levels. These factors may negatively influence health outcomes. As part of the Catch & Match Project in the Western Cape province, South Africa, this study was conceptualised with the overall aim of identifying women and children at risk of ill-health resulting from environmental factors.

Aim: The research aim was to investigate the viewpoints of at-risk primary caregivers (the biological mothers within this study) on the importance of play with their children from the ages of birth to 2 years of age.

Methods: The research, comprising multiple case studies, utilised focus groups, individual interviews and reflection logs as data collection tools. A social determinant perspective framed the inductive analysis process as we explored participants' views on the importance of play.

Findings: Participants identified play as an important occupation in childhood development. Play mainly took place indoors for safety reasons, where the immediate caregivers and the home environment determine the opportunities for play.

Conclusion: Children use play to explore their own abilities and the home environment. Occupational therapists, as educators and advocates within the First 1,000 Days initiative, could help promote children's rights to engage in play in a safe environment.

Background

Play, in children, is a precursor to developing appropriate social skills in adulthood. Play is also viewed as one of the main tasks in childhood, as most of their time during this developmental stage should be spent playing. All children have the basic right to rest, leisure, and access to play environments that are safe (Assembly, UG 1989). It also posits that children have the right to engage in play and recreational activities that are appropriate to their age. The rate of children without equitable access to early childhood development centres in South Africa is alarmingly high (Ashley-Cooper 2021).

The aim of the Healthcare 2030 vision for the Western Cape Department of Health and Wellness is equal access to quality care. The First 1,000 Days initiative aligns with the principles of Healthcare 2030, as its overarching goal is to improve maternal and child health care services. Given this study's rights perspective, we used Healthcare 2030 as a framework (Western Cape Government Health 2014). The initial First 1,000 Days refer to the period from

conception to the second year of a child's life. According to the First 1,000 Days initiative, if play opportunities are optimised during the First 1,000 Days, it will likely lead to a healthier, more prosperous future. There are five aims for the First 1,000 Days initiative, and this study – the stimulation of early learning and access to a nurturing environment – falls under one of them.

Occupational therapists can provide invaluable input for the First 1,000 Days initiative, as they deliver interventions that facilitate engagement in purposeful, meaningful activities that contribute to children's overall well-being. Stimulation for early development is initially achieved through play (Worku et al. 2018). Occupational therapists use play to achieve developmental goals. International literature focusing on the importance of play for early childhood development (Lynch & Moore 2016; Prins et al. 2023; Whitebread et al. 2017) emphasises the dearth of literature on the primary caregivers' views on the importance of play for play's sake and play for the purpose of enabling life development.

Play allows the primary caregiver to bond, share values and create educational opportunities for the child (Milteer et al. 2012). Primary caregivers play a pivotal role in creating and maintaining a nurturing play environment during early childhood. It is imperative to include the views of primary caregivers to enrich the data. Although play in childhood may be a focus for occupational therapists, social workers and other health professionals can derive valuable information from the play profiles of children. The play trajectory during early childhood provides insight into milestones of development and could inform interventions that promote play in home and community environments that are safe.

Restricting play environments can prevent children from reaching their developmental milestones. Barriers to learning may result in learning difficulties and behavioural difficulties in childhood. Imposed occupations are described as those occupations that are sustained by oppressive practices, norms and values. These are embedded in the social matrix of society in which marginalised groups, who have lost their ability to voice their concerns or views, engage. Imposed occupations have a negative impact on not only the personal and social health, well-being and the development of individuals but also the social groups to which they belong (Cloete 2012; Cloete & Ramugondo 2015). Restricted play development because of safety considerations in the home environment can be viewed as an imposed occupation.

Takata (1974) identified five stages of play, namely: sensorimotor (0–2 years); symbolic and simple constructive play (2–4 years); dramatic, complex constructive, and pregame (4–7 years); game (7–12 years); and recreational (12–16 years) (Bernard 2013). The first 1,000 days of a child's life are characterised by sensorimotor play. During the sensorimotor stage,

the baby mimics the primary caregiver, like playing peek-a-boo, hide-and-seek, practising motor tasks (standing, walking), exploring different properties of objects and the foundation of simple problem-solving (Keven & Akins 2017). As the child develops, explorative play evolves towards activities in and around the home that involve different textures, sounds, colours and forms. When these infants crawl, they feel the different textures beneath their hands and fingers, stimulating them with sensory input (Eğrikılınç & Dere 2024). It is during explorative play that the child learns about the self and the environment. In addition, through play and exploration, the child's brain will develop (Yogman et al. 2018).

If the primary caregivers appreciate the value of play, they will encourage play as a means for enjoyment, development and growth. Participation between a primary caregiver and child is a precursor to participation in play. Caregiver–child participation also facilitates the attainment of social, emotional and cognitive abilities (Western Cape Government Health 2014). For development to occur, it is necessary for a primary caregiver to actively participate with her child and not merely just be present (Western Cape Government Health 2014). Often, children do not live with their biological primary caregivers, but rather with non-related primary caregivers, family members or foster parents. Health care practitioners should ascertain whether the environment in which the primary caregiver and child are during early childhood is safe and nurturing. Benninger and Savahl (2017) suggest that an environment in which the child feels safe will elicit a sense of inclusion and belonging in the child, which will enable the child to develop a positive self-concept. According to the Department of Health and Ageing in Australia, a negative environment experienced by the child, where they do not feel safe, cared for or valued, may lead to negative behavioural patterns and the development of problematic coping strategies, which may, in turn, lead to mental health problems later in life. A developing child will, therefore, learn social cues from their immediate environment and will, additionally, learn early responses to environmental cues from their immediate caregivers and family members first (Magnuson & Schindler 2019). Henricks (2023) states that participation in play depends on the cultural setting and atmosphere. Unconsciously, the infant is developing the skill of learning and complying with social norms that the primary caregiver has been reinforcing during play (Trevarthen 2015). If the primary caregiver is at-risk of ill-health, then play and play development may be at stake.

Play is central to child development

The first 1,000 days of a child's life (from conception to 2 years old) is critical in overall development (United Nations Children's Fund [UNICEF] 2017). Foundational building blocks in neurobehavioural, sensory and motor skills support the development of communication and social skills. During interactive

play, the stimulus provided by the primary caregiver is the primary caregiver herself, through the initiation of play. Play can also occur when the primary caregiver provides regular sounds, facial expressions, motions, tactile and kinaesthetic events, which stimulate the infant's senses (Bleibinger, Van Niekerk & Pienaar 2019). Eğrikılınç and Dere (2024) explain that infants play using their senses of sight, smell, touch, taste and hearing, as well as the feedback they receive from their movements. According to Bornstein, Suwalsky and Breakstone (2012), emotions are versatile and guide survival strategies in child rearing and development. Emotional availability has a substantial influence on the connection that a primary caregiver establishes between herself and her child (Brumariu 2015). Through this processing of facial expressions, the infant will engage several different cognitive processes (Barrett et al. 2019). The infant will learn to interact with the primary caregiver through both vocalisations and non-verbal cues. The way in which a child experiences play and learn to play is therefore greatly shaped by the primary caregiver. Similarly, primary caregivers model other social responses that children copy during early childhood.

Social determinants influencing play and the development of the child

Poor socio-economic circumstances beyond the primary caregiver's control may disrupt the primary caregiver–child relationship. Prerequisites for health may influence the primary caregiver's capacity to provide support and give love to her or their infant (Hardison-Moody et al. 2018). Occupational therapists can intervene by identifying the social determinants of health for at-risk children. Occupational therapists have a responsibility to advocate for the right of infants to engage in meaningful play interactions in a safe and nurturing environment. Primary caregivers play a pivotal role in creating and maintaining a nurturing play environment. It is for this reason that the researchers have identified the area of play as a form of social participation as a topic to be further investigated.

Social determinants of health in early childhood (Atashbahar et al. 2022):

1. Economic factors
2. Political factors
3. Socio-cultural setting of society
4. Socio-cultural setting of the family
5. Role of international organisation
6. Political sanctions.

Play and social participation

Within occupational therapy, social participation is a domain that affects human development and participation in society. According to Ruprecht,

Elicker and Choi (2019), the lack of social participation between the primary caregiver and the infant may lead to behavioural problems, withdrawal from society and prevent optimal (play, emotional and cognitive) development of the child. The quality of participation in health-promoting activities within the context of a nurturing environment for at-risk women and their infants is negatively affected by contributing factors such as poverty, as it disturbs the capacity of the primary caregiver to provide attentive care, which can compromise elementary development skills in early childhood (Bradley 2019; Delgado 2024)

With reference to how an unsupportive environment can render women and children at-risk of ill-health, poor development and participation in imposed occupations, at-risk women may need external support, as well as access to information on the importance of play. Providing the needed support may raise awareness in the primary caregiver of the role of play as a precursor to holistic development in early childhood and may produce constructive social participation later in life for the child. Before occupational therapists can embark on developing educational material that could support primary caregivers in creating supportive and nurturing environments for their infants, we need to explore their understanding of the importance of playfulness during early childhood as a precursor to social skills that are needed for later developmental stages. This chapter responds to the following research question: What are the viewpoints of at-risk women on the importance of play for children aged between 0 and 24 months?

Methods

Research context

The study was conducted within the Cape Town metropolis in the Western Cape province, South Africa, with a general population of 77,121, of which 38.1% (29,383) are adult women between the ages of 15 and 85 years, and 27.8% (21,439) are male and female children between the ages of zero and 14 years (Statistics South Africa 2011). Gangsterism, drug abuse and violent crimes are rife. Forty-nine per cent of the adult population has 'some secondary' level of education, which in the South African context falls between Grades 8 and 10 (Statistics South Africa 2011). The prevalent employment in this setting is classified as 'employment', such as factory workers in the industrial sector, administrative jobs and self-employed entrepreneurs in the food and craft trade (Solinger 2019). Negative external factors such as gangsterism, drug abuse and violent crimes may create a challenging environment to meet the prerequisites for health. The study community has support structures in place in the form of access to

health care. Within the community, there is a health care centre, a clinic, a day hospital, and a rehabilitation centre. The research was conducted in the antenatal clinic at the rehabilitation centre. This clinic was selected as the research site as the centre was one of the five sites at which the First 1,000 Days initiative was implemented in the Western Cape province.

The study was conducted using a qualitative approach, a descriptive methodology and a multiple collective case study (Stake 1995). Case One consisted of two focus groups with a duration of 35 minutes each. Each focus group had six participants. Case Two included two individual interviews with a duration of 20 minutes each, with information-rich participants. Six researcher reflection logs (a total of 60 minutes of reflection per researcher after individual and focus group sessions) formed part of Case Three. The researchers explored the collective views of a group of 30 participants in total. A pilot study of the first individual interview was conducted to confirm the appropriateness of the interview questions. Minor changes included adjustments to the wording of interview questions to align more closely with the vernacular of the study population. Data collection continued until the same patterns emerged in the data, and data saturation was achieved. Thick description was used during data collection. The objectives of the study were to describe participants' views of play as one form of verbal and non-verbal interaction with their own children. The researchers also wanted to describe how participants created a nurturing environment for their infants' play engagements. The antenatal clinic provided free prenatal and antenatal services to the participants. Twelve participants were purposefully recruited from a cohort of all women who attended the antenatal clinic for the period between 28 and 40 weeks of gestation. Nurse practitioners closely observed the health status of all participants and their babies during data collection. Ethical principles used for this study included the use of pseudonyms to keep all the participants' identities anonymous. Although the participants did not benefit directly from their participation, they did receive a contribution of R30 towards transport costs to and from the Community Clinic Maternity Ward, snacks, beverages and a pamphlet on the importance of play for children. The researchers considered the participants' circumstances, their knowledge of what is familiar to them and their culture to ensure respect and dignity throughout the process.

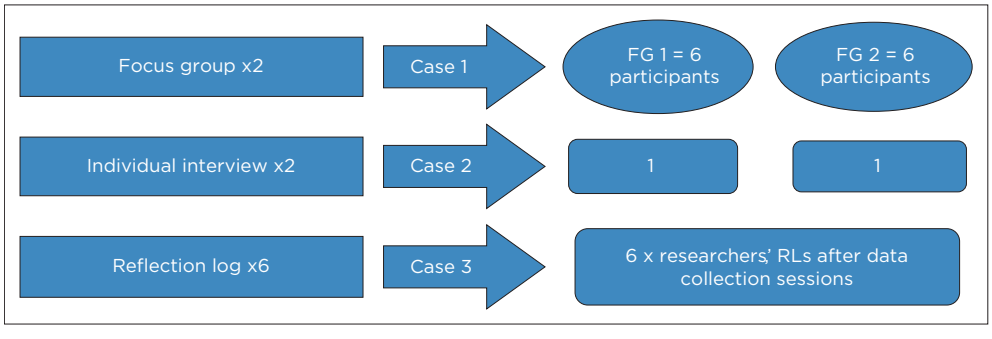
When conducting interviews, the participants' frame of reference, thoughts, values and backgrounds were respected. Participants' right to confidentiality, freedom of choice, freedom of speech and the freedom to communicate in the language they were most comfortable with were also upheld. The participants engaged in this study on their own account and understanding that they could withdraw at any point during the research

process without negative consequences. Only information-rich participants were recruited for individual interviews.

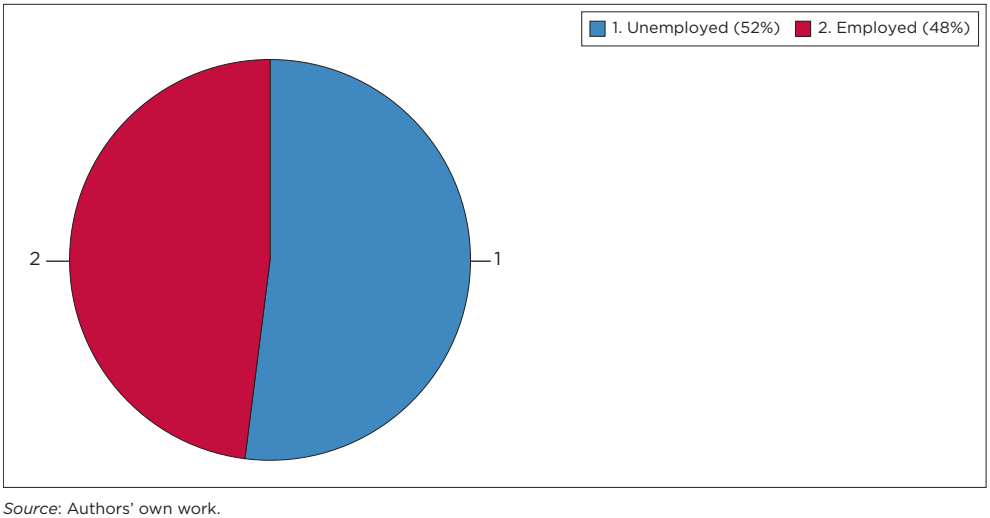
Selection criteria

Participants had to:

1. Be of legal age (18 years and older)
2. Have had at least one child between the ages of 0 and 24 months at the time that the research study was conducted
3. Be consistent in attending monthly antenatal clinic appointments from the initial appointment or from 28 weeks of gestation within the previous six months of clinic attendance
4. Be readily available to attend the antenatal centre for the week during which data were collected.



Source: Authors' own work.
Key: FG, focus group; RL, reflection log.
FIGURE 12.1: Multiple collective case study: Focus groups.

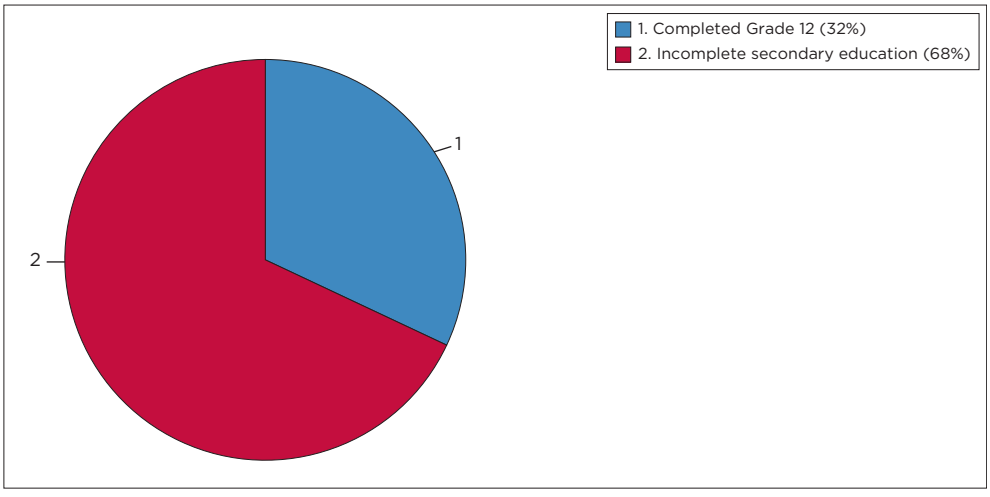


Source: Authors' own work.
FIGURE 12.2: Pie chart depicting the employment status of participants.

TABLE 12.1: Demographics of focus group participants.

Focus group (Case study)†	Participants (*n*)‡	Language§	Primigravida participants (*n*)¶	Participants with two children or more (*n*)††
1	7	Afrikaans	2	5
2	5	Afrikaans	3	2
3	6	English	0	0

Source: Authors' own work.
† Case study number for each focus group.
‡ Total number of participants in the focus group.
§ Language selected by participants for data collection.
¶ Number of first-time pregnant participants (primigravida).
†† Number of participants with two or more children.



Source: Authors' own work.
FIGURE 12.3: Pie chart depicting the participants' highest level of education.

Data analysis

The researchers employed an inductive approach to analyse the collected data. The following steps were used (Thomas 2006): (1) All transcribed files were prepared by arranging them with a common layout. Backup files of all the data were created, and hard copies of the original data were printed. (2) The researchers closely read though the transcripts to familiarise themselves with all data. (3) The researchers studied the data by reading through it multiple times and created 226 codes. A code was defined as a unit of meaning (Thomas 2006). (4) Attention and precautions were applied when creating and handling the codes. Parts of the text that were coded under different categories of the same theme were revised until the best match under one category could be found. It was acceptable if there were parts of the transcribed text which were not coded because the information may not have been relevant to the aim of the research project.

The data were continually refined during the study. All of the codes and themes were subcategorised. This ensured that all the data were

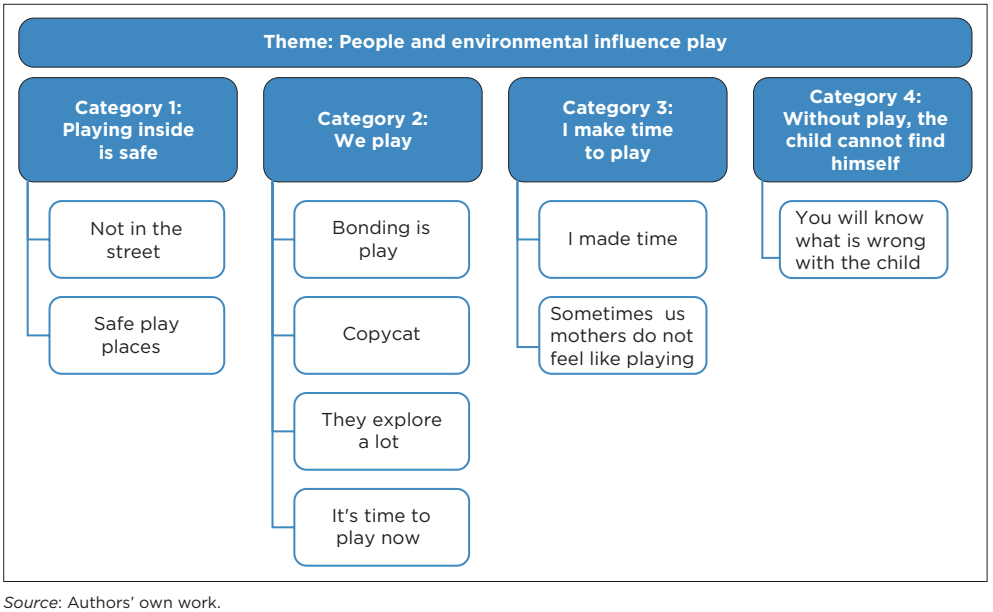
grouped according to relevant subcategories (Thomas 2006). Therefore, the data coded were grouped into subcategories based on their similarities. The subcategories were then further grouped into four categories. These four individual categories contained correlated information, which led to the formation of a theme. The main theme was thus identified.

Trustworthiness and rigour

Credibility (giving a true representation of participant perspectives), transferability (application to other contexts and scenarios), dependability (clear research strategy and consistent findings) and confirmability (findings supported by the collected data) were implemented to ensure trustworthiness of the study (Birt et al. 2016; Elgin 2008).

Results

Inductive data analysis yielded one theme, namely 'people and environment influencing play'. The main space in which play took place was inside a room in the house. As the babies of participants were still very young at the time of the research, most time was spent inside the home. The nature of the games was exploratory and facilitated interaction between the infant and the primary caregiver. Nine subcategories, four categories and one theme are discussed in Figure 12.4.



Source: Authors' own work.

FIGURE 12.4: Themes, categories and subcategories.

Theme 1: Category 1: Playing inside is safe

In a community where violence is common, the options of playing outside are limited.

Subcategory 1: Not in the streets

Participants acknowledged that the communities they live in are unsafe.

Jenny (group 2 participant, Afrikaans) stated:

> […] the violence in the environment. The people shoot, children go missing, [children get] rape (d). So, you think about all those things.

A play space for older children was the street because of the absence of structured play spaces in the community, but because of the participants' safety concerns in their neighbourhoods, they do not want their children playing in the streets.

Anna (group 1 participant, Afrikaans) stated:

> Inside of the yard, just in the yard not outside of the yard in the street because we know and can hear the shooting and so. The bullets do not ask and tell you who they are going to hit. Yes, so it is better to play inside of the yard and then we know they are safe.

Lana (group 1 participant, Afrikaans) stated:

> I will tell them [my children] they must play in the yard or in the house. Not in the streets, especially not how it is outside now with the gangs and shooting.

Subcategory 2: Safe play places

This category focuses on the main areas where the primary caregivers want their children to play in the house and where the child and primary caregiver will mostly engage, given the safety concerns mentioned in the above category. The play space within the home has been described as either the child's room or a room where the primary caregiver and child are together, with the primary caregiver supervising the child.

Debbie (group 1 participant, Afrikaans) stated:

> I prefer that she rather plays in her room. The two of us alone or she on her own but not outside of the house.

The above-mentioned statements explain that the primary caregivers believe that, because of the barriers in the environment and the presence of violence, it is safest for the children to be playing in their rooms inside the house.

Theme 1: Category 2: We play

This category confirms that participants value play during childhood and that they do play with their children when possible.

☐ Subcategory 1: Bonding is play

This first subcategory explores how participants encourage their children to interact with them through talking, singing, facial expressions and ultimately bonding.

Anna (group 1 participant, Afrikaans) stated:

> It is important to bond with your child so that they know you are their primary caregiver.

☐ Subcategory 2: Copycat: They sometimes do what I do

Wanda (group 1 participant, Afrikaans) described how her child began copying the words she heard and the actions she saw performed by those in the child's presence.

> Like being a role model for your children; they learn from us.

Thandi (group 2 participant, Afrikaans) suggested that children use role-modelling (of the primary caregiver) as a method of learning how to play. Imitating their parents while playing occurs through observation and listening, which results in the development of language and social skills.

☐ Subcategory 3: They explore a lot

This subcategory addresses the participants' view on the development of the child's awareness of their own bodies and the environment.

Ingrid (group 2 participant, Afrikaans) has a 10-day-old baby, and she explains how she engages with her infant. She also has older children and spoke about their experience.

> Yes, they play with a rattle, but then I must have one also to make noise together. Then, they put them in their mouths if they are teething. They play a lot with soft balls too, kicking it around [...] They threw us with toys or unpacked the pots and pans.

Rene (group 2 participant, Afrikaans) has a 5-day-old baby. She spoke about the activities the child engages in between the ages of 0 and 24 months.

> They [the children] will be more energetic [...] busy and crawl on the ground [...] they are all over the place and busy crawling and doing their own thing really.

☐ Subcategory 4: It's time to play now

This subcategory refers to the cues the baby gives to indicate when they want to play. The cues and signs the babies give with their faces or body language are mostly understood by the primary caregiver. In the interviews, the researchers realised that even first-time primary caregivers could

recognise the signs by just spending time with their baby and connecting with them.

Wanda (group 1 participant, Afrikaans) stated:

> He cannot say what he wants to do, so he uses his crying or sounds like 'uhmm uhmm' all the time, then I know now he wants to interact now.

Berna (group 1 participant, Afrikaans) stated:

> My child was alone, there were no friends. So, if she lies down, she points and laughs, then I know she wants to play. And then we play together.

This highlights that the primary caregivers have good ideas of what their children need and when they need it. They can read the facial cues and recognise the different types of cries that the babies give. This can only be learned by spending time with their children.

Theme 1: Category 3: I make time to play

Two subcategories emerged under this category that either highlight the time a primary caregiver makes to play with her child or her lack of time and willingness to play with the child because of other tasks.

Subcategory 1: 'I made time'

Anna (group 1 participant, Afrikaans) stated:

> Normally, with my first child, I made time in the day to play so it became a routine; and then we had a specific time to play.

These statements of the primary caregivers reflect their understanding of the importance of spending time with their child and making that time available in their daily schedules or taking a short leave from work to make time for play.

Subcategory 2: Sometimes us mothers do not feel like playing

In contrast to Anna's (group 1 participant, Afrikaans) statement above, Debbie (group 1 participant, Afrikaans) stated:

> We must do things in the house.

This subcategory emerged after the primary caregivers began speaking about how their employment or household chores and tasks leave less time to play with their child.

Anna (group 1 participant, Afrikaans) stated:

> Because we are always making food, cleaning the house, we have little time in the day.

Their household chores are mentioned the most out of all their tasks: the amount of time in their day it takes up, and how much of time this leaves for playing with their child. This explains how the primary caregiver feels her play interactions with her child are influenced by her work and free time.

Most participants view their playtime with their child as only occurring when they are not working or engaged in household chores. Free time seems to be a determinant for playing with their child. They do not view their interactions with their child, or tasks such as play, in the same light as doing chores.

Theme 1: Category 4: Without play, the child cannot find himself

This category emphasises the participants' view that they can identify limitations through play and that a child develops certain skills and abilities because of play.

The subcategory called 'You will know what is wrong with your child' highlights the assumptions participants had regarding play and the opportunity to see when something is wrong with their children.

Wanda (group 1 participant, Afrikaans) stated:

> Without play, the child cannot find himself. He is not going to know who he wants to be.

Jenny (group 2 participant, Afrikaans) stated:

> Through play, children's physical strength can develop.

The participants understand that through play, their children can create their own identity, and physical strength can be promoted.

Participants preferred that the infants play inside their homes. The reasons for not allowing their children to interact with play environments outside the home stem from fearing for the safety of their children.

During the first two years of the baby's development, it often practical to spend more time playing inside the house, mainly with the primary caregiver. One participant stated that her boyfriend takes responsibility for playing with their child.

Discussion

The findings demonstrated that the primary caregivers, close family members and the community environment influence play.

Playing inside is safe

During early childhood, a lack of play activities can negatively affect childhood development and interfere with crucial stages of identity development. Although caregivers keep younger children from playing outside because of violence in the area, the fact that children are unsafe when they play outside, regardless of their age and stage of development, is alarming. Despite the participants' appreciation for the importance of play during early childhood, safe play spaces outside the home environment are not available in the study community.

Carver, Timperio and Crawford (2008) explain that a child's engagement and participation in play activities are 'negatively' influenced by crime in the local communities. Sturges et al. (2023) added that a caregiver should ensure that the physical environment gives her children the opportunity for independence and autonomy, with a range of areas that are safe to explore and play. A child's development may be repressed if they are not able to access opportunities for play (Cohen 2018).

The first form of play, as identified by some of the participants, was bonding with their baby. The participants at this first stage of early life suggested that they wanted to form an attachment with their baby and vice versa. It is essential for the development of the baby that the caregiver and baby form an attachment, as a child with a healthy and secure emotional attachment develops the foundation of trust and safety, which can influence the child's confidence and willingness to explore their environment. (Salehi & Kohan 2017). The participants recorded themselves using facial expressions, singing and talking as a form of play with their baby to develop and strengthen their bond. This is known as 'explorative play', which refers to the sensorimotor stage of play. According to Takata (1974), in this stage the infant's communication is initially characterised by exploration, which includes observing facial features, touching, babbling and listening to their caregiver's voice, which in turn leads to repetitive experiences which is the start of reciprocal interaction (Bernard 2013).

The findings confirm that primary caregivers value and support play during the sensorimotor, symbolic and simple constructive play stages, as children can still play inside the safety of their homes. The findings further demonstrate that primary caregivers keep their children inside the house for as long as possible, as the environment outside the house is unsafe because of gang violence. Participation in dramatic, complex, constructive, as well as pregame, game and recreational stages of play during later childhood is therefore compromised because of crime and violence in the study community.

We play

The participants have conveyed their opinion that play can be a helpful tool in observing whether there can be any limitations regarding their children. By observing their children while they play, they will be able to see whether they have any physical problems. Anna (group 1 participant, Afrikaans) also stated that through play, children develop physically and mentally. It is also said that play contributes to the development of a child. Children who grow up in the study community may be stunted in their play development because of the restriction of participation in the stages of play later in childhood (4–16 years). The skills developed during these stages are prerequisite skills for social participation in circles outside the nuclear family during adolescence and adulthood.

Wanda (group 1 participant, Afrikaans) stated both in the group and in the individual interview that if a child does not play, he will not be able to find himself and create his own identity. According to Winston and Chicot (2016), there have been numerous studies suggesting that forming a social bond in the early stages of life is very important (Winston & Chicot 2016). It has an influence on how we relate to other people in our lives and how good we are at forming sustainable relationships. Earlier (Kochanska & Kim 2013) confirmed links between early security in the child's early relationship and future adaptive developmental outcomes. Security or insecurity therefore has an influence on how we relate to other people later in our lives and how good we are at forming sustainable relationships. Children learn by observation and, in turn, learn from social bonds that they have observed and experienced. This includes learning to effectively listen, being mindful of others' emotions and feelings, as well as taking action to benefit others. Therefore, a family dynamic that is healthy (encouraging, supportive) is fundamental for the core development of a child and formation of strong future relationships (Osher et al. 2021).

I make time to play

An influencing factor of a child's cognitive development during infancy is the quality of the primary caregiver's involvement (Rocha et al. 2020). This study included participants who were either working (away or from home) or those who were unemployed or on maternity leave. The available time and quality of interaction during this period with their child will be affected. According to Goldstein (2012), primary caregivers need to find time to play with their children by setting aside a specific time in their daily schedules, with few distractions, thus establishing a regular habit (Goldstein 2012). From the findings, it was noted that some primary caregivers understood the importance of this daily playtime. Jenny (group 2 participant, Afrikaans), for example, temporarily took some time off

from her work and studies to spend more beneficial time with her child. Although the strategy to take time off work may be viable in some families, the choice to stop working versus not having a choice but to keep working because of childcare financial demands may exacerbate the financial and socio-cultural status of the family (Atashbahar et al. 2022).

Some participants who were involved in multiple domestic tasks that include family, household and work responsibilities, incorporated play during childcare tasks, such as playing peek-a-boo while dressing. While acknowledging the importance of play, others prioritised their responsibilities related to their role of caregiving above playing with their toddlers. Participants may prioritise work or chores over spending time with their child. This leaves little free time, and during the free time that they do have available, primary caregivers may feel too tired to play with their children. The findings support this, as participants reported they feel that their play time with their child occurs only when they are not engaged in other activities. It has been found that having free time seems to be a determinant for playing with a child. According to all the participants, engagement with their child while doing chores or other tasks is not seen as play.

Without play, the child cannot find herself

Children develop self-identity and begin to form connections and relations through play (Pui et al. 2020). Jenny (group 2 participant, Afrikaans) stated that play makes children's bodies stronger. Although participants did not specify how play specifically strengthens a child's body, Jenny (group 2 participant, Afrikaans) suggested that play has the potential to develop the physical strength of children. Although parents would like to keep their children safe, play opportunities may highlight physical impairments, especially if children struggle to do certain things. This finding is in keeping with work done by Adi, Masgumelar and Fathoni (2022), who suggested that gross motor activities could strengthen upper body strength. In support of the notion that children learn physical, social, cognitive and language skills through play during the early years of child development (Parker & Thomsen 2019), Lana (group 1 participant, Afrikaans) stated that play allows young children to communicate with peers and family members, which promotes their social skills. During the early years of childhood, crucial development of the brain occurs, and a lack of play activity can negatively impact the child's cognitive development, which is a crucial stage for identity development (Nijhof et al. 2018).

Participants agree that play with children between the ages of 0 and 24 months is vital in development. The general view, according to the participants, is that their children participate in a social manner (verbally or non-verbally) with peers and/or family members when playing.

They mentioned that they will always allow family members to play with the babies because it is important to play.

It seems common for every situation that parents may not feel safe taking their children to play parks within the neighbourhood and prefer their babies to play inside the house or room, or inside the yard. The limitation would therefore be that children aged between 0 and 24 months are restricted to playing inside the house, mainly with the primary caregivers, with one primary caregiver stating that her boyfriend takes responsibility for playing with her child.

Thus, the primary caregivers view play as an important occupation in early childhood development, specifically for the achievement of milestones and the formation of identity. Ironically, primary caregivers did not question the fact that their children's right to safe play spaces was denied. Further research can be conducted about the rights of children to safe play spaces. This could inform occupational therapists on the role that they could play in creating supportive and stimulating environments for primary caregivers and their babies at risk of ill-health. In exploring the views of primary caregivers on the importance of play, the researchers were also able to identify the educational and other support needs of these populations. Play has been identified as an intervention to achieve developmental goals and is an age-appropriate form of participation between a primary caregiver and child (Lynch & Moore 2016). Moore and Lynch explain that play is an occupational domain of childhood and known to be the window into the child's socioemotional and cognitive development (Moore & Lynch 2015).

Limitations

Because of the limited number of participants, the findings from this study cannot be generalised to other populations. The transferability of the study was ensured by providing detailed descriptions of the research context and methodology. As a result of time constraints, primigravida and multigravida primary caregivers participated in the same group interview; multigravida primary caregivers may have drawn on past experiences to answer the questions, thereby influencing primigravida caregivers' viewpoints and responses.

Conclusion

The main finding of this research is that the environment outside of the house was not safe for children to play. Participants therefore created play spaces in a room inside the house, and children mainly played with primary caregivers. Participants viewed play as an important activity for identifying developmental delays as well as for identity development of children. For healthy

development, play is an important occupation as the child explores their own body and the immediate environment. The safe and supportive environment will elicit belonging and inclusion for the child. When the primary caregiver is physically and emotionally available to interact with the child, the child will have a positive social interaction. Poor socio-economic circumstances beyond the primary caregiver's control may influence a primary caregiver's capacity to provide support for play development. The quality of participation and the creation of a supportive environment may be negatively affected by factors such as violence in the community.

Although children between the ages of 0 and 24 months are not expected to play unsupervised in the neighbourhood, an unsafe environment may inhibit their exploration through interaction with other children in play parks and in the neighbourhood in the later stages of play development. The participants identified play as an important occupation in childhood development but did not express concern for their children's right to safe play spaces. Occupational therapists need to advocate for the rights of children to engage in play as a health determinant, as well as for safe play spaces in South Africa.

Recommendations

Future studies could explore participants' knowledge of play as a right for child development. Comparisons could be made across various cultural, economic and geographic groups. Individual views of what play is, as well as the importance of play during different stages of child development, may inform occupational therapy prevention initiatives towards enhancing maternal and child health outcomes. A cross-sectional study to identify the educational needs of first-time primary caregivers at all primary health care clinics could further inform occupational therapy contributions. In communities where violence and gang-related activities are rife, children are restricted to the safety of their homes. Restricted movement to school and recreational spaces in the community may stunt their personal and social development. Occupational therapists can establish and advocate for the importance of play as a form of social participation between primary caregiver and child by creating interventions that address the importance of play as a precursor to the development of appropriate social skills.

Declarations

Ethical considerations

The Health and Research Ethics Committee at Stellenbosch University approved the study (U17/11/056).

Consent

Consent was obtained from the Western Cape Department of Health as well as from parents and guardians at a local primary health care clinic.

Author contributions

Lizahn Cloete: Conceptualisation, Formal analysis, Methodology, Project administration, Resources, Supervision, Validation, Writing – original draft, Writing – review and editing.

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Zusange Shweni: Writing – review and editing.

All authors reviewed the chapter, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

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Data availability

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Disclaimer

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Conclusion

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The two themes in this book provide a comprehensive and multidimensional exploration of early childhood development (ECD) and intervention in South Africa. The themes focus on advocacy, access to health and educational services, and contextual relevance and provide a clinical description of the local population. Twelve chapters are included in these two themes.

In Theme 1, the value of social support is illustrated as early prevention and intervention of maternal postnatal depressive symptoms of hospitalised infants. The importance and potential of ECD centres are highlighted as they provide opportunities for nutrition education of staff and caregivers to ultimately improve young children's health outcomes. Furthermore, well-equipped school playgrounds can prevent motor delays in preschool children. Crafting a global ECD strategy specifically tailored for children with disabilities is recommended.

The need for collaboration between medical and rehabilitation professionals and community members is emphasised in Theme 1. The skills, knowledge and perspectives of communities are needed to improve access and to adapt services to be contextually relevant. The importance of prevention and early intervention is emphasised, especially given the high burden of disease in majority world contexts, such as South Africa.

Theme 2 provides information about young South African children, especially those at risk of developmental delays and/or disorders. The chapters indicate that there is a lack of literature supporting the use of neurodevelopmental assessment tools to identify delayed or atypical gross motor outcomes, beyond cerebral palsy, in high-risk infants at 3–4 months corrected age. However, both Prechtl's General Movement Assessment (GMA) with the Motor Optimality Score-Revised (MOS-R) and the Hammersmith Infant Neurological Examination (HINE) have demonstrated good predictive validity in estimating later gross motor outcomes among high-risk infants.

Although not significant, a trend of increased feeding difficulties was noticed in young children with human immunodeficiency virus (HIV) and neurodevelopmental delays compared to those without developmental delays. Another aspect that needs further investigation is the factors that may negatively affect children's language development in South Africa, so that those who require support to achieve optimal language functioning are accurately identified. The case is also made that a health care system that enables coordinated services for children with hearing loss is needed to ensure that these children are followed up and managed as needed. Language, hearing and feeding abilities are important domains of early

childhood development and of the foundation that supports learning in the school years that follow.

Concerning foetal alcohol spectrum disorders (FASDs), it is suggested that balance impairment may manifest more in severe FASD cases, particularly during more demanding balance tasks such as single-leg standing (SLS) with eyes closed. Additional research could be conducted to investigate FASD motor control patterns in greater detail.

In communities where violence and gang-related activities are rife, children are restricted to the safety of their homes. Restricted movement to school and recreational spaces in the community may stunt their personal and social development. Occupational therapists, assisted by other rehabilitation workers, can establish and advocate for the importance of play as a form of social participation between the primary caregiver and child by creating interventions that address the importance of play as a precursor to the development of appropriate social skills.

Collectively, the chapters in this book indicate that collaborative efforts between doctors and health scientists, such as nutritionists, speech-language therapists, audiologists, physiotherapists and occupational therapists, are recommended to provide comprehensive care tailored to each child's unique challenges. In a country with limited health care personnel, such collaboration is necessary for access to holistic early intervention. Furthermore, all academic disciplines with a stake in early childhood development and intervention are needed to create the contextually relevant knowledge to best serve South African children and their families.

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Early childhood development and intervention in a majority world context: A multi-disciplinary perspective, Volume 3 in the Human Functioning, Technology and Health Book Series, presents a curated collection of chapters authored by scholars from diverse professional backgrounds. The volume showcases high-quality research on the intersections of early childhood development (ECD) within the South African social, education and health care context.

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This scholarly volume examines early childhood development (ECD) in South Africa and comparable resource-constrained settings through an interdisciplinary lens. It integrates interdisciplinary perspectives on maternal mental health, nutrition and policy across key ECD domains, including psychosocial well-being, nutrition and feeding, safe environments, play, motor and sensory development, language development and education. By foregrounding contextually grounded responses within global ECD frameworks, the book provides an analysis of relevance to scholars and may also be of relevance to practitioners and policymakers engaged in strengthening ECD systems, policies and advancing equitable outcomes.

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