



**A Descriptive Study Investigating Functional Balance in Deaf School-Aged
Children: Towards the Adaptation and Validation of Subjective
Questionnaires**

by

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Declaration/Conflict of interest

I, Sphilile Mbhele, hereby declare that all of the work in the thesis, except for that which is properly acknowledged, is my own and is in my own words (except where I have attributed it to others). I have used the American Psychological Association (7th Edition) convention for citation and referencing, and this project has been submitted into the Turnitin software.

I have not let, and will not permit, anyone to replicate my work with the goal of passing it off as their own. However, the abstract was submitted, accepted and orally presented at the XXXII Bárány Society Meeting 2024, comprising findings from this study. The abstract was authored by Sphilile Mbhele, Christine Rogers, Peter Rea, Qadeer Arshad, Yougan Saman, and was titled “Does the absence of speech development predict functional balance in older children?”. The abstract was also published as part of the conference proceedings in the Journal of Vestibular Research.

No conflict of interest was noted in this project. The researcher had mainly collegial relationships with the stakeholders involved in this study.

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Signature

Date: 16 December 2024

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Dedications

To my little pumpkin, Uminathi Nina Nxumalo, uyilanga lami, my greatest inspiration. Your laughter, boundless curiosity and burst of energy has kept me going throughout this journey. I hope this work serves as a testament that your potential is limitless and that you can achieve anything your heart desires. May you always have the bravery and courage to pursue your dreams and know that I will always be proud of you. This dissertation is for you.

I love you every day

Glossary

South African spelling is used throughout, with the exception of assessments developed in the United States of America.

Balance – A state of equilibrium maintained by a complex relationship involving sensory and motor function (Melo et al., 2018; National Department of Health, 2023). The optimal function of these sensory systems is necessary for posture, coordinated movements and other components of daily activities such as play and exercise (Daneshmandi & Alyarnezhad, 2020).

Deafness – Hearing impairment that results in limited acquisition of oral communication and language such that other modes of communication such as sign language need to be considered (American Speech-Language-Hearing Association, 1993).

Deaf – Culture and community of people who communicate using primarily sign language. In contrast, the term *deaf* refers to hearing loss that requires audiological intervention (Pendergrass et al., 2019). Therefore, the use of Deaf with a capital letter is intentional in this report, and assists in distinguishing between Deaf (culture) and deaf (hearing impairment).

Hearing loss – May be conductive (involving the outer and middle ear), sensorineural (involving the inner ear and nerve pathways) or mixed (combination of conductive and sensorineural components) (Centers for Disease Control and Prevention, 2020). Hearing loss can occur in all populations and can either be congenital or acquired.

Sensorineural hearing loss – A decrease in hearing acuity as a result of insult to the cochlea, the auditory nerve or the central processing system (Tanna et al., 2021). An interrelationship exists between hearing loss, vestibular deficits, risk of falls and balance dysfunction in children (Vitkovic et al., 2016).

Vestibular system – A system that assists in maintaining balance and equilibrium through the complex coordination of the vestibular, visual and somatosensory system (Morita et al., 2020). This system allows for multi-sensory integration that facilitates stability of posture and gaze (Rine & Wiener-Vacher, 2013).

Abbreviations

BOT-2 – Bruininks-Oseretsky Test of Motor Proficiency, Second edition

CWD – Children with deafness

DCD – Developmental coordination disorder

DHI-CA – Dizziness Handicap Inventory-Child/Adolescent

DoE – Department of Basic Education

DoH – Department of Health

HRQoL – health-related quality of life

HPCSA – Health Professions Council of South Africa

KZN – KwaZulu-Natal

LMIC – Low- and middle-income country

m-CTSIB – Modified Clinical Test of Sensory Interaction in Balance

Mini-BESTest – The Mini-Balance Evaluation Systems Test

NCD – Non-communicable disease

NH – Normal hearing children

PVSQ – Pediatric Vestibular Symptom Questionnaire

QoL – Quality of life

SASL – South African Sign Language

SASLwoS – South African Sign Language without speech

SASLwS – South African Sign Language with speech

SLS – Single leg stand

SNHL – Sensorineural hearing loss

TUG – Timed- Up- and Go

VAS – Visual analogue scale

VEMPs – Vestibular Evoked Myogenic Potentials

Abstract

BACKGROUND: Balance deficits are common in children with deafness. They have an impact on the child's general well-being and holistic development. However, the extent to which children with deafness experience this condition is relatively unknown given the inability of children to communicate their symptoms to healthcare professionals and the lack of self-assessment tools for this population. Although balance function has been studied in literature, the functional impact of balance deficits in children with deafness remains undervalued and under-researched.

OBJECTIVE: To evaluate functional balance by quantifying symptoms of imbalance, balance-related handicap and measuring balance performance in school-aged children with deafness and children with normal hearing between the ages of 9 to 17 years.

METHODS: A descriptive, case-controlled research study was conducted with 155 children; 97 with deafness and 58 with normal hearing of both sexes, between the ages of 9–17 years (mean age 14 years). The PVSQ was used to quantify balance symptoms, DHI-CA to quantify dizziness-related handicap, and the EQ-5D-Y proxy version questionnaire to determine health-related quality of life. Physical outcome measures included visual acuity, the Mini-Balance Evaluation Systems Test (Mini-BESTest) and the Modified Clinical Test of Sensory Interaction in Balance (m-CTSIB).

RESULTS: The PVSQ showed a high internal consistency (Cronbach's $\alpha=0.904$) and construct validity demonstrated good sensitivity (80%) and specificity (90%). The DHI-CA showed similar results with internal consistency of Cronbach's $\alpha=0.949$, and sensitivity and specificity of 80%. Significant differences ($p<.001$) were noted between the two groups. Children with deafness showed reduced balance scores on the Mini-BESTest and m-CTSIB ($p<0.001$), and had reduced dynamic and static visual acuity when compared with children with normal hearing. A significant relationship was noted between the balance tests and the PVSQ and DHI-CA. The EQ-5D-Y proxy version questionnaire indicated that children with deafness experienced difficulties in all five domains, while children with normal hearing showed difficulties in only two domains (*Having pain or discomfort* and *Feeling worried, sad or unhappy*). A correlation was found between the PVSQ, DHI-CA and domain 4 (*Doing usual activities*) and domain 5 (*Having pain and discomfort*) of the EQ-5D-Y proxy version questionnaire.

CONCLUSION: Children with deafness presented with greater balance difficulties than normal hearing children of the same age group. The adapted PVSQ is able to detect symptoms

of imbalance, while the adapted DHI-CA can describe the severity of the handicap imposed by balance symptoms in children with deafness. These tools were able to discriminate between children with impairment versus those from the control sample. Thus, the tools adapted in this study are suitable for identifying balance symptoms and the related impact thereof. These tools will provide invaluable information to healthcare professionals about a child's self-reported balance outcomes, and assist in the subsequent individualisation of therapeutic interventions, ultimately playing a significant role in enhancing the quality of life of children with deafness.

CHAPTER 1: INTRODUCTION

“Blindness separates people from things; deafness separates people from people.”

Helen Keller (Keller, 2024)

Introduction

This study is about understanding the complexities of functional balance in deaf children. Chapter 1 introduces the research study by providing an extensive background into the area of interest. It also describes the underlying research problem, the rationale and the related research question for the current study. The chapter will conclude with an outline of the thesis.

Background of the study

Approximately 32 million children present with disabling hearing loss globally, and in low- and middle-income countries (LMIC), its prevalence rate is 6 per 1 000 live births (World Health Organization, 2016). Hearing loss in children is considered an insidious disorder as it often goes unnoticed, resulting not only in language and communication deficits but also socio-emotional, psychological and academic difficulties (Mulwafu et al., 2016). The most common type of hearing loss is sensorineural hearing loss (SNHL) and gradually progressive hearing loss amongst hearing impaired individuals, including children (Louw et al., 2018; Smith et al., 2005). Soylemez et al. (2019) note that children with SNHL may also present with vestibular dysfunction. The relationship between the two can be attributed to the close anatomical approximation and physiological relatedness of the inner ear sensory structures (Said, 2013; Zhou et al., 2009). The multi-sensory integration of auditory, vestibular, visual and somatosensory input through complex cognitive processes allows humans to maintain posture and balance (Blodgett et al., 2018; Horowitz et al., 2020; Morita et al., 2020). Additionally, sensory input, cerebral processes, and cognition all make significant contributions to coordinated and accurate motor movements (Sadri et al., 2021). These processes assist in daily balance function and play an instrumental part in how we view, interact and navigate through the world (Hazen & Cushing, 2020).

Balance is mediated by the optimal functioning of the musculoskeletal, vestibular, visual, proprioceptive and central nervous systems (Dasgupta et al., 2020). Therefore, any

insult to these systems can result in balance dysfunction (Blodgett et al., 2018; Daneshmandi & Alyarnezhad, 2020; Horowitz et al., 2020; Sokolov et al., 2019; Vitkovic et al., 2016). According to Dasgupta et al., (2020) in children with SNHL, the prevalence of cochleovestibular deficits in children with SNHL was reported to be between 18.75–38.7% and a further 38% of children diagnosed with vestibular dysfunction report experiencing balance problems (Dasgupta et al., 2020). In addition, balance impairments have been noted to be relatively high in children with hearing loss (77.7%) (Ghaffar et al., 2024), and children with deafness (CWD) have also been reported to have greater probabilities of ophthalmologic abnormalities compared with their normal-hearing (NH) peers (Gogate et al., 2016), which could further impede balance function. They may also experience difficulties with coordination and maintaining both static and dynamic balance (Stepanchenko et al., 2020). In CWD, auditory deprivation is the greatest contributor to delays in neurocognitive development, ultimately impacting social and cognitive development (Almomani et al., 2021). The effect on cognitive development presents a barrier to the multi-sensory integration of balance signals, thus further impeding the balance function of CWD (Sadri et al., 2021). The evidence indicates that CWD are likely to experience difficulties with vestibular, proprioception, visual and cognitive function that may ultimately impact their balance and overall function in activities of daily living.

Balance dysfunction in children often results in deficits in the acquisition of motor skills and significant delays in fine and gross motor development (Hazen & Cushing, 2020; Yassin et al., 2020). Children with balance dysfunction will be poorly coordinated and may have difficulty reaching developmental motor milestones like crawling and walking (Ghai et al., 2019; Yassin et al., 2020). They may also report symptoms such as light-headedness, vertigo and frequent falls (Li et al., 2016). When hearing is also affected children may present with impaired biomechanical gait features resulting in slower walking speed and lower limb musculoskeletal instability (Jafarnezhadgero et al., 2017). Such difficulties are associated with increased incidences of falls and injuries. Thus, children with hearing loss have been found to be at increased risk for falls (Fernandes et al., 2015; Ghai et al., 2019; Li et al., 2016; Soylemeza et al., 2019). Globally, more than 400,000 childhood fatal falls occur annually, with at least 80% of these events occurring in LMICs with inadequate infrastructure and housing (Kiragu et al., 2018). Falls in children are a critical adverse effect of imbalance because they can lead to injuries that, in turn, result in increased costs to the healthcare system or even medical morbidity (Chaudhary et al., 2018). Falls are not only a hazard to a child's health, but can also

lead to mortality. The consequences of balance dysfunction in children significantly impact overall development. Therefore, if left undetected, such dysfunction may result in debilitating complications further impeding the child's quality of life (Ghai et al., 2019). Thus, the abovementioned evidence highlights the need for early identification and intervention to curb the adverse effects of balance dysfunction.

Although hearing screening programmes provide early identification of hearing loss, they often do not include balance assessments, except for children with obvious deficits (Martens, Dhooge, et al., 2023; Rajendran & Roy, 2011). Such exclusion ignores the possible balance deficits in those children who are at high risk, such as infants with SNHL, prematurity, low-birth weight, and meningitis (Melo et al., 2018). The high patient caseload in healthcare institutions, time required for testing, equipment, specialized training and confidence in healthcare practitioners are reasons contributing to the low priority given to balance deficits in children with hearing loss (Martens, Dhooge, et al., 2023; Said, 2013; Zhou et al., 2009). Such factors may decrease the likelihood of balance assessment being routinely practiced in audiology. Furthermore, guidelines for professionals such as the *Early Hearing Detection and Intervention* (EHDI) (The Health Professions Council of South Africa, 2018) refer to the use of a multidisciplinary approach to intervention for children with hearing loss but are limited in describing the management of balance dysfunction in children. Thus, a gap exists in both guidelines and regulations that govern healthcare professionals in providing holistic management for CWD.

Several tests can be used to assess balance function in children with hearing loss (Stepanchenko et al., 2020). Literature indicates that these tests can assist in exploring aspects of balance (static and dynamic) (Ebrahimi et al., 2016; Eustaquio et al., 2011; Van Hecke et al., 2021). However, there are currently few instruments that quantify the functional impact of balance deficits in CWD. Questionnaires that assist in obtaining this information in paediatrics include the Vanderbilt Dizziness Handicap Inventory for Patient Caregivers (DHI-PC) and Pediatric Vestibular Symptom Questionnaire (PVSQ) (Doettl, 2017). These tools are predominantly available in English, although translations have been developed for French (Rigal et al., 2024), Spanish (Sommerfleck et al., 2023) and Portuguese (De Souza et al., 2017). However, to date such questionnaires are not available in Sign Language. This becomes a challenge for CWD as processing and comprehension of written language and vocabulary may pose difficulties due to auditory deprivation (Howerton-Fox & Falk, 2019). This is the gap that

this study aimed to address. Therefore, this study translated, cross-culturally adapted and validated the Paediatric Vestibular Symptom Questionnaire (PVSQ) and the Dizziness Handicap Inventory for Children/Adolescents (DHI-CA) from English to South African Sign Language (SASL) to provide suitable tools for CWD who understand SASL. These tools may provide a lens through which the symptomology and impact of balance dysfunction on everyday lives can be understood from the perspective of CWD.

Contextual setting: The study was conducted in KwaZulu-Natal (KZN), South Africa. South Africa is considered an LMIC with a population of 62 million living in nine provinces (South African Government, 2024). Due to the country's socio-economic factors, burden of disease and poor infrastructure (Gordon et al., 2020). A recent article published by Sunday Times revealed the horrific living conditions in which children are subjected to within their educational facilities. The article exposed that deaf and blind children in Polokwane are currently utilizing dilapidated infrastructure (both dormitories and classrooms), unhygienic restrooms and have had no running water since 2023; while situated across a fully equipped mainstream school with running water in the same yard (Abraham & Abraham, 2024). Thus, for the purpose of this study, it was important to conduct a preliminary situational analysis before the commencement of the work.

A situational analysis provides a comprehensive and specific background in which to understand relationships, patterns, interactions or activities that relate to the phenomenon of interest (Martin et al., 2016). Therefore, in March 2022, the researcher visited Schools for the Deaf in the eThekweni district of KZN for this purpose. Many concerns were raised on that visit. Staff described limited healthcare services for CWD before and during their admission at the schools. Lack of service provision was noted across multiple disciplines, including audiology, psychology, social work, physiotherapy, and occupational therapy. Some children at the schools have a primary diagnosis of hearing loss, but no formal diagnosis of other comorbidities although they may be suspected. The primary reason for such issues is the communication and language barrier between the children and professionals at healthcare institutions. The healthcare system fails to provide individuals with deafness equitable access to services due to the low preparedness of healthcare professionals and their limited knowledge and competence in managing these patients (De Souza et al., 2017). Additionally, patients experience dehumanization during consultations, and marginalization due to limited communication and the unavailability of sign language interpreters (De Souza et al., 2017;

Kritzinger et al., 2014). It is thus evident that CWD are currently experiencing a violation of their basic human right of access to healthcare, right to basic needs and a right to protection (Constitutional Court of South Africa, 2017), which ultimately leads to late identification and intervention, thus, fuelling the impact of adverse effects on development and the therapeutic prognosis (Hazen & Cushing, 2020; Ionescu et al., 2020).

Preview of the dissertation

The next chapter (Chapter 2) reviews literature related to the research area, rationale and conceptual framework. Chapter 3 discusses the research aim, objectives and methodological framework used to achieve the study purpose. Chapter 4 presents the results of this study and Chapter 5 provides a comprehensive discussion of the study findings, recommendations and the conclusion. Figure 1 illustrates the flow of this dissertation.

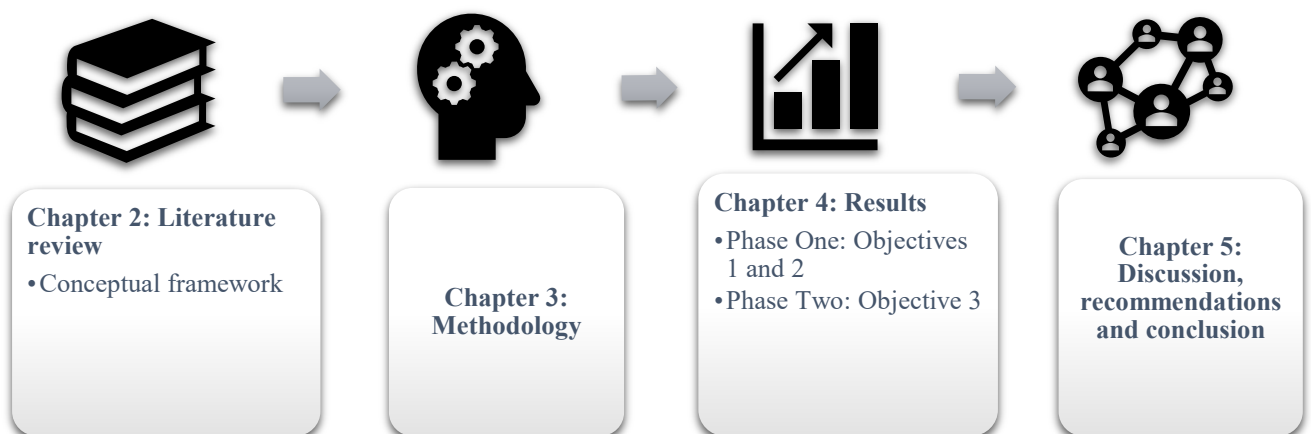


Figure 1: Overview of the chapters of this research study in relation to the objectives

CHAPTER 2: LITERATURE REVIEW

“I think the deafness affects me more than I realise; I think it makes me more tired. I loathe parties. I attend, smile and leave.”

Stephanie Beacham (Beacham, 2024)

Introduction

This chapter reviews contextual and international literature regarding balance and vestibular dysfunction in children, functional balance and the dynamics at interplay with these factors. The chapter will highlight the research gaps that prompted the formation of the research question, the rationale and the researcher’s positionality.

Hearing loss in children

Hearing loss has been deemed a leading cause of disability in the world (Neumann et al., 2019). The World Health Organization estimates that over 466 million people were living with disabling hearing loss in 2018 and this figure is likely to increase as the global population increases (World Health Organization, 2018). More recently, WHO states that at least 1 in every 10 individuals will present with disabling hearing loss (World Health Organization, 2024). The number of people with disabling hearing loss is likely to increase to 630 million by 2030 and over 900 million by the year 2050, with rapid increases seen in regions such as sub-Saharan Africa (World Health Organization, 2018).

Hearing loss may occur at different parts of the auditory pathway and can, therefore, be categorized as conductive hearing loss, mixed-hearing loss or SNHL, and may range in severity (Dimitrov & Gossman, 2023). Eksteen et al. (2022) found that at least 90% of children with sensory issues such as hearing loss, live predominantly in LMICs like South Africa. In South Africa, the prevalence of hearing loss in preschool children was estimated to be 22 per 1000 (Eksteen et al., 2022). This population is also known to be the most susceptible to infectious diseases of the outer and middle ear causing a conductive hearing loss (Biagio et al., 2014). According to Banda and Nakstad (2021), SNHL is the most common type of hearing loss in the paediatric population and it is estimated that profound hearing loss affects at least 1 to 2 per 1000 infants in Western countries (Banda & Nakstad, 2021). Furthermore, SNHL is estimated to affect approximately 0.5 to 5.0 of every 1000 newborns, and may be higher in LMICs (Neumann et al., 2019). These statistics are alarming because hearing deficits are

associated with reduced developmental outcomes in children. Later in life, hearing loss increases the risk for cognitive decline and the development of dementia (Di Stadio et al., 2021). The presence of severe hearing impairment increases risk for all-cause dementia at least 4.94 times more than in normal hearing individuals (Kim et al., 2018; Lin et al., 2011).

Hearing screening has been used to identify hearing loss in infants and children. Early detection of hearing loss enables healthcare professionals to provide timely interventions and therapeutic services (Kosmidou et al., 2021). Early identification and intervention have positive effects on developmental, cognitive and academic outcomes (Kosmidou et al., 2021). Although the hearing screening of every neonate (universal newborn hearing screening) has been implemented in many countries globally (World Health Organization, 2021), it has not been feasible in South Africa due to challenges of limited staffing, financial resources and infrastructure (Bezuidenhout et al., 2018). Thus, hearing screening of those children who are at higher risk of hearing impairment (targeted newborn screening) has been suggested for this context, although it has not been formally and systematically employed (Bezuidenhout et al., 2018; Khoza-Shangase, 2021). Literature suggests that this approach can potentially miss at least 50% of children with hearing loss (Bezuidenhout et al., 2018), creating a possibility of children with hearing loss being identified later in life – discussed in the section that follows.

Banda and Nakstad (2021) suggest that in Africa children with hearing loss are likely to be identified late. In South Africa specifically, the mean age of diagnosis was found to be 2.24 years for the private healthcare sector and 3.71 years for the public healthcare sector (Butler et al., 2015). Regrettably, this belated identification affects most South African children, who receive healthcare services in the under-resourced public health sector, with only a minority of people able to afford private care (Achoki et al., 2022). Significant delays in language, communication, cognition, behavioural and emotional issues, and higher risk for learning disabilities are attributed to late diagnosis (Banda & Nakstad, 2021; Butler et al., 2015; World Health Organization, 2016). When hearing loss is identified late, the subsequent interventions and related therapies to remediate these effects are also provided late. In South Africa, even when children are identified, access to re/habilitative services is often limited with an estimated 90% of hearing impaired children not receiving them (Casoojee et al., 2021). Factors such as socioeconomic status, race, culture, language, and the child's age affect the implementation of interventions for children with hearing loss (Gentili & Holwell, 2011;

Naidoo & Khan, 2022), further hindering successful developmental outcomes for these children.

Regardless of early identification and intervention services, some children diagnosed with hearing loss may never catch up with their normal hearing peers (Heinrichs-Graham et al., 2021). Literature states that children with more profound degrees of hearing loss experience more significant adversities, including more behavioural problems related to attention deficits, distractibility, anxiety and impulse control (Carpenter & Campos, 2020; Hedayatjoo et al., 2020). During social interaction, CWD may deviate from social norms and display problematic behavioural patterns, altered moral reasoning, and reduced trust of the environment (Roksandic et al., 2018), thus affecting peer interaction (McPhillips, 2015). In addition, children with profound hearing loss may develop at a slower rate than their peers with normal hearing, with comprehension, reading and literacy significantly delayed (Banda & Nakstad, 2021; Dall et al., 2022). Hearing impairment is not the sole factor contributing to psycho-emotional or cognitive issues in many cases. However, it places children at greater risk of such problems (Gentili & Holwell, 2011). The interaction between hearing loss, environmental factors, familial dynamics, societal and cultural influences can influence a child's overall development (Gentili & Holwell, 2011).

Dysfunctions associated with hearing loss in children

Vestibular issues in children with hearing loss

The vestibular system assists in maintaining balance and equilibrium through the complex coordination of the vestibular, visual and somatosensory system (Morita et al., 2020). Such coordination allows for multi-sensory integration that facilitates stability of posture and gaze (Apeksha et al., 2021), making it possible to execute activities of daily living. In children, the structure of the vestibular system is complete from birth, but its maturation is a gradual process. Absolute maturation and related skills such as integrating sensory information and resolving sensory conflicts is reached between the ages of 11 to 15 in normal-developing children (Hazen & Cushing, 2020).

Several factors can negatively affect the vestibular system. These include neurological conditions, ear and hearing disorders, genetic syndromes, traumatic brain injuries, post-operative complications, medication, visual disorders and sensory disorders such a hearing loss (Li et al., 2016). Hearing loss has been found to increase the risk of vestibular deficits (Martens

et al., 2020; Raj & Gupta, 2017). The association is attributed to the anatomical proximity of the cochlea and the vestibular end organs and their anatomical and functional interrelation (Raj & Gupta, 2017; Wang et al., 2020). Thus, it is unsurprising that at least 50% of children with SNHL present with concurrent vestibular deficits (Sokolov et al., 2019; Wang et al., 2020). Hearing loss in children has thus been recognized as a comorbidity for vestibular dysfunction, along with chronic middle ear infections, head trauma, intrauterine infections and premature birth (Rine, 2018). Vestibular dysfunction in children with hearing loss can result in further morbidity (Wang et al., 2020).

At least 30–74% of children with profound SNHL presented with vestibular dysfunction (Janky & Givens, 2015), and the prevalence increases in children with bilateral profound SNHL (Ghai et al., 2019). Children with this degree of hearing loss may also experience functional impairments, such as developmental delays, dizziness and difficulty reading (Singh et al., 2022). Furthermore, children may experience symptoms of imbalance, gait abnormalities, uncoordinated movements and frequent falls, leading to reduced ability to engage in age-related motor skills such as enjoying playground activities (Melo et al., 2018; Soylemeza et al., 2019). Walking speed has been referred to as the “6th vital sign” as it can indicate an individual’s health and functional capabilities, therefore can be an important predictor for morbidity and mortality (Middleton et al., 2015). Vestibular dysfunction may also impact on cognitive development, socio-emotional development and literacy. Such children may later experience learning difficulties, developmental delays and poor academic performance (Martens et al., 2020; Melo et al., 2018; Rine & Wiener-Vacher, 2013).

Factors like degree of severity, age of onset, and neuroplasticity of the brain mean that children with vestibular deficits may be able to complete everyday activities as long as they do not exceed the threshold of their compensation. In many cases, this results in the significance of vestibular deficits being underappreciated by families and healthcare professionals (Hazen & Cushing, 2020). Furthermore, children are unable to effectively communicate their symptoms, which further contributes to the underdiagnosis (Antoine et al., 2017; Ionescu et al., 2020; Martens et al., 2020). Due to the similarities in presentation between vestibular deficits and other medical conditions, children are often misdiagnosed and inappropriately managed (Crunkhorn et al., 2023). For example, congenital vestibular deficits may be mistaken for neurological conditions such as cerebral palsy or cerebellar ataxia (Antoine et al., 2017). Without awareness of such issues, particularly in children with severe to profound SNHL, the

insidious effect of these deficits may continue to impact childhood development. Thus, there is a need for appropriate assessment procedures and subsequent intervention opportunities to improve the health-related quality of life (HRQoL), social participation and overall functional abilities of CWD.

Balance dysfunction in children with deafness

Activities in everyday life require an interaction between cognition and sensory systems such as the visual, somatosensory and vestibular system to maintain balance (Carpenter & Campos, 2020; Melo et al., 2018). Postural control is an integral part of this process. The ability to maintain posture while stationary (static) or during movements (dynamic) is important for coordinated movements; this is what is operationally referred to as static and dynamic balance (Rajendran & Roy, 2011). In addition, hearing allows children the ability to monitor, localize, react and perceive their movements in space, thus also contributing to maintenance of balance (Carpenter & Campos, 2020). Balance is the functional outcome of these components (Ebrahimi et al., 2017) and is essential for motor development in children (De Kegel et al., 2011; Yanovich & Bar-Shalom, 2022). It allows children to interact with their environments and participate in everyday activities such as running, jumping or skipping, or practice sporting activities (Melo et al., 2019). Ultimately, such activities result in the holistic development of personality and overall physical fitness (Sadri et al., 2021).

Injury to either the auditory, vestibular, visual or proprioceptive systems often results in conflicting signals being sent for processing in the brain. The presence of conflicting sensory input consequently affects sensory integration, leading to balance dysfunction (Melo et al., 2021). Literature describes a higher incidence of balance dysfunction in CWD (De Kegel et al., 2011). Children may experience abnormalities in gait patterns and parameters, and demonstrate greater width when walking (Melo et al., 2019; Van Hecke et al., 2019). They may also present with poor coordination and visual-motor skills, clumsiness, and delayed reaction time (Hedayatjoo et al., 2020). Ebrahimi et al. (2017) investigated postural control through measuring the velocity of the centre of pressure (COP) in 81 CWD between 7 to 12 years. The study found that CWD displayed reduced postural control and overall reduced sensory organization compared with the NH control group (Ebrahimi et al., 2017). Similar outcomes on reduced postural control in CWD were also noted in other studies (Derlich et al., 2011; Melo et al., 2015). These findings show a good correlation between profound hearing loss and

balance function, which may ultimately affect participation in academic and sporting activities of CWD. Thus, it behoves healthcare professionals to look deeper into the impact of hearing loss, including all the aspects affecting a child's life.

Melo et al. (2017) investigated static and dynamic balance in 96 children between the ages of 7–18 years, 48 of whom had SNHL. The findings indicated that children with hearing loss had reduced performance in both static and dynamic balance when compared to those with normal hearing. Similar findings were obtained by Karakoc and Mujdeci (2021) who noted poor static and dynamic balance, functional balance and mobility in children aged 6–15 years with SNHL compared with their normal hearing peers (Hedayatjoo et al., 2020). In further work with children aged 7–11 years, Melo et al. (2021) found that static balance was impaired in children with severe and profound SNHL compared to children with normal hearing. Combined, the findings by these authors highlight the presence of balance impairments in CWD when compared to NH children, and further draw attention to the need for appropriate intervention with this population. Interestingly, these studies indicate the feasibility of performing clinical balance assessments with children who have limited spoken language acquisition: the authors provided instructions in sign language. This further underscores the rationale for the current study, suggesting that differences in language should not be a determinant for access to healthcare services.

Children with deafness experience an array of deficits and related symptoms. Balance function needs to be intact for a child to stand still without movement, initiate motor movement, coordinate the movement or stop moving (Melo et al., 2024). Importantly, balance dysfunction has physical health and fitness implications for young children; children with disabilities experience reduced health-related fitness due to both physical and psychosocial factors (Ellis et al., 2013). Moreover, a higher prevalence of obesity and overweight has been recorded in CWD, in turn linked to reduced physical activity (Shavel et al., 2021; Stough et al., 2016) and ultimately increasing the risk for developing non-communicable diseases (NCDs) such as hypertension or diabetes. Tension between managing communicable and non-communicable diseases is often noted in resource-constrained settings such as Africa, resulting in limited access to healthcare services, and un- or sub-optimally treated NCDs (Mawani & Chiluba, 2020). In addition, multiple layers of inequality in South Africa mean that persons with disabilities are disadvantaged in multiple ways, further compounding the challenges of accessing services (McKinney et al., 2021). Young children in developing countries who need

support to manage a balance or vestibular deficit are often disadvantaged when rehabilitation is viewed as a putative ‘luxury’ rather than a necessity, given that many NCDs are linked to lifestyle issues (Stucki et al., 2017).

Balance assessment in the South African context

South Africa is a developing country faced with many challenges in its healthcare system. Financial mismanagement, human resource shortages, high patient case-loads, medical negligence and poor staff attitudes have been noted as factors contributing to the evident crisis (Aikman, 2019). These challenges were exposed by the country’s response to the COVID-19 pandemic, where barriers to accessing healthcare services were exacerbated especially for individuals from lower socioeconomic backgrounds (Lalla-Edward et al., 2022; Moon & Falick Ascher, 2021). Furthermore, a sharp increase in non-fatal burden of disease and NCD risk factors was noted, with significant implications for the healthcare system (Achoki et al., 2022).

Provision of hearing healthcare is imperative in relation to the disability caused by hearing loss. In the South African public healthcare sector, Bhamjee et al. (2022) found that hearing healthcare is compromised by the lack of resources such as audiological equipment, audiologists, appropriate infrastructure and finances. Persons with disabilities experience the burden of limited services even more intensely as they face health, social and economic inequalities (Pillay et al., 2020). Of 3266 registered audiologists and/or speech therapists¹ in South Africa, 18.9% were audiologists. Specifically, in KZN, the setting for this study, the service provision ratio was 0.53 audiologist per 10 000 people (Pillay et al., 2020). In addition, literature suggests that 78% of African countries utilize one audiologist per one million people (Bhamjee et al., 2022). Hearing healthcare services that *are* provided by audiologists mainly prioritize communication and social skills affected by hearing deficits; a large number of audiologists do not provide vestibular assessments and management (Seedat et al., 2018). Khoza-Shangase et al. (2020) found that 62.5% of audiologists in South Africa were not performing vestibular management, and 86% were not providing falls management. These findings related to audiologists providing services to adults, most of whom are verbal and can express themselves. The provision of these services to children is likely to be more limited. Furthermore, 90% of participants working in the public healthcare sector indicated they were not confident in performing vestibular assessment and management services (Khoza-Shangase

¹ Audiology and speech-language therapy were initially considered one profession in South Africa until 2005, where the two became two independent professions.

et al., 2020), adding another layer to the barriers to access because the public healthcare sector provides services for approximately 84% of the South African population (de Villiers, 2021). Evidence suggests it is unlikely that CWD who communicate in sign language will receive timely and appropriate diagnostic and management services from qualified professionals. Furthermore, this is a concern as the Health Professions Council of South Africa (HPCSA) recognizes the need for healthcare services to cater for the linguistic diversity of the South African population, and implores audiologists and speech-language therapists to be proactive in dealing with the limitations regarding availability of interpreters (Health Professions Council of South Africa, 2019). However, this has not been the case for deaf children. It is important to note that regardless of the shortfalls of the South African healthcare system, children still have the basic right to access to healthcare services as expressed by the constitution (Section 27(1) and Section 28(1)(c)) (Buchner-Eveleigh, 2016). Thus, the provision of subjective tools that provide a means for children to express their symptoms in their own language ensures that their right to access equitable healthcare is upheld, as recommended by London et al. (2020).

Vestibular and balance assessments have been noted to require expensive and often inaccessible techniques such as videonystagmography, Vestibular evoked myogenic potentials (VEMP) or video head impulse test (vHIT) and computerized dynamic posturography, which often focus on children who are cochlear implant candidates (Antoine et al., 2017; Martens et al., 2020). In countries like South Africa with an already overburdened resource-constrained healthcare system, these measures may not be readily available (Hofman & Madhi, 2020; Pascoe et al., 2020). Conversely, literature also details simpler assessment techniques for balance. For instance, Soylemez et al. (2019) found that the use of balance tests such as the Tandem Stance Test, Flamingo Balance Test and One-Leg-Standing² Test in combination with the Pediatric Balance Scale allowed for the assessment of fall risks in children with congenital bilateral profound SNHL. An assortment of tests to assess aspects of balance is evident in literature, indicating the feasibility and necessity of this practice in paediatrics. However, the screening and assessment for balance dysfunction has not yet been fully included in routine assessment of CWD (Gronski, 2013; Hedayatjoo et al., 2020). In the paediatric population, the assessments have been noted to be time-consuming and challenging, requiring highly competent professionals to carry them out efficiently (Martens et al., 2020). Although

² The One-Leg-Standing test can also be referred to as the Single-Leg-Stance test

observations of imbalance, clumsiness and coordination difficulties may be reported by caregivers, healthcare professionals often lack the appropriate training and time to effectively screen for both balance and developmental issues during routine clinic visits (Said, 2013; Singh et al., 2022; Yang et al., 2023), thus leading to the under-detection and underdiagnosis of these deficits (Kelly et al., 2018). Furthermore, CWD may be unable to detail their symptoms to healthcare professionals or their caregivers (Antoine et al., 2017; Fancello et al., 2021; Martens et al., 2020; Singh et al., 2022) in a manner that is easily understandable due to limited communication, literacy skills and language development (Alothman, 2021).

Access to healthcare services for individuals with deafness poses significant challenges associated with communication issues (Andrade et al., 2018; Graham et al., 2023). Communication breakdown due to patients' deafness may occur during consultations, impeding timely diagnosis and management, and reducing the effectiveness of care (Andrade et al., 2018). Communication limitations are prominently seen in paediatric consultations where CWD are frequently side-lined and overlooked due to communication barriers, such that interactions with healthcare professionals are viewed as traumatic (London et al., 2020). Andrade et al. (2018) further state that these difficulties result in lower patient satisfaction, autonomy and quality of life. Involving children in their management processes has been noted as a critical part of person-centred care, which is often overlooked by healthcare professionals (Hayes et al., 2013). CWD should have a say in their consultations to promote inclusion, lessen marginalization, and ensure that resultant management strategies are individualized. Therefore, there is a need for instruments that bridge the linguistic and communication barrier between the child with deafness and the healthcare professional – the main aim of this study.

Lack of early identification of balance dysfunction hinders the provision of early intervention and leads to a direct lack of responsive rehabilitation, despite evidence for improvement of balance function through the use of rehabilitation efforts. Some authors have noted the importance of balance rehabilitation exercises and guidelines in children with vestibular and balance deficits (Reynard et al., 2024). However, such practices have not yet been recognized and integrated into standard clinical practice for CWD (Hedayatjoo et al., 2020). Karakoc and Mujdeci (2021) consider that inclusion of balance assessments for CWD may assist in the provision of early identification and intervention, thus, curbing the negative effects on the child's development. Sewpersad (2014) investigated co-morbidities in children with hearing loss admitted to the South African Centre for Language and Hearing-Impaired

Children, finding that most children presented with motor deficiencies, visual-motor integration disorders and vestibular disorders. Therefore, the author identified the need for a multidisciplinary approach to assessment and intervention given the impact of hearing loss on cognition, communication, behaviour and motor function (Sewpersad, 2014). Martins et al. (2012) further noted that children with SNHL presented with reduced dynamic visual acuity and motor deficits which can impact on the child's safety and general well-being. These studies were undertaken more than ten years ago, but no real traction has been gained in service delivery in the intervening period. Vestibular rehabilitation therapy can also be used as a therapeutic intervention to remediate balance difficulties in CWD by improving gaze stability, postural stability and gait (Melo et al., 2019). When provided later, some children may not fully recover from their deficits, and for those who do recover, there may still be distinguishable differences between them and their typically developing peers (Rine & Wiener-Vacher, 2013). Thus, the requirement for professionals to provide much-needed assessment and management to CWD is highlighted.

Guidelines such as the *Early Hearing Detection and Intervention* (EHDI) established by the HPCSA (The Health Professions Council of South Africa, 2018), do not yet prioritise balance assessment and management, especially in children with hearing loss. Furthermore, the *Paediatric Hospital Level Standard Treatment Guidelines and Essential Medicines List* (National Department of Health, 2023), which aim to streamline quality healthcare services provided to children, also do not recognize the adversities associated with hearing loss and balance disorders. Guidelines are imperative in shining a light on underappreciated health issues and related services for marginalized populations, thus contributing to the establishment of efficient service delivery, health promotion and distributive justice (Panteli et al., 2019; Woolf et al., 1999). The lack of standardized guidelines impacts on overall quality care and efficiency of interventions provided to individuals, which may be especially detrimental for children. Assessment and intervention for adults with symptoms of imbalance is challenging for professionals especially because symptoms and clinical findings are not typically linear. Zwergal et al. (2023) note the significant global limitation to healthcare provided for patients with imbalance symptoms. The lack of support for adults with balance difficulties leads one to question: If this is the case for adults who can articulate their difficulties and needs, what is the prognosis for young children who use sign language?

Although there are challenges that cannot be ignored, as discussed in this review, balance assessments can be conducted with children, including those with deafness. Thus, there is a need to elucidate the balance assessment process in children and the barriers that impact service delivery, leaving CWD (who could benefit greatly from such services) in dire need (Seedat et al., 2018).

Researcher's positionality

My professional background as a qualified audiologist introduced me to the concept of hearing impairment. Although uncommon for descriptive methodological designs, I believe my positionality as the researcher should be made overt, given the cross-cultural nature of this research.

My scope of profession comprises the identification, assessment, management and prevention of hearing, balance and related disorders that affect individuals across the lifespan (American Speech-Language-Hearing Association, 2018; South African Government, 2011). My training promoted early identification and intervention of hearing loss through providing early access to auditory stimulation. However, I am cognisant that viewing hearing loss as a medical problem that requires intervention is not the only view that exists. There is a minority group that does not subscribe to this notion. This community includes persons with hearing impairment and their family members or interpreters who identify as part of the Deaf culture. In so doing, this promotes a common language (SASL) and cultural and linguistic identity (National Institute for the Deaf, 2022; World Federation of the Deaf, 2016). I have experience working with individuals with deafness, both clinically and as colleagues from diverse backgrounds. I was able to witness, first-hand, the convergence of cultural identities, communication preferences and hearing health services. Conversely, the challenges and barriers regarding inclusion and access for individuals with hearing impairment were also evident. My academic and clinical knowledge helps me recognize my limitations in comprehensively understanding what it means to be deaf/Deaf as I have normal hearing and am not a member of the Deaf community. Within this research I use constructivism philosophy. The participants in the study are masters of their own experiences and my role as a researcher was to gain insight into their world through their perspectives.

Hearing assessment, management and prevention in children is prominent in the audiology undergraduate curriculum and clinical practice. However, a similar focus is lacking on the balance aspect of our scope of practice, as noted in the literature review, and from my experience as a student and healthcare professional. I have been guilty of primarily prioritizing the rehabilitation of hearing, appropriate school placement and aural rehabilitation in this population, without realizing that both my scope of practice and services needed by this population, extend beyond that. Undertaking this research, I considered how many practitioners involved in the management of children with hearing impairment shared this lack of awareness. The rehabilitation of children with balance deficits is under-prescribed in audiological consultations, and we, as audiologists, should be spearheading these interventions as part of our professional scope. I believe that there is a lot of work to be done to improve access to hearing and balance services, promote inclusion, participation and prevention of disorders which reduce a child's quality of life. Furthermore, the formation of the International Paediatric Balance Network in 2024 by clinicians and experts around the globe indicates a positive shift towards the management of children with balance deficits and the University of Cape Town will be actively involved in this endeavour (Rogers, 2024).

Rationale for this study

On its own, hearing loss has a significant impact on development, communication, livelihood and economic independence (World Health Organization, 2016). Furthermore, impairment of hearing and the structures involved in maintaining balance causes functional disability, thereby impacting performance of everyday activities (Daneshmandi & Alyarnezhad, 2020). Some CWD may not perceive deafness as a disability, rather viewing it as a way of life and consequently belonging to the Deaf community and subscribing to Deaf culture. Notwithstanding, ensuring access to healthcare services and subsequent interventions is still necessary to improve overall health and quality of life. Unaddressed balance deficits and fall risks are serious health concerns which may be evident throughout an individual's life, ultimately leading to mortality and/ morbidity. Therefore, the provision of linguistically and culturally appropriate questionnaires could provide a basis from which access and inclusion are extended to all CWD. The World Federation for the the Deaf also recognizes the need for diverse methods of communication such as sign language to promote inclusivity and access (World Federation of the Deaf, 2016).

This study subscribes to the Sustainable Development Goals (2030) for Sustainable Development (United Nations, 2015). Advancing inclusivity and quality access to healthcare services by individuals with disability promotes Goal 3 (*Ensure healthy lives and promote well-being for all at all ages*), thus contributing to holistic healthcare practices for all children with hearing loss, especially those with deafness. A contribution to Goal 4 (*Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all*) is also made as literature indicates that balance dysfunction can cause academic difficulties (Mulwafu et al., 2016). Identifying such limitations to provide early intervention as appropriate investigations and management of balance dysfunction is a clear necessity (Antoine et al., 2017; Hazen & Cushing, 2020). The current study promotes enablement, inclusion and participation in CWD, such that with early identification, early intervention and management can be provided, leading to healthy teenagers and adults.

Conceptual framework: The International Classification of Functioning, Disability and Health/ Health-related functioning (ICF/Hrf) Model

The International Classification of Functioning, Disability and Health (ICF) is a biopsychosocial framework that works to classify, organize, measure, describe and record information to address functioning and disability in individuals (World Health Organization, 2013). The multidimensional framework uses components such as body function, body structure, activities, participation, environmental factors and personal factors to describe an individual's experiences. Use of the ICF encourages person-centred³ care and provides a common language for use within healthcare and research settings, especially in Audiology (Meyer et al., 2016). Within the ICF, health is viewed in two ways: first, through functioning and disability, which describe components such as body function, body structure, activities and participation, and how they are negatively impacted by health conditions by using terms such as impairment, activity limitation and participation restriction. Second, health is described through contextual factors, considering the influence of environmental and personal factors on an individual (Meyer et al., 2016). The ICF Research Branch further developed ICF Core Sets for hearing loss and vertigo to better understand and respond to functioning and health for all populations (ICF Research Branch, 2017). In the ICF core sets, body function also includes

³ Person-Centred Care- refers to the provision of care that focuses on addressing an individual's health needs and experiences within the appropriate context and contributing towards individuals living meaningful lives.

orientation, anxiety, confidence, emotions or exercise intolerance among other factors; activity and participation includes basic, every day activities such as self-care, leisure; and environmental factors includes temperature, or attitudes with the family structure or the community (Mueller et al., 2012). Authors noted these factors to be associated with daily living and quality of life which is often limited by the presence of dizziness symptoms.

The ICF can be used as a construct and conceptual framework of Health-related Functioning (HrF) (Salvador-Carulla & Garcia-Gutierrez, 2011). The ICF/HrF model is a framework shown in Figure 2 that provides direct connections between underlying health condition, functioning, contextual factors and the services and interventions required (Salvador-Carulla & Garcia-Gutierrez, 2011). The current study was based on this framework.

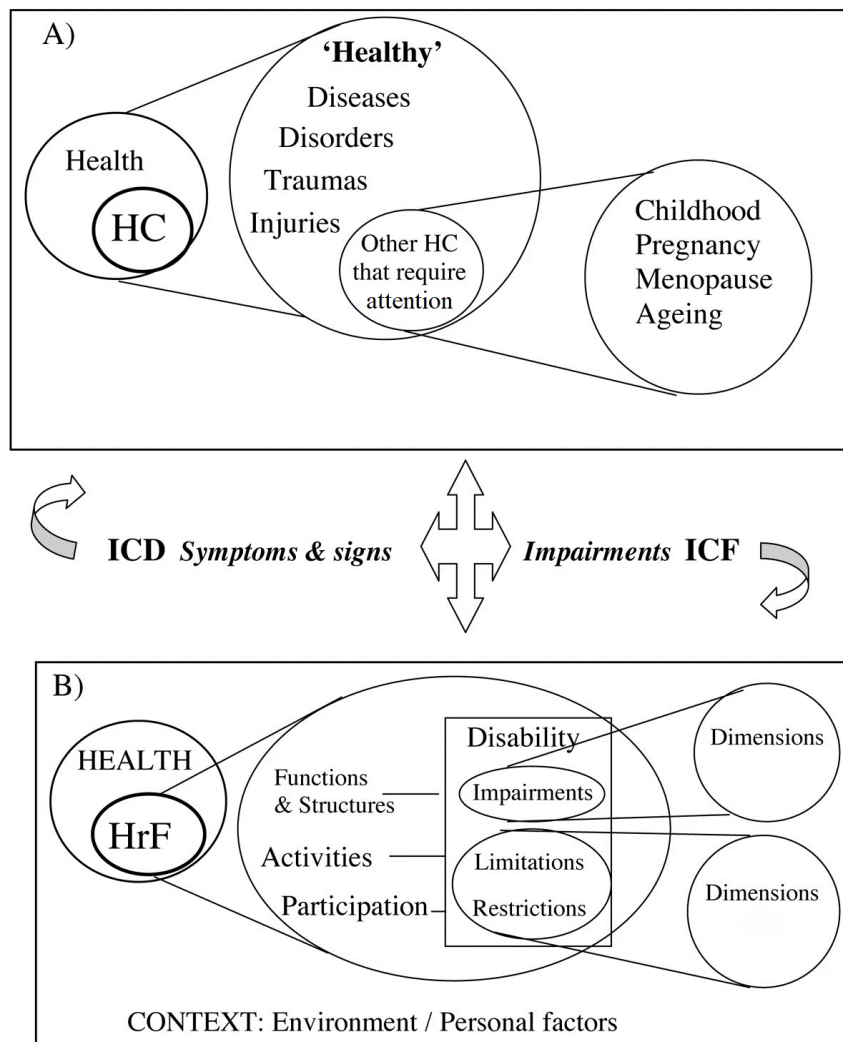


Figure 2: A diagram illustrating health conditions and health-related functioning based on the International Classification of Functioning, Disability and Health (ICF) where A) refers to health conditions, and B) refers to health-related functioning.

Notes: HC: health conditions; ICD: International Classification of Diseases; ICF: International Classification of Functioning, Disability and Health; HrF: Health-related functioning

Based on: (Salvador-Carulla & Garcia-Gutierrez, 2011)

The ICF may be considered bipolar, with disability viewed as a negative pole and functioning as a positive pole. Within the ICF/HrF model, functioning and disability are highlighted as two related domains where functioning is a positive pole with greater alternatives and the negative pole is functioning-disability. HrF describes disability as difficulty in functioning experienced by an individual with a health disorder in interacting with environmental or personal domains (Salvador-Carulla et al., 2014). The difficulty can arise at any level (body, individual or societal).

The model further highlights the need for positive functioning to be included in the definitions of the ICF and for health-related functioning to be a stand-alone term (Salvador-Carulla & Garcia-Gutierrez, 2011). Unlike other models related to the ICF, the ICF/HrF model provides a positive approach to understanding activities and participation of individuals with underlying health conditions. Contextual factors, including subjective reports of functioning regarding quality of life are a clear aspect of HrF (Salvador-Carulla et al., 2014). Although further advancement of the ICF/HrF model is needed, it is deemed a comprehensive way of understanding an individual's well-being (Salvador-Carulla et al., 2014).

In the current study the ICF/HrF model was utilized because it encompassed various aspects of a child's life and the ways in childhood hearing loss and balance deficits can impact on those aspects. Thus, it assisted in guiding the adaptation of the PVSQ and DHI-CA, the inclusion of the EQ-5D-Y proxy version questionnaire and the evaluation of functional impact of balance deficits in the current study. Further, this framework was used as a lens through which to view and report on the study findings. This chapter highlights the impact that balance deficits can have in the lives of young children, not only impeding on everyday functionality but also reducing their quality of life. Thus, this nascent study intends to answer the following research question: "How can functional balance be evaluated in school-aged children with deafness?"

CHAPTER 3: METHODOLOGY

“Deafness and sign language are extremely close to my heart.”

Rachel Shenton (Shenton, 2024)

Study methods

Aims of the study

The aim of this study was to evaluate functional balance in school-aged CWD when compared to NH children between the ages of 9 to 17 years.

Objectives

To achieve the study aim, the following objectives were explored:

1. To translate and cross-culturally adapt the Pediatric Vestibular Symptom Questionnaire (PVSQ) and the Dizziness Handicap Inventory for Children/Adolescents (DHI-CA) from English to SASL
2. To validate the adapted SASL PVSQ and DHI-CA questionnaires for CWD
3. To assess balance performance in CWD and NH children using a standardized clinical balance measure, the Mini- Balance Evaluation Systems Test (Mini-BESTest)
4. To investigate the impact of sensory input on balance performance in CWD and NH children using the visual acuity tests and the modified Clinical Test of Sensory Interaction for Balance (mCTSIB)
5. To explore parents’/guardians’ perceptions of health-related quality (HRQoL) in CWD and NH using the EQ-5D-Y proxy version questionnaire

To achieve these objectives, the study was carried out in two phases, and will be presented as such throughout this report. Phase One aimed to address Objectives 1 and 2, while Phase Two addressed Objective 3 – 5.

Study design

A descriptive, quantitative, case-control, clinimetric study design was used for this study. Clinimetric studies are clinically grounded assessment methods that assist in the development or improvement of clinical measures (Carrozzino et al., 2021). This research

approach fosters the development of measures that allow for the quantification of symptoms and other clinical presentations (Fava et al., 2018; Feinstein, 1983). It was also important to incorporate a descriptive design, which allows for studying populations as they exist in nature and investigating their characteristics and issues between them (Siedlecki, 2020). To effectively study the area of interest, the researcher needed to distinguish between a control group and a case group with and without the phenomenon of interest, as is seen in case-control studies (Dey et al., 2020). Case-control methods are viewed as ‘observational’ and are suitable for building evidence-based care and best practice by investigating factors associated with the phenomenon of interest within the individual’s natural environment (Carlson & Morrison, 2009; Tenny et al., 2023). Collectively, this approach allowed for the investigation and categorisation of functional balance in school-aged children.

Sampling method

Purposive sampling, a form of non-probability sampling, was used in this study as it enabled the researcher to choose the participants based on their qualities, i.e., those who could best provide information about the phenomena being researched (Martinez-Mesa et al., 2016).

Study setting

The study was conducted in the eThekwin Municipality in KZN, South Africa as illustrated in Figure 3.

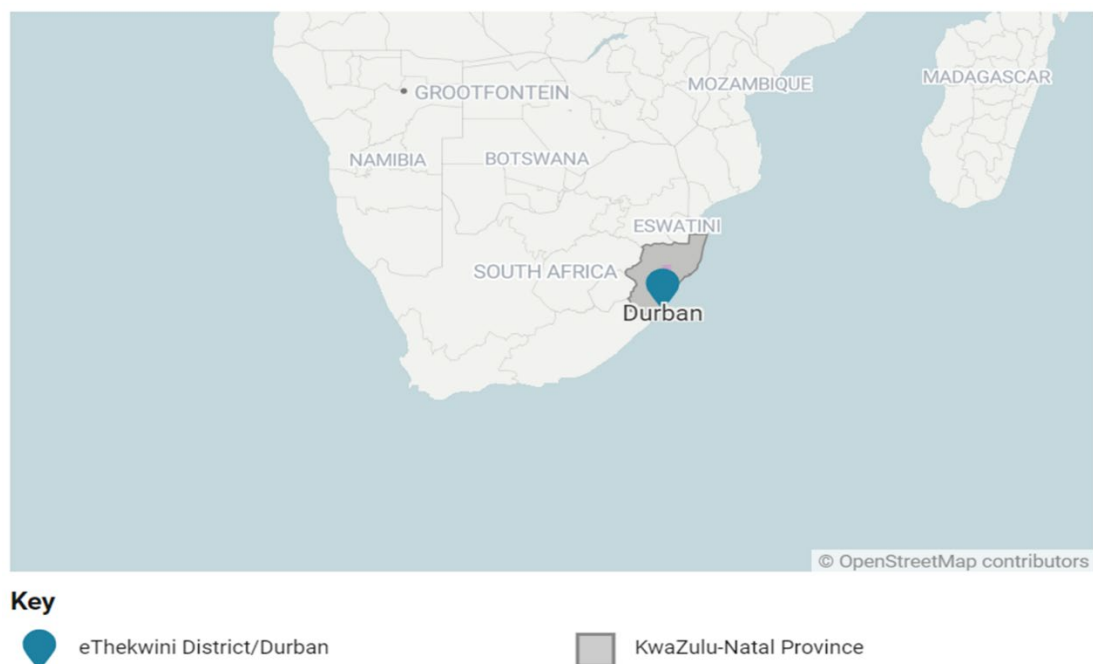


Figure 3: Map of South Africa showing the study setting

This setting was chosen through convenience sampling because it would allow the researcher to conduct the study efficiently due to close geographical proximity and ease of access (Etikan, 2016). EThekwini, also referred to as Durban, is a metropolitan municipality with a population of approximately 3.9 million people.

Educational institutions were included for the purpose of this study. EThekwini has 1125 schools, including primary, secondary, combined and independent schools (Cooperative Governance Traditional Affairs, 2020). Of these schools, there are five schools for the hearing impaired in the region and all the schools were invited to participate in the study. Four schools responded positively and were included in the study. For the control group, 15 mainstream schools (primary and secondary) were conveniently sampled and invited to participate in the study. Two institutions responded positively, granting the researcher gatekeeper permission to commence with the research. Thus, for this study, only six public schools⁴ responded (Table 1) and were included as part of the study.

Table 1: Schools in the eThekwini Municipality that participated in the study

Type of schools	Schools
Mainstream schools	• Insizwakazi Primary School • Durban Academy High School
Schools for the Deaf	• VN Naik School for the Deaf • Kwavulindlebe School for the Deaf • Durban School for the Hearing Impaired • Fulton School for The Deaf

Although all schools were located in the eThekwini district, which is considered an urban area, this municipality faces many challenges with inequality, unemployment, poverty and poor housing, and infrastructure (Sutherland et al., 2024). Some of the schools were expected to lack adequate facilities to assist in the current study as previous studies have noted

⁴ Public schools in South Africa include schools: a) which are fully funded by the government, no fees from parents b) partly funded by the government and parents also contribute through school fees.

that schools for the hearing impaired often have limited space and poor classroom infrastructure (Skrebneva & Fordham, 2024). However, all sites were found to have appropriate space for the research study to commence and the assessments to be conducted.

Sample size

For Phase One (tool adaptation and validation), a total of six panellists were involved. This sample size was appropriate for encouraging robust discussion and successful outcomes (Humphrey-Murto et al., 2017; Staykova, 2019). All panellists were proficient in SASL to ensure a linguistically and culturally appropriate outcome. For the validation process, a sample of 20 children (10 CWD and 10 with NH) between the ages of 9–17 years (mean age 13 years) were included.

Phase Two of the study, a sample size of 356 deaf school-aged children was initially determined by a statistician ($P=41.3\%$ prevalence of the condition of study from previous literature/studies, margin of error (d)= 0.05 and the absolute precision, taken as 0.05). For the control group, a sample of 300 normal hearing children was to be used, similar to a validation study by Pavlou et al. (2016). However, for the current study, this sample could not be achieved due to low response rate of schools, schools refusing to grant permission and the limited number of students in the schools for the deaf. Ultimately, the target population consisted of 97 CWD and 58 NH children. This sample was viewed as appropriate when compared to similar translation and validation studies, e.g., 53 cases and 59 controls (Rigal et al., 2024), 52 cases and 40 controls (Altin & Aksoy, 2023) and 30 cases with 30 controls (Dreepatta & Dasgupta, 2022).

Study population and selection criteria

The researcher has no relationship with participants in this study. In Phase One, for the translation and adaptation of the tools, the recruitment of participants followed the following criteria:

- Two sign language translators who are qualified and accredited by the South African Translators' Institute (SATI) were recruited. They presented with a minimum of two years of working experience as a translator and were knowledgeable about the Deaf culture, enabling them to consider linguistic and cultural sensitivity of the tool.
- A panel of experts was purposively selected to provide a variety of opinions regarding the cultural and linguistic components of the tools. The panel consisted of two

individuals (one prelingually deaf individual using SASL and one bilingual individual using SASL and English) who were members of the Deaf community from the KZN Blind and Deaf Society⁵. Further, it included four teachers working at different schools for the hearing impaired who were accustomed to Deaf culture, working with deaf children and shared understanding of sign language used by CWD. All individuals had a minimum of three years in their respective roles and were able to share and provide their expertise. Those individuals who did not meet the turnaround time needed to confirm availability and those who did not provide consent were excluded from the study.

- The final aspect of validation involved children who were selected from two schools: one for the Deaf and one mainstream school. Ten consent forms were randomly picked out from a collective pile and those students were included in this aspect of the study. They presented with the characteristics described below (see Phase Two).

In Phase Two, the study included CWD and NH children between the ages of 9–17 years, attending the selected schools in the eThekweni Municipality. The selection criteria for these participants are presented in Table 2.

⁵ KZN Blind and Deaf Society- an organization that works to improve the lives of Blind, partially sighted, Deaf and Hard of Hearing individuals by improving communal participation and integration.

Table 2: Selection criteria

Inclusion criteria	Exclusion criteria
Children with Deafness	
- All learners within the ages of 9 to 17 years registered at the Deaf schools were considered for this study. <i>Rationale:</i> The age range was chosen because this study required participants to be proficient in SASL. Furthermore, children younger than 8 years may find it difficult to describe their perception of dizziness (Dasgupta et al., 2020), which is important for completing the PVSQ and DHI-CA. - Children who have a confirmed diagnosis of hearing loss as classified by Clark (1981) regardless of the type of hearing loss (see Appendix A: Characteristics and degree of hearing loss in paediatrics (Clark, 1981)) - As no significant changes were made to the data collection tool and method, data generated from the pilot study was included in the final analysis.	- Children who had physical injuries affecting proprioception, vision or musculoskeletal input during the week and day of assessment. Teachers and/school nurse assisted with this information. - Children diagnosed/suspected to have other disabilities co-occurring with the hearing loss such as physical limitations (lower limb injuries, reduced muscle tone, musculoskeletal issues etc.), neurodevelopmental conditions and syndromic disorders <i>Rationale:</i> These factors may impact on balance function. The information was retrieved from the school medical file - Participants who did not give assent and those who withdrew assent during the assessment
Normal hearing children	
- Children were between the ages of 9–17 years old, and presented with normal hearing confirmed by onsite hearing screening results. - Children who presented with auditory and otological symptoms such as hearing loss, infection, impacted cerumen etc. were referred for management then rescreened. If they passed, they were then included. - Children who have received parental consent and have further given assent.	- Children presenting with hearing loss and/or physical abnormalities that impacted on balance function. - Children who reported hearing loss and/ obtained a refer on the hearing screening and on the rescreen

Study personnel

The study personnel included a research assistant with an undergraduate degree in audiology, who was proficient in Microsoft Office and has prior experience with research

procedures. The assistant was involved throughout the study, undertaking administrative duties such as organizing and filing data collected on site, assisting with setting up and cleaning out the research space, and preparing refreshments for participants. The research assistant signed a confidentiality agreement prior to involvement in the study (see **Appendix B: Confidentiality agreement**)

Participant recruitment

In Phase One, the researcher browsed the SASL Interpreting National Centre website for possible participants and their respective contact information. All candidates who met the criteria were contacted via email and invited to participate in the study. Once a positive response was received and candidates had shared their rates for remuneration, two candidates were selected based on credentials, affordability and ease of access. They were contacted and requested to consent to participation (see **Appendix C1: Invitation to participate for SASL interpreters**) and sign a contractual agreement (see **Appendix B: Confidentiality agreement**). These two candidates assisted in the translation of the tool. A similar strategy was used to contact and invite the expert panel (see **Appendix C2: Invitation to panel experts**).

For Phase Two, the researcher contacted the schools informing them of the study and the inclusion criteria. Appointments were arranged with the schools to clarify issues of concern and to disseminate information documents and consent forms (see **Appendix D1: Information document and informed consent** and **Appendix D2: Information document and informed consent (IsiZulu translation)**). The EQ-5D-Y proxy version questionnaire (see **Appendix E1: EQ-5D-Y Proxy version questionnaire** and **Appendix E2: EQ-5D-Y Proxy version questionnaire**) was attached to the consent forms for caregivers to complete. These forms were shared with every child who met the criteria. Those who had parental consent and provided assent were included in the study. This recruitment process was followed for children with hearing loss and normal hearing. The procedure was followed for both the validation process in Phase One and data collection in Phase Two.

Data collection materials

Two self-assessment questionnaires were selected to assist in identifying vestibular/balance symptoms and the related handicap in young children. Thus, the following questionnaires were used in this study:

- *Paediatric Vestibular Symptom Questionnaire (PVSQ)* (see **Appendix F**: The Paediatric Vestibular Symptom Questionnaire (PVSQ) (Pavlou et al., 2016)) is a ten question self-assessment tool that aims to identify and quantify vestibular-related symptoms in children (Alves & Silva, 2019; Pavlou et al., 2016). According to Alves and Silva (2019), the questionnaire is suitable for children between the ages of 6 and 17 years, consistent with the age range of children in the current study. The questionnaire consists of items that can be rated from 0 (*never*) to 3 (*most of the time*) and a *don't know* category can be included. The responses from each question are summed to arrive at a total score, ranging from 0–30. The sum (total score) is then divided by the number of questions answered in the questionnaire (Tiwari, 2018). For example, if the child answered all 10 questions, the total score would be divided by 10. Therefore, the higher the score, the greater the severity of symptoms. The appropriate cut-off score used is ≥ 0.68 , to allow for the differentiation of children with and without vestibular symptoms. This questionnaire was found to have a sensitivity of 95% and specificity of 85% (Pavlou et al., 2016).
- The *Dizziness Handicap Inventory Child/Adolescent (DHI-CA)* (see **Appendix G**: The Dizziness Handicap Inventory for Children/Adolescents (DHI-CA) (Tiwari, 2018)) is an adaption of the Dizziness Handicap Inventory (DHI), which is a subjective tool that assesses and quantifies the impact of balance impairment on the quality of life in children between the ages of 6 and 14 years (De Souza et al., 2017). The DHI-CA is a 3-point Likert scale questionnaire that consists of 25 questions with three sub-sections or domains: functional (9 questions), emotional (9 questions) and physical (7 questions). The components of the DHI-CA are also in keeping with the ICF. Scores for responses range from 0 (*no*), 2 (*sometimes*) and 4 (*yes*), yielding a total score that can range from 0–100. The interpretation of these scores is as follows: *slight* (0–30); *moderate* (30–60); and *severe* (over 60 points), indicating degree of handicap (Castro et al., 2007; De Souza et al., 2017; Jacobson & Newman, 1990).

These instruments are currently available in English and have been translated into other spoken languages as mentioned in Chapter 1. In Phase One, the two tools were translated into SASL with the aim of extending the applicability of this tool to CWD, thus allowing for more tailored consultation and management of this population.

The adapted self-assessment questionnaires, in combination with the physical outcome measures and quality of life questionnaire, were used in the validation process in Phase One and the data collection process in Phase Two. The physical outcome measures used in the study are displayed in Table 3. Assessment results were recorded on a record form (see **Appendix H**: Case record form).

Table 3: Assessment procedures used for the direct assessment of all participants

Area evaluated	Assessment procedure	Purpose and materials
Otological evaluation	Otosopic examination	This procedure involves the visual inspection of the auricle, pre-and post-auricular area, external auditory meatus, and tympanic membrane for disease, infection or blockage. Anatomical obstructions of the ear were also observed (e.g., microtia, atresia). It is non-invasive and suitable for all populations (Mankowski & Raggio, 2021). For detailed tools and procedure (see Appendix I: Otoscopic Examination).
	Tympanometry	An objective measure of the mobility of the middle ear system in response to pressure changes in the external auditory canal. It can assist in detecting middle ear pathologies (Resende et al., 2012). For the tools and procedure for tympanometry, and normative data, refer to Appendix J: Tympanometry .
	Transient otoacoustic emissions	Otoacoustic emissions (OAEs) provide an objective measure of cochlear outer hair cell function, and early detection of hearing loss (Chan et al., 2022). Transient Evoked Otoacoustic Emissions (TEOAE) are considered tolerable, easy to administer and, therefore, appropriate to conduct in school hearing screening (Nunes et al., 2021). This procedure was used for the control group to screen for hearing status. The tools, procedures and normative data for TEOAE are included in the appendices (see Appendix K: Transient Evoked Otoacoustic Emission).

Evaluation of Vision	Static Visual Acuity test (SVA)	The Snellen chart was used to screen for static visual acuity, which can assist in early detection of visual changes and is appropriate for children aged 7 years and older (Marsden et al., 2014). Procedure and instructions are available in Appendix L: Static visual acuity .
	Dynamic visual acuity (DVA)	This test assesses visual acuity during head movements in the horizontal plane (Rine et al., 2004). It can also indirectly indicate the functioning of the vestibular ocular reflex. The Snellen chart was used as recommended by experts (Chen et al., 2023; Peters et al., 2012). Procedure and instructions are available in Appendix M: Dynamic visual acuity .
Evaluation of balance	The modified Clinical Test of Sensory Interaction for Balance (mCTSIB)	The mCTSIB assesses the impact of sensory integration in maintaining balance and postural ability (Lotfi et al., 2018). It is a modification of the Clinical Test of Sensory Interaction in Balance (CTSIB) test and includes eyes open, and eyes closed on firm and foam surfaces. It can be used from the age of 2 years onwards (Horn et al., 2015). The tools, procedure and scoring are detailed in Appendix N: Procedure and tools for the mCTSIB .
	The Mini-Balance Evaluation Systems Test (Mini-BESTest)	This is the short version of the Balance Evaluation Systems Test (BESTest), which evaluates balance function and postural control (Southard, 2020). The test is validated for ages 7–17 years and inexpensive. Developed to improve identification of factors contributing to balance dysfunction (Shirley Ryan Abilitylab, 2013b; Southard, 2020), this test was appropriate for the age-range investigated in this study. This test was chosen as it is easily available, its ability to assess balance function comprehensively and its suitability for use with the study population. Although various versions of the BESTest exist, clinicians can

		choose which to use depending on the time they have available and the intended purpose (O’Hoski et al., 2015). This tool has also been used with children who have developmental coordination disorder (Suresh J, 2023). The Mini-BESTest consist of tests such as the Timed-Up-and-Go (TUG), the Single-Leg-Stance (SLS) and the incline- eyes closed tests which may be useful in the evaluation of fall risks. For the TUG dual task condition (item 14), a motor task was used instead of asking the participants to count backwards due to spoken language acquisition. The participants were asked to conduct the TUG and walk while carrying a glass of water (Lundin-Olsson et al., 1998; Vance et al., 2015), this procedure is commonly referred to as the TUG-manual. Tools, normative data and procedure are detailed in Appendix O: Mini Balance Evaluation Systems Test (Mini-BESTest).
Quality of life questionnaire	EQ-5D-Y proxy version questionnaire	This tool quantifies HRQoL, functioning and daily living in young children and adolescents (Wille et al., 2010). The proxy version is especially suitable for children who may be considered vulnerable, and it can be completed by a caregiver or the interviewer. The tool consists of five dimensions of health state including: <i>mobility, looking after myself, doing usual activities, having pain or discomfort, and feeling worried, sad or unhappy</i> (Kreimeier & Greiner, 2019) (see Appendix E1: EQ-5D-Y Proxy version questionnaire and Appendix E2: EQ-5D-Y Proxy version questionnaire). A translation certificate was obtained for this tool to be used (see Appendix P: Certification of the EQ-5D-Y proxy version questionnaires).

Data collection procedure

Ethical approval was obtained from the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee (HREC ref: 265/2023, see **Appendix Q:** Human Research Ethics Committee clearance) and thereafter, gatekeeper permission from the KZN Department of Education was obtained (Ref.:2/4/8/112 see **Appendix R:** KwaZulu-Natal Department of Education permission) for access to schools within the district. In data collection for Phase One, once consent documents and contractual agreements were received, the data collection process was initiated using a protocol suggested by Mason (2005). Although recent translation protocols exist in literature (McKown et al., 2020; Ozolins et al., 2020; Ramazanzadeh et al., 2023), the protocol by Mason (2005) was chosen because it involves the translation of written English into sign language. In addition, it aims to guide the development of culturally and linguistically appropriate instruments for individuals with deafness (Mason, 2005) which was pivotal in this study. This protocol was similar to Andrade et al., (2018) which further supported its applicability and feasibility. Figure 4 displays the process for cross-cultural translation and adaptation.

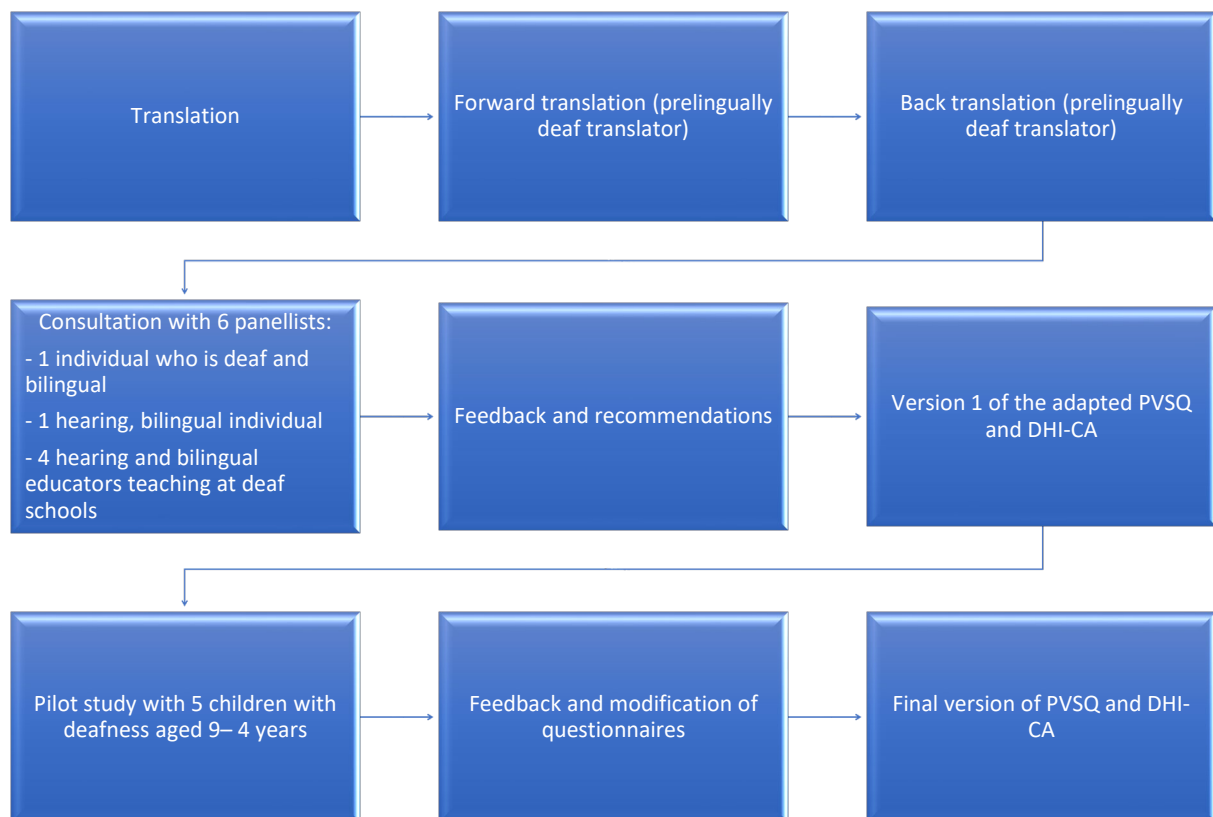


Figure 4: Flowchart illustrating the translation process used in the study (Mason, 2005)

The following steps were recommended (Andrade et al., 2018; Mason, 2005):

- Forward translation

The two questionnaires were emailed to the first translator, a qualified translator who is prelingually deaf. The PVSQ and DHI-CA questionnaires were translated from written English into SASL video recordings. The video recordings were then sent to the researcher via Dropbox.

- Back translation

A second qualified, prelingually deaf translator was contacted. She was sent the Dropbox link to access the SASL video recordings of the PVSQ and DHI-CA. The video recordings were back-translated from SASL into written English. Translators had no prior knowledge of each other's involvement in the process and worked independently.

- Expert panel consultation

The selection criteria were applied and the panellists were confirmed. The researcher contacted each member and an appointment was scheduled to discuss the study focus, their role in the study and the related expectations. Participants who accepted the invitation and provided consent were included in the study. Although Mason (2005) recommends that two people be involved in this aspect (a deaf bilingual person and a hearing bilingual person), for this study, six participants were involved to ensure reliability and validity of the process, and to improve the comprehensiveness of the conclusions (Staykova, 2019). Two members of the KZN Blind and Deaf Society and four educators teaching at deaf schools were given both the original questionnaires and the back-translation. This aspect of the process was conducted to ensure that the translated versions reflected the content equivalence of the original questionnaire. The panellists also discussed the semantic, grammar, conceptual and cultural appropriacy of the tools. Additionally, they were asked to comment on the suitability of the tools for the deaf paediatric population.

The researcher held individual meetings with each panellist and obtained qualitative feedback on the tools. It was not feasible to conduct round-table panel discussions due to schedule clashes and delayed responses in confirming meeting times. Therefore, the researcher opted for this approach to consultation. Expert judgement may include qualitative aspects to

identify strengths and weaknesses of tools (Fernández-Gómez et al., 2020). Panellists reported that the tools were appropriate for CWD and were, furthermore, linguistically and culturally aligned. The structure of the questions was noted to differ between the original questionnaires and the back translation, and in some cases words were described and synonyms used to convey meaning. However, this was in keeping with the phonological and grammatical rules of SASL. As a language, SASL has its own lexical, semantic and phonological structures (Lillo-Martin & Gajewski, 2014). It also incorporates manual and non-manual expressions, sometimes describing objects or movements more overtly than in written English (Köhlo et al., 2017; Van der Walt et al., 2021). No misunderstandings or inaccuracies were identified from the back translated version of the self-assessment tools.

Panellists suggested making the videos shorter so that responses would not be affected by factors such as attention and concentration. These recommendations were considered and the video recordings were edited by reducing the time lag between each question asked. The panel was contacted again to review the changes made to the SASL video recordings. Upon review, no further changes were recommended by all panellists, implying that the adapted instruments were conceptually equivalent to the original tool.

SASL does not have a written form (Van der Walt et al., 2021). Thus, the PVSQ (**Appendix S:** Adapted Pediatric Vestibular Symptom Questionnaire (PVSQ)) and DHI-CA (**Appendix T:** Adapted Dizziness Handicap Inventory Child/Adolescent (DHI-CA)) questionnaires were adapted to include a visual analogue scale (VAS) to capture participants' responses. The VAS is widely used for evaluating pain intensity and has been effectively applied to the paediatric population (Begum & Hossain, 2019; Le May et al., 2018). Furthermore, it may be a scale that is suitable for daily use as it can be used to measure participants subjective features which may be difficult to measure with other tools (Sybilski, 2018). The VAS can assist in providing a participant's health state in a simple and reproducible manner (Froberg & Kane, 1989) and such a scale can be used in a variety of settings (Froberg & Kane, 1989; Wehby et al., 2014). The VAS is a time efficient method which requires little literacy to complete, and thus can be suitable for children (Rhee et al., 2017).

For the purpose of this study, the anchor words from the original PVSQ and DHI-CA were kept consistent, however, the VAS was added to the scale to capture the participants' experiences of symptoms. It was not important for the participants to read the questions on the

questionnaires, given that reading may be difficult for individuals with deafness (Van der Walt et al., 2021). Therefore, the questionnaire was used as a means to record their responses to the video-recorded questions. On the PVSQ, participant marked their response on a 18cm line that consists of a scale from 0 (never) to 3 (most of the time). On the DHI-CA, they chose their responses between No, Sometimes and Yes. The VAS has been used in other studies investigating dizziness (Genç et al., 2023). Thus, two versions arose from this study; a video recording of the PVSQ and DHI-CA in SASL and a paper-based questionnaire to record responses. Following this, the first version of the video-recorded PVSQ and DHI-CA questionnaires were ready for piloting. The pilot study is described in the following section.

- Final revisions

The feedback received from the pilot study indicated that no revisions were required. However, the instructions on the paper-based tools were highlighted in bold and the researcher made a note to emphasise that information before participants completed the questionnaires. Thus, the video-recorded PVSQ and DHI-CA (**Appendix U: Video-Recorded PVSQ and DHI-CA questionnaire**) and subsequently adapted paper-based questionnaires were finalized.

Once Phase One was completed, Phase Two was initiated. The researcher contacted the schools telephonically to arrange the logistics surrounding the data collection process and to prepare the schools for the arrival of the research team. A research schedule was derived (see an example of this schedule in Table 4). Furthermore, the researcher requested to review the school files for additional information such as medical history, audiological history and academic performance. Only one school granted permission for this exercise to be conducted. The researcher considered the school breaks (usually of approximately 45 minutes duration) across schools, and school closing times, which impacted on data collection.

Table 4: Example of research schedule used for data collection

Monday	Tuesday	Wednesday	Thursday	Friday
Durban Academy HS (8am–2pm)		Fulton SFTD (2pm–3:30pm)	Fulton SFTD (2pm–3:30pm)	Durban Academy HS (8am–2pm)
KwaVulindlebe SFTD (8am–1:30pm)				Insizwakazi PS (9am–1:30pm)

Data capturing	Durban Academy HS (8am-2pm)		Data capturing	
Fulton SFTD (2:30pm–3:30pm)	Data capturing	Fulton SFTD (2:30pm–3:30pm)		Data capturing

Students who met the criteria were called from the classroom to the research room in groups of five. Study information was explained to them in SASL by the class teacher and assent was requested thereafter. In mainstream schools, assent was requested by the researcher. All students who did not assent and who did not meet the study criteria were ushered back to their classroom.

The researcher projected the adapted PVSQ and DHI-CA video recordings for the participants. The videos were either paused or rewound where necessary to aid in accurate responses. The participants were required to watch the video and then respond by selecting their answer on the adapted VAS/paper-based questionnaires provided. This process took approximately 20 minutes to complete. In mainstream schools, participants were given the paper-based questionnaires only to complete. Following this procedure, all questionnaires were collected and the direct assessment was initiated thereafter.

Each student was selected from the group. A brief case history was taken from the participants regarding ear-related concerns such as pain or otorrhoea. For children in the deaf schools, this was done with the assistance of a designated teacher. Instructions for the assessment battery (Table 4) were given, and the researcher demonstrated each test for the participants, who were required to confirm their understanding of instructions. A trial-run of each test was conducted, and this was not counted in the final scores. Instructions and demonstrations were repeated where necessary. A case record form was used to record the participants' biographical information and all results and scores (see **Appendix H**: Case record form). Participants were given comfort breaks and refreshments during the data collection process. All assessments were conducted by the researcher and the research assistant. Direct assessment of each participant took approximately 25 minutes. A similar process was conducted for the validation process of the questionnaires in Phase One.

Pilot Study

A pilot study was conducted prior to the main study. The aim was to assist with modifications, planning and ensuring validity (In, 2017). The pilot also assisted in informing the researcher about the feasibility and acceptability of the main study, and was used to refine the selection criteria for the study. In total, 10 participants were part of the pilot study (5 CWD and 5 NH children). The sex distribution was equal in both groups and the age distribution is displayed in Figure 5.

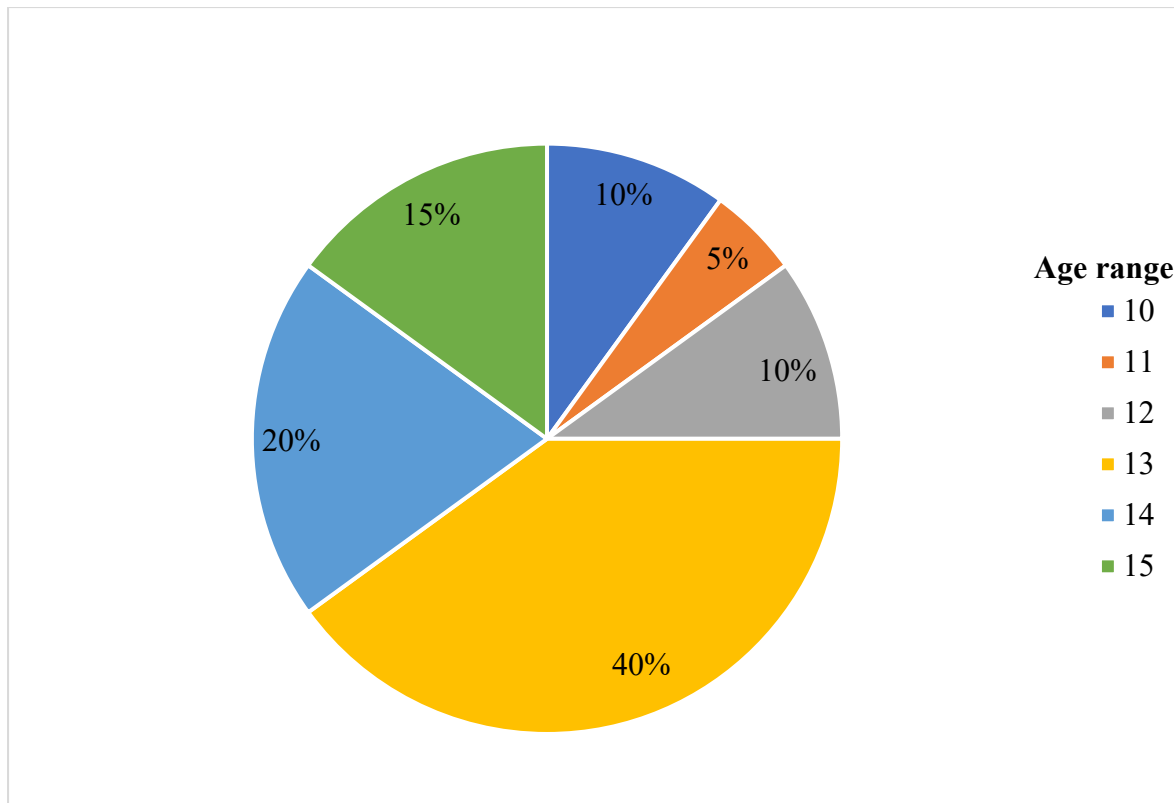


Figure 5: Age distribution of pilot participants

The two adapted questionnaires were piloted as part of Phase One. Five CWD were involved in this aspect of the study. An odd number of the target population was selected to avoid tie responses (Nascimento et al., 2015; Oliveira et al., 2008). The researcher contacted one deaf school, and consent and assent were obtained from guardians and the children, respectively. The completion of the questionnaires was conducted in the presence of educators who were proficient in SASL. The teacher explained this aspect of the study and detailed what was required from each child. Children were also asked about their understanding of dizziness. Although instructions were included in the videos, participants' understanding of the process was vital so that the researcher could obtain reliable feedback.

The video recorded PVSQ and DHI-CA were displayed using a projector. The video was paused after each question to allow participants to log their responses on the adapted paper-based questionnaire. The process took approximately 20 minutes to complete. Younger children (9–11 years) required the videos to be replayed frequently, which may have impacted on the administration time. On completion of the questionnaire children were asked to provide feedback. While the feedback was generally positive, all children felt the video recordings were too long and reported often feeling bored or tired. Due to the nature of the video-recordings, it was difficult to shorten the videos without affecting the integrity of the tools. Another comment that was common across the group was that the children were unsure where on the VAS to record their responses. The feedback received indicated that logistical changes needed to be employed in the main study to ensure that data is collected adequately. Firstly, the instructions on paper-based tools were highlighted in bold and the researcher made a note to emphasise these before participants complete the questionnaires and to provide demonstrations on how to log responses on the VAS. Moreover, participants could be given breaks between questionnaires to ensure that their attention is maintained. No further revisions were made to both the video-recorded and paper-based. Thus, the video-recorded PVSQ and DHI-CA and subsequently adapted paper-based questionnaires were finalized.

In Phase Two, two schools were included: one school for the deaf and one mainstream school. Participants from the deaf school in Phase One were included in this aspect of the study as well and relevant consent was attained. In the mainstream school, teachers were given five consent forms to distribute to children who met the study criteria. Once the forms were returned, those children were included in the study. The researcher had no influence over this process. A brief interview was conducted with participants after the data collection was completed. For CWD the interviews were facilitated by a teacher who was proficient in SASL. The interviews were held for participants to provide feedback on the process, and a feedback form (**Appendix V: Feedback form**) was filled out by the researcher. The outcomes of the pilot study are outlined in Table 5.

Table 5: Outcomes of the pilot study

Area	Outcome	Recommendations
Logistics	• Contacting schools proved to be challenging due to disconnected phone lines and unavailability of school principals • Power-cuts affected use of equipment such as the tympanometer and TEOAE screener • No nurses present at sites	• Personal visits to schools are necessary to inform them about the study and drop off consent forms • Charge all equipment prior to avoid power failure impeding data collection • Carry a first-aid kit and immediately terminate assessment should a child not feel well
Time management	• Scheduling of dates was difficult due to school activities and the researcher's personal schedule • The researcher's teaching and academic activities made it difficult to find a common time when all stakeholders would be available for the process to commence	• Share schedule of dates and times with school during the school visit and confirm appointment
Space	• Space to conduct the assessment was provided, although furniture had to be moved around	• No recommendations. Tests could be conducted accurately within the space provided
Participant recruitment	• Access to participants who meet the study criteria was challenging, requiring multiple site visits • Subsequently, participants were obtained and files (in the deaf school) were reviewed • Access to participants is achievable for the main study	• Recruitment depends heavily on teacher selection and willingness to assist in the process • Clearly outline selection criteria to staff during school visit and also provide a hard copy for easy reference

Appropriateness of tools	• The adapted PVSQ and DHI-CA were displayed and participants found the video recording unambiguous and understandable • All participants felt that the test procedures were longer than they anticipated • The researcher noted that the case record form could be modified for ease of reference	• Provide participants with short breaks in between assessments • Change the structure of the record form to also include scores of the questionnaires and ensure the form is user friendly to minimise time wastage
Selection criteria	• The selection criteria were appropriate for this study. Children who were turning 9 in 2024 struggled to complete the questionnaire • IsiZulu-speaking participants struggled with instructions given in English	• Only include children who are 9 years or older • The researcher is bilingual (IsiZulu and English) and can therefore assist in explaining instructions in IsiZulu • The main study will include students who can comprehend written English to ensure successful completion of the questionnaires
Research staff	• A sign language interpreter was necessary for providing instructions. However, the researcher also learnt signs related to the assessments • The research assistant was key in setting up equipment, collecting questionnaires, filing, cleaning up stations and assisting with ensuring the research process was well-organized • The researcher was able to conduct the assessments without a physiotherapist	• Should research funds be available, an additional therapist should be requested to join the research team (audiologist or physiotherapist) to improve the efficiency of the data collection process

Overall, the pilot study findings provided valuable insight into the feasibility and practicality of the study. The constraints experienced enabled the researcher to make amendments to the research protocol prior to the main study to avoid wasteful expenditure of time and resources, an ethical imperative. Piloting also helped the researcher become familiar with the research procedures.

Data management

The researcher was responsible for securely organizing and storing data produced from this study. Alpha-numeric codes were used to capture results to maintain anonymity for participants. The researcher checked the data entry for each day of data collection to ensure accurate representation of the data. Data collected from the study were stored on a password protected laptop and hard copies were stored in a locked cabinet in the researcher's office. Furthermore, data were backed-up in an access controlled and password protected external hard-drive and cloud. Such information was only accessible to the researcher and the supervisors, ensuring confidentiality of sensitive information from responses. The researcher also strictly followed the University of Cape Town (UCT) data management policy and the data will be stored for a period of 15 years (Department of Health, 2006, 2015). Thereafter, all records will be deleted/formatted and printed copies will be shredded.

Data analysis

Statistical Package for the Social Science (SPSS) version 29 was used and descriptive statistics were also applied for the purpose of data analysis. This data analysis method assisted in organizing and synthesizing data in a meaningful way by describing the associations between variables in the population (Kaur et al., 2018). Measures of central tendency were established through the use of the mean and/or median to identify central points in the data set. Measures of spread were established through sample standard deviations to describe the spread of data and for generalizability of data. The measure of position was also established using percentile and quantile ranks comparing scores to available normative data.

For Phase One, internal consistency of the questionnaires and correlation between questionnaire items were analysed using the Cronbach alpha, Spearman-Brown coefficient and Guttman split-half coefficient. An alpha coefficient of .80 was considered adequate, with higher values indicating greater internal consistency (De Vet et al., 2017; Mason, 2005). Content and face validity were evaluated through expert opinion as explained above under

Expert Panel Consultation. In addition, the Receiver Operating Characteristic (ROC) Curve was used to evaluate the sensitivity and specificity of the questionnaires. This form of analysis can be conducted for data that are not normally distributed (Nahm, 2022). For the validation process and Phase Two of the study, descriptive statistics were used to determine the mean and standard deviation of the data sample. Each questionnaire was scored and interpreted, along with all tests included in Table 4. Results were interpreted according to the normative data for each test. It was important to determine the normality of the data set. Thus, the Shapiro-Wilk Test was used to determine the distribution of the data (Mishra et al., 2019), where a significant value of less than .05 indicated data that were not normally distributed. Such information was necessary to determine whether parametric or non-parametric tests would be used. Thereafter, the independent-samples Mann-Whitney U test was applied to evaluate differences between variables and continuous data. The level of significance was considered to be $p < .05$ (Kwak, 2023). The independent-samples Mann-Whitney U test was used to determine construct validity through the known-groups technique. The hypothesis that was tested was: there are significant differences in PVSQ and DHI-CA scores between CWD and children who have NH (De Souza et al., 2017). The Chi-square and Spearman's Coefficient Correlation were used to determine relationships between variables. For all analysis conducted, the confidence level was set at 95% and a p -value of $< .05$ was deemed statistically significant (Kwak, 2023).

Reliability and validity

Assessment of physical outcomes was done by the researcher, a qualified audiologist who has undergone extensive vestibular assessment and management training from audiologists and physiotherapists. For assessments at deaf schools, the instructions were given by the participants' class teacher who was proficient in SASL and was more familiar with the children, to ensure accuracy of instructions and assessment procedures. This also assisted in reducing anxiety in participants and improved cooperation.

Quality of research instruments is important to maintain validity as it is through these tools that research findings will be drawn (Zohrabi, 2013). A scoping review was conducted by the researcher prior to commencement of this study to ensure that the tools selected for the assessment process are evidence-based, the scoping review article was published with the BMC Pediatrics Journal (<https://doi.org/10.1186/s12887-025-05563-2>). This process also ensured that all assessment tools and procedures were standardized, with age and sex appropriate norms

(Appendices I–O). A pilot study that used the same methods and procedures as the main study was undertaken, thus assisting in ensuring reliability.

This study aimed to achieve external validity through its sampling methods. Selection bias was limited by ensuring that the sample was representative of the population under study. To maintain reliable data and research findings, the researcher explicitly detailed the selection criteria, sampling methods, data collection and analysis methods of the study and ensured that these were in keeping with the aim and objectives of the study. The researcher also maintained internal validity and reliability through content triangulation (using multiple sources of data collection to reach a conclusion). This method also served to reduce bias, increase confidence in research outcomes and provide a comprehensive way of responding to the research question (Johnson et al., 2016). Data triangulation assisted in limiting the impact of the Hawthorne effect and improving the reliability of results. These methods are among those recommended by Zohrabi (2013) for maintaining validity and reliability in research.

Selection bias can occur due to gatekeeper permission refusal, non-response from gatekeepers, parents/caregivers and participants, and informed consent refusal, resulting in a smaller sample size and reduced value of the research. Therefore, more than one site was selected to improve the likelihood of obtaining sample size. Social desirability bias was reduced by emphasizing the maintenance of confidentiality and anonymity in the study (Larson, 2018).

Ethical considerations

This research was conducted in accordance with the Declaration of Helsinki (World Medical Association, 2013) and endorses the Singapore statement on research integrity (**Appendix W**: Singapore statement of research integrity). The regulations provided by the Minister of Health allow for the research ethics committees (RECs) to provide permissions for research involving minors (Strode & Slack, 2015), therefore, ethical clearance was obtained from the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee (HREC ref: 265/2023, see **Appendix Q**: Human Research Ethics Committee clearance). Thereafter, gatekeeper permission from the KZN Department of Education was obtained (Ref.:2/4/8/112 see **Appendix R**: KwaZulu-Natal Department of Education permission) to access schools within the district.

Autonomy and informed consent. Information documents (see **Appendix D1:** Information document and informed consent and **Appendix D2:** Information document and informed consent (IsiZulu translation)) with the details of the study were shared with all potential participants and their legal guardians. These forms included a request for informed consent from guardians. Assent from child participants was requested before enrolment in the study and was requested with the aid of a teacher who was proficient in SASL. Participation was voluntary and participants were free to withdraw from the study at any point, including during assessments. Informed consent forms were translated into IsiZulu for participants who are not first language English speakers.

Anonymity and confidentiality. The data generated from the study included no personal identifying information to ensure anonymity. The research assistant in this study signed a confidentiality agreement (see **Appendix B:** Confidentiality agreement) prior to commencement of the study to ensure that all participant information was kept confidential.

Beneficence and non-maleficence. This study is of value to society. It showed respect and sensitivity to all persons and did not expose participants to undue harm. The risks involved in this study were no more than those of daily living, and are therefore favourable. Assessments in this study were conducted during school hours, which may have disrupted teaching and learning. Although this was unfavourable, the risk benefit ratio was justified in terms of the greater good.

Children identified with any dysfunction of the ear, eyes or proprioceptive system were referred for further assessment and rehabilitation therapy. Referrals were made to the healthcare professionals at the local clinic, base hospital and/or the University of KwaZulu-Natal audiology clinic (see Referral letter **Appendix X:** Referral letter). Children who became upset or dizzy during the assessments had their safety assured and were comforted.

The researcher ensured that the research environment was child-friendly and safe. Furthermore, a gait belt was used to ensure safety of the participants to minimise falls. Comfort breaks were taken between assessment procedures, and participants' well-being was monitored throughout the assessment. A copy of the assessment schedule/timetable was shared with the teachers and/or school nurse, and a first aid kit was brought to the study sites by the researcher

in the unlikely event of injury. In this study, there were no injuries, falls or adverse events. The researcher catered snacks for participants.

Justice. This research advocates for children with hearing loss and aims to raise awareness of balance dysfunction, promote overall health and well-being. The study informs future developments of tools that are suitable for this population to provide inclusive healthcare, thus contributing to distributive justice. Last, this study was conducted in South Africa, a LMIC and involved individuals within the Deaf community; thus, allowing for context specific knowledge to be generated. Such endeavours are important for cross-cultural research (Broesch et al., 2020).

Results dissemination

The assessment findings of each participant were made available to parents/caregivers and they were given feedback regarding the assessment results and recommendations. Feedback was also provided to each school that participated to inform them about the study findings. The findings will also be shared with the Departments of Education and Health in an effort to influence policy and reform. They have been, and will also be shared at conferences, for example the XXXII Bárány Society Meeting 2024 and in peer-reviewed publications. The findings will be shared with deaf schools, especially those who participated in the study.

CHAPTER 4: RESULTS

“Let your deafness no longer be a secret – even in art”

Ludwig van Beethoven (van Beethoven, 2024)

Introduction

This chapter details the results of the study according to the two study phases, which are linked to the study objectives. Currently, there are no subjective questionnaires that quantify balance symptoms and related handicap in CWD who use SASL. Thus, there was a need to provide contextually, culturally and linguistically appropriate tools for this population to provide a means of exploring their balance-related complaints. This chapter describes the results of adaptation, translation and validation of the Pediatric Vestibular Symptom Questionnaire (PVSQ) and the Dizziness Handicap Inventory for Children/Adolescents (DHI-CA) for children between the ages of 9–17 years who use sign language. The chapter also provides results of the investigation of the balance function in CWD and those with NH, and further analyses findings within the CWD group. Parts of this section were accepted for an oral presentation at the Bárány Society Meeting 2024, held in Uppsala, Sweden. Furthermore, a journal article has been submitted to the Journal of Vestibular Research and is currently under review.

Phase One

To calculate the internal consistency of the video-recorded PVSQ and DHI-CA, the responses from CWD (pilot participants) were used. Cronbach’s α was 0.904 for the PVSQ and 0.949 for the DHI-CA, indicating that the PVSQ and DHI-CA demonstrated a high level of internal consistency among the items within the video-recorded questionnaires. Thus, these tools can be considered reliable. Similar results were obtained on the Spearman-Brown prophecy formula (PVSQ: $r_{xy} = .845$ and DHI-CA: $r_{xy} = .727$) and the Guttman split-half coefficient (PVSQ: $\lambda_4 = .845$; DHI-CA: $\lambda_4 = .726$). The reliability statistics indicated high internal consistency between these questionnaires. This information is presented in Table 6.

Table 6: Internal consistency statistics for the Pediatric Vestibular Symptom Questionnaire (PVSQ) and the Dizziness Handicap Inventory for Children/Adolescents (DHI-CA)

Measure		PVSQ	DHI-CA
Cronbach's Alpha		.904	.949
Spearman-Brown coefficient	Equal Length	.732	.571
	Unequal Length	.845	.727
Correlation between forms		.845	.727
Guttman split-half coefficient		.845	.726

Through this process, it was concluded that the video-recorded PVSQ and DHI-CA questionnaires and their corresponding adapted paper-based versions were reliable and could be applied to a larger sample size.

Post-pilot validation

The Shapiro-Wilk test indicated that the data used for the post-pilot validation were not normally distributed for either the PVSQ ($p = .016$) or the DHI-CA ($p = .045$). Thus, non-parametric tests were used. The independent-samples Mann-Whitney U test showed a significant difference in the PVSQ ($p = .0090$) where the CWD had a mean rank of 13.95 and NH children had a mean rank of 7.05.

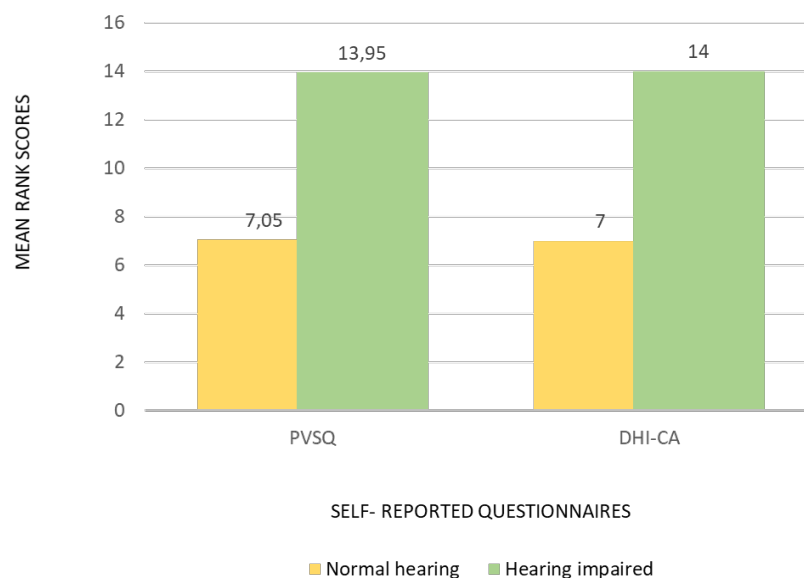


Figure 6: Mean rank scores for the self-assessment questionnaires

Similarly, for the DHI-CA, significant differences were noted ($p=.008$) where the mean rank for CWD was 14.00 in contrast with 7.00 for NH children (Figure 6). These results indicate that CWD had significantly higher scores on the PVSQ and the DHI-CA questionnaire compared to their NH peers. Thus, CWD presented with greater experience of imbalance symptoms and related handicap when compared to NH children. Thus, the hypothesis was rejected, demonstrating that these tools measure what they are intended to measure (De Souza et al., 2017).

The ROC curves for both questionnaires showed satisfactory results (Figure 7). For the PVSQ, the area under the curve (AUC) was 0.845 ($p=.009$) and the cut-off point ≥ 1.05 . At this cut-off, the PVSQ had good sensitivity (80%) and specificity (90%). For the DHI-CA, the AUC was 0.850 ($p=.008$), the cut-off was 23, and the sensitivity and specificity 80%. Thus, both the video-recorded PVSQ and DHI-CA are acceptable and can be used for identifying symptoms and handicap due to balance deficits (Nahm, 2022).

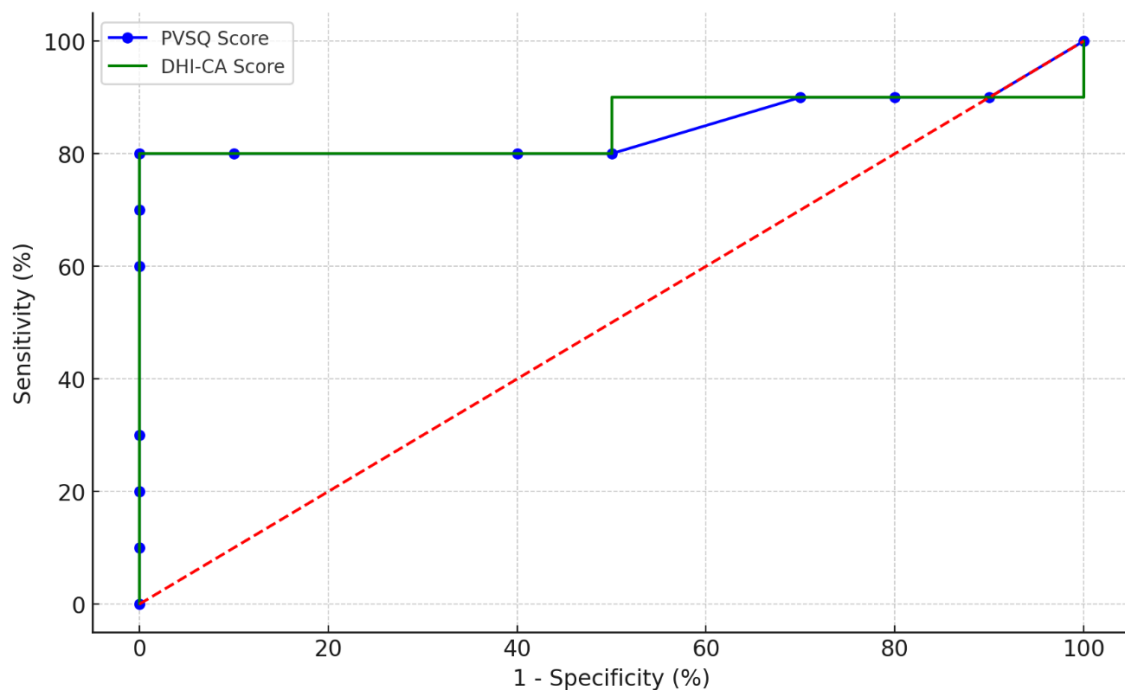


Figure 7: The ROC curves for the PVSQ and the DHI-CA questionnaires

Last, there was a strong and significant correlation noted between the PVSQ and DHI-CA on the Spearman's rank correlation coefficient ($\rho = .824$; $p = <.001$).

Phase Two

The study assessed 155 participants between the ages of 9–17 years: 97 children attending schools for the deaf and 58 attending mainstream schools. The mean age was 14.07 years with a range of eight for both CWD (SD: 2.705) and NH children (SD: 1.824). The sample had a nearly equivalent sex distribution as 49% of children were male and 51% were female. Furthermore, it was possible to match participants according to age. No participants withdrew from the study. The age range for all participants is displayed in Figure 8.

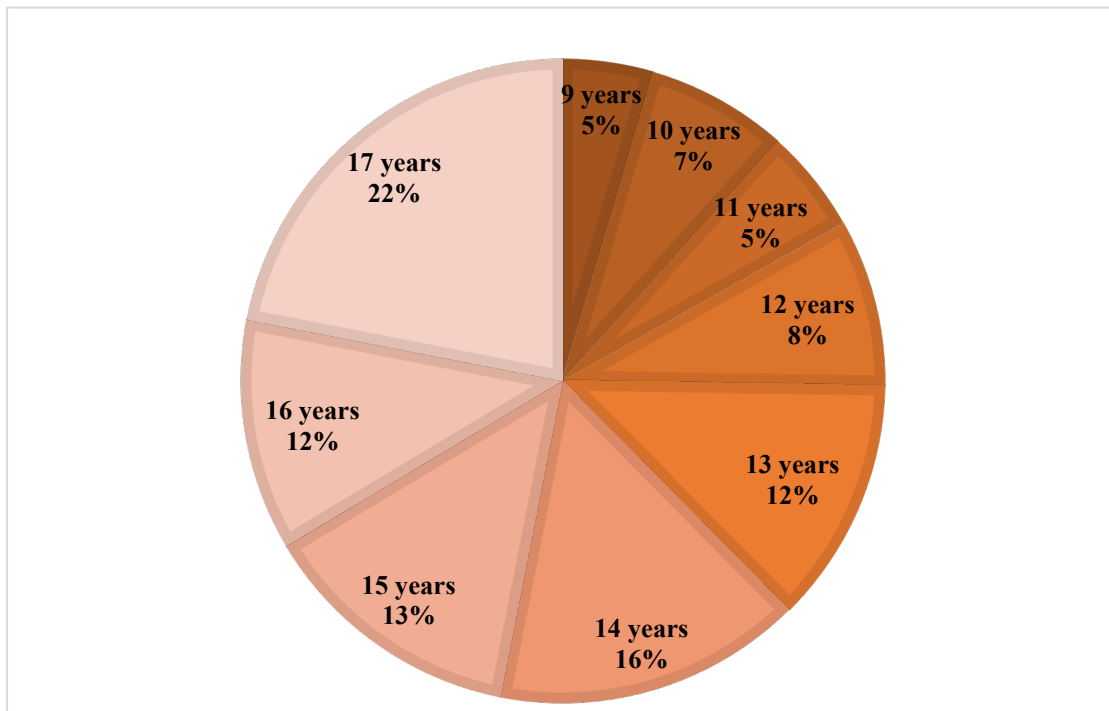


Figure 8: Distribution of participants according to age

In the children from deaf schools, 5.8% (n=9) presented with pre-lingual deafness (deafness before language development), 12.3% (n=19) with post-lingual deafness (deafness after language development), and for 44.5% (n=69) this information was unknown. The inability of the researcher to review school files for all participants contributed largely to the “unknown” group, for whom it could not be determined when the hearing loss occurred. Furthermore, within the unknown group, 61.9% (n=60) were monolingual, communicating only using SASL (SASLwoS – without speech) and 38.1% (n=37) were bilingual, primarily using SASL as their first language and spoken language (IsiZulu/English) as a second language (SASLwS – with speech). None of the children in the mainstream schools presented with existing hearing loss.

Case history information obtained from all participants in combination with the medical reports from the deaf school files revealed that some participants had a history of ear-related difficulties such as aural fullness, otorrhoea (discharge) or otalgia (ear pain), as seen in Figure 9.

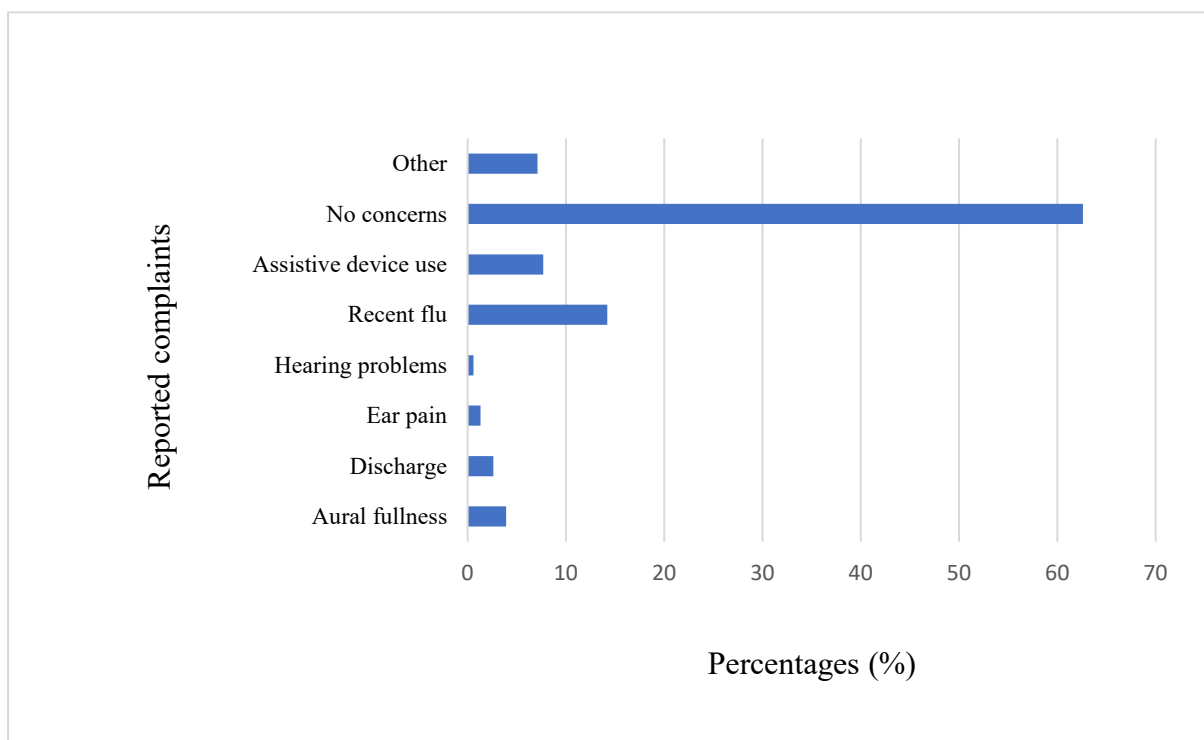


Figure 9: Illustration of case history information from all participants

Most participants (62.6%, n=97) did not report any pertinent information and relayed no difficulties. Of the children who presented with hearing impairment, 7.7% (n=12) were wearing assistive listening devices such as hearing aids or cochlear implants. In the *Other* category 7.1% (n=12) of children presented with a history of impacted cerumen, learning disabilities, literacy issues (reading and writing), intellectual disability, craniofacial abnormalities or visual problems. A total of 22 participants (14.2%) reported experiencing a recent flu/common cold, not unexpected as data collection for some participants occurred during the winter season.

Otological evaluation

Hearing screening was conducted with children from mainstream schools to assess whether they met the inclusion criteria. The results for the otological examination (case history,

otoscopic examination, tympanometry and transient evoked emissions) in this group were normal. It can be noted that pure-tone audiometric assessment was not conducted with this group. In CWD otoscopic examination revealed no abnormalities in 77.3% (n=75) of participants, whereas 22.7% (n=22) presented with abnormalities. Abnormalities are reported according to the observations in each ear because results for some participants differed per ear. For the right ear, 8.2% of participants presented with impacted cerumen, 1.0% with perforation, 3.1% with discharge in the ears, 5.2% with inflamed tympanic membrane and 4.1% had other difficulties. In the left ear, 83.5% presented with no abnormalities, 4.1% with impacted cerumen, 2.1% with perforation, 4.1% with discharge, 3.1% with inflamed tympanic membrane and 3.1% with other. In this test, *Other* referred to soft cerumen, a scarred tympanic membrane, microtia, stenosis or atresia.

Thereafter, tympanometry was conducted to evaluate the status of the middle ear. Most of the participants in the CWD group (84.5%, n=82) presented with Type A tympanograms indicating no presence of middle ear abnormalities in the right ear. Middle ear abnormalities were noted in 14.4% (n=14) and middle ear status could not be determined in 3.1% (n=3) of children due to pathologies of the outer ear. The transient evoked potential otoacoustic emissions (TEOAE) was the last test conducted in this category to evaluate the response of the cochlea to sound. The TEOAE results in this group were *refer* in all participants. However, this was expected as the children present with hearing loss. The TEOAE results are displayed in Figure 10. Children who presented with abnormalities in the otoscopic examination and tympanometry tests were referred for medical intervention and reassessed thereafter. For this group, the participants were still included following abnormal results. In this population, a conductive or mixed hearing loss was part of the inclusion criteria.

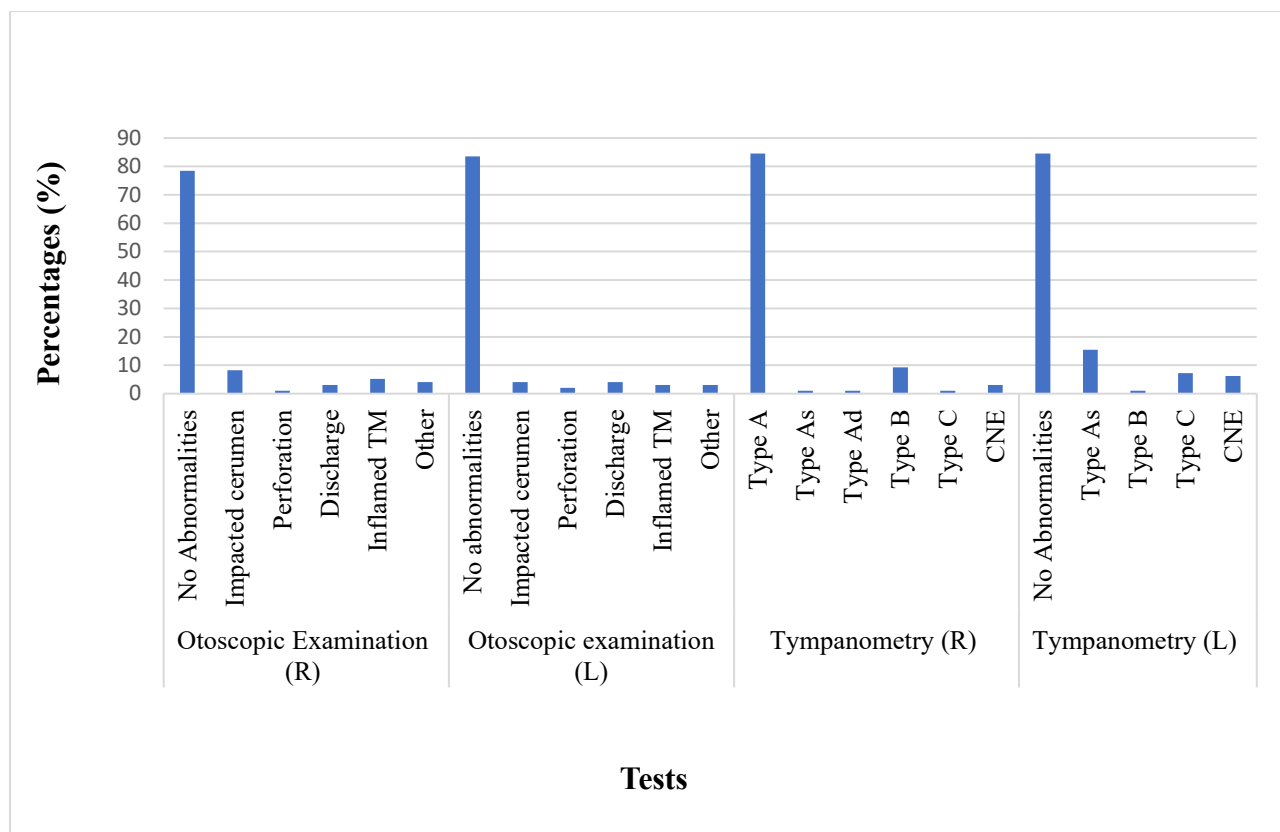


Figure 10: Otological results for children with deafness

There was a significant ($p = <.001$; $\rho = .782$) correlation between the otoscopic examination and tympanometry results ($p = <.00$; $\rho = .456$).

Static and dynamic vision

The Snellen chart was used to screen for static and dynamic vision in participants. Participants in deaf schools were asked to fingerspell the alphabets on the chart. The researcher was familiar with SASL alphabets, but a teacher was present to assist where necessary.

Static visual acuity (SVA): Results for the NH group (both eyes) indicated five (8.6%) participants with a *refer* result and 47 (81%) who passed. Six (3.9%) participants provided inconsistent responses and needed frequent reinforcement and instruction. In CWD, for the right eye, 12 (12.4%) obtained a *refer* and 80 (82.6%) obtained a pass. On the left eye, 11 (11.3%) obtained a *refer* and 81 (83.5%) a pass. In this test, the *refer* results indicate poor static visual acuity. A total of five (3.2%) participants could not be assessed as some CWD had not yet fully acquired knowledge of the alphabets. The Tumbling E-Chart was attempted with these participants. However, they struggled with the instructions and the test was discontinued. CWD

presented with greater difficulties with static visual acuity compared with NH children. For this test, the results between the two eyes showed significant correlation in both the CWD ($p = <.001$; $\rho = .838$) and in NH ($p = <.001$; $\rho = .732$) children.

Dynamic visual acuity (DVA): After static visual acuity was established, dynamic visual acuity (DVA) was assessed by the researcher with the assistance of a teacher. The researcher manually moved the participant's head in the horizontal plane at a frequency of 2 Hz while timing with a metronome. The participant re-read the Snellen chart and the number of "drop" on the line of best corrected vision was noted. In the NH group, 57 (98.3%) participants had no abnormalities and one participant (1.7%) could not be assessed as they requested not to participate in this test. For the CWD, 75 (77.3%) participants had no abnormalities, 12 (12.4%) participants had a drop of 2–4 lines, five (5.2%) participants could not be assessed and five (5.2%) struggled to stabilize vision and complete the test. There is limited literature on DVA performance in individuals who are deaf.

A drop of three or more lines in best corrected vision indicated poor dynamic visual acuity. A significant correlation ($p = <.001$, $\rho = .382$) between SVA and DVA results in CWD was found, indicating a relationship between SVA and DVA results in this group. However, for the NH group, no significant correlation was noted ($p = .966$, $\rho = -.006$).

Evaluation of balance

The Shapiro-Wilk test produced a statistically significant result ($p = <.001$) for both the modified Clinical Test of Sensory Interaction for Balance (m-CTSIB) and the Mini-Balance Evaluation Systems Test (Mini-BESTest). These results indicated that the data for this study were not normally distributed. Therefore, non-parametric tests were used to analyse the data.

The independent-samples Mann-Whitney U test revealed a significant difference ($p = <.001$) between the CWD and the NH group on the m-CTSIB. The mean rank was 58.68 for the CWD, and 110.32 for the NH group. In the NH group, 98.3% ($n=57$) presented with no balance difficulties and only 1.7% ($n=1$) had difficulties with condition 4 of the test (eyes closed on foam). Conversely, for the CWD, 67% ($n=64$) participants presented with abnormalities in this test. Thirty-three participants were able to complete the test within the time of 120 seconds. Within those who experienced difficulties, 49.5% ($n=48$) of participants presented with difficulties with condition 4 only and 16.5% ($n=16$) had difficulties in more

than one condition (difficulties in condition 2, 3 and 4). Although 33 participants were able to complete the test, they still presented with a sway in condition 4. Their score was not considered abnormal because they were able to maintain balance without moving from test position or opening their eyes. Furthermore, this test was not instrumented. Therefore, the degree of sway/ Sway Index could not be calculated to determine its impact on balance.

For the Mini-BESTest, a score above 24 out of 28 indicated good balance. For this study, one (1.7%) participant from the NH group had a score of less than 22, while the majority (98.3%, n=57) obtained scores above 24, which indicated good balance. In the CWD group, 46 (47.4%) participants presented with scores below 24, and 51 (52.6%) participants had a score of or above 24 (Table 7).

Table 7: Statistics on the Mini-BESTest and the related subtests for CWD and NH groups

Tests	Range of scores (CWD)	Range of scores (NH)	NH (Mean $\pm$ SD)	CWD (Mean $\pm$ SD)	<i>p</i> -value
Mini- BESTest	12–15 (n=2) 15–20 (n=18) 20–23 (n=26) 24–28 (n=51)	22 (n=1) 24–28 (n=57)	27.07 $\pm$ 1.21	23.30 $\pm$ 3.39	<.001
SLS	1.0 sec- 20.0 sec	20.0 sec- 20.0 sec	20.0 $\pm$.00	15.39 $\pm$ 6.28	<.001
TUG	5.6 sec – 16.1 sec	3.3 sec- 9.7 sec	6.16 $\pm$ 1.48	9.15 $\pm$ 1.94	<.001
TUG-manual	6.6 sec - 20.3sec	4.2 sec- 11.5 sec	7.14 $\pm$ 1.66	10.90 $\pm$ 2.59	<.001
Percentage difference: TUG and TUG-manual	0 – 32%	1% - 13%	7.05 $\pm$ 1.58	10.89 $\pm$ 2.61	.012
Incline: Eyes-Closed	2.0 sec – 30.0 sec	9.0 sec – 30.0	28.76 $\pm$ 4,32	25.19 $\pm$ 8.35	.003

The significance level (*p*-value) is 0.05

Overall, a significant difference ($p = <.001$) was found between both groups on the Mini-BESTest, where NH children showed better performance when compared to CWD. The mean rank difference for the CWD was noted to be 55.77, and for the NH group it was 115.17; indicating that CWD had poorer scores and reduced balance outcomes when compared to the NH group. Significant differences were also found between NH children and CWD in the TUG, TUG-manual/dual task, SLS and the Incline- eyes closed test as reflected in Table 7. These are

subtests incorporated within the Mini-BESTest where the SLS is part of the anticipatory domain, Incline- eyes closed is a part of the sensory orientation domain and both the TUG and TUG dual task are part of the dynamic gait domain. On the SLS, a mean rank difference of 100.5 (NH children) and 64.55 (CWD) was obtained, indicating that CWD had reduced static balance when compared to NH children. The TUG demonstrated a mean rank difference of 101.36 in CWD while NH children obtained a mean rank of 38.98; indicating that CWD had poorer dynamic balance and were at greater risk for falls when compared to their NH peers. The TUG dual task (TUG-manual) showed that CWD had significantly increased walking times when dual-tasking compared to NH children as their mean ranks were 101.34 and 38.97 respectively. The difference in walking times in the TUG and the TUG-manual between both groups, indicate that CWD are at greater risk of falls when dual-tasking (mean rank: NH- 66.34; CWD- 84.97). Last, the Incline-eyes closed test showed a mean rank difference of 72.23 (NH children) and 87.65 (CWD); further indicating poorer static balance in CWD when compared to NH children.

On both balance tests, NH children presented with better balance outcomes when compared to their peers with hearing impairment. There was a significant correlation ($p < .001$; $\rho = .515$) between the scores on the m-CTSIB and the Mini-BESTest in the CWD. No significant correlation was observed in the NH group ($p = .225$; $\rho = .162$).

Questionnaires

The independent-samples Mann-Whitney U test indicated a significant difference ($p < .001$) between the Pediatric Vestibular Symptom Questionnaire (PVSQ) and the Dizziness Handicap Inventory-Child/Adolescent (DHI-CA) scores in CWD and those with NH. On the PVSQ, the mean rank difference was 94.46 in the CWD and 50.47 in the NH group, indicating more balance-related symptoms for the CWD. The mean rank on DHI-CA was 94.71 for the CWD and 50.06 for the NH, suggesting that CWD reported greater handicap due to balance symptoms compared with NH children. Spearman's rank correlation was calculated to determine the relationship between the PVSQ and DHI-CA questionnaires. Spearman's rho demonstrated a significant correlation between the PVSQ and DHI-CA scores in CWD ($p < .001$; $\rho = .736$) and NH children ($p < .001$; $\rho = .539$), as seen in Table 8.

Table 8: Correlation statistics between the PVSQ and DHI-CA questionnaires

Confidence intervals of Spearman's rho					
Group		Spearman's rho (ρ)	Significance (2-tailed)	95% Confidence Intervals (2-tailed) ^{a, b}	
				Lower	Upper
CWD	PVSQ score – DHI-CA Score	.736	<.001	.626	.818
NH	PVSQ score – DHI-CA Score	.539	<.001	.320	.704

a. Estimation is based on Fisher's r-to-z transformation

b. Estimation of standard error is based on Fieller, Hartley, and Pearson's formula

Note: CWD, children with deafness; NH, normal hearing children

Parental reports on the EQ-5D-Y proxy version questionnaire also revealed differences. Forty-two participants did not return the questionnaire. Therefore, these participants were not included in the analysis. A total of 113 questionnaires were included in this analysis: 64 questionnaires from CWD and 49 from the NH group. Incomplete questionnaires were included and categories not completed were marked as "missing scores/999".

Each parent rated their child's health on *The Child's Health Today* and the responses ranged from 40–100, as presented in Table 9. The closer the rating was to 100, the better the child's health was perceived to be. Overall, parents felt that on the day of completing the questionnaire, their child was in relatively good health.

Table 9: Participants' scores on The Child's Health Today

EQ-5D-Y proxy questionnaire score		
Score	<i>N</i>	%
40	2	1.8%
50	5	4.4%
55	1	0.9%
60	1	0.9%
65	1	0.9%
70	1	0.9%
75	2	1.8%
80	16	14.2%
83	1	0.9%

85	6	5.3%
88	1	0.9%
90	10	8.8%
94	2	1.8%
95	15	13.3%
98	1	0.9%
99	1	0.9%
100	37	32.7%
999	10	8.8%

Parents also reported their child's abilities based on the five domains (*Mobility, Looking after Her/Himself, Doing Usual Activities, Having Pain or Discomfort, and Feeling Worried, Sad or Unhappy*), which relate to the child's HRQoL. The results are displayed in Figure 11. In the *Mobility* domain, 84.4% of CWD experienced no difficulties, 7.8% experienced some difficulties, and 7.8% had missing scores. In *Looking after Her/Himself*, 84.4% had no difficulties, 9.4% had some difficulties, and 6.3% had missing scores. For *Doing Usual Activities*, 81.3% experienced no difficulties, 14.1% had some difficulty, and 4.7% had missing scores. For *Having Pain or Discomfort*, 71.9% experienced no difficulties, 23.4% had some difficulties, and 4.7% had missing scores. Last, for *Feeling Worried, Sad or Unhappy*, 65.6% experienced no difficulties, 26.6% had some difficulties, 1.6% had a lot of difficulties and 6.3% had missing scores.

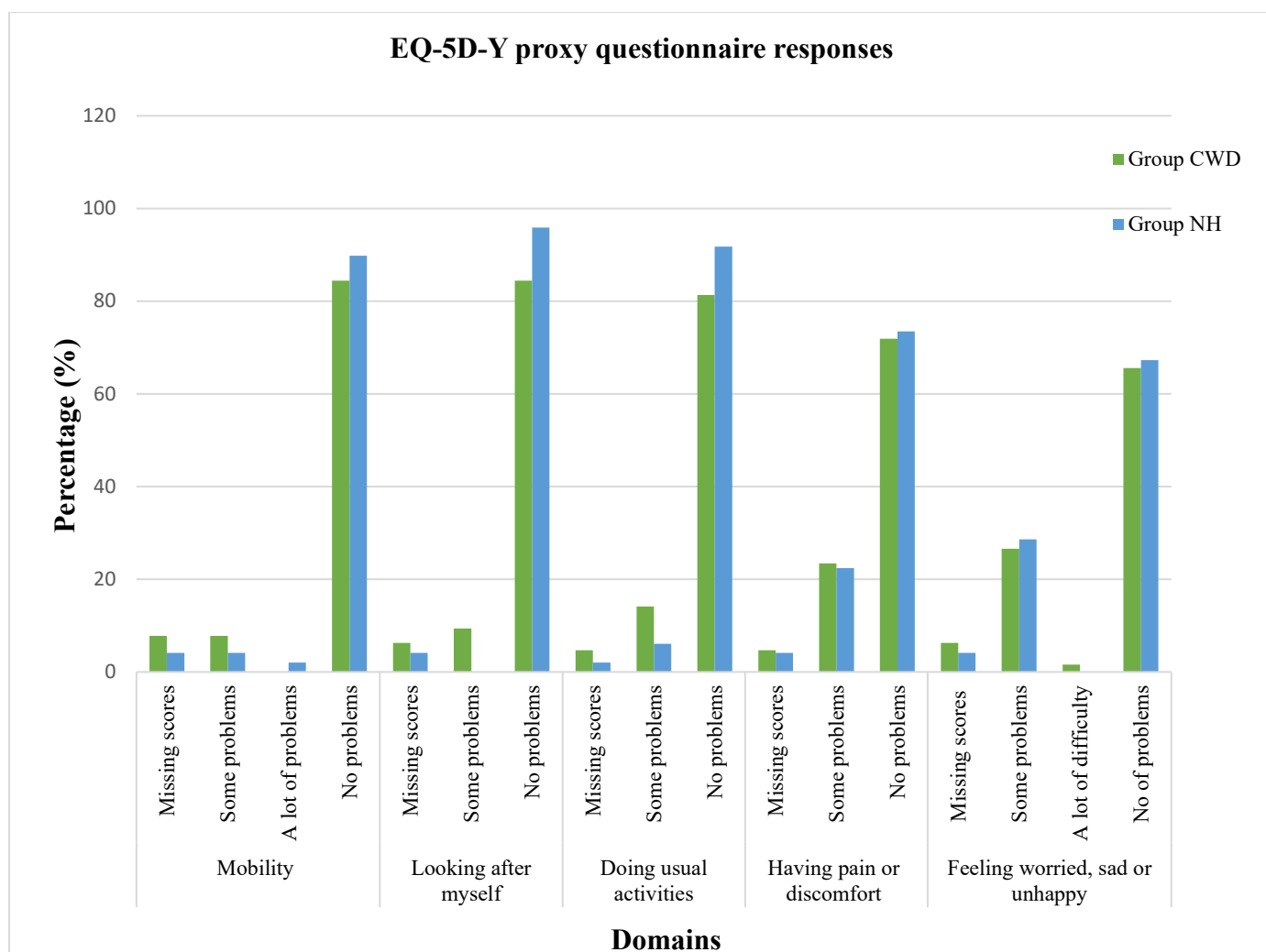


Figure 11: EQ-5D-Y proxy version questionnaire responses from children with deafness (CWD) and normal hearing (NH)

For children with NH, in the *Mobility* domain, 89.8% of participants experienced no difficulties, 4.1% experienced some difficulties, 2.0% experienced a lot of difficulties, and 4.1% had missing scores. In *Looking after Her/Himself*, 95.9% experienced no problems and 4.1% had missing scores. For *Doing Usual Activities*, 91.8% experienced no problems, 6.1% had no difficulties, and 2.0% had missing scores. For *Having Pain or Discomfort*, 73.5% had no difficulties, 22.4% had some difficulties, and 4.1% had missing scores. For *Feeling Worried, Sad or Unhappy*, 67.3% experienced no difficulties, 28.6% experienced some difficulties, and 4.1% had missing scores. Table 10 depicts the statistical findings from this questionnaire.

Table 10: Descriptive statistics of the EQ-5D-Y proxy version questionnaire results from children with deafness (CWD) and normal hearing (NH)

Group		EQ-5D-Y proxy version domains				
		Mobility	Looking after her/himself	Doing usual activities	Having pain or discomfort	Feeling worried, sad or unhappy
CWD	Mean	3.61	3.63	3.58	3.39	3.27
	Median	4.00	4.00	4.00	4.00	4.00
	Mode	4	4	4	4	4
	Std. deviation	.936	.900	.905	1.002	1.058
NH	Mean	3.78	3.88	3.82	3.43	3.31
	Median	4.00	4.00	4.00	4.00	4.00
	Mode	4	4	4	4	4
	Std. deviation	.715	.600	.635	.979	1.025

Ultimately, children with NH showed better outcomes for mobility, self-care and doing usual activities when compared with CWD. In domains four and five, both groups experienced difficulties with pain and emotional well-being. Ultimately, the CWD experienced reduced quality of life when compared to NH children because they experienced difficulties in all domains.

Relationship between the questionnaire responses (PVSQ, DHI-CA and EQ-5D-Y)

The relationship between the three questionnaires was analysed. Spearman's rho indicated no relationship between the *Mobility*, *Looking After Her/Himself*, *Feeling Worried, Sad or Unhappy* domains of the EQ-5D-Y proxy questionnaire, the PVSQ and DHI-CA scores. Furthermore, there was no relationship between the *Having Pain or Discomfort* domain and the DHI-CA score. However, there was a significant correlation ($p=0.45$; $\rho = -.189$) between the *Doing Usual Activities* domain and the PVSQ score. Similar results were obtained for the DHI-CA ($p=.013$; $\rho = -.232$). For the *Having Pain or Discomfort* domain, a correlation was noted ($p=.035$; $\rho = -.199$), indicating that although weak, there is a relationship between doing usual activities, pain or discomfort and the experience of balance symptoms.

Relationship between the self-assessment questionnaires and balance tests

When the data from the self-assessment questionnaires and balance test were compared, the relationship between the assessments was significantly correlated ($p = <.05$) as seen in

Table 11. However, the correlation was negative and weak between the PVSQ and m-CTSIB scores ($\rho = -.239$), PVSQ and MiniBEST scores ($\rho = -.365$), and the DHI-CA and m-CTSIB scores ($\rho = -.261$). The balance tests had a moderate correlation ($\rho = .658$) to each other.

Table 11: Correlation statistics between self-assessment questionnaires and balance tests

Confidence Intervals of Spearman's rho				
	Spearman's rho (ρ)	Significance (2-tailed)	95% Confidence Intervals (2-tailed) ^{a, b}	
			Lower	Upper
PVSQ score – m-CTSIB score	-.239	.003	-.386	-.079
PVSQ score – Mini-BEST score	-.365	<.001	-.497	-.215
DHI-CA Score – m-CTSIB score	-.261	.001	-.406	-.103
DHI-CA Score – Mini-BEST score	-.315	<.001	-.454	-.161
m-CTSIB score – Mini-BEST score	.658	<.001	.555	.741

a. Estimation is based on Fisher's r-to-z transformation

b. Estimation of standard error is based on Fieller, Hartley, and Pearson's formula

Furthermore, a multiple regression was computed from DHI-CA, PVSQ, m-CTSIB and Mini-BEST scores with the DHI-CA used as an independent variable. The results from the model summary were significant, $F(3)=81.666$, $p= <.001$, $R^2= .619$. A further evaluation of individual predictors indicated that the PVSQ score was a significant predictor of functional balance ($t=14.393$, $p= <.001$).

Differences in the CWD group

This analysis included a total of 97 CWD as displayed in Table 12.

Table 12: Participants' demographic information

		<i>n</i>	%	Mean	Median	Mode	Range
Age (years)				14.07	14.00	17	8
Gender	Male	48	49.5%				
	Female	49	50.5%				
Language use	No speech, SASL only	60	61.9%				

	Speech and SASL	37	38.1%	
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Note: SASL, South African Sign Language

The Shapiro-Wilk test produced statistically significant results for the deaf children (PSVQ= .010, DHI-CA=<.001, Mini-BESTest=<.001, m-CTSIB=<.001) indicating that the data from this sample were not normally distributed. Therefore, non-parametric tests for analysis were applied.

The independent-samples Mann-Whitney U test showed significance between the two groups with different communication strategies. The self-assessment questionnaires (PSVQ, $p=.002$; DHI-CA, $p=.013$) indicated a difference between the scores attained between the groups where the mean rank on the PVSQ was 55.88 for the SASLwoS and 37.84 for the SASLwS. For the DHI-CA, the mean rank was 54.58 and 39.95, respectively, indicating that the SASLwS group presented with lower scores on both questionnaires and, therefore, had fewer perceived symptoms and handicaps. When comparing scores on the balance tests, there was no significant difference on the m-CTSIB score ($p=.732$), and the mean ranks were 48.24 for the SASLwoS and 50.23 for the SASLwS. This suggests that performance in this test was homogenous between the two groups. Conversely, on the Mini-BESTest, a significant difference was noted ($p=.037$) and the mean ranks were 44.34 and 56.55, respectively. These results indicate that the SASLwoS group presented with lower balance scores when compared to the SASLwS group. These results are illustrated in Figure 12.

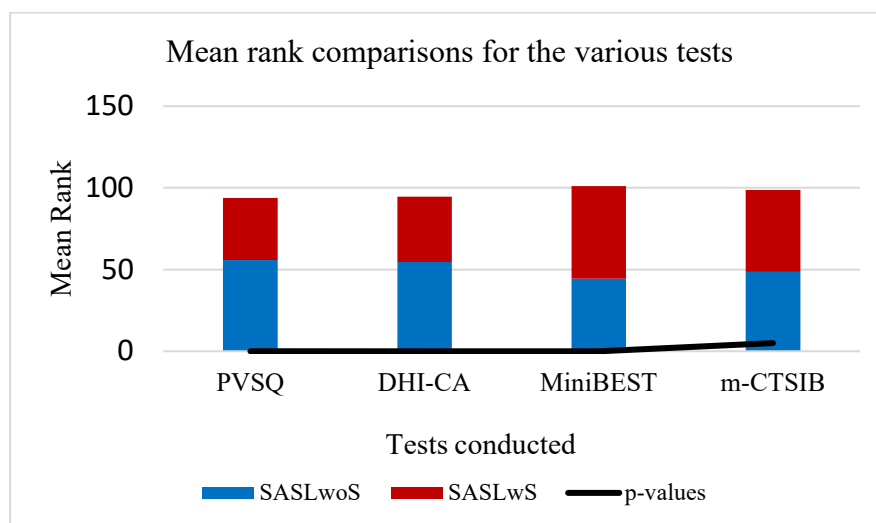


Figure 12: Independent-samples Mann-Whitney U test results for the SASLwS and SASLwoS groups

(Notes: SASLws, South African Sign Language with speech; SASLwoS, South African Sign Language without speech)

Spearman's rank correlation coefficient was conducted between the two groups. In the SASLwoS group, there was a statistically significant strong correlation ($\rho = 0.770, p < .001$) between the PVSQ and DHI-CA scores, as well as the m-CTSIB and the Mini-BESTest ($\rho = .534, p < .001$). The SASLws group also showed a moderate, statistically significant relationship between the PVSQ and DHI-CA scores ($\rho = .637, p < .001$) and the m-CTSIB and the Mini-BESTest ($\rho = .468, p = .004$). In other words, there was a significant relationship between scores from subjective self-assessment measures and scores from balance tests for all deaf participants (Table 13).

Table 13: Correlation statistics between the SASLwoS and SASLws groups

Language use	Tests	Spearman's rho (ρ)	Significance (2-tailed)
SASLwoS	DHICA score – PSVQ score	.770**	<.001
	m-CTSIB score – Mini-Bests test score	.534**	<.001
SASLws	DHI-CA score – PSVQ score	.637**	<.001
	m-CTSIB score – Mini-Best test score	.468**	.004

** Correlation is significant at the 0.01 level (2-tailed); SASLws, South African Sign Language with speech; SASLwoS, South African Sign Language without speech

For the EQ-5D-Y proxy version questionnaire, a total of 64 questionnaires were returned and included into the analysis. Incomplete questionnaires were included into the analysis and aspects with no responses were recorded as “missing scores/999”. Parents of all CWD rated their child's health on *The Child's Health Today* as above 50 and the majority from both groups recorded a score of 95–100. This meant that on the day when parents completed the questionnaire, they perceived their child to be in good health. However, analysis of the ratings reveals that parents of the SALws group rated their child's health higher compared with those from the SASLwoS group (Figure 13).

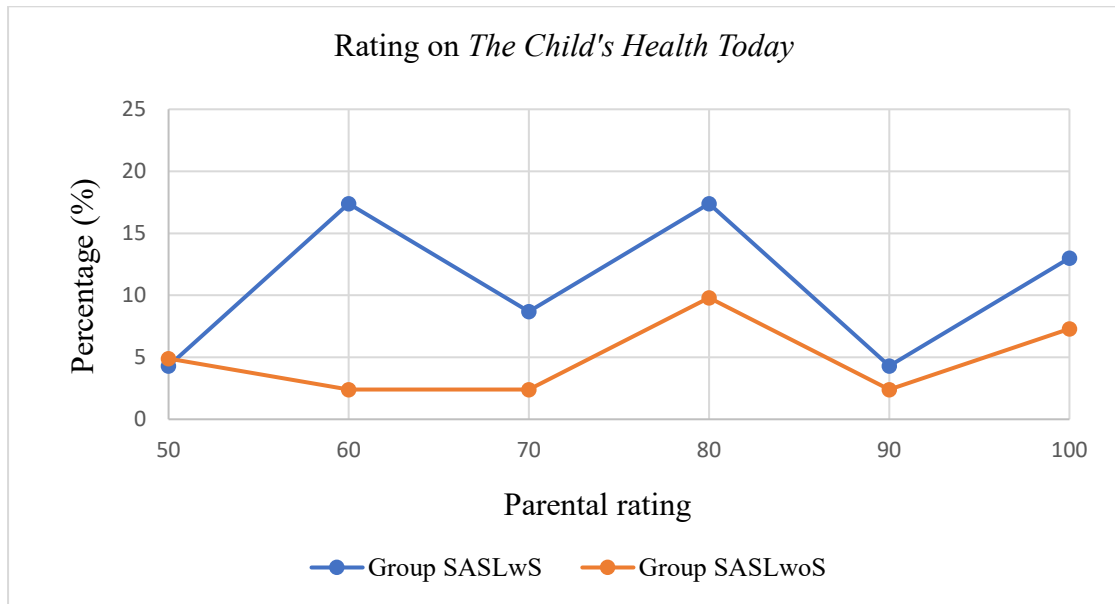


Figure 13: Parental ratings on the EQ-5D-Y proxy version questionnaire The Child's Health Today, for the SASLwS (South African Sign Language with speech) and SASLwoS (South African Sign Language without speech) groups

Parents rated their child's abilities within each domain of the EQ-5D-Y proxy version questionnaire. The SASLwoS group ratings in the five domains were as follows. For *Mobility*, most children (78.0%) experienced no problems, although 12.2% had some problems and 9.8% had missing scores. For *Looking After Her/Himself*, most children (82.9%) experienced no problems, although 9.8% experienced some difficulty, and missing scores were found for 7.3%. For *Doing Usual Activities*, 17.1% of children experienced some problems, no problems were reported for 78.0%, and missing scores affected 4.9%. *Having Pain or Discomfort* was no problem for three-quarters of these children (75.6%), but 19.5% did experience some problems, and missing scores affected 4.9%. For the last domain, *Feeling Worried, Sad or Unhappy*, most children experienced no problems (87.0%), with some problems noted for (8.7%) and missing scores for 4.3%.

Table 14: Statistics for the EQ-5D-Y proxy version questionnaire for children with deafness

Language use		EQ-5D-Y proxy version domains				
		Mobility	Looking after her/himself	Doing usual activities	Having pain or discomfort	Feeling worried, sad or unhappy
SASLwoS	Mean	3.46	3.59	3.51	3.46	3.20
	Median	4.00	4.00	4.00	4.00	4.00
	Mode	4	4	4	4	4
	Std. deviation	1.051	.948	.952	.977	1.100
SASLwS	Mean	3.87	3.70	3.70	3.26	3.39
	Median	4.00	4.00	4.00	4.00	4.00
	Mode	4	4	4	4	4
	Std. deviation	.626	.822	.822	1.054	.88

Notes: SASLws, South African Sign Language with speech; SASLwoS, South African Sign Language without speech

For the SASLwS group, 95.7% of children experienced no problems with *Mobility* and 4.3% had missing scores. In *Looking After Her/Himself*, 9.1% of children showed some problems, and 90.9% had no problems. For *Doing Usual Activities*, 8.7% of children had some problems, 87.0% had no problems, and 4.3% had missing scores. For *Having pain or discomfort*, 30.4% of children had some problems, 65.2% had no problem, and 4.3% had missing scores. Finally, in the *Feeling Worried, Sad or Unhappy* domain, 21.7% had some problems, 4.3% had a lot of problems, no problems were experienced by 69.6% and 4.3% had missing scores. Results for the EQ-5D-Y proxy questionnaire are presented in Table 14.

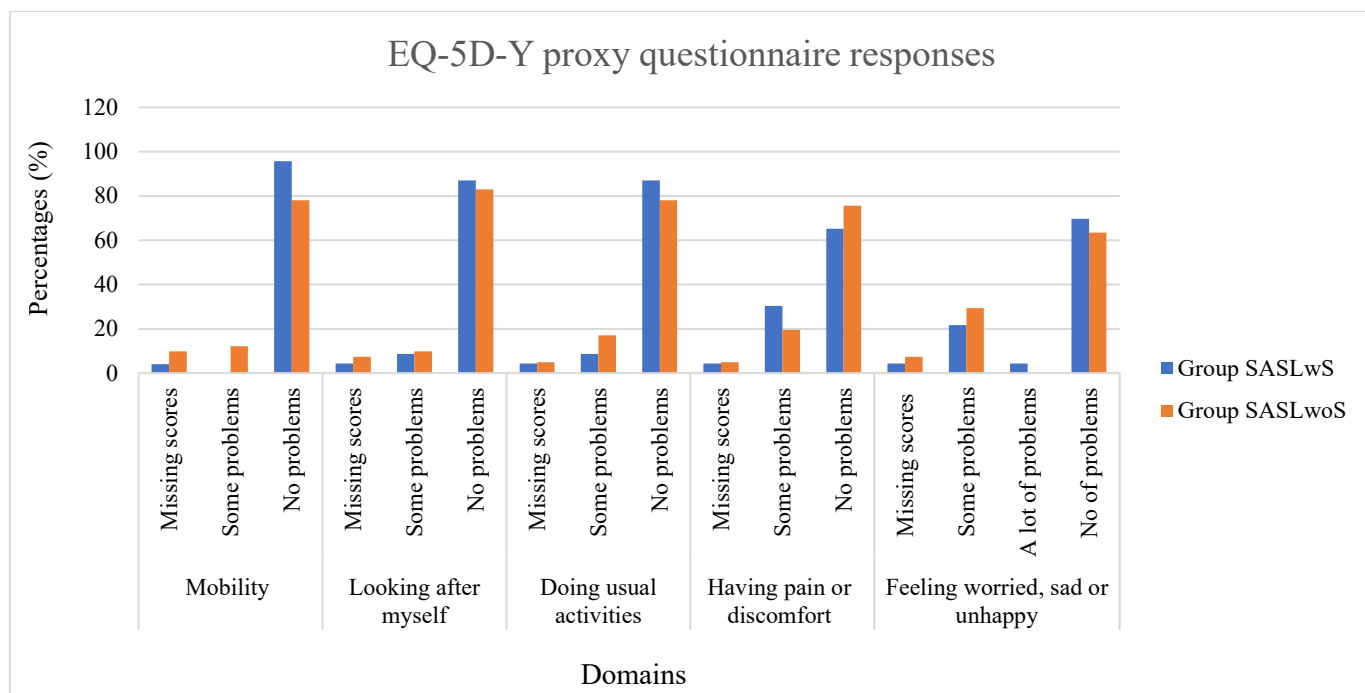


Figure 14: EQ-5D-Y proxy version questionnaire response according to the SASLwS and SASLwoS groups

Notes: SASLws, South African Sign Language with speech; SASLwoS, South African Sign Language without speech

In all domains, both groups were reported to experience difficulties. However, the SASLwoS group consistently experienced more difficulty than the SASLwS with the exception of domain four (Figure 14). This suggests that the SASLwS group had better outcomes in terms of mobility, self-care, usual activities, and emotional well-being.

CHAPTER 5: DISCUSSION

“Language skills are best learned through free usage; they evolve and expand in an atmosphere of freedom, as with hearing children.”

Andrew Foster (Foster, 2024)

Introduction

Chapter 5 begins by providing an overview of the study results and the findings in relation to the contextual framework. This chapter will bring meaning to the study findings by relating them to available literature in the field. Thereafter, the recommendations and study limitations will be highlighted. The study conclusion will be presented at the end of this chapter.

Overview of study results

In the current study underlies a unique and innovative perspective in the conceptualization of functional balance in school-aged children. The novelty highlighted in this study is as follows: a) translation and validation of two tools developed in Western countries for linguistic and contextual relevance in an underserved minority within an LMIC; b) evaluation of balance performance in CWD and NH children using an inexpensive, low technology, comprehensive and yet feasible test battery that incorporated both clinical tests and self-assessment questionnaires, allowing deaf children to ‘voice’ their symptoms; c) use of the full Mini-BESTest with hearing-impaired children and further using a sub-test (TUG and SLS) to identify potential risk of falls in children who communicate in SASL; last, d) exploration of the potential impact of speech acquisition on balance function in CWD which has been a neglected area in literature.

In accordance with the abovementioned findings, the aim of the study was to explore functional balance in school-aged children between the ages of 9–17 years. The aim was achieved through a two-phase approach. In the first phase, the Pediatric Vestibular Symptom Questionnaire (PVSQ) and Dizziness Handicap Inventory Child/Adolescent questionnaire (DHI-CA) were translated and cross-culturally adapted from English into SASL. Forward and back translation were conducted and thereafter, a panel of experts which included Deaf, hearing

and bilingual individuals, provided their views to attain content validity. Expert opinion was necessary to ensure that the tools were linguistically and culturally appropriate. Through the known-groups technique, the tools were validated with a sample of 20 children (10 NH children and 10 CWD) to achieve construct validity. Ultimately, both tools were found to have good internal consistency and validity. The results for the PVSQ indicated IC of $\alpha=0.904$ with good sensitivity (80%) and specificity (90%). For the DHI-CA, IC was $\alpha=0.949$, and the tool also had good sensitivity and specificity (80% for both). Phase One addressed Objectives 1 and 2 of this research study.

Phase Two addressed Objective 3, 4 and 5 and included an investigation of functional balance performance through physical balance assessments. Because balance is achieved through the integration of multisensory information from the visual, vestibular and proprioceptive systems (Karakoc & Mujdeci, 2021), tests such as visual acuity tests, the Mini-BESTest and the m-CTSIB test were used. Self-report assessments were also included where children completed the adapted PVSQ and DHI-CA, and parents reported on their child's HRQoL on the EQ-5D-Y proxy version questionnaire. All these measures were used in an effort to investigate physical balance performance, balance symptoms and related handicap, as at present, there is no balance assessment battery that is considered a "gold standard". In this study, CWD were found to present with greater imbalance symptoms and related handicap. They had reduced balance performance and reduced HRQoL when compared with their NH peers of the same age group. When the CWD results were further analysed, it was noted that some children were bilingual (SASL and spoken language), while others were monolingual (SASL only). Therefore, comparisons were made between the two groups. The results indicated that bilingual children (SASLwS) experienced fewer symptoms of imbalance, balance-related handicap, had better balance performance and HRQoL when compared to monolingual children (SASLwoS).

In summary, the results indicated that hearing loss affects balance performance, increases experiences of handicap and reduces HRQoL. Furthermore, in CWD for whom spoken language is inaccessible, symptoms and experiences of imbalance are exacerbated. Thus, the overall findings of this study allowed the researcher to affirmatively respond to the study research question: "How can functional balance be categorized in school-aged children with deafness?"

Study findings within the ICF-HrF framework

Balance function in CWD has been studied in the literature, as presented in Chapter 2. Authors detail the various aspects of a child's life that can be disrupted by the presence of balance deficits, the cause of which has been largely attributed to vestibular dysfunction. Although this may be true, based on the high prevalence of vestibular dysfunction in CWD, it cannot be ignored that any defects to the predictive, proactive and reactive mechanisms from the cognitive, proprioceptive, vestibular or visual systems could result in balance deficits (Chisari et al., 2023; Verbecque et al., 2015). Balance deficits can occur due to an array of factors. However, the functional impact of these deficits in children's lives has been grossly neglected in the literature. Thus, in this study, emphasis was placed on quantifying symptoms of imbalance and their impact on quality of life in CWD rather than establishing the cause of the balance deficits.

Health is a continuum that encompasses both objective and subjective perspectives of functioning (Cieza & Stucki, 2008). An individual's subjective reports are integral to understanding their symptoms, perception of disability, and physical and socio-emotional well-being (Mueller et al., 2012; Revicki et al., 2014). Furthermore, self-assessment questionnaires have been noted to be an important component in healthcare consultations as they improve communication, decision-making and quality of care (Damman et al., 2019). However, the availability of these resources for CWD who mainly communicate in SASL is limited, making patient reports in this population unattainable. Thus, the premise of this study was to provide self-assessment tools to encapsulate the subjective experiences of imbalance in CWD. This study was an important undertaking into better understanding functional balance in CWD and the limitations it imposes in their everyday lives given that balance is the foundation for performing activities of daily living (Chisari et al., 2023; Daneshmandi & Alyarnezhad, 2020), The current study findings narrated this relationship fluently.

This study used the ICF-HrF framework as a lens through which functional balance could be viewed in CWD (see Chapter 2). Although self-assessment responses and balance performance differed across CWD, the discussion according to the ICF-HrF encompasses the overall responses obtained (Figure 15).

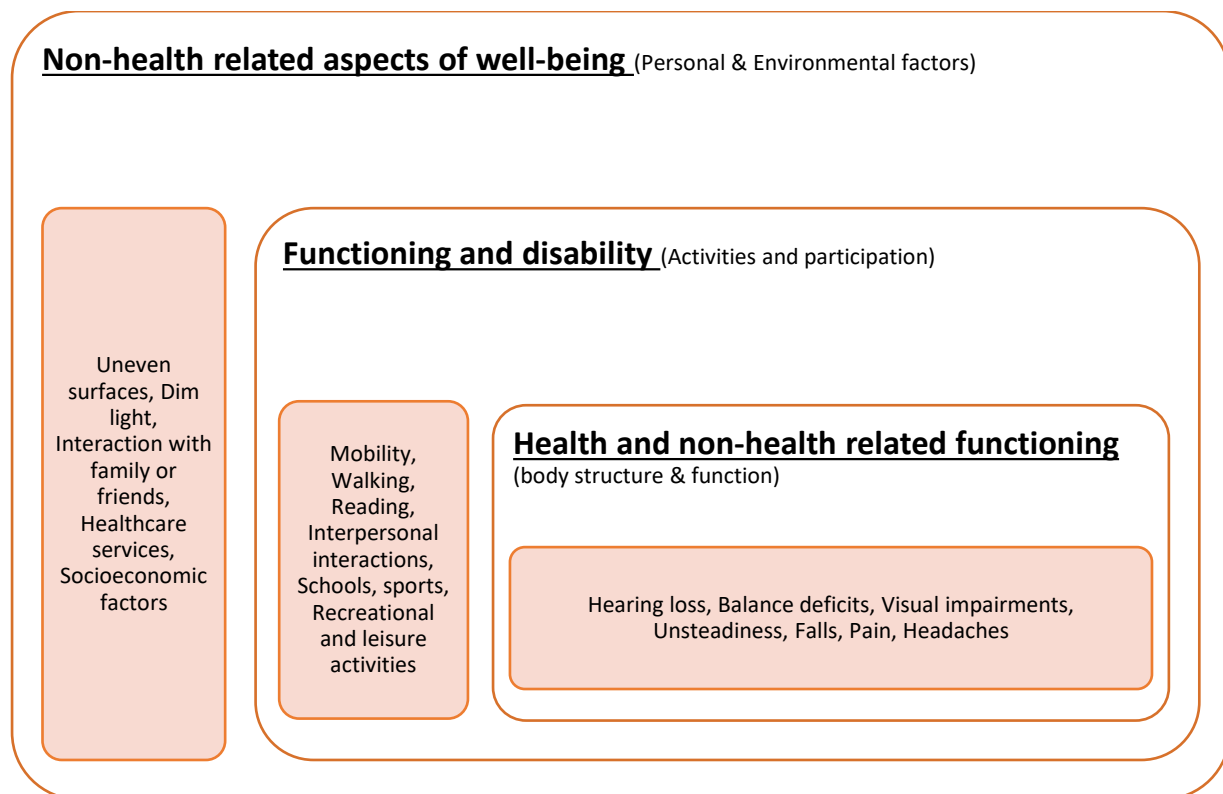


Figure 15: Health-related functioning in children with deafness based on the ICF (Cieza & Stucki, 2008; Salvador-Carulla & Garcia-Gutierrez, 2011)

In respect of *body structure and function*, CWD presented with altered sensory deficits that included hearing loss and ear-related abnormalities, balance deficits and visual disturbances. The symptoms expressed by the PVSQ comprise unsteadiness, falls, pain and headaches, which can also be included within this category. These factors may limit the child's ability to physically participate and engage with their environment. Subsequently, for the *activities and participation* categories, participants responded to the DHI-CA, which demonstrated physical and functional difficulties that impacted on walking, reading, interpersonal interactions and participation at school. In addition, participation in recreational and leisure activities was also reported to be affected by symptoms of imbalance. These categories demonstrated the general impact of the balance disorders on children's lives and highlighted the barriers faced by CWD. The questionnaire also indicated that CWD experienced emotional difficulties such as feelings of frustration, shame, fear, isolation or sadness due to the symptoms of imbalance. This was similar to findings of Gheysen et al. (2008), who stated that emotional factors can negatively contribute to balance outcomes in children. These can be exacerbated by reduced self-confidence, parental neglect or overprotective parents, which may limit how the child explores their environment (Gheysen et

al., 2008). The EQ-5D-Y proxy version questionnaire further indicated that CWD had difficulties with mobility, self-care, carrying out everyday activities, experiences of pain and discomfort and emotional well-being, thus demonstrating the extent to which balance deficits impede a child's quality of life and reduce participation.

Self-reports of *environmental and personal factors* such as uneven surfaces or dim light, as well as interaction with family or friends, impacted on functioning in CWD. Seeking and receiving healthcare services is noted to be a part of environmental factors. For the current study, CWD had been diagnosed with hearing loss, yet only a few (7.7%) were prescribed assistive listening devices (most children used hearing aids rather than CIs). Some children reported that although they were issued with assistive listening devices, they were not using them. In this study, it appeared that although interventions to rehabilitate hearing impairment were initiated, implementation throughout the population, in combination with services like monitoring and aural rehabilitation, was insufficient. Therefore, such environmental factors can impact on functioning in CWD. In addition, socioeconomic factors form a part of non-health aspects that can affect functioning (Cieza & Stucki, 2008). These factors are worth mentioning because the participants in this study are from an LMIC still riddled with inequality, unemployment and poverty (Marnewick & Bekker, 2022). Last, literature recognizes environmental factors such as involvement in physical activities, type of school and parental involvement, as having an impact on motor skills in CWD (Lieberman et al., 2004). The nature of reported symptoms suggests that these factors should be considered in this study as they may exacerbate the experience of physical, social and environmental limitations in CWD.

The ICF-HrF model was an appropriate framework for the current study as it comprehensively outlines relationships between functional impairments (e.g., balance deficits), impact on activities of daily living (e.g., walking), participation (e.g., sports), personal (e.g., interaction with friends and family) and environmental factors (e.g., school placement). In CWD, the interaction of these factors ultimately limits the effortless execution of everyday activities such as playing or reading, which are critical for their development. The study findings reflect that exclusion, disability and reduced quality of life may originate from a structural/functional impairment but the impact of this impairment cascades throughout the individual's life. Moreover, it highlights the barriers faced by CWD, which places them on an unequal playing field with their hearing peers. Therefore, in the current context, this framework highlights that CWD should not be viewed in isolation but rather holistically, with all the

experiences that surround their health. Thus, it requires audiologists more especially, to be responsive and proactive in the delivery of healthcare services to this population, which indeed is their ethical obligation. Ultimately, this framework suggests a need for patient-related outcome measures to be placed at the forefront of the assessment and management for CWD to improve clinical decision-making and the development of realistic and attainable treatment intervention strategies (van Stiphout et al., 2022).

Self-assessment questionnaires in SASL and health-related quality of life

Language is an important facilitator for communication between individuals. In healthcare consultations, a common language between the healthcare practitioner and the child is necessary as it allows for accurate reporting and gathering of information (Mahakwe et al., 2021). Self-reporting of balance symptoms is challenging for CWD given their reduced communication skills (Balzanelli et al., 2021). Furthermore, the lack of professionals who are proficient in SASL and the limited availability of interpreting services intensify communication barriers during consultations with CWD. To bridge this gap, the researcher sought to translate, cross-culturally adapt and validate the PVSQ and the DHI-CA questionnaires for CWD who use SASL to communicate. Self-report questionnaires are universally accepted measures in paediatric health that provide an opportunity for children to accurately reflect on their well-being (Bevans et al., 2020).

The use of self-report questionnaires can provide direct insight into the child's perception of their health, presence of deficits, symptoms and impact on quality of life (Varni et al., 2007). Similarly, it was central to this study to provide tools that allow for CWD to express their experience of imbalance symptoms and their immediate impact on their well-being given that they are the true owners of their health experiences (Bevans et al., 2020; Ekberg et al., 2022). The road to assessing a child's balance system is not linear. Even if a person has a structural limitation that can be measured objectively and physically, it is possible that their subjective experience differs from the results of those measurements (Viergever et al., 2021). Furthermore, there are limitations to how individuals account for their symptoms, which, in turn, can affect health-seeking behaviours and decision-making (Kjeldsberg et al., 2021). For CWD, the same could be true and the expression of symptoms may be reduced even further due to the known barriers to healthcare. The inability of children to communicate their discomfort, in combination with their ability to tolerate symptoms, has led to subtle symptoms

of imbalance being missed (Balzanelli et al., 2021), further contributing to the underestimation of balance deficits in children. The development of the video-recorded SASL PVSQ and DHI-CA, therefore, provides an opportunity to review the subjective effects of imbalance as experienced by CWD.

In the current study, a protocol suggested by Mason (2005) and Andrade et al. (2018) was used to translate and cross-culturally adapt tools from written form into sign language. The findings revealed that the translated and adapted questionnaires have a conceptual, linguistic and cultural likeness to the original instruments based on expert opinion. Furthermore, they demonstrated good internal consistency, indicating that components of the video-recorded questionnaires are consistent and stable (De Souza et al., 2017). For this study, it was important that the signs and expressions be suitable and easily understandable by children who are proficient in SASL. Maximizing understandability is important for paediatric self-report questionnaires, and it can be enhanced through multimodal presentations such as auditory or visual depictions (Bevans et al., 2020). Therefore, the questionnaires in this study were also adapted to include the VAS to improve the reliability of responses, and this may be one of the few studies to make these considerations for CWD. The SASL questionnaires were found to have good construct validity. These findings were significant as they demonstrate good reliability and validity of the video-recorded PVSQ and DHI-CA, similar to other translation and validation studies (Altin & Aksoy, 2023; Pavlou et al., 2016; Sommerfleck et al., 2023). The findings from the post-pilot validation process demonstrated that the video-recorded PVSQ and DHI-CA questionnaires had good sensitivity and specificity, suggesting that these tools measure what they are intended to measure (De Souza et al., 2017).

Dizziness and balance symptoms have been noted in CWD, where symptoms increase with the severity of the hearing loss (Apeksha et al., 2021). A study by Pavlou et al. (2016) with 168 children between the ages of 6–17 years found that children with hearing impairment presented with greater symptoms on the PVSQ when compared to NH children. These findings were similar to that of the current study. For the DHI-CA, Sommerfleck et al. (2023) studied 32 children, aged 4–17 years, who complained of dizziness, vertigo or unsteadiness. The study found that clinically, impairments diagnosed through objective measures such as the video-head impulse test did not correlate with scores from the DHI-CA. In addition, the authors noted that children with inner ear disorders affecting the vestibular system presented with higher scores, indicating greater handicap (Sommerfleck et al., 2023). In the current study, there was

a strong correlation between the presence of balance symptoms identified in the adapted PVSQ, and the impact of the symptoms on the child's quality of life as seen on the DHI-CA.

When the questionnaires were administered to a wider population (Phase Two of the study), the findings reflected that CWD reported greater experience of imbalance symptoms on the adapted PVSQ and greater balance handicap on the DHI-CA when compared to children with NH. Furthermore, the multiple regression model indicated that the experience of imbalance symptoms (PVSQ) was a significant predictor for subsequent handicap. These findings are consistent with results from an epidemiological study by Li et al. (2016), where the authors found that balance difficulties were most prevalent in children with hearing loss (20.9%) compared to those with NH (4.9%). Furthermore, the authors noted that hearing impairment increased the risk of balance problems. Similarly, a study by Altin and Aksoy (2023) involving 52 children with dizziness complaints and 40 healthy children between the ages of 6–17 years, found that 29% of children experiencing balance problems had a diagnosis of hearing loss and used assistive listening devices. Likewise, the current study found that CWD expressed greater imbalance symptoms than those with NH.

This study further found that the SASLwoS group reported greater imbalance symptoms in the adapted PVSQ questionnaire compared with the SASLwS group. They also experienced increased handicap as a result of the imbalance symptoms on the DHI-CA. These results were similar to those found by Buchman et al. (2009) in a study involving 86 participants, 22 of whom were between the ages of 2–16 years and had undergone cochlear implantation. Assessments such as the Dizziness Handicap Inventory (DHI), bi-thermal caloric irrigations (ENG), rotational chair-generated sinusoidal harmonic accelerations (SHA) and computerized posturography were conducted. The results obtained from the pre-operative assessments were significantly poorer when compared to post-operative results. The intervals of assessment and follow-up were at 1 and 4 months, and 1 and 2 years. Results indicated that cochlear implant users experienced improvement in balance function in both the computerized dynamic posturography and subjective measures (Buchman et al., 2009). The reports of imbalance symptoms in the current study by older children concurs with the observations made by Li et al. (2016). The authors suggest that the experience of imbalance symptoms does not lessen with age but rather increases. In this study, older children up to 17 years reported experiencing balance symptoms and related handicap. Furthermore, these findings contradict the notion that compensation may alter the perception of balance symptoms in CWD such that

children are less likely to present with balance symptoms (Dasgupta et al., 2020). Therefore, the current study findings highlight the importance of early identification and intervention to improve balance function in this population.

The findings on the adapted questionnaires suggest that CWD experience greater symptoms of imbalance and subsequently reduced quality of life when compared to NH children. This is a significant finding suggesting that the use of self-assessment tools can shape the way healthcare professionals triangulate information to reach a diagnostic conclusion in CWD. Self-assessment questionnaires can be completed by children as young as 8 years of age, provided cognitive, comprehension and linguistic capabilities are accounted for (Bevans et al., 2020). In the past, the same sentiments could not be shared for CWD as, to the best of the researcher's knowledge, there were currently no balance-related questionnaires available in sign language. Thus, the adapted PVSQ and DHI-CA are the first self-assessment questionnaires to be made available to CWD in their first language (SASL), providing new insight into how subjective experiences in this population can be included in balance assessments. Therefore, the undertaking of this research was important, not only for recognising the need for access to inclusive healthcare services, but also to promote autonomy in CWD.

It is already understood that having caretakers or medical professionals assist children in completing questionnaires might add bias and result in erroneous reflections of the child's health (Kooijmans et al., 2022). Moreover, much of the available literature has been ascertained from proxies (caregivers or parents) or objective assessments, and rarely, if ever, from the child's perspective (Coyne, 2006). Coyne (2006) further states that when children know about their symptoms, the extent of their condition and are involved in their healthcare, they are likely to adhere to interventions and have better treatment outcomes. Therefore, it goes without saying that CWD have a pivotal role to play within their management, which can now be facilitated through the use of these two questionnaires. The addition of valid and reliable self-reported questionnaires to a balance assessment test battery, even for CWD, can also significantly reduce cost implications as they merely require bedside skills to confirm a healthcare professional's diagnosis or identify children who require vestibular rehabilitation therapy. When self-report questionnaires are integrated with a comprehensive medical history and subsequent assessment, they can guide healthcare practitioners in the provision of appropriate therapeutic interventions (Fancello et al., 2021).

Turning now to HRQoL, the EQ-5D-Y proxy questionnaire completed by participants' parents showed reduced HRQoL in CWD compared with NH children. Although NH children also experienced difficulties relating to pain and emotional well-being, CWD were reported to display difficulties in all five domains. The similarities noted in domains 4 and 5 of the questionnaire between CWD and NH children can be viewed as typical because a high prevalence of pain and psycho-emotional difficulties have been reported in children (Ogundele, 2018; Shinde et al., 2022). Not only are the two factors interdependent, they intensify in children from low-socioeconomic backgrounds (Shinde et al., 2022). Even so, such issues require intervention as they may impact on quality of life in both NH and CWD.

The findings on the EQ-5D-Y proxy questionnaire for this study are similar to those typically seen in children with developmental coordination disorders (DCD), where the emotional, social and physical well-being domains of HRQoL are affected (Weber et al., 2023; Zwicker et al., 2013). Zwicker et al. (2013) reported that children with DCD tend to experience reduced HRQoL compared with NH children. This is unsurprising as balance deficits have been noted to have a detrimental impact on quality of life. Li et al. (2016) found that increased reports of balance symptoms were associated with children experiencing challenges with activities in and outside the home. This could explain the relationship between the adapted PVSQ, the adapted DHI-CA, and the *Doing Usual Activities* and *Having Pain or Discomfort* domains of the EQ-5D-Y questionnaire noted in this study, thus, indicating that the presence of balance symptoms is associated with handicap and reduced HRQoL, similar to a systematic review by Rajendran and Roy (2011). Weber et al.'s (2023) systematic review of children with DCD and those who were typically developing found that children with DCD experienced a significantly lower HRQoL compared to their peers.

A study conducted by Niemensivu et al., (2018) on HRQoL in a 100 hearing-children between the ages of 7 – 17 years of age found that children and adolescents with hearing impairment had poorer HRQoL when compared to NH children (Niemensivu et al., 2018). These results were similar to that of the current study which warrants the need for HRQoL assessment tools to also be included in audiological consultations as this aspect is compromised in CWD. Rajendran and Roy (2010) conducted a study involving 50 deaf children with and without motor deficits and 50 typically developing children to investigate HRQoL using the Paediatric Quality of Life Inventory (PedsQL™). The authors found that children with

hearing loss had lower HRQoL when compared to the control group. Furthermore, it was found that children with hearing impairment and motor deficits had lower scores compared to those who had hearing loss and no motor issues (Rajendran & Roy, 2010). These findings reiterate the consistent theme in this study that balance deficits impact on quality of life in CWD and should be actively investigated by audiologists.

The EQ-5D-Y proxy version questionnaire also reflected differences between the two subgroups of CWD (SASLwoS and SASLwS). Within the five domains, the SASLwoS group reported greater difficulties, reflecting reduced HRQoL when compared to the SASLwS group. Similarly, Liu et al. (2016) in a study investigating HRQoL in deaf children with cochlear implants found that both HRQoL and speech perception significantly improved post-operatively. Although the authors could not find a correlation between the two (Liu et al., 2016), the findings highlight the provision of auditory input significantly improves HRQoL, which is of great clinical significance for the management of CWD. Another study conducted by Zaidman-Zait et al., (2017) found that children with CI had lower HRQoL when compared to typically developing children. However, there was no significant difference between the two groups on the physical and emotional well-being subscales (Zaidman-Zait et al., 2017). These results, in conjunction with the results from the current study indicate that the role of auditory stimulation and input in CWD should not be downplayed; however, clinicians should seek to maximise the provision of audiological services with the understanding that it has far-reaching effects on the child's life.

Literature states that children with chronic disabilities often experience reduced HRQoL where factors such as socioeconomic status, limited access to healthcare and language barriers are significant aggravating factors (Pinquart, 2020). It is thus understandable that the CWD in this study were reported to have reduced HRQoL when compared to their hearing peers. Another layer of proxy reports is the possibility that caregivers may routinely underestimate their child's quality of life (QoL) (Overgaard et al., 2021). In a study conducted by Overgaard et al., (2021), it was found that when rating QoL, parents rated their child's QoL higher than when children had rated themselves. This suggests that it is probable that in reality, the children's HRQoL could be further reduced than what has reported by their caregivers. Moreover, it has been noted that parental health literacy impacts on the child's health, safety and adherence to intervention; thus, limited parental literacy contributes to worsening of condition and poorer child outcomes (Lawrence et al., 2021). This evidence further drives the

need for children to have means of reporting their symptoms, be well integrated into consultations and their subjective experiences included when making management plans.

The consideration of global development, inclusive of psychosocial well-being, is vital when aiming to improve the quality of life of children with hearing impairment (Hammer et al., 2024). Hammer et al. (2024) found that children who had been identified through neonatal newborn hearing screening, provided with hearing technology (hearing aids, then later CI) before 6 months of age and were provided with educational intervention from age of detection had comparable social well-being to children with normal hearing. Balance dysfunction and symptoms of imbalance can have a serious negative influence on a child's development, quality of life, and day-to-day functioning (Božanić Urbančić et al., 2022). Consequently, it is critical to recognize the existence of symptoms and associated disabilities in children, particularly in CWD who may be more likely to experience these difficulties and may lack the resources to communicate this information to medical experts. Within the clinical context, HRQoL tools can be instrumental in identifying concealed health issues, diagnosis and decision-making as well as subsequent management (Pinquart, 2020).

Functional balance performance in children

Presence of sensory impairments in children with deafness

Auditory feedback is useful in providing temporal and spatial information to the nervous system to help maintain postural control (Cornwell et al., 2020). In CWD, the natural transmission of such information may be restricted due to the presence of hearing impairment. However, the provision of assistive listening devices has potential to offer children access to adequate auditory information (Holt, 2019). The Joint Committee on Infant Hearing (JCIH) 2019 position statement recommends that children with hearing impairment should be provided with early interdisciplinary intervention no later than six months of age, and their family should be included in the intervention program (Joint Committee on Infant Hearing, 2019). Although, as mentioned in Chapter 2, late identification and intervention of hearing loss is prominent in South Africa, the findings in this study were unexpected.

This study revealed that the majority of CWD did not use assistive listening devices (cochlear implants and/or hearing aids) during the study period. When probed about the reasons for not using hearing devices, children cited not being issued any devices, devices being broken

and not repaired, or opting not to use them as they communicated through SASL. These reasons are not uncommon beyond the study context. Gentili and Holwell (2011) and Naidoo and Khan (2022) noted that hearing aid breakage, educational background, parental perception and associated stigma affect consistent use of assistive listening devices. Furthermore, parents of children who belong to the Deaf community may not be keen for the use of these devices as hearing loss is not viewed as a disability, and hearing rehabilitation can restrict the growth of their community (Byrd et al., 2011). Regardless, untreated hearing loss has lasting impacts on emotional, social, psychological and academic development, affecting vocational opportunities later in adulthood (World Health Organization, 2016). Thus, these results require reflection on the audiological interventions and practices provided to CWD. Perhaps there is room to reframe audiologists' thinking behind the provision of assistive listening devices for this population. Literature states that not only do assistive listening devices help with providing auditory information, they improve achievement of age-appropriate literacy skills (Holt, 2019), and can improve balance outcomes in hearing impaired individuals (Mahafza et al., 2022). When coupled with aural rehabilitation and cognitive rehabilitation, children can develop auditory perception, speech intelligibility, communication, linguistic skills, attention and improvement in metacognitive skills (Ashori et al., 2019). Thus, this evidence calls for reflective, updated and evidence-based interventions to be provided to CWD and further, to strengthen informational counselling, communication options and education given to parents and children to improve outcomes and prognosis.

This study also showed that CWD not only present with audiological manifestations, but also exhibit difficulties with static and dynamic visual acuity in conjunction with hearing loss. Vision is a contributing sensorimotor system that provides input for the maintenance of balance. Thus, impairment in this system places these children at further risk for imbalance. Among the sensory systems, vision plays a critical role in accessing environmental information and also compensating when other balance systems are defective (Gogate et al., 2016; Zylka et al., 2013). When SVA was screened, most CWD presented with no concerns, but a small number of children (right eye: $n=12$; left eye: $n=11$) demonstrated possible visual impairments. When compared to NH children, CWD showed greater difficulties with both visual acuity tests. This is consistent with findings from Ostadimoghaddam et al. (2015) who conducted a study involving 254 children in the hearing-impaired group and 506 children with NH. The authors found that children with hearing impairment were more likely to exhibit visual problems when

compared to NH children. Similarly, literature describes a prevalence of visual impairment in children between the ages of 6–16 years who attend deaf schools (Peheré et al., 2019).

The current study further found reduced DVA in some of the participants in the CWD group when compared to NH children. These results were similar to those of Martin et al. (2012) who investigated balance function and DVA in 32 children with hearing loss and 32 children with NH. The study found that DVA was reduced in children with hearing impairment, and reduced visual acuity was associated with poorer motor performance on the M-ABC-2. Janky and Givens (2015) obtained similar findings in their study of 11 children with cochlear implants and 12 children with NH. The children with hearing loss tended to display reduced DVA and balance function. For the current study, CWD presented with visual disturbances, which can become a significant barrier that exacerbates communication, academic and social difficulties (Hollingsworth et al., 2014; Ostadimoghaddam et al., 2015). Furthermore, reduced DVA impacts literacy (reading) and may lead to decreased activity, reduced quality of life and limited social interactions with peers (Janky & Givens, 2015; Martin et al., 2012).

To move around in the real world, both static and dynamic visual acuity are imperative. These functions allow for adept performance of activities such as sports, video games, reading, school work or scrolling, and are a good predictor of the execution of activities of daily living (Quevedo et al., 2018). Furthermore, the consistent need to dual task due to insufficient gaze stabilization leads to deficits in attention, learning and concentration (Crunkhorn & Cane, 2022). Thus, it can be argued that children who exhibit difficulties in static and dynamic visual acuity will experience inevitable issues with reading, literacy and other academic activities. Within LMICs, barriers to learning not identified within the healthcare system or at school are less likely to be identified at home. Literature suggests that most South African parents are not always able to meaningfully engage with their child's education (Ndebele, 2015; Seleka & Masoabi, 2024). Thus, they may miss academic difficulties. In the absence of assessments, such as those undertaken in this study, children who present with these deficits may fall through the cracks, becoming more susceptible to increased risk for further functional disability. This report supports the preliminary inquiry at deaf schools, where audiologists described a general lack of access to healthcare services for CWD. This is not only specific to this study – other authors have made similar observations and have attributed the lack of service provision to individuals with deafness to the limited language compliance and interpretation services (Dalal et al., 2022). Evidently CWD face considerable health and access-related challenges that could

potentially amalgamate and reduce their quality of life. Therefore, it calls for healthcare practitioners to tighten their referral pathways and ensure children reach the appropriate level of care.

Balance performance on the Mini-BESTest

The Mini-BESTest was an important test to include in this study as it involves the assessment of anticipatory motor responses, reactive postural control, sensory orientation and dynamic gait, all of which are important for maintaining balance (Dai et al., 2023). Furthermore, this test has been utilized with children with cerebral palsy (Dewar et al., 2019), CHARGE (Perreault et al., 2020), Down's syndrome (Rutka & Pałac, 2020) and in typically developing children (Dewar et al., 2017; Southard, 2020). The current study is among the first research projects to administer the Mini-BESTest with children who are hearing-impaired. Although the scarcity of literature involving the use of this test with CWD presented a challenge in comprehensively discussing the study findings in relation to other studies; the Mini-BESTest findings provided a good clinical picture of the difficulties CWD experience when performing everyday activities and responding to their environment.

This study revealed that CWD experienced significantly poorer balance outcomes on the Mini-BESTest when compared to NH children. These results were similar to those found by Karakoc and Mujdeci (2021). In their study, the authors evaluated balance function in 40 children with severe to profound SNHL and 40 children with NH between the ages of 6 to 15 years. Using tests such as the Single-Leg Stance test (SLS), Functional Reach test, Time Up and Go (TUG) and Pediatric Balance Scale (PBS) they found that children with SNHL presented with impaired static, dynamic and functional balance skills when compared to children with NH. In the current study, it was found that CWD had poorer performance in the TUG, SLS and incline eyes closed, when compared to NH children. These tests are embedded within the Mini-BESTest.

Soylemez et al. (2019) noted poorer balance performance in children with SNHL compared with NH children between the ages of 10–18 years. In their assessment, the authors used the flamingo balance test, tandem stance test, one-leg standing test and the PBS to assess balance. A similar trend was noted in the current study as NH children performed better on the SLS test when compared to CWD. When considering the influence of amplification, Ebrahimi et al. (2016) found that regardless of implantation, CWD were at risk for balance and motor

difficulties because they presented with reduced balance scores compared to NH children. The authors investigated balance function in 85 CWD, 35 of whom were fitted with unilateral cochlear implants, and 60 children with NH. These findings were comparable to that of the current study, as CWD, regardless of assistive device use, had poorer balance performance than NH peers. The findings are consistent with available literature in the field.

In adults, the Mini- BESTest has been noted to be a useful tool in determining risk of falls and predicting adults who are likely to be future fallers in 6-months (Lopes et al., 2020; Magnani et al., 2020; Magnani et al., 2021; Shirley Ryan AbilityLab, 2013a; Yingyongyudha et al., 2016). Typically for the Mini-BESTest, a cut-off score of 16 can be used to identify individuals with a history of falls and a cut-off score of 19 could predict future falls (King et al., 2012; Yingyongyudha et al., 2016). In the current study at least 20 CWD presented with a scores below 20 which indicates that they are at risk for falls. Although, investigations on the Mini-BESTest in relations to falls have been largely on adults, comparing these cut-off values to the results obtained in this study raises concern. The assumption is that a child's balance is not impacted by frailty, advancing age, or cognitive defects which is commonly noted to contribute to increased fall risks in adults (Batistela et al., 2023); however, children in this study who had no physical limitations presented with significantly reduced scores. Furthermore, this study highlights a need for development of appropriate cut-off scores for the paediatric population, which can assist in developing tailored falls prevention strategies for children.

When looking at individual components of this test, the current study shows that CWD are at greater risk of falls when compared to NH children as they performed poorer on the TUG and the TUG dual-task. Although the TUG-manual was used for the dual-task (majority of children were proficient in SASL), the difference in walking times between the TUG and TUG dual-task was significantly different between the two groups; indicating that gait speed in CWD reduced more than 10% when compared to NH children. This modification was deemed appropriate as authors have suggested that TUG and TUG dual-task scores (either cognitive or manual) are able to identify individuals who are at risk for falls (Shumway-Cook et al., 2000). These results are similar to those found by Ghaffar et al., (2024). In their study, the authors conducted investigations involving 377 hearing-impaired children aged 8 to 15 years, and they found that children had poor performance on the TUG (Ghaffar et al., 2024). The results found in this study not only indicate increased fall risks in CWD, but also show reduced capacity for

these children to plan and anticipate transitioning from a motor task (Beerse et al., 2019; Carmeli et al., 2003).

The ability to simultaneously execute two tasks improves efficiency in everyday life (Möhring et al., 2021). Walking and talking, walking while scrolling on the phone or running while kicking a ball are typical examples of dual-tasking, and this is an integral aspect of safe functioning in day-to-day activities (Subara-Zukic et al., 2024). Thus, difficulty with dual tasking increases postural instability and falls (Elhinidi et al., 2016). According to Krajenbrink et al., (2023), it is possible that if a motor task is not automatized and requires the child's attention, the concurrent performance of another task unautomated task will result in reduced performance in both tasks. The authors note that this phenomena may be seen in children with DCD when compared to their typically developing peers (Krajenbrink et al., 2023). The limitations in dual-tasking can be a barrier to participation and involvement in recreational and leisure activities for children, thus contributing to functional disability. Finally, in the current study CWD also demonstrated challenges with the incline eyes closed test which indicates reduced postural control in this population. The interaction between increased inclination, which increases the sheer forces as well as the presence of friction, contribute to slips, trips and falls (Svensson et al., 2018). Simply put, these results demonstrate that when children are on a flat surface with eyes open, they utilize less energy to maintain balance. However, when in an incline with eyes closed, more energy and force is used to maintain postural control (Svensson et al., 2018). The results found in this study suggest that the impairment of both static and dynamic balance is not a phenomenon that should be overlooked when managing CWD as it also has safety implications for these children.

Identifying fall risks in CWD was an important contribution to originate from this study. Falls, can be injurious or fatal and the likelihood is further increase for children living in LMICs (Tupetz et al., 2021); this necessitates the attention of all healthcare practitioners involved in the management of CWD. Although it is already understood that falls are prevalent in children with hearing loss (Fernandes et al., 2015); impairment of anticipatory and reactive postural control, sensory orientation and dynamic gait, as seen on the Mini-BESTest findings, can be considered as intrinsic factors that increase the risk of falls and injury (Hill et al., 2019). Gür et al.'s (2021) study of 218 adolescents with hearing loss found that they are at increased risk for falls and injury, with most incidents occurring at school or on the road. The authors noted that many adolescents do not perceive their injuries as serious, and this is a potential

barrier for health seeking (Gür et al., 2021). Furthermore, it can be assumed that lower health literacy and frequent falls being reduced to clumsiness can potentially reduce health-seeking behaviours. A study conducted by Schwebel and Brezausk (2010) on 7391 children with sensory impairments found that more injuries occurred in children with sensory deficits when compared to typically developing children. The authors further found that risk was significantly increased in children who did not use the prescribed eyeglasses or hearing aids (Schwebel & Brezausk, 2010). In view of this evidence, it could be expected that children in the present study are at greater risk for falls and injury because they presented with visual and auditory difficulties and were largely unaided. Over and above the much-needed rehabilitative intervention, there is a need to prioritize health promotion and education for children with hearing loss about safety, targeting the children themselves, educators and parents, to promote health and safety in CWD.

Influence of spoken language on balance performance on the Mini-BESTest

In this study, CWD had difficulties with the anticipatory, sensory orientation and dynamic gait domains of the test. These findings call for a detailed inquiry into the quality of life of CWD because these factors are critical for safety, postural stability, balance, mobility and execution of routine activities (Lucksch et al., 2023). Within the subgroups of CWD, the SASLwS group showed better balance performance on the Mini-BESTest than the SASLwoS group. Although there is limited literature exploring balance function within a heterogeneous group of CWD, findings from studies involving children with cochlear implantation devices can provide insight into this phenomenon. It can be assumed that access to auditory input also improves access to spoken language and opportunities for better communication (Sharma et al., 2020).

A study by Schlumberger et al. (2004) evaluating motor and balance development in 25 children with cochlear implantations, 29 CWD and 40 NH children found that NH children performed better than CWD. Furthermore, CWD without cochlear implants had more poorly sustained attention and balance than those with cochlear implants. The authors attributed this difference to the development of oral language (Schlumberger et al., 2004). These results could be comparable to those of the current study as differences in balance performance were noted between SASLwS and SASLwoS, where those who had acquired spoken language performed better. Another study by Suarez et al. (2019) involving 17 adolescents with pre-lingual cochlear implants found that balance function is affected by auditory deprivation. Furthermore, access

to auditory input via cochlear implants improved postural control in CWD. Other authors found similar results, highlighting the difference auditory and subsequent speech stimulation can impose on balance function in CWD (Mazaheryazdi et al., 2017; Wolter et al., 2021).

Literature supports the notion that bilingual children who acquire spoken and sign language are at an advantage for increased language skills as the combination of vocabularies in both languages is comparable to that of their NH monolingual peers (Pontecorvo et al., 2023). This observation is important because linguistic skills can have implications for motor function, and could potentially explain the results obtained in this study. This evidence implores audiologists and speech-language therapists not to solely prioritise audition but rather language development as part of early intervention (Wilkinson & Morford, 2020). A two-sided experiment by Carello et al. (2002) showed the relationship between phonological decoding and sequential movements. In the study, authors noted a link between spoken language and motor function, and this relationship could also extend to reading fluency. The findings revealed a significant relationship between phonological decoding skills and fine motor movement (sequential tapping) (Carello et al., 2002). Simply put, lack of spoken language impacts on phonological awareness, which may then impact on reading fluency and fine motor coordination. The presence of spoken language impacts on fine and gross motor development in CWD. In addition, more overt changes can be noted in fine motor skills (Horn et al., 2006). Bi- and multilingualism in CWD has been noted to aid the achievement of appropriate intellectual and psycho-emotional development, thereby enabling CWD to reach their full potential (World Federation of the Deaf, 2016).

In summary, the findings obtained indicated that NH children had better balance performance than CWD, and the SASLwS group showed better outcomes in comparison to the SASLwoS group. The findings serve to further advocate for early detection of hearing loss, provision of timely intervention through assistive listening devices and the subsequent provision of comprehensive rehabilitation services to improve auditory, communication, balance function and falls prevention. Last, this study highlights the need, now more than ever, for audiologists to be competent and practice the full range of their scope when managing children, thus ensuring that adequate and effective services are accessible to reduce burden of disability.

Performance on the m-CTSIB: The ability to integrate sensory input from the visual, vestibular and somatosensory systems to maintain balance was assessed using the m-CTSIB. CWD performed more poorly on this test than their normal hearing peers. Similar findings were observed by De Kegel et al. (2012) when they assessed 48 children with hearing loss (23 using cochlear implants) and 51 with NH. The authors found that children with hearing loss had difficulties with balance and manual dexterity, and presented with absent Vestibular Evoked Myogenic Potentials (VEMPS) responses and abnormal Rotatory chair results. In addition, balance performance on the eyes-closed on foam condition (condition 4) of the m-CTSIB showed significant differences. Their findings on balance performances were similar to that of this study where CWD performed poorly on the m-CTSIB test, demonstrating significant difficulties in condition 4 compared with NH children. When Kelly et al. (2018) conducted this test on children with cochlear implantation and those with NH, similar results to the current study were obtained. The authors found reduced performance in CWD to an extent that a portion of the sample of CWD could not complete the test. In a study by Said (2014), children with hearing loss exhibited significantly reduced results on the m-CTSIB, Bruininks-Oseretsky Test of Motor Proficiency second edition (BOT-2) and the tandem stand test compared to NH children. These findings are similar to that of the current study.

An in-depth review of the CWD population showed no differences on the m-CTSIB test between the SASLwoS and SASLwS groups. A possible explanation for these results is that all the participants had SNHL, which is associated with poor postural stability (Walicka-Cupryś et al., 2014). Similar to this report, Melo et al. (2024) found that children with SNHL presented with reduced postural stability compared with NH children. Regardless of vestibular function, children with SNHL showed greater postural sway velocity. The current study findings concur with literature that details that children with balance deficits will exhibit reduced postural control and motor performance, which ultimately impact participation in physical and recreational activities (Melo et al., 2024; Zarei et al., 2023) because balance and postural control are complementary and interdependent (Lage et al., 2021).

The results of the m-CTSIB in this study align with findings from other studies. CWD, irrespective of the acquisition of spoken language, presented with significantly poorer results than NH children. This suggests that when altering sensory conditions by disrupting either visual and/or proprioceptive input, CWD experience difficulty in maintaining balance and postural control (Zarei et al., 2023), more especially if vestibular function is compromised

(Chisari et al., 2023; De Kegel et al., 2012). This is not surprising given vestibular impairment is more common in children with SNHL (Sokolov et al., 2019). Thus, a deficit within the vestibular system may lead to children experiencing difficulty maintaining balance when input from other sensory systems is limited, e.g., standing on foam with eyes closed (Van Hecke et al., 2019). This could possibly account for the difficulties experienced by CWD on the m-CTSIB in this study. Thus, the current study suggests that CWD struggle to reweight sensory input and adapt to changing environmental conditions. In the real world, such difficulties can have serious implications for health and safety because they imply that CWD would struggle mobilizing in dim light or on uneven and soft surfaces, which could increase fall risks.

The findings of this study are significant because postural control should have reached adult-like maturation by the age of 10 years (Mazaheryazdi et al., 2017). However, in this study, older children (>10 years) still presented with imbalance. Contrary to proposals by other scholars (Dasgupta et al., 2020; Kaga, 1999), this study suggests that balance difficulties do not resolve or self-correct over time. Rather, they persist and can affect the child's quality of life. The findings are similar to the preliminary conclusions by Janky and Givens (2015) who noted that children with hearing loss do not naturally recover and perform at the level of their normally hearing peers, especially in activities that require vestibular input such as balance and motor skills. Moreover, the results from that study demonstrate that all children with hearing loss are at risk of developing poor postural control. Thus, this population needs to be prioritized for the delivery of assessment and rehabilitation services.

Summary

The study findings indicate that CWD report greater balance symptoms, have poorer balance performance than NH children and the experience of this deficit impacts their quality of life. CWD who had acquired spoken language showed better balance outcomes than those without spoken language. The m-CTSIB and Mini-BESTest indicate that CWD have impaired static and dynamic balance when compared to their NH peers. In conjunction with poor balance, this population is also at greater risk for falls when compared to NH children, thus, there is also a need to consider safety concerns that may be consequential to the presence of balance deficits in CWD. To conclude, balance deficits are a significant contributor to diminished quality of life in CWD. The knowledge synthesized in this study supports the need to increase stakeholder awareness and create agency to change the current healthcare practices to improve the quality of care for CWD. The limitations of living with hearing impairment in

a hearing world poses challenges for children. The presence of balance deficits further takes away meaningful experiences and strips children from appreciating all the joys of being a child. Thus, it is no wonder that functional disability increases in this population. This study places emphasis on functioning and quality of life because, as much as quality of life is a multidimensional concept, good quality of life is associated with positive emotional development, fulfilment and happiness (Aqdam et al., 2023). In addition, the authors note that a high quality of life improves one's ability to cope with life challenges and enhances self-efficiency. As healthcare professionals, the facilitation and improvement of children's quality of life should be the overarching goal for all consultations. Based on the study findings, exploring management approaches for CWD such that both hearing and balance aspects are prioritized is a favourable place to start.

Back to basics: Balance within the South African context

Balance is a complex skill that involves the interaction of multiple systems, allowing for automatic functions to maintain postural stability during everyday activities (Sember et al., 2020). Balance is not a consistent and stable function across an individual's lifespan. However, it is largely affected by age, gradually increasing until young adulthood, thereafter, slowly declining (Schedler et al., 2021). Consequently, a closer look at balance function or postural control can give us useful information regarding a child's development as it closely aligns with maturation processes of sensory organization and the central nervous system, and the development of cognitive, social and motor function (Orendorz-Frączkowska & Kubacka, 2019). The optimal functioning of the balance system allows children to safely navigate their environments, participate in activities of daily living, and engage in sports and recreational activities (Kiss et al., 2018).

Differences in socio-economic class contribute to varying balance performance in children (Coetzee, 2016). South Africa, as an LMIC, has made significant strides in living conditions amongst its citizens by providing social welfare grants, free basic services such as electricity and water, and an increase in income for the working class (Francis & Webster, 2019). Nevertheless, since 1994, inequality has risen, making it one of the world's most unequal countries (World Bank Group, 2024). Approximately 30.3 million live in poverty within the country and, specifically in KZN, at least 52% of the population are considered poor (Statistics South Africa, 2020; World Bank Group, 2024). According to Ndebele (2015), in

South Africa individuals who are of a higher socio-economic status reside in suburbs whereas those of lower socio-economic status usually live within inner cities, townships or peri-urban areas. Learners living in these environment tend to have fewer opportunities to participate in sports, playground activities or other physical activities due to limited resources and a lack of safe spaces (Du Plessis et al., 2020). Furthermore, the lack of structured physical education classes and involvement in active play that does not require any equipment can impact on the development of normal balance and motor skills (Smits-Engelsman et al., 2022).

De Waal et al. (2018) found that children from lower socio-economic backgrounds were more likely to experience developmental coordination disorders. Thus, in our context, typically developing children have been noted to exhibit reduced motor performance, running, dexterity, strength and balance (Smits-Engelsman et al., 2022). A study by Coetzee (2016) involving 862 participants between ages 9–10 years from the North-West Province found that participants experienced below average balance skills, but had adequate strength and agility. Authors have linked the differences noted in these children to variations in motor tasks available in the child’s environment, developmental attributes, cultural and ethnic influences, and resource availability (Du Plessis et al., 2020; Smits-Engelsman et al., 2022; Verbecque et al., 2021). Figure 16 displays all the factors that are associated with imbalance in children and the aspects of the child’s life that are affected.

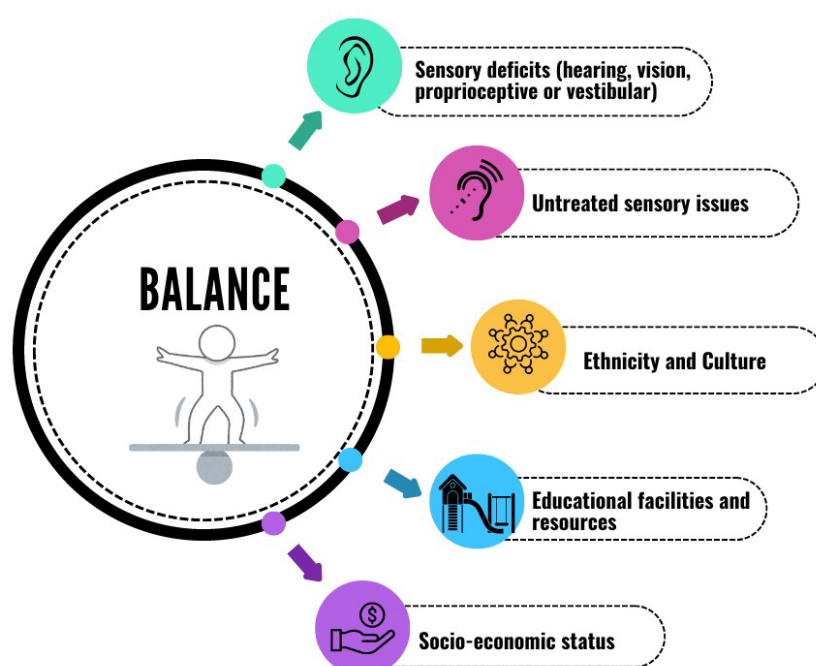


Figure 16: Factors that attribute to imbalance in children within the South African context

Hearing loss adds further complexity in the development of balance function in children. Hearing loss is a disabling condition that has serious implications on the development of language, socio-emotional well-being and communication, and may reduce a child's quality of life (Yıldırım Gökay et al., 2024). The only solution to curbing the debilitating effects of hearing loss is through hearing and ear-related healthcare services throughout childhood. In so doing, hearing loss can be identified and managed early; children who acquire hearing loss later in life can also receive timely management (Hussein et al., 2018). It is unfortunate that in LMICs this is often not possible due to the shortcomings of health systems (Hussein et al., 2018). Thus, the inability of LMICs to provide efficient and accessible hearing screening services, lower socio-economic status and the lack of general awareness of hearing has contributed to a higher prevalence of hearing loss (Kuschke et al., 2020). The limited provision of early identification and intervention services for hearing creates a domino effect on all aspects of the child's development, including balance. Evidence of this is seen in literature where authors report that children with hearing loss demonstrate poorer balance function compared to those with normal hearing (Melo et al., 2018; Patel et al., 2017). A child growing up in South Africa, with a hearing loss, is predisposed to having balance deficits and further developmental adversities. Thus, it was an ethical duty for me as a researcher and a clinician to shine a light on the impact of such deficits, especially on the quality of life for CWD and the need for specific interventions.

The South African government has made significant strides, through the Integrated School Health Policy (ISHP), to provide school-aged children with better access to health services such as health screening (vision, hearing and oral health) and sexual and reproductive health (Department of Basic Education, 2021). However, there has been widespread non-compliance in the implementation of this policy (Rasesemola et al., 2019). Furthermore, although the services were to be extended to special schools, teams involved in this programme were to prioritize children in schools in quintiles 1 and 2⁶ (Bamford, 2017). It is not a question of who needs the services the most, but rather, noting that children who are already facing restricted access to healthcare services are further short-changed by a policy that ought to bridge that gap. In an ideal world, difficulties in hearing, balance, vision and proprioception

⁶ Quintiles 1 and 2 refer to Department of Education schools that do not charge school fees.

would be identified early in school-aged children, especially those at risk for having deficits. However, this is currently not common practice. Therefore, this research advocates for the provision of healthcare services such as audiology, physiotherapy, occupational therapy, optometry, psychology and speech and language therapy for CWD prior to placement in a special school. In turn, CWD can be placed accordingly at schools with facilities that can provide them with the appropriate rehabilitation services. Such a proactive approach would assist in minimizing future health, learning and literacy difficulties, and create an environment conducive for academic success.

The abovementioned literature details the challenges faced by typically developing children living in South Africa and the contribution of their environment to balance function. One can conclude that for children who have hearing loss, presenting with balance deficits, and at greater risk for falls, the outcomes would be considerably worsened. In addition, when considering the contextual factors mention in Chapter 1 and the current state of schools for the hearing impaired reflected by the *Sunday Times* article, it is clear that barriers to access, quality of life, and fulfilment of basic human rights for CWD are a major cause for concern. The amalgamation of these factors sets children at greater risk for health, developmental and educational issues. Limitations in financial and human resources, infrastructure and policies regulating physical education in schools and school health programmes ensures that CWD remain highly susceptible and exposed to increased functional disability and reduced quality of life. Unless a change is introduced and advocacy for young children is promoted, the perpetual cycle is less likely to be broken.

This study contributes to a possible solution for some of the issues raised in balance assessment of children within the South African context. Firstly, balance symptoms have been underreported partly because children are not able to describe their symptoms, equipment to assess for deficits is expensive and inaccessible, and prolonged consultation times are often required for assessments which may not be feasible in the clinical setting (Božanić Urbančić et al., 2022; Martens, Maes, et al., 2023). Secondly, there are various balance tools which exist as mentioned in Chapter 1 and 2, however, the use of these tests may be limited in LMIC due to linguistic and/or cultural appropriacy as well as financial constraints (Smits-Engelsman et al., 2021). Therefore, this study highlights the feasibility of using a test battery approach to evaluate balance function in school-aged children, especially those with deafness. In healthcare settings, a test battery approach is necessary to capture an individuals' complexities and

abilities adequately, and this cannot be achieved with a single test (Chakrabartty, 2020). The tools used in this study are valid, reliable and inexpensive, and can be used to evaluate balance in all children, inclusive of CWD. Moreover, a time period of approximately 45 minutes was taken to complete the entire battery of tests, thus this indicates that it may be feasible to conduct within audiological consultations. In addition, as clinicians become more familiar with the test procedures, administration time is likely to reduce. This battery of tests may be suitable for a low-resourced country like South Africa as it includes the use of both subjective and clinical findings. Furthermore, the SASL PVSQ and DHI-CA questionnaires have been cross-culturally and linguistically adapted to suit CWD within this context; allowing for CWD to relay their symptoms. The use of the Mini-BESTest can also be used for falls evaluation, and based on the study current findings, clinicians can use the SLS, TUG, TUG-manual and Incline-eyes closed test subtests in isolation as cut-off values for CWD are not yet available for children. However, this test is an efficient measure for balance performance and can also be used to monitor balance improvement in therapy as it has a Minimal Clinically Important Difference (MICD) of 3.2 to 4.5 points and a pooled value of 3.8 (Tamura et al., 2024).

Growing up with balance disorders

The inability to identify and manage balance disorders early in childhood allows the adverse effects to have a ripple effect throughout a child's lifespan. The balance deficits, if untreated, do not always self-resolve, however, may transcend into adolescent and adulthood (Melo, 2024). Therefore, CWD with balance problems grow up to become adults with balance problems, which are then compounded from the age of 40, according to the National Health and Nutrition Examination Survey (Cao et al., 2021). As extensively discussed in this chapter, balance, motor and coordination deficits impact health and activity-related components of an individual's daily life (Kiss et al., 2018). Consequently, children with such deficits may demonstrate reduced participation in play activities, which directly places them at risk for developing NCDs like being overweight, obese or having reduced cardiorespiratory fitness (Smits-Engelsman et al., 2022). Thus, it is unsurprising that a high rate of obesity and being overweight is found in CWD (Stough et al., 2016). A study by Dair et al. (2006) evaluating the 6–11-year age group found that CWD were at greater risk of being overweight. Furthermore, the authors noted trends of being overweight or obese in childhood continued well into adulthood (Dair et al., 2006). This could mean an increase in the burden of NCDs, which is already being witnessed in South Africa (Senekal et al., 2015) and will further challenge the already overwhelmed health system. Seeking healthcare for individuals with deafness is a

challenge for most because the current healthcare system lacks services to bridge the communication barrier between individuals with deafness and healthcare professionals. Thus, they are likely to live with undiagnosed, chronic illnesses (Dalal et al., 2022). The systemic inequalities faced by individuals with deafness leave much to be desired, especially for conditions that can be identified and managed in early childhood to optimize a child's overall health outcomes.

The presence of chronic diseases, lower socio-economic status and educational levels, and reduced physical activity increases the likelihood of significant balance-related difficulties in adulthood (Cao et al., 2021). Kowalewski et al. (2018) conducted a study in younger hearing adults (mean age 27 years) and older adults (mean age of 68 years) with and without hearing loss. The authors found that older adults with hearing loss presented with poorer balance control and increased risk for falls when compared with adults with normal hearing (Kowalewski et al., 2018). Furthermore, adults with hearing loss may exhibit subjective difficulties with walking, frailty and physical fitness, which may affect stability in everyday situations (Wunderlich et al., 2024). The TUG had been noted to indicate falls risks and low functional mobility in adults (Tan et al., 2023). Likewise, in their study, the authors found that as adults advanced in age, they had slower TUG scores. When older adults were asked to dual-task, gait speed decreased indicating greater risk of falls (Hausdorff et al., 2008). The authors also note that emotional and psychological well-being as well as fear of falls affected gait performance when dual tasking. Lundin-Olsson et al., (1998) found that adults who had a time difference of ≥ 4.5 seconds between the TUG and TUG dual-task were more at risk for falls as they often had a fall during the follow-up period. Moreover, these participants were also considered frail (Lundin-Olsson et al., 1998). These difficulties then, in turn, perpetuate the vicious cycle of inactivity, increasing the risk of NCDs and further difficulties with mobility in adults with hearing loss (Goodwin et al., 2024). Yan et al. (2022) found that adults with balance problems had lower cognitive function in their study investigating the potential association between balance and cognition in Chinese adults. The authors noted that the participants with lower balance scores also presented with reduced mental status, episodic memory and mental status (Yan et al., 2022). It seems clear that balance deficits have negative consequences for physical health, and cascade through every aspect of an individual's life, even leading to their demise. A cohort study by Cao et al. (2021) found that individuals with balance problems are at increased risk of death from all known causes, cardiovascular disease or cancer, compared

to those without balance problems. In addition, individuals with balance problems face greater risk of mortality due to accidents (Cao et al., 2021).

Although the evidence cited in this section presents a gloomy prospect potentially awaiting children with untreated balance deficits, the key message is that this is preventable. If impairments are identified timeously in early childhood, evidence-based management and intervention can be introduced, enabling participation and inclusion (Christy, 2019), thus reshaping the trajectory for CWD. Literature suggests that hearing and balance disorders do not resolve without directed and comprehensive auditory and vestibular rehabilitation therapy (Zarei et al., 2023). Therefore, this study implores audiologists to actively play their role as the primary healthcare practitioners who identify, diagnose, and manage hearing, balance and ear-related disorders. Researchers in LMICs also have a responsibility to advocate for CWD and highlight the current gaps in the way in which healthcare services are currently provided for this population.

Recommendations

Future research

Embarking on a review of literature for this research, a scarcity of studies investigating functional impact of balance deficits on CWD and the impact on HRQoL was evident. Further research is needed to substantiate the existing reviews within this area. Although the findings of this research contribute to the knowledge base in this field, there is a need for investigations of children younger than 9 years of age to further advocate for early intervention in CWD, especially in LMIC.

Further research should explore the adapted PVSQ and DHI-CA in terms of criterion validity. A similar study could be conducted with a wider population of CWD from different socio-economic backgrounds, given that this study was only limited to schools for the deaf within the eThekweni Municipality. Furthermore, research into SASL HRQoL measures applicable within the South African context would be instrumental for CWD. There is room to translate and validate such measures for this population to pave the way for access and inclusivity of CWD and allow for clinicians to ascertain HRQoL directly from children without relying only on proxy reports. Qualitative methodologies would also be valuable to explore the

lived experiences of CWD, which would further assist in shaping clinical practice and management

It would be of clinical significance for research to evaluate the use of the SASL PVQS and DHI-CA post intervention to understand if these tools are able to detect changes (MCID). Such research could support the use of these tools for baseline assessments as well as their use as outcome measures after therapeutic services have been employed. Moreover, research on the reliability and validity of the test battery used in this research study could be pursued, especially in different populations so to promote the development of a “gold standard” assessment battery for LMICs.

Future research could also be conducted with CWD versus NH children using a detailed test battery to maximize the quantification of balance performance. Objective vestibular and posturography assessments could also be included. Vestibular and balance research in paediatrics is a growing field with much work required, especially within the South African context. It is equally important to develop tools for assessment that are contextually and culturally relevant, and to advance research on rehabilitation approaches in CWD. Investigating the impact of assistive listening devices on balance within CWD in South Africa is an important potential line of investigation. Longitudinal research would be invaluable in this work, ultimately advocating for hearing and ear-related interventions for all CWD to reduce the adverse effects on balance.

Future studies could investigate falls, fall-risks and parental attitudes regarding falls in CWD. Furthermore, exploring the use of the Mini-BESTest in falls assessment in CWD in an effort to determine cut-off scores for falls, and cut-off values to predict future falls in CWD would be integral. This research will be useful in guiding clinicians on decision-making for falls prevention interventions as well as advocating for the integration of falls management in school exercise programmes.

Clinical practice

Audiologists, as healthcare practitioners who specialize in the assessment, management and prevention of hearing and balance impairment in all populations (Miller et al., 2022), should be central to the identification and intervention of these conditions. Although balance assessment has not yet been integrated into routine audiological procedures, the assessment of

vestibular deficits could be a logical start in minimizing the resultant balance deficits. This is a feasible approach, as can be seen with the Vestibular Infant Screening-Flanders (VIS-Flanders) project, which can assist in assessment and diagnosis in children as young as 6 months of age (Martens et al., 2020; Martens, Maes, et al., 2023), ultimately providing a basis for early detection of vestibular disorders. Furthermore, instead of identifying disorders in silos, the merging of both auditory, motor and balance-related services could allow for early diagnosis and subsequent early intervention. Melo (2024) suggests that the inclusion of vestibular assessments soon after birth then referring neonates who present with issues for motor assessments, therapeutic interventions from paediatric physiotherapists and providing informational counselling to parents. Such an approach could improve early identification and intervention.

Intervention of the auditory system with assistive listening devices, such as hearing aids or implantable devices, could provide access to acoustic stimulation and subsequently, exposure to spoken language. This would, in turn, assist in improving balance outcomes (Gheysen et al., 2008) and, as suggested by the current study, CWD who acquired speech presented with better balance outcomes. Authors have noted that children with cochlear implants had better balance outcomes than those with no assistive listening devices, despite the violation of the vestibular space (Schlumberger et al., 2004). Early identification of hearing loss allows children to develop language (SASL or spoken language), cognition and linguistic identity that is important for autonomy and socialization (World Federation of the Deaf, 2016). The combination of auditory and balance interventions can significantly improve the lives of CWD and balance interventions are more effective earlier in life than in children >13 years of age (Zhou & Qi, 2022).

The assessment of balance deficits in children should utilize a multidisciplinary team (MDT) approach. Professionals consulting with a child who experiences imbalance should be able to take a comprehensive case history, which can now be done in part, through the video recorded PVSQ and DHI-CA questionnaires. The use of these tools can give professionals information regarding the presence of symptoms of imbalance and resultant handicap, thus informing decisions on appropriate referrals and interventions. Professionals who need to be involved in the clinical work-up of a child with imbalance include neurologists, paediatricians, otorhinolaryngologists, ophthalmologists, psychiatrists and physiotherapists (Božanić Urbančič et al., 2022; Melo et al., 2024). An MDT approach is necessary to accurately establish

the root-cause of the balance symptoms, thus allowing for more effective management (Božanić Urbančič et al., 2022). Figure 17 demonstrates a preliminary protocol that could be used by professionals in clinical practice.

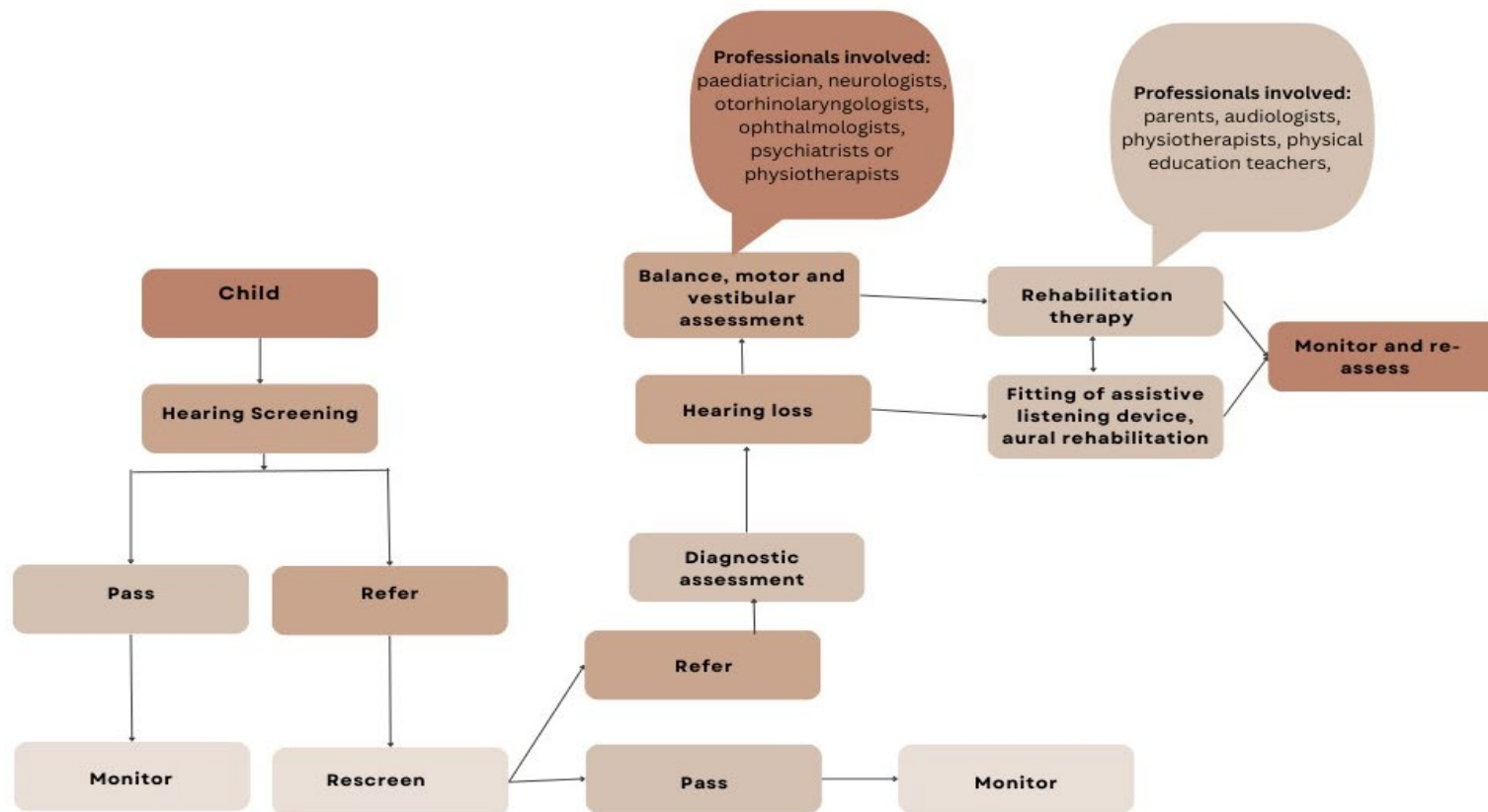


Figure 17: Suggested protocol for managing children with deafness in clinical practice

Promotion of family-centred intervention can be useful in addressing all the domains related to the child's health as per the ICF-HrF. If children have been identified late, extensive and exhaustive intervention practices are recommended to mitigate the negative effects of balance deficits. The provision of acoustic stimulation through assistive listening devices and physical therapy that places emphasis on vestibular, motor, visual and somatosensory function can improve balance outcomes and cognitive function in children with hearing loss (Hedayatjoo et al., 2020). Vestibular rehabilitation inclusive of balance exercises may also improve imbalance, gait disturbances and postural stability in CWD (Melo et al., 2024). These can be facilitated through physical activity and sports, virtual reality-based games, rhythmic activities and recreational activities. Sensory re-weighting and task-specific interventions can also be included to promote postural stability and safety while navigating everyday life (Fong et al., 2016). Veiskarami and Roozbahani (2020) also suggested the use of sports and rhythmic movement such as aerobics, ball games, skipping or swimming to improve balance and postural control. These exercises have been shown to improve balance performance and attention in CWD (Hedayatjoo et al., 2020). It is equally important to include dual-tasking within VRT strategies (Dual-Task Balance Training) has been found to improve balance performance more effectively than conventional balance training (Atak & Algun, 2022). The use of dual-tasking can also aid in the improvement of gait performance, functional motor skills and improve quality of life (Okur et al., 2022). Therefore, incorporating such activities will allow children to effectively participate in activities of daily living. Rehabilitation may involve audiologists, physiotherapists for motor rehabilitation (Melo et al., 2024), and physical education teachers (Božanić Urbančić et al., 2022). Furthermore, preventative programmes need to be implemented with periodic monitoring and evaluations of neuromotor function, and intervention provided as soon as impairment is uncovered (Melo et al., 2017).

Information sharing and creating awareness within healthcare spaces should be prioritized by those professionals who are mainly involved in the assessment and management of CWD. This will help to capacitate and upskill other professionals. Furthermore, evidence-based practice needs to be promoted and continued professional development in this area is necessary. When healthcare professionals are aware of the presence of balance and vestibular deficits in children, they are more likely to assess and treat such difficulties and make appropriate referrals (Ghai et al., 2019). The dissemination of information about the impact of hearing loss and balance deficits should also involve parents or caregivers and nursing staff at immunization/primary healthcare facilities so that they are aware of symptoms to look out for,

who they should refer to, and the importance of physical activity. Healthcare professionals in all related fields need to learn alternate modes and languages to effectively manage all patients. Ultimately, promoting awareness of fall risks in CWD is urgently needed to protect children and reduce preventable injuries, and caregivers, educators, healthcare professionals and the general public should all be targeted in such information campaigns. Last, healthcare professionals need to improve health literacy and parental involvement when caring for CWD, this will improve adherence to interventions and better health outcomes for children.

Stakeholders and policy makers

There is a need to review Department of Health and Education policies that directly impact on service provision for CWD. This study highlights the importance of improving existing policies, implications and implementation to ensure visibility and utility of these policies. It is equally important to involve audiologists in the development of policies that cater for CWD as their scope of practice allows them to grasp the extent to which hearing impairment can affect an individual's life and the intervention required. Inadequate policy management has dire effects as it can prolong policy implementation and delay the adoption of scientific and evidence-based practices (Lane et al., 2020). This study advocates for the need to create job opportunities for audiologists who will provide ear and balance-related services to CWD within the health and education sector. Appropriate human resources and support can aid in improving service delivery, which will ultimately improve early identification and intervention for young children.

There is a need, now more than ever, to implement and nationalize the universal newborn hearing screening programme, which will mobilize initiatives for early identification and intervention services for all children with hearing loss. Moreover, to get the implementation started, children diagnosed with hearing loss should be routinely screened for balance deficits and provided with early intervention, if required. Balance assessment and management should be included in *Early Hearing Detection and Intervention* (EHDI), stipulating guidelines for healthcare professionals on the appropriate services to be provided to children with hearing loss.

Although physical education is part of the curriculum in South African schools, factors such as staffing, infrastructure and time allocations often limit its adequate implementation (Stroebe et al., 2016). The present study also highlights a need for structured and specific

physical education for CWD and resources for special schools that will promote active learning, fitness and a physically active lifestyle, participation in Deaf sports, peer-tutoring and recreational programmes (Dair et al., 2006). Participation in sporting activities not only improves physical health, but can also improve DVA (Brancaleone et al., 2023). School health programmes in special schools should be equally prioritised as in mainstream schools.

Limitations

While this study makes several contributions to the field, it also had some limitations. Health practitioners such as audiologists or Ear, Nose and Throat specialists (ENTs) were not included as panel experts. Although this would have been ideal as these professionals are familiar with audio-vestibular management, there were limitations with accessing such professionals who had an in-depth understanding of SASL. However, this study sought to validate the translations of the SASL tools only and not the existing tools themselves, which have been widely reported in literature. Therefore, the six panellists were included because they were considered to be experts on the language of interest.

A small sample was randomly sampled for the pilot and post-pilot assessments, which could have impacted the results. A larger sample size could have improved the construct validity of the study. Furthermore, the aetiology of the dizziness and balance symptoms was not investigated to determine the cause of the reported symptoms, which may have further improved construct validity. However, diagnosis of vestibular and balance issues was not the primary aim for this aspect of the study. In addition, symptoms of imbalance may originate from a spectrum of disorders and not only be of vestibular origin. Thus, prioritizing subjective complaints of dizziness allows for professionals to take the child's entire context into account for diagnostic purposes (Cao et al., 2021; Casani et al., 2015). As already noted, this study is the first to translate and validate these two tools into SASL. Therefore, it was not possible to evaluate criterion validity. For future research, a similar study could be conducted on a larger scale to determine if the outcomes are comparable with the findings of this study.

The use of the visual acuity within balance assessment may not be typical, however, it was necessary to include for the purpose of this study as visual acuity has been noted to impact on balance performance. As the researcher only conducted a screening, it may be necessary to include a qualified optometrist to conduct assessments and ensure accuracy of results.

Furthermore, the use of the DVA for this population was less than ideal due to limitations with spoken language, therefore, the use of SASL could have compromised the reliability of the test. It can be noted that the use of sign language, a visuospatial language (Brancaleone et al., 2023) may positively influence performance on the DVA assessment. Furthermore, the central pre-programming can also impact on results (Rine & Braswell, 2003). Therefore, it is recommended that future studies use more direct measures of the vestibulo-ocular reflex such as the video-head impulse test. Last, theoretically, the use of pure tone audiometric screening would have been beneficial in confirming normal hearing in the control group, as it could have assisted in identifying hearing loss due to retro-cochlear pathologies which may have not been identified with TEOAEs.

Physical assessments of balance were conducted in this study (m-CTSIB and Mini-BESTest). These tests assessed various conditions that affect balance in children within the 9–17-year age group. They were easy, quick to administer to CWD and did not require any specialised equipment. This can be viewed as a strength; the test battery can be used to quantify balance performance in CWD in LMICs similar to the present study. However, the limitation was that diagnostic vestibular assessments were not conducted in this population. The resultant information could have provided a quantification of vestibular impairment in CWD, thus allowing for greater specificity in the subsequent management provided. Nonetheless, this limitation does not directly impact the study findings as the purpose of the study was to evaluate the impact of functional balance rather than determine the cause and extent of the balance deficits in CWD.

A limitation to this study was the sample size for the main study. The initial size was proposed to be higher, due to issues such as recruitment process, participation, small number of learners in each deaf school, such sample size could not be attained. This could affect the generalisability of the study results. Therefore, it is recommended that future studies include a larger sample size and participants from various contexts.

The study identified variation in balance performance and subjective reports in CWD. Although reported in some earlier studies, there is a scarcity of literature in this area. Therefore, this study contributed to the knowledge in the field. Further research needs to be conducted to determine the effects of spoken language on balance function in a larger sample size. A more detailed assessment battery would be beneficial to determine the extent to which speech

impacts on balance function, inclusive of both balance and speech tests. The determination of age of speech acquisition and fitting of assistive listening devices would assist in the comprehensive understanding of this phenomenon.

Conclusion

Balance disorders have a wide range of causes and can occur as a result of several sensory, motor or musculoskeletal impairments (Cao et al., 2021). The study focused on the functional impact of balance disorders in CWD. Children are the owners of their experiences but may be unable to effectively communicate their symptoms due to communication deficits. This study aimed to bridge this gap, allowing children to be active participants in consultations (Ekberg et al., 2022). This participation is an important component of patient-related outcomes to consider because inclusion of children's subjective experiences in consultations improves their self-esteem and autonomy, in addition to ensuring more robust clinical outcomes (Coyne, 2006). This is the first study to translate, adapt and validate subjective questionnaires for CWD to quantify the presence and impact of balance symptoms, and further, it is one of few studies to report on HRQoL measures in this population. Thus, the use of the EQ-5D-Y proxy version questionnaire was a strength of this study.

The video-recorded Pediatric Vestibular Symptom Questionnaire and Dizziness Handicap Inventory can be used with children who are proficient in SASL and between the ages of 9–17 years. These tools were able to efficiently detect and describe functional balance in CWD, thus providing healthcare professionals with much-needed information to improve diagnostic and therapeutic impressions, and subsequently, improving the quality of life for CWD. While literature suggests that many children with disabilities are likely to be neglected or die young (Tupetz et al., 2020), this does not have to be their fate especially for health conditions that are preventable (i.e., falls and injury) or managed early through appropriate therapeutic interventions. This study shows that CWD typically present with multiple impairments (hearing, balance and vision), which directly translate to facing triple barriers to access. Consequently, the starting line for these children is significantly shifted when compared to their NH peers, further fuelling the vicious cycle of disability and poverty as these two factors are inextricable (Paudel et al., 2017). The study highlights key issues that need our attention as advocates of health. In so doing, there is greater likelihood to achieve the

Sustainable Development Goals such as good health and well-being, quality education, reduced inequality, decent work and economic growth and no poverty. Children, like all people, deserve to experience life fully and have a bright future to look forward to (Wallander & Koot, 2016). Therefore, as a public health issue, balance deficits in children demand our immediate attention. The availability of these tools is a step in the right direction in improving care for this population and may potentially lead to more innovative developments in future.

“I never thought someone like me could become Miss South Africa”

Ms Le Roux (le Roux, 2024)

References

- Abraham, N., & Abraham, V. (2024, 08 December 2024). Sharing water with the dead. *Sunday Times*, 5.
- Achoki, T., Sartorius, B., Watkins, D., Glenn, S. D., Kengne, A. P., Oni, T., Wiysonge, C. S., Walker, A., Olatunji O Adetokunboh, O. O., Babalola T. K., Bolarinwa, O. A., Claassens, M., Cowden, R. G., Day, C. T., Ezekannagha, O., Ginindza, T. G., Iwu, C. C. D., Iwu, J., 1, Karangwa, I., . . . Naghavi, M. (2022). Health trends, inequalities and opportunities in South Africa's provinces, 1990–2019: findings from the Global Burden of Disease 2019 Study. *Journal of Epidemiology and Community Health*, 76, 471-481.
- Aikman, N. (2019). The crisis within the South African healthcare system : a multifactorial disorder. *South African Journal of Bioethics and Law*, 12(2), 52-56. <https://doi.org/doi:10.7196/SAJBL.2019.v12i2.694>
- Almomani, F., Al-Momani, M. O., Garadat, S., Alqudah, S., Kassab, M., Hamadneh, S., Rauterkus, G., & Gans, R. (2021). Cognitive functioning in Deaf children using cochlear implants. *BMC Pediatrics*, 21(1), 71. <https://doi.org/10.1186/s12887-021-02534-1>
- Allothman, D. (2021). Language and Literacy of Deaf Children. *Psychology and Education Journal*, 58, 799-819. <https://doi.org/10.17762/pae.v58i1.832>
- Altin, B., & Aksoy, S. (2023). The Turkish Validity and Reliability of the Pediatric Vestibular Symptom Questionnaire. *Namık Kemal Tıp Dergisi*, 11(3), 180-185. <https://doi.org/10.4274/NKMJ.GALENOS.2023.15870>
- Alves, C. C., & Silva, A. L. S. (2019). Pediatric Vestibular Rehabilitation: A Case Study. *Pediatr Phys Ther*, 31(4), E14-E19. <https://doi.org/10.1097/PEP.0000000000000654>
- American Speech-Language-Hearing Association. (1993). *Definitions of communication disorders and variations*. Retrieved 11 February from <https://www.asha.org/policy/rp1993-00208/>
- American Speech-Language-Hearing Association. (2018). *Scope of Practice in Audiology*. <https://www.asha.org/policy/sp2018-00353/>
- Andrade, L., Borges, K., Raponi, M. B., Felix, M., Castro, S., & Barbosa, M. (2018). Translation methods of instruments to sign language: An evidence-based proposal. *Texto & Contexto - Enfermagem*, 26. <https://doi.org/10.1590/0104-07072017002210017>
- Antoine, M. W., Vijayakumar, S., McKeehan, N., Jones, S. M., & Hebert, J. M. (2017). The Severity of Vestibular Dysfunction in Deafness as a Determinant of Comorbid Hyperactivity or Anxiety. *J Neurosci*, 37(20), 5144-5154. <https://doi.org/10.1523/JNEUROSCI.3545-16.2017>
- Apeksha, K., Singh, S., Rathnamala, M., Varalakshmi, S., Preethu, D. J., Kavya, V., Sowndarya, D. S., Arpitha, S., Milana, K., Navya, S., & Thejasvi, M. A. (2021). Balance Assessment of Children with Sensorineural Hearing Loss. *Indian journal of otolaryngology and head and neck surgery : official publication of the Association of Otolaryngologists of India*, 73(1), 12-17. <https://doi.org/10.1007/s12070-020-01797-x>
- Aqtam, I., Ayed, A., & Zaben, K. (2023). Quality of Life: Concept Analysis. *Saudi Journal of Nursing and Health Care*, 6, 10-15. <https://doi.org/10.36348/sjnhc.2023.v06i01.003>
- Ashori, M., Yazdanipour, M., & Pahlavani, M. (2019). The effectiveness of cognitive rehabilitation program on auditory perception and verbal intelligibility of deaf children. *American Journal of Otolaryngology*, 40(5), 724-728. <https://doi.org/https://doi.org/10.1016/j.amjoto.2019.06.011>
- Atak, E., & Algun, Z. C. (2022). Dual-Task Balance Training for Motor Skill Development among Children with Intelligence Quotient Discrepancy. *Rehabilitation research and practice*, 2022(1), 2822171. <https://doi.org/https://doi.org/10.1155/2022/2822171>
- Azzam, D., & Ronquillo, Y. (2023). *Snellen Chart* (StatPearls, Ed.). StatPearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK558961/>

- Balzanelli, C. A.-O., Spataro, D. A.-O., & Redaelli de Zinis, L. A.-O. (2021). Prevalence of Pediatric and Adolescent Balance Disorders: Analysis of a Mono-Institutional Series of 472 Patients. . *Children (Basel, Switzerland)*, 8(2227-9067 (Print)), 1056. <https://doi.org/https://doi.org/10.3390/children8111056>
- Bamford, L. (2017). *School Health* (District Health Barometer 2016/17, Issue. [https://www.hst.org.za/publications/District%20Health%20Barometers/7%20\(Section%20A\)%20School%20Health.pdf](https://www.hst.org.za/publications/District%20Health%20Barometers/7%20(Section%20A)%20School%20Health.pdf)
- Banda, F. M., & Nakstad, B. (2021). Childhood Hearing Loss in Developing Countries: From Multidisciplinary Team Work to Public Health. In W. Tang-Chuan (Ed.), *Hearing Loss* (pp. Ch. 10). IntechOpen. <https://doi.org/10.5772/intechopen.97659>
- Batistela, R. A., Rinaldi, N., & Moraes, R. (2023). Mini-BESTest cutoff points for classifying fallers and non-fallers female older adults. *Brazilian Journal of Motor Behavior*, 17, 155-162. <https://doi.org/10.20338/bjmb.v17i4.354>
- Beacham, S. (2024). *Stephanie Beacham Quotes*. Retrieved 14 December from
- Beerse, M., Lelko, M., & Wu, J. (2019). Biomechanical analysis of the timed up-and-go (TUG) test in children with and without Down syndrome. *Gait & Posture*, 68, 409-414. <https://doi.org/https://doi.org/10.1016/j.gaitpost.2018.12.027>
- Begum, M. R., & Hossain, M. A. (2019). Validity and reliability of visual analogue scale (VAS) for pain measurement. *Journal of Medical Case Reports and Reviews*, 2(11).
- Bevans, K. B., Ahuvia, I. L., Hallock, T. M., Mendonca, R., Roth, S., Forrest, C. B., Blackwell, C., Kramer, J., & Wakschlag, L. (2020). Investigating child self-report capacity: a systematic review and utility analysis. *Quality of Life Research*, 29(5), 1147-1158. <https://doi.org/10.1007/s11136-019-02387-3>
- Bezuidenhout, J. K., Khoza-Shangase, K., De Maayer, T., & Strehlau, R. (2018). Universal newborn hearing screening in public healthcare in South Africa: Challenges to implementation. *South African Journal of Child Health*, 12(4). <https://doi.org/10.7196/SAJCH.2018.v12i4.1522>
- Bhamjee, A. A.-O. X., le Roux, T., Schlemmer, K. A.-O., Graham, M. A., & Mahomed-Asmail, F. (2022). Audiologists' Perceptions of Hearing Healthcare Resources and Services in South Africa's Public Healthcare System. (1178-6329 (Print)).
- Biagio, L., Swanepoel Dw Fau - Laurent, C., Laurent C Fau - Lundberg, T., & Lundberg, T. (2014). Paediatric otitis media at a primary healthcare clinic in South Africa. *South African medical journal = Suid-Afrikaanse tydskrif vir geneeskunde*, 104(0256-9574 (Print)), 431-435. <https://doi.org/10.7196/samj.7534>
- Blodgett, J. M., Kuh, D., Hardy, R., Davis, D. H. J., & Cooper, R. (2018). Childhood Cognition and Age-Related Change in Standing Balance Performance From Mid to Later Life: Findings From a British Birth Cohort. *The Journals of Gerontology: Series A*, 75(1), 155-161. <https://doi.org/10.1093/gerona/gly275>
- Božanić Urbančič, N., Vozel, D., Kordiš, Š., Hribar, M., Urbančič, J., & Battelino, S. (2022). Indicators of pediatric peripheral vestibular disorder: A retrospective study in a tertiary referral center. *International Journal of Pediatric Otorhinolaryngology*, 159, 111221. <https://doi.org/https://doi.org/10.1016/j.ijporl.2022.111221>
- Brancaleone, M. P., Boucher, L. C., Yang, J., Merfeld, D., & Onate, J. A. (2023). Comparing dynamic visual acuity between athletes who are deaf or hard-of-hearing and athletes who are hearing. *Journal of American College Health*, 1-4. <https://doi.org/10.1080/07448481.2023.2198018>
- Broesch, T., Crittenden, A. N., Beheim, B. A., Blackwell, A. D., Bunce, J. A., Colleran, H., Hagel, K., Kline, M., McElreath, R., Nelson, R. G., Pisor, A. C., Prall, S., Pretelli, I., Purzycki, B., Quinn, E. A., Ross, C., Scelza, B., Starkweather, K., Stieglitz, J., & Mulder, M. B. (2020). Navigating cross-cultural research: methodological and ethical considerations. *Proceedings of the Royal Society B: Biological Sciences*, 287(1935), 20201245. <https://doi.org/10.1098/rspb.2020.1245>

- Buchman, C. A., Joy, J., Hodges, A., Telischi, F. F., & Balkany, T. J. (2009). Vestibular Effects of Cochlear Implantation. *The Laryngoscope*, 114(S103), 1-22. <https://doi.org/https://doi.org/10.1097/00005537-200410001-00001>
- Buchner-Eveleigh, M. (2016). Children's rights of access to health care services and to basic health care services: a critical analysis of case law, legislation and policy. *De Jure Law Journal*, 49, 307-325. http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S2225-71602016000200008&nrm=iso
- Butler, I. R., Ceronio D Fau - Swart, T., Swart T Fau - Joubert, G., & Joubert, G. (2015). Age of diagnosis of congenital hearing loss: Private v. public healthcare sector. *South African medical journal = Suid-Afrikaanse tydskrif vir geneeskunde*, 105(0256-9574 (Print)), 927-929. <https://doi.org/https://doi.org/10.7196/SAMJ.2015.v105i11.9576>
- Byrd, S., Shuman Ag Fau - Kileny, S., Kileny S Fau - Kileny, P. R., & Kileny, P. R. (2011). The right not to hear: the ethics of parental refusal of hearing rehabilitation. *The Laryngoscope*, 121(1531-4995 (Electronic)), 1800- 1804. <https://doi.org/10.1002/lary.21886>
- Cao, C., Cade, W. T., Li, S., McMillan, J., Friedenreich, C., & Yang, L. (2021). Association of Balance Function With All-Cause and Cause-Specific Mortality Among US Adults. *JAMA otolaryngology-- head & neck surgery*, 147(2168-619X (Electronic)), 460-468. <https://doi.org/10.1001/jamaoto.2021.0057>
- Carello, C., LeVasseur V. M., & Schmidt, R. C. (2002). Movement sequencing and phonological fluency in (putatively) nonimpaired readers. *Psychological science*, 13(0956-7976 (Print)), 375-379. <https://doi.org/https://doi.org/10.1111/1467-9280.00467>
- Carlson, M. D., & Morrison, R. S. (2009). Study design, precision, and validity in observational studies. *J Palliat Med*, 12(1), 77-82. <https://doi.org/10.1089/jpm.2008.9690>
- Carmeli, E., Bar-Chad, S., Lotan, M., Merrick, J., & Coleman, R. (2003). Five Clinical Tests to Assess Balance Following Ball Exercises and Treadmill Training in Adult Persons With Intellectual Disability. *The Journals of Gerontology: Series A*, 58(8), M767-M772. <https://doi.org/10.1093/gerona/58.8.M767>
- Carpenter, M. G., & Campos, J. L. (2020). The Effects of Hearing Loss on Balance: A Critical Review. *Ear and Hearing*, 41, 107S-119S. <https://doi.org/10.1097/AUD.0000000000000929>
- Carrozzino, D., Patierno, C., Guidi, J., Berrocal Montiel, C., Cao, J., Charlson, Mary E., Christensen, Kaj S., Concato, J., De las Cuevas, C., de Leon, J., Eöry, A., Fleck, Marcelo P., Furukawa, Toshi A., Horwitz, Ralph I., Nierenberg, Andrew A., Rafanelli, C., Wang, H., Wise, Thomas N., Sonino, N., & Fava, Giovanni A. (2021). Clinimetric Criteria for Patient-Reported Outcome Measures. *Psychotherapy and Psychosomatics*, 90(4), 222-232. <https://doi.org/10.1159/000516599>
- Casani, A. P., Dallan, I., Navari, E., Sellari Franceschini, S., & Cerchiai, N. (2015). Vertigo in childhood: proposal for a diagnostic algorithm based upon clinical experience. *Acta otorhinolaryngologica Italica : organo ufficiale della Societa italiana di otorinolaringologia e chirurgia cervico-facciale*, 35(1827-675X (Electronic)), 180-185.
- Casoojee, A., Kanji, A., & Khoza-Shangase, K. (2021). Therapeutic approaches to early intervention in audiology: A systematic review. *International Journal of Pediatric Otorhinolaryngology*, 150, 110918. <https://doi.org/https://doi.org/10.1016/j.ijporl.2021.110918>
- Castro, A. S., Gazzola Jm Fau - Natour, J., Natour J Fau - Ganança, F. F., & Ganança, F. F. (2007). [Brazilian version of the dizziness handicap inventory] [Versão brasileira do dizziness handicap inventory.]. *Pro-fono: revista de atualizacao cientifica*, 19(0104-5687 (Print)), 97- 104. <https://doi.org/10.1590/s0104-56872007000100011>
- Centers for Disease Control and Prevention. (2020, 08 June 2020). *Hearing Loss in Children*. Retrieved 17 July from <https://www.cdc.gov/ncbddd/hearingloss/types.html>
- Chakrabartty, S. N. (2020). Reliability of test battery. *Methodological Innovations*, 13(2), 2059799120918340. <https://doi.org/10.1177/2059799120918340>

- Chan, J., Ali, N., Najafi, A., Meehan, A., Mancl, L. R., Gallagher, E., Bly, R., & Gollakota, S. (2022). An off-the-shelf otoacoustic-emission probe for hearing screening via a smartphone. *Nature Biomedical Engineering*, 6(11), 1203-1213. <https://doi.org/10.1038/s41551-022-00947-6>
- Chaudhary, S., Figueroa, J., Shaikh, S., Mays, E. W., Bayakly, R., Javed, M., Smith, M. L., Moran, T. P., Rupp, J., & Nieb, S. (2018). Pediatric falls ages 0-4: understanding demographics, mechanisms, and injury severities. *Injury epidemiology*, 5(2197-1714 (Print)). <https://doi.org/10.1186/s40621-018-0147-x>
- Chen, G., Zhang, J., Qiao, Q., Zhou, L., Li, Y., Yang, J., Wu, J., & Huangfu, H. (2023). Advances in dynamic visual acuity test research [Review]. *Frontiers in neurology*, 13. <https://www.frontiersin.org/journals/neurology/articles/10.3389/fneur.2022.1047876>
- Chisari, D., Vitkovic, J., Clark, R., & Rance, G. (2023). Vestibular function and balance performance in children with sensorineural hearing loss. *International Journal of Audiology*, 1-9. <https://doi.org/10.1080/14992027.2023.2281878>
- Christy, J. (2019). Use of Vestibular Rehabilitation in the Pediatric Population. *Perspectives of the ASHA Special Interest Groups*, 4(6), 1399-1405. https://doi.org/10.1044/2019_PERS-SIG7-2019-0002
- Cieza, A., & Stucki, G. (2008). The International Classification of Functioning Disability and Health: its development process and content validity. *European journal of physical and rehabilitation medicine*, 44(1973-9087 (Print)), 303–313.
- Clark, J. G. (1981). Uses and abuses of hearing loss classification. *Asha*, 23(7), 493-500.
- Coetzee, D. (2016). Strength, running speed, agility and balance profiles of 9- to 10-year-old learners : NW-child study. *South African Journal for Research in Sport, Physical Education and Recreation*, 38(1), 13-30. <https://doi.org/10.10520/EJC186990>
- Constitutional Court of South Africa. (2017). *Section 28 - Children*. Constitutional Court of South Africa. Retrieved 14 December from
- Cooperative Governance Traditional Affairs. (2020). *EThekwini Metropolitan KZN*. https://www.cogta.gov.za/ddm/wp-content/uploads/2020/07/Metro-Profile_Ethekwini.pdf
- Cornwell, T., Woodward, J., Wu, M. M., Jackson, B., Souza, P., Siegel, J., Dhar, S., & Gordon, K. E. (2020). Walking With Ears: Altered Auditory Feedback Impacts Gait Step Length in Older Adults [Original Research]. *Frontiers in Sports and Active Living*, 2. <https://www.frontiersin.org/journals/sports-and-active-living/articles/10.3389/fspor.2020.00038>
- Coyne, I. (2006). Consultation with children in hospital: children, parents' and nurses' perspectives. *Journal of Clinical Nursing*, 15(1), 61-71. <https://doi.org/https://doi.org/10.1111/j.1365-2702.2005.01247.x>
- Crunkhorn, R., & Cane, D. (2022). 952 Paediatric vestibular rehabilitation – video resources for children. *Archives of Disease in Childhood*, 107(Suppl 2), A129. <https://doi.org/10.1136/archdischild-2022-rcpch.208>
- Crunkhorn, R., Dasgupta, S., Seal, A. K., & Dasgupta, S. (2023). Fifteen-minute consultation: The dizzy child. *Archives of disease in childhood - Education & practice edition*, 108(1), 10. <https://doi.org/10.1136/archdischild-2020-320569>
- Dai, S., Yuan, H., Wang, J., Yang, Y., & Wen, S. (2023). Effects of aquatic exercise on the improvement of lower-extremity motor function and quality of life in patients with Parkinson's disease: A meta-analysis. *Frontiers in physiology*, 14(1664-042X (Print)), 1066718. <https://doi.org/https://doi.org/10.3389/fphys.2023.1066718>
- Dair, J., Ellis, M., & Lieberman, L. (2006). Prevalence of Overweight Among Deaf Children. *American annals of the deaf*, 151, 318-326. <https://doi.org/10.1353/aad.2006.0034>
- Dalal, J., Reyes, D., Hulo, N., Martinez, A., Coelho, F., Keiser, O., & Rivas Velarde, M. (2022). Health Inequities Across D/Deaf Persons in LMIC: Examining High Rates of Potentially Preventable Loss of Sight, Cognition, Mobility, Self-Care, and Communication Across Deaf Population in Colombia. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.4201400>

- Dall, M., Kiblböck, S., Müllegger, D., Fellingner, J., Hofer, J., Kapplmüller, R., Breitwieser, S., Schossleitner, K., Weber, C., Zöhrer, R., & Holzinger, D. (2022). Understanding the Impact of Child, Intervention, and Family Factors on Developmental Trajectories of Children with Hearing Loss at Preschool Age: Design of the AChild Study. *Journal of Clinical Medicine*, 11(6).
- Damman, O. A.-O., Verbiest, M. A.-O., Vonk, S. I., Berendse, H. W., Bloem, B. A.-O., de Bruijne, M. A.-O., & Faber, M. A.-O. (2019). Using PROMs during routine medical consultations: The perspectives of people with Parkinson's disease and their health professionals. *Health expectations : an international journal of public participation in health care and health policy*, 22(1369-7625 (Electronic)), 939–951. <https://doi.org/10.1111/hex.12899>
- Daneshmandi, H., & Alyarnezhad, C. (2020). Investigation of the Functional Balance in Children With Sensory Impairment Aged 6 to 14 Years Old. *Journal of Sport Biomechanics*, 6(1), 22-31. <https://doi.org/10.32598/biomechanics.6.1.4>
- Dasgupta, S., Mandala, M., Salerni, L., Crunkhorn, R., & Ratnayake, S. (2020). Dizziness and Balance Problems in Children. *Current Treatment Options in Neurology*, 22(3), 8. <https://doi.org/10.1007/s11940-020-0615-9>
- De Kegel, A., Dhooge, I., Cambier, D., Baetens, T., Palmans, T., & Van Waelvelde, H. (2011). Test-retest reliability of the assessment of postural stability in typically developing children and in hearing impaired children. *Gait & Posture*, 33(4), 679-685. <https://doi.org/10.1016/j.gaitpost.2011.02.024>
- De Kegel, A., Maes, L., Baetens, T., Dhooge, I., & Van Waelvelde, H. (2012). The influence of a vestibular dysfunction on the motor development of hearing-impaired children. *Laryngoscope*, 122(12), 2837-2843. <https://doi.org/10.1002/lary.23529>
- De Souza, A. C., Alexandre, N. M. C., & Guirardello, E. B. (2017). Propriedades psicométricas na avaliação de instrumentos: avaliação da confiabilidade e da validade. *Epidemiologia e Serviços de Saúde*, 26.
- De Vet, H. C. W., Mokkink, L. B., Mosmuller, D. G., & Terwee, C. B. (2017). Spearman–Brown prophecy formula and Cronbach's alpha: different faces of reliability and opportunities for new applications. *Journal of Clinical Epidemiology*, 85, 45-49. <https://doi.org/https://doi.org/10.1016/j.jclinepi.2017.01.013>
- de Villiers, K. (2021). Bridging the health inequality gap: an examination of South Africa's social innovation in health landscape. *Infectious Diseases of Poverty*, 10(1), 19. <https://doi.org/10.1186/s40249-021-00804-9>
- Department of Basic Education. (2021). *Integrated School Health Programme (ISHP)*. Retrieved 09 September from [https://www.education.gov.za/Programmes/HealthPromotion/IntegratedSchoolHealthProgramme.aspx#:~:text=The%20Health%20Services%20Package%20for,and%20onsite%20services%20\(such%20as](https://www.education.gov.za/Programmes/HealthPromotion/IntegratedSchoolHealthProgramme.aspx#:~:text=The%20Health%20Services%20Package%20for,and%20onsite%20services%20(such%20as)
- Department of Health. (2006). *South African Good Practice Guidelines* Pretoria, South Africa
- Department of Health. (2015). *Ethics in Health Research- Principles Processes and Structures*. South African Medical Research Council Retrieved from <https://www.samrc.ac.za/research/ethics/guideline-documents>
- Derlich, M., Kręcis, K., & Kuczyński, M. (2011). Attention demand and postural control in children with hearing deficit. *Research in Developmental Disabilities*, 32(5), 1808-1813. <https://doi.org/https://doi.org/10.1016/j.ridd.2011.03.009>
- Dewar, R., Claus, A. P., Tucker, K., Ware, R., & Johnston, L. M. (2017). Reproducibility of the Balance Evaluation Systems Test (BESTest) and the Mini-BESTest in school-aged children. *Gait & Posture*, 55, 68-74. <https://doi.org/https://doi.org/10.1016/j.gaitpost.2017.04.010>
- Dewar, R., Claus, A. P., Tucker, K., Ware, R. S., & Johnston, L. M. (2019). Reproducibility of the Kids-BESTest and the Kids-Mini-BESTest for Children With Cerebral Palsy. *Archives of Physical Medicine and Rehabilitation*, 100(4), 695-702. <https://doi.org/10.1016/j.apmr.2018.12.021>

- Dey, T., Mukherjee, A., & Chakraborty, S. (2020). A Practical Overview of Case-Control Studies in Clinical Practice. *CHEST*, 158(1), S57-S64. <https://doi.org/10.1016/j.chest.2020.03.009>
- Dimitrov, L., & Gossman, W. (2023). *Pediatric Hearing Loss* (I. S. [Internet], Ed.). StatPearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK538285/>
- Doettl, M. (2017). *How Young Is Too Young to Evaluate Children for Dizziness?* ASHAWIRE. <https://leader.pubs.asha.org/doi/full/10.1044/leader.AEA.22072017.18#:~:text=No%20patient%20is%20too%20young,we%20should%20evaluate%20the%20child.>
- Dreepatta, V. S., & Dasgupta, A. (2022). Development of pediatric vestibular symptom questionnaire in malayalam language for children aged 3-6 years. *IP Journal of Paediatrics and Nursing Science*, 5(2), 82-87. <https://doi.org/10.18231/j.ijpns.2022.013>
- Du Plessis, A., de Milander, M., Coetzee, F., & Nel, M. (2020). Prevalence of possible developmental coordination disorder among Grade 1 learners in low socio-economic environments in Mangaung, South Africa. *South African Journal of Childhood Education*, 10. <https://doi.org/10.4102/sajce.v10i1.836>
- Ebrahimi, A. A., Movallali, G., Jamshidi, A. A., Haghgoo, H. A., & Rahgozar, M. (2016). Balance Performance of Deaf Children With and Without Cochlear Implants. *Acta Med Iran*, 54(11), 737-742.
- Ebrahimi, A. A., Movallali, G., Jamshidi, A. A., Rahgozar, M., & Haghgoo, H. A. (2017). Postural Control in Deaf Children. *Acta Med Iran*, 55(2), 115-122.
- Ekberg, K. A.-O., Ekberg, S. A.-O., Weinglass, L. A.-O., Herbert, A. A.-O., Rendle-Short, J. A.-O., Bluebond-Langner, M. A.-O., Yates, P. A.-O., Bradford, N. A.-O., & Danby, S. A.-O. (2022). Attending to child agency in paediatric palliative care consultations: Adults' use of tag questions directed to the child. *Sociology of health & illness*, 43(1467-9566 (Electronic)), 566–585. <https://doi.org/https://doi.org/10.1111/1467-9566.13437>
- Eksteen, S., Eikelboom, R. H., Kuper, H., Launer, S., & Swanepoel, D. W. (2022). Prevalence and characteristics of hearing and vision loss in preschool children from low income South African communities: results of a screening program of 10,390 children. *BMC Pediatrics*, 22(1), 22. <https://doi.org/10.1186/s12887-021-03095-z>
- Elhinidi, E. I. M., Ismaeel, M. M. I., & El-Saeed, T. M. (2016). Effect of dual-task training on postural stability in children with infantile hemiparesis. *Journal of Physical Therapy Science*, 28(3), 875-880. <https://doi.org/10.1589/jpts.28.875>
- Ellis, M. K., Lieberman, L. J., & Dummer, G. M. (2013). Parent Influences on Physical Activity Participation and Physical Fitness of Deaf Children. *The Journal of Deaf Studies and Deaf Education*, 19(2), 270-281. <https://doi.org/10.1093/deafed/ent033>
- Erdinest, N., & London, N. (2022). Dynamic visual acuity and methods of measurement [10.1016/j.optom.2021.06.003]. *Journal of Optometry*, 15(3), 247-248. <https://doi.org/10.1016/j.optom.2021.06.003>
- Ertekin, Y. H., Tekin, M., Uludag, A., Arikan, S., & Sahin, E. M. (2016). Vision screening in children: Is 7-9 years of age a threshold for visual impairment? *Pakistan journal of medical sciences*, 32(1682-024X (Print)), 1194–1198.
- Etikan, I. (2016). Comparison of Convenience Sampling and Purposive Sampling. *American Journal of Theoretical and Applied Statistics*, 5(1). <https://doi.org/10.11648/j.ajtas.20160501.11>
- Eustaquio, M. E., Berryhill, W., Wolfe, J. A., & Saunders, J. E. (2011). Balance in Children With Bilateral Cochlear Implants. *OTOLOGY & NEUROTOLOGY*, 32(3), 424-427. <https://doi.org/10.1097/MAO.0b013e318210b6d2>
- Fancello, V. A.-O., Palma, S., Monzani, D., Pelucchi, S., Genovese, E., & Ciorba, A. A.-O. (2021). Vertigo and Dizziness in Children: An Update. *Children (Basel, Switzerland)*, 8(2227-9067 (Print)), 1025. <https://doi.org/https://doi.org/10.3390/children8111025>
- Fava, Giovanni A., Carrozzino, D., Lindberg, L., & Tomba, E. (2018). The Clinimetric Approach to Psychological Assessment: A Tribute to Per Bech, MD (1942–2018). *Psychotherapy and Psychosomatics*, 87(6), 321-326. <https://doi.org/10.1159/000493746>

- Feinstein, A. R. (1983). An additional basic science for clinical medicine: IV. The development of clinimetrics. *Annals of internal medicine*, 99(6), 843-848.
- Fernandes, R., Hariprasad, S., & Kumar, V. K. (2015). Physical therapy management for balance deficits in children with hearing impairments: A systematic review. *Journal of paediatrics and child health*, 51(1440-1754 (Electronic)), 753–758. <https://doi.org/https://doi.org/10.1111/jpc.12867>
- Fernández-Gómez, E., Martín-Salvador, A., Luque-Vara, T., Sánchez-Ojeda, M. A., Navarro-Prado, S., & Enrique-Mirón, C. (2020). Content Validation through Expert Judgement of an Instrument on the Nutritional Knowledge, Beliefs, and Habits of Pregnant Women. *Nutrients*, 12(4).
- Fong, S. S., Guo, X., Liu, K. P., Ki, W. Y., Louie, L. H., Chung, R. C., & Macfarlane, D. J. (2016). Task-Specific Balance Training Improves the Sensory Organisation of Balance Control in Children with Developmental Coordination Disorder: A Randomised Controlled Trial. *Scientific reports*, 6(2045-2322 (Electronic)), 20945. <https://doi.org/10.1038/srep20945>
- Foster, A. (2024). *US Deaf History*. WordPress.com. Retrieved 14 December from <https://usdeafhistory.com/quotes/>
- Francis, D., & Webster, E. (2019). Poverty and inequality in South Africa: critical reflections. *Development Southern Africa*, 36(6), 788-802. <https://doi.org/10.1080/0376835X.2019.1666703>
- Gelfand, S. A. (2009). *Essentials of audiology* (3rd ed. ed.). Thieme. <http://catdir.loc.gov/catdir/enhancements/fy1009/2008054549-b.html>
- <http://catdir.loc.gov/catdir/enhancements/fy1002/2008054549-d.html>
- Genç, S. G., Budak, M., Yilmaz, M. S., & Algun, Z. C. (2023). Effects of structured exercise program on severity of dizziness, kinesiophobia, balance, fatigue, quality of sleep, activities of daily living, and quality of life in bilateral vestibular hypofunction. *Medicine*, 102(30). https://journals.lww.com/md-journal/fulltext/2023/07280/effects_of_structured_exercise_program_on_severity.22.aspx
- Gentili, N., & Holwell, A. (2011). Mental health in children with severe hearing impairment. *Advances in Psychiatric Treatment*, 17(1), 54-62. <https://doi.org/10.1192/apt.bp.109.006718>
- Ghaffar, E., huda, N., Fatima, S., Fatima, Q., Haider, M., Ain, N., Mazhar, F., ahmad, B., & Tariq, R. (2024). Prevalence of Balance Impairment in Children with Hearing Impairment: Balance Issues in Hearing-Impaired Children. *Journal of Health and Rehabilitation Research*, 4, 1-8. <https://doi.org/10.61919/jhrr.v4i3.1245>
- Ghai, S., Hakim, M., Dannenbaum, E., & Lamontagne, A. (2019). Prevalence of Vestibular Dysfunction in Children With Neurological Disabilities: A Systematic Review. *Front Neurol*, 10, 1294. <https://doi.org/10.3389/fneur.2019.01294>
- Gheysen, F., Loots G Fau - Van Waelvelde, H., & Van Waelvelde, H. (2008). Motor development of deaf children with and without cochlear implants. *Journal of deaf studies and deaf education*, 13(1081-4159 (Print)), 215–224. <https://doi.org/https://doi.org/10.1093/deafed/enm053>
- Godi, M., Franchignoni, F., Caligari, M., Giordano, A., Turcato, A. M., & Nardone, A. (2013). Comparison of reliability, validity, and responsiveness of the mini-BESTest and Berg Balance Scale in patients with balance disorders. *Phys Ther*, 93(2), 158-167. <https://doi.org/10.2522/ptj.20120171>
- Gogate, P., Bhusan, S., Ray, S., & Shinde, A. (2016). Impact of correcting visual impairment and low vision in deaf-mute students in Pune, India. *Indian journal of ophthalmology*, 64(1998-3689 (Electronic)), 898–903. <https://doi.org/https://doi.org/10.4103/0301-4738.198847>
- Goodwin, M. V., Hogervorst, E., & Maidment, D. W. (2024). Physical activity interventions for adults with hearing loss: a systematic review. *Speech, Language and Hearing*, 27(1), 32-42. <https://doi.org/10.1080/2050571X.2023.2222261>
- Gordon, T., Booysen, F., & Mbonigaba, J. (2020). Socio-economic inequalities in the multiple dimensions of access to healthcare: the case of South Africa. *BMC Public Health*, 20(1), 289. <https://doi.org/10.1186/s12889-020-8368-7>

- Graham, C., Gina, A., Seeley, J., & Saman, Y. (2023). Development of a questionnaire to assess mothers' knowledge, attitudes and practice with regard to childhood hearing loss and Universal Newborn Hearing Screening. *International Journal of Pediatric Otorhinolaryngology*, 165, 111449. <https://doi.org/https://doi.org/10.1016/j.ijporl.2023.111449>
- Gronski, M. (2013). Balance and motor deficits and the role of occupational therapy in children who are deaf and hard of hearing: A critical appraisal of the topic. *Journal of Occupational Therapy, Schools, & Early Intervention*, 6(4), 356-371.
- Gür, K., Kılınç, E., Günaydın, E., & Gülsün, H. (2021). The epidemiology of injury among adolescents with hearing loss, health beliefs regarding injury and associated factors. *Disability and Health Journal*, 14(2), 100994. <https://doi.org/https://doi.org/10.1016/j.dhjo.2020.100994>
- Hammer, L., Kamper, N. R., Jantzen, L., Serafin, S., & Percy-Smith, L. (2024). Self-reported social well-being of children with hearing loss in 2023. *Cochlear Implants International*, 25(3), 205-211. <https://doi.org/10.1080/14670100.2024.2347769>
- Hausdorff, J. M., Schweiger, A., Herman, T., Yogev-Seligmann, G., & Giladi, N. (2008). Dual-Task Decrements in Gait: Contributing Factors Among Healthy Older Adults. *The Journals of Gerontology: Series A*, 63(12), 1335-1343. <https://doi.org/10.1093/gerona/63.12.1335>
- Hayes, T. S., Hult, H., & Dahlgren, M. A. (2013). A phenomenographic approach to research in medical Education. *Medical Education*, 47, 261–270. <https://doi.org/10.1111/medu.12101>
- Hazen, M., & Cushing, L. S. (2020). Implications of Concurrent Vestibular Dysfunction in Pediatric Hearing Loss. *Current Otorhinolaryngology Reports*, 8, 267–275. <https://doi.org/https://doi.org/10.1007/s40136-020-00298-3>
- Guidelines for practice in a culturally and linguistically diverse South Africa., (2019). https://www.hpcs.co.za/Uploads/professional_boards/slh/guidelines/Guidelines_for_practice_in_a_culturally_and_linguistically_divers.pdf
- Hedayatjoo, M., Rezaee, M., Alizadeh Zarei, M., Mirzakhany, N., Nazeri, A., Akbarzadeh Baghban, A., Hedayatjoo, Z., & Mokhber Dezfoly, R. (2020). Effect of Balance Training on Balance Performance, Motor Coordination, and Attention in Children with Hearing Deficits [Research Article]. *Arch Neurosci*, 7(1), e84869. <https://doi.org/10.5812/ans.84869>
- Heinrichs-Graham, E., Walker, E. A., Eastman, J. A., Frenzel, M. R., Joe, T. R., & McCreery, R. W. (2021). The impact of mild-to-severe hearing loss on the neural dynamics serving verbal working memory processing in children. *NeuroImage : Clinical*, 30.
- Hill, M. W., Wdowski, M. M., Pennell, A., Stodden, D. F., & Duncan, M. J. (2019). Dynamic Postural Control in Children: Do the Arms Lend the Legs a Helping Hand? *Frontiers in physiology*, 9(1664-042X (Print)), 1932. <https://doi.org/10.3389/fphys.2018.01932>
- Hofman, K., & Madhi, S. (2020). The unanticipated costs of COVID-19 to South Africa's quadruple disease burden. *South African Medical Journal*, 110(8), 698- 699. <https://doi.org/10.7196/SAMJ.2020.v110i8.15125>
- Hollingsworth, R., Ludlow, A. K., Wilkins, A., Calver, R., & Allen, P. M. (2014). Visual performance and ocular abnormalities in deaf children and young adults: a literature review. *Acta Ophthalmologica*, 92(4), 305-310. <https://doi.org/https://doi.org/10.1111/aos.12302>
- Holt, R. F. (2019). Assistive Hearing Technology for Deaf and Hard-of-Hearing Spoken Language Learners. LID - 153 [pii] LID - 10.3390/educsci9020153 [doi]. *Education Sciences*, 9(2227-7102 (Print)), 153. <https://doi.org/10.3390/educsci9020153>
- Horn, D., Pisoni, D., & Miyamoto, R. (2006). Divergence of Fine and Gross Motor Skills in Prelingually Deaf Children: Implications for Cochlear Implantation. *The Laryngoscope*, 116, 1500-1506. <https://doi.org/10.1097/01.mlg.0000230404.84242.4c>
- Horn, L. B., Rice, T., Stoskus, J. L., Lambert, K. H., Dannenbaum, E., & Scherer, M. R. (2015). Measurement Characteristics and Clinical Utility of the Clinical Test of Sensory Interaction on Balance (CTSIB) and Modified CTSIB in Individuals With Vestibular Dysfunction. *Archives of Physical Medicine and Rehabilitation*, 96(9), 1747-1748. <https://doi.org/10.1016/j.apmr.2015.04.003>

- Horowitz, G., Ungar, O. J., Levit, Y., Himmelfarb, M., & Handzel, O. (2020). The impact of conductive hearing loss on balance. *Clin Otolaryngol*, 45(1), 106-110. <https://doi.org/10.1111/coa.13473>
- Howerton-Fox, A., & Falk, J. L. (2019). Deaf Children as 'English Learners': The Psycholinguistic Turn in Deaf Education. *Education Sciences*, 9(2).
- Humphrey-Murto, S., Varpio, L., Gonsalves, C., & Wood, T. J. (2017). Using consensus group methods such as Delphi and Nominal Group in medical education research*. *Medical Teacher*, 39(1), 14-19. <https://doi.org/10.1080/0142159X.2017.1245856>
- Hussein, S. Y., Swanepoel, D. W., Mahomed-Asmail, F., & de Jager, L. B. (2018). Hearing loss in preschool children from a low income South African community. *International Journal of Pediatric Otorhinolaryngology*, 115, 145-148. <https://doi.org/10.1016/j.ijporl.2018.09.032>
- ICF Research Branch. (2017). *ICF Core Sets Projects*. Retrieved 10 October from <https://www.icf-research-branch.org/icf-core-sets-projects2/other-health-conditions>
- In, J. (2017). Introduction of a pilot study. *Korean J Anesthesiol*, 70(6), 601-605. <https://doi.org/10.4097/kjae.2017.70.6.601>
- Ionescu, E., Reynard, P., Gouleme, N., Becaude, C., Spruyt, K., Ortega-Solis, J., & Thai-Van, H. (2020). How sacculo-collic function assessed by cervical vestibular evoked myogenic Potentials correlates with the quality of postural control in hearing impaired children? *Int J Pediatr Otorhinolaryngol*, 130, 109840. <https://doi.org/10.1016/j.ijporl.2019.109840>
- lucksch, D. A.-O., Siega, J. A.-O., Leveck, G. A.-O., de Araujo, L. A.-O., Mélo, T. A.-O., & Israel, V. A.-O. (2023). Improvement of Balance, Motor Aspects, and Activities of Daily Living in Parkinson's Disease after a Sequential Multimodal Aquatic- and Land-Based Intervention Program. *Rehabilitation research and practice*, 2023(2090-2867 (Print)), 2762863. <https://doi.org/10.1155/2023/2762863>
- Jacobson, G. P., & Newman, C. W. (1990). The development of the dizziness handicap inventory. *Archives of otolaryngology-head & neck surgery*, 116(4), 424-427.
- Jafarnezhadgero, A. A., Majlesi, M., & Azadian, E. (2017). Gait ground reaction force characteristics in deaf and hearing children. *Gait Posture*, 53, 236-240. <https://doi.org/10.1016/j.gaitpost.2017.02.006>
- Janky, K. L., & Givens, D. (2015). Vestibular, Visual Acuity, and Balance Outcomes in Children With Cochlear Implants: A Preliminary Report. *Ear and Hearing*, 36(6), E364-E372. <https://doi.org/10.1097/AUD.0000000000000194>
- Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. (2016). Toward a Definition of Mixed Methods Research. *Journal of Mixed Methods Research*, 1(2), 112-133. <https://doi.org/10.1177/1558689806298224>
- Joint Committee on Infant Hearing. (2019). Year 2019 Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs. *Journal of Early Hearing Detection and Intervention*, 4, 1-44. <https://doi.org/10.15142/fptk-b748>
- Kaga, K. (1999). Vestibular compensation in infants and children with congenital and acquired vestibular loss in both ears. *International Journal of Pediatric Otorhinolaryngology*, 49(3), 215-224. [https://doi.org/10.1016/S0165-5876\(99\)00206-2](https://doi.org/10.1016/S0165-5876(99)00206-2)
- Karakoc, K., & Mujdeci, B. (2021). Evaluation of balance in children with sensorineural hearing loss according to age. *Am J Otolaryngol*, 42(1), 102830. <https://doi.org/10.1016/j.amjoto.2020.102830>
- Kaur, P., Stoltzfus, J., & Yellapu, V. (2018). Descriptive statistics [Biostatistics]. *International Journal of Academic Medicine*, 4(1), 60-63. https://doi.org/10.4103/ijam.ijam_7_18
- Keller, H. (2024). Quotable Quote. Goodreads. Retrieved 14 December from <https://www.goodreads.com/quotes/391727-blindness-separates-people-from-things-deafness-separates-people-from-people>

- Kelly, A., Liu, Z., Leonard, S., Toner, F., Adams, M., & Toner, J. (2018). Balance in children following cochlear implantation. *Cochlear Implants Int*, 19(1), 22-25. <https://doi.org/10.1080/14670100.2017.1379180>
- Khoza-Shangase, K. (2021). "Confronting Realities to Early Hearing Detection in South Africa." In K. K.-S. a. A. Kanji (Ed.), *Early Detection and Intervention in Audiology: An African Perspective* (pp. 66–88). JSTOR. <https://doi.org/https://doi.org/10.18772/22021026567.10>
- Khoza-Shangase, K., Sebothoma, B., & Seedat, T. (2020). Vestibular assessment and management in adults: South African audiologists' expressed level of confidence and knowledge explored. *Hearing, Balance and Communication*, 18(1), 55-60. <https://doi.org/10.1080/21695717.2019.1630981>
- Kim, S. Y., Lim, J. S., Kong, I. G., & Choi, H. A.-O. (2018). Hearing impairment and the risk of neurodegenerative dementia: A longitudinal follow-up study using a national sample cohort. *Scientific reports*, 8(2045-2322 (Electronic)), 15266. <https://doi.org/10.1038/s41598-018-33325-x>
- King, L. A., Priest Kc Fau - Salarian, A., Salarian A Fau - Pierce, D., Pierce D Fau - Horak, F. B., & Horak, F. B. (2012). Comparing the Mini-BESTest with the Berg Balance Scale to Evaluate Balance Disorders in Parkinson's Disease. *Parkinson's disease*(2042-0080 (Electronic)), 375419.
- Kiragu, A. W., Dunlop, S. J., Mwarumba, N., Gidado, S., Adesina, A., Mwachiro, M., Gbadero, D. A., & Slusher, T. M. (2018). Pediatric Trauma Care in Low Resource Settings: Challenges, Opportunities, and Solutions. *Frontiers in pediatrics*, 6(2296-2360 (Print)), 155. <https://doi.org/10.3389/fped.2018.00155>
- Kiss, R., Schedler, S., & Muehlbauer, T. (2018). Associations Between Types of Balance Performance in Healthy Individuals Across the Lifespan: A Systematic Review and Meta-Analysis [Systematic Review]. *Frontiers in physiology*, 9. <https://doi.org/10.3389/fphys.2018.01366>
- Kjeldsberg, M., Tschudi-Madsen, H., Mdala, I., Bruusgaard, D., & Natvig, B. (2021). Patients in general practice share a common pattern of symptoms that is partly independent of the diagnosis. *Scandinavian journal of primary health care*, 39(1502-7724 (Electronic)), 184–193. <https://doi.org/10.1080/02813432.2021.1913886>
- Köhlo, M. D. K., Siebörger, I., & Bennett, W. G. (2017). A perfect end: A study of syllable codas in South African Sign Language. *Stellenbosch Papers in Linguistics Plus*, 52, 127-156. <https://doi.org/10.5842/52-0-727>
- Kooijmans, R., Langdon, P. E., & Moonen, X. (2022). Assisting children and youth with completing self-report instruments introduces bias: A mixed-method study that includes children and young people's views. *Methods in Psychology*, 7, 100102. <https://doi.org/https://doi.org/10.1016/j.metip.2022.100102>
- Kosmidou, P., Tzifas, S., Lygeros, S., Danielides, G., Nikolopoulos, T., Dimitriou, G., Angelis, S., & Naxakis, S. (2021). Newborn Hearing Screening: Analysing the Effectiveness of Early Detection of Neonatal Hearing Loss in a Hospital in Greece. *Cureus*, 13(2168-8184 (Print)), e19807. <https://doi.org/https://doi.org/10.7759/cureus.19807>
- Kowalewski, V., Patterson, R., Hartos, J., & Bugnariu, N. (2018). Hearing Loss Contributes to Balance Difficulties in both Younger and Older Adults. . *Journal of preventive medicine*, 3(2572-5483 (Electronic)), 12. <https://doi.org/10.21767/2572-5483.100033>
- Krajenbrink, H., Lust, J. M., Wilmut, K., & Steenbergen, B. (2023). Motor and cognitive dual-task performance under low and high task complexity in children with and without developmental coordination disorder. *Research in Developmental Disabilities*, 135, 104453. <https://doi.org/https://doi.org/10.1016/j.ridd.2023.104453>
- Kreimeier, S., & Greiner, W. (2019). EQ-5D-Y as a Health-Related Quality of Life Instrument for Children and Adolescents: The Instrument's Characteristics, Development, Current Use, and Challenges of Developing Its Value Set. *Value in Health*, 22(1), 31-37. <https://doi.org/https://doi.org/10.1016/j.jval.2018.11.001>

- Kritzinger, J., Schneider, M., Swartz, L., & Braathen, S. H. (2014). "I just answer 'yes' to everything they say": Access to health care for deaf people in Worcester, South Africa and the politics of exclusion. *Patient Education and Counseling*, 94(3), 379-383. <https://doi.org/https://doi.org/10.1016/j.pec.2013.12.006>
- Kuschke, S., Swanepoel, D. W., le Roux, T., & Strauss, S. (2020). Profile of childhood hearing loss in the Western Cape, South Africa. *International Journal of Pediatric Otorhinolaryngology*, 137, 110248. <https://doi.org/https://doi.org/10.1016/j.ijporl.2020.110248>
- Kwak, S. (2023). Are Only p-Values Less Than 0.05 Significant? A p-Value Greater Than 0.05 Is Also Significant! *Journal of lipid and atherosclerosis*, 12(2287-2892 (Print)), 89–95. <https://doi.org/https://doi.org/10.12997/jla.2023.12.2.89>
- Lage, J., Silva, L., Borges, M., Nascentes, G., Ferreira, I., Teixeira, V., & Espindula, A. P. (2021). Assessment of functional balance in children with sensory impairments undergoing hippotherapy. *REVISTA CIÊNCIAS EM SAÚDE*, 11, 51-58. <https://doi.org/10.21876/rcshci.v11i2.1072>
- Lalla-Edward, S. T., Mosam, A., Hove, J., Erzse, A., Rwafa-Ponela, T., Price, J., Nyatela, A., Nqakala, S., Kahn, K., Tollman, S., Hofman, K., & Goldstein, S. (2022). Essential health services delivery in South Africa during COVID-19: Community and healthcare worker perspectives. *Frontiers in public health*, 10(2296-2565 (Electronic)), 992481. <https://doi.org/10.3389/fpubh.2022.992481>
- Lane, J., Andrews, G., Orange, E., Brezak, A., Tanna, G., Lebesse, L., Carter, T., Naidoo, E., Levendal, E., & Katz, A. (2020). Strengthening health policy development and management systems in low- and middle- income countries: South Africa's approach. *Health Policy OPEN*, 1, 100010. <https://doi.org/https://doi.org/10.1016/j.hlopen.2020.100010>
- Larson, R. B. (2018). Controlling social desirability bias. *International Journal of Market Research*, 61(5), 534-547. <https://doi.org/10.1177/1470785318805305>
- Lawrence, P. R., Feinberg, I., & Spratling, R. (2021). The Relationship of Parental Health Literacy to Health Outcomes of Children with Medical Complexity. *Journal of Pediatric Nursing*, 60, 65-70. <https://doi.org/https://doi.org/10.1016/j.pedn.2021.02.014>
- Le May, S., Ballard, A., Khadra, C., Gouin, S., Plint, A. C., Villeneuve, E., Mâsse, B., Tsze, D. S., Neto, G., Drendel, A. L., Auclair, M.-C., McGrath, P. J., & Ali, S. (2018). Comparison of the psychometric properties of 3 pain scales used in the pediatric emergency department: Visual Analogue Scale, Faces Pain Scale-Revised, and Colour Analogue Scale. *PAIN*, 159(8). https://journals.lww.com/pain/fulltext/2018/08000/comparison_of_the_psychometric_properties_of_3.10.aspx
- le Roux, M. (2024). *I never thought someone like me could become Miss South Africa*. BBC. <https://www.bbc.com/news/videos/cly87r4659do>
- Li, C. M., Hoffman, H. J., Ward, B. K., Cohen, H. S., & Rine, R. M. (2016). Epidemiology of Dizziness and Balance Problems in Children in the United States: A Population-Based Study. *J Pediatr*, 171, 240-247 e241-243. <https://doi.org/10.1016/j.jpeds.2015.12.002>
- Lieberman, L. J., Volding L Fau - Winnick, J. P., & Winnick, J. P. (2004). Comparing motor development of deaf children of deaf parents and deaf children of hearing parents. *American annals of the deaf*, 149(0002-726X (Print)), 281–289. <https://doi.org/https://doi.org/10.1353/aad.2004.0027>
- Lillo-Martin, D. C., & Gajewski, J. (2014). One grammar or two? Sign Languages and the Nature of Human Language. *Wiley interdisciplinary reviews. Cognitive science*, 5(1939-5086 (Electronic)), 387–401. <https://doi.org/https://doi.org/10.1002/wcs.1297>
- Lin, F. R., Metter, E. J., O'Brien, R. J., Resnick, S. M., Zonderman, A. B., & Ferrucci, L. (2011). Hearing loss and incident dementia. *Archives of neurology*, 68(2), 214-220.
- Liu, H., Liu, H.-X., Kang, H.-Y., Gu, Z., & Hong, S.-L. (2016). Evaluation on health-related quality of life in deaf children with cochlear implant in China. *International Journal of Pediatric*

- <https://doi.org/https://doi.org/10.1016/j.ijporl.2016.06.027>
- London, L., Zweigenthal, V., & Heapi, M. (2020). Ensuring equal access to health services for the Deaf in South Africa. *South African Health Review*, 2020. <https://doi.org/https://hdl.handle.net/10520/ejc-healthr-v2020-n1-a22>
- Lopes, L. K. R., Scianni, A. A., Lima, L. O., de Carvalho Lana, R., & Rodrigues-De-Paula, F. (2020). The Mini-BESTest is an independent predictor of falls in Parkinson Disease [10.1016/j.bjpt.2019.07.006]. *Brazilian Journal of Physical Therapy*, 24(5), 433-440. <https://doi.org/10.1016/j.bjpt.2019.07.006>
- Lotfi, Y., Javanbakht, M., Sayaf, M., & Bakhshi, E. (2018). Modified clinical test of sensory interaction on balance test use for assessing effectiveness of Epley maneuver in benign paroxysmal positional vertigo patients rehabilitation. *Aud Vest Res* 27(1), 12 - 18.
- Louw, C., Swanepoel, D. W., Eikelboom, R. H., & Hugo, J. (2018). Prevalence of hearing loss at primary health care clinics in South Africa. *African health sciences*, 18(2), 313- 320 <https://doi.org/10.4314/ahs.v18i2.16>
- Lundin-Olsson, L., Nyberg, L., & Gustafson, Y. (1998). Attention, Frailty, and Falls: The Effect of a Manual Task on Basic Mobility. *Journal of the American Geriatrics Society*, 46(6), 758-761. <https://doi.org/https://doi.org/10.1111/j.1532-5415.1998.tb03813.x>
- Magnani, P. E., Genovez, M. B., Porto, J. M., Zanellato, N. F. G., Alvarenga, I. C., Freire, R. C., Jr., & de Abreu, D. C. C. (2020). Use of the BESTest and the Mini-BESTest for Fall Risk Prediction in Community-Dwelling Older Adults Between 60 and 102 Years of Age. *Journal of Geriatric Physical Therapy*, 43(4). https://journals.lww.com/jgpt/fulltext/2020/10000/use_of_the_bestest_and_the_mini_best_test_for_fall.3.aspx
- Magnani, P. E., Porto, J. M., Genovez, M. B., Zanellato, N. F. G., Alvarenga, I. C., dos Santos, P. F., & de Abreu, D. C. C. (2021). What is the best clinical assessment tool for identification of adults aged ≥80 years at high risk of falls? *Physiotherapy*, 110, 63-69. <https://doi.org/https://doi.org/10.1016/j.physio.2020.03.002>
- Mahafza, M. A.-O., Wilson, W. A.-O., Brauer, S., Timmer, B. H. B., & Hickson, L. (2022). A Systematic Review of the Effect of Hearing Aids on Static and Dynamic Balance in Adults with Hearing Impairment. *Trends in hearing*, 26(2331-2165 (Electronic)), 23312165221121014. <https://doi.org/10.1177/23312165221121014>
- Mahakwe, G., Johnson, E. A.-O., Karlsson, K. A.-O., & Nilsson, S. A.-O. (2021). A Systematic Review of Self-Report Instruments for the Measurement of Anxiety in Hospitalized Children with Cancer. *International journal of environmental research and public health*, 18(1660-4601 (Electronic)), 1911. <https://doi.org/https://doi.org/10.3390/ijerph18041911>
- Mankowski, N. L., & Raggio, B. S. (2021). *Otoscope Exam*. StatPearls Publishing LLC.
- Marnewick, C., & Bekker, G. (2022). Projectification within a developing country: The case of South Africa. *Journal of Contemporary Management*, 19(1), 362-380. <https://doi.org/10.35683/jcm21047.151>
- Marsden, J., Stevens, S., & Ebri, A. (2014). How to measure distance visual acuity. *Community eye health*, 27(85), 16.
- Martens, S., Dhooge, I., Dhondt, C., Vanaudenaerde, S., Sucaet, M., Rombaut, L., Boudewyns, A., Desloovere, C., Janssens de Varebeke, S., Vinck, A. S., Vanspauwen, R., Verschueren, D., Foulon, I., Staelens, C., Van den Broeck, K., De Valck, C., Deggouj, N., Lemkens, N., Haverbeke, L., . . . Maes, L. (2020). Vestibular Infant Screening (VIS)-Flanders: results after 1.5 years of vestibular screening in hearing-impaired children. *Scientific reports*, 10(2045-2322 (Electronic)), 21011. <https://doi.org/https://doi.org/10.1038/s41598-020-78049-z>
- Martens, S., Dhooge, I., Dhondt, C., Vanaudenaerde, S., Sucaet, M., Rombaut, L., & Maes, L. (2023). Pediatric Vestibular Assessment: Clinical Framework. *Ear and Hearing*, 44(1538-4667 (Electronic)), 423–436. <https://doi.org/https://doi.org/10.1097/AUD.0000000000001303>

- Martens, S., Maes, L., Dhondt, C., Vanaudenaerde, S., Sucaet, M., De Leenheer, E., Van Hoecke, H., Van Hecke, R., Rombaut, L., & Dhooge, I. (2023). Vestibular Infant Screening-Flanders: What is the Most Appropriate Vestibular Screening Tool in Hearing-Impaired Children? *Ear and Hearing*, 44(1538-4667 (Electronic)), 385–398. <https://doi.org/https://doi.org/10.1097/AUD.0000000000001290>
- Martin, W., Jelsma, J., & Rogers, C. (2012). Motor proficiency and dynamic visual acuity in children with bilateral sensorineural hearing loss. *International Journal of Pediatric Otorhinolaryngology*, 76(10), 1520-1525. <https://doi.org/10.1016/j.ijporl.2012.07.007>
- Martin, W., Pauly, B., & MacDonald, M. (2016). Situational Analysis for Complex Systems: Methodological Development in Public Health Research. *AIMS public health*, 3(2327-8994 (Print)), 94–109. <https://doi.org/10.3934/publichealth.2016.1.94>
- Martinez-Mesa, J., Gonzalez-Chica, D. A., Duquia, R. P., Bonamigo, R. R., & Bastos, J. L. (2016). Sampling: how to select participants in my research study? *An Bras Dermatol*, 91(3), 326-330. <https://doi.org/10.1590/abd1806-4841.20165254>
- Mason, T. C. (2005). Cross-cultural instrument translation: assessment, translation, and statistical applications. *American annals of the deaf*, 150(0002-726X (Print)), 67- 72. <https://doi.org/https://doi.org/10.1353/aad.2005.0020>
- Mawani, I. K., & Chiluba, B. C. (2020). Assessment of Non Communicable Diseases Awareness Among Pupils with hearing impairment at Munali High School in Lusaka, Zambia. *Indonesian Journal of Disability Studies*, 7(1), 19-27. <https://doi.org/10.21776/ub.ijds.2019.007.01.3>
- Mazaheryazdi, M., Moossavi, A., Sarrafzadah, J., Talebian, S., & Jalaie, S. (2017). Study of the effects of hearing on static and dynamic postural function in children using cochlear implants. *Int. J. Pediatr. Otorhinolaryngol.*, 100, 18-22. <https://doi.org/10.1016/j.ijporl.2017.06.002>
- McKinney, E. L., McKinney V Fau - Swartz, L., & Swartz, L. (2021). Access to healthcare for people with disabilities in South Africa: Bad at any time, worse during COVID-19? *South African family practice : official journal of the South African Academy of Family Practice/Primary Care*, 63(2078-6204 (Electronic)), e1–e5. <https://doi.org/10.4102/safp.v63i1.5226>
- McKown, S., Acquadro, C., Anfray, C., Arnold, B., Eremenco, S., Giroudet, C., Martin, M., & Weiss, D. (2020). Good practices for the translation, cultural adaptation, and linguistic validation of clinician-reported outcome, observer-reported outcome, and performance outcome measures. *Journal of Patient-Reported Outcomes*, 4(1), 89. <https://doi.org/10.1186/s41687-020-00248-z>
- McPhillips, M. (2015). Motor difficulties and mental health in children who are deaf. *Developmental Medicine & Child Neurology*, 57(10), 893-894. <https://doi.org/https://doi.org/10.1111/dmcn.12831>
- Melo, Lemos, A., Raposo, M. C. F., Belian, R. B., & Ferraz, K. M. (2018). Balance performance of children and adolescents with sensorineural hearing loss: Repercussions of hearing loss degrees and etiological factors. *Int J Pediatr Otorhinolaryngol*, 110, 16-21. <https://doi.org/10.1016/j.ijporl.2018.04.016>
- Melo, R. D., Marinho, S. E. D., Freire, M. E. A., Souza, R. A., Damasceno, H. A. M., & Raposo, M. C. F. (2017). Static and dynamic balance of children and adolescents with sensorineural hearing loss. *EINSTEIN-SAO PAULO*, 15(3), 262-268. <https://doi.org/10.1590/S1679-45082017AO3976>
- Melo, R. S. (2024). How to Help Deaf Children Who Do Not Understand Their Vestibular Symptoms and Motor Disorders as Abnormal? *J Audiol Otol*, 28(4), 314-317. <https://doi.org/10.7874/jao.2024.00045>
- Melo, R. S., Lemos, A., Cristina, M., Raposo, F., Monteiro, M. G., Lambertz, D., Mônica Ferraz, K., & Melo, R. S. (2021). Title: Repercussions of the Degrees of Hearing Loss and Vestibular Dysfunction on the Static Balance of Children With Sensorineural Hearing Loss RUNNING HEAD: Balance Stability of Children With SNHL TOC CATEGORY: Pediatrics. *Makgatho Health Sciences University user on*, 26. <https://doi.org/10.1093/ptj/pzab177/6322542>

- Melo, R. S., Lemos, A., Macky, C. F. S. T., Raposo, M. C. F., & Ferraz, K. M. (2015). Postural control assessment in students with normal hearing and sensorineural hearing loss. *Brazilian journal of otorhinolaryngology*, 81(4), 431-438. <https://doi.org/10.1016/j.bjorl.2014.08.014>
- Melo, R. S., Lemos, A., Paiva, G. S., Ithamar, L., Lima, M. C., Eickmann, S. H., Ferraz, K. M., & Belian, R. B. (2019). Vestibular rehabilitation exercises programs to improve the postural control, balance and gait of children with sensorineural hearing loss: A systematic review. *Int J Pediatr Otorhinolaryngol*, 127, 109650. <https://doi.org/10.1016/j.ijporl.2019.109650>
- Melo, R. S., Lemos, A., Wiesiolek, C. C., Soares, L. G., Raposo, M. C., Lambertz, D., Belian, R. B., & Ferraz, K. M. (2024). Postural Sway Velocity of Deaf Children with and without Vestibular Dysfunction. *Sensors*, 24(12).
- Metsing, T. I., Hansraj, R., & Jacobs, W. (2020). Comparison of the Snellen and Spectrum LogMAR visual acuity charts in schoolgoing children. *African Vision and Eye Health; Vol 79, No 1 (2020)DO - 10.4102/aveh.v79i1.531*. <https://avehjournal.org/index.php/aveh/article/view/531/1273>
- Meyer, C., Grenness, C., Scarinci, N., & Hickson, L. (2016). What Is the International Classification of Functioning, Disability and Health and Why Is It Relevant to Audiology? *Semin Hear*, 37(3), 163-186. <https://doi.org/10.1055/s-0036-1584412>
- Middleton, A., Fritz, S. L., & Lusardi, M. (2015). Walking Speed: The Functional Vital Sign. *Journal of Aging and Physical Activity*, 23(2), 314-322. <https://doi.org/10.1123/japa.2013-0236>
- Miller, E. L., Jilla, A. M., & Arnold, M. L. (2022). Defining Audiology through Occupational and Health Policy Action. *Seminars in hearing*, 43(0734-0451 (Print)), 3 - 12. <https://doi.org/https://doi.org/10.1055/s-0042-1743123>
- Mishra, P., Pandey, C. M., Singh, U., Gupta, A., Sahu, C., & Keshri, A. (2019). Descriptive statistics and normality tests for statistical data. *Annals of cardiac anaesthesia*, 22(0974-5181 (Electronic)), 67- 72. https://doi.org/https://doi.org/10.4103/aca.ACA_157_18
- Möhring, W., Klupp, S., Zumbrennen, R., Segerer, R., Schaefer, S., & Grob, A. (2021). Age-related changes in children's cognitive-motor dual tasking: Evidence from a large cross-sectional sample. *Journal of Experimental Child Psychology*, 206, 105103. <https://doi.org/https://doi.org/10.1016/j.jecp.2021.105103>
- Moon, J. R., & Falick Ascher, A. (2021). Post-COVID-19 Health Care System: A Call for Community-Based, Person-Centered, and Primary Care-Driven Care. *American journal of public health*, 111(1541-0048 (Electronic)), 1451-1455. <https://doi.org/10.2105/AJPH.2021.306160>
- Morita, H., Kaji, H., Ueta, Y., & Abe, C. (2020). Understanding vestibular-related physiological functions could provide clues on adapting to a new gravitational environment. *J Physiol Sci*, 70(1), 17. <https://doi.org/10.1186/s12576-020-00744-3>
- Mueller, M., Schuster, E., Strobl, R., & Grill, E. (2012). Identification of aspects of functioning, disability and health relevant to patients experiencing vertigo: a qualitative study using the international classification of functioning, disability and health. *Health and Quality of Life Outcomes*, 10(1), 75. <https://doi.org/10.1186/1477-7525-10-75>
- Mulwafu, W., Kuper, H., & Ensink, R. J. (2016). Prevalence and causes of hearing impairment in Africa. *Trop Med Int Health*, 21(2), 158-165. <https://doi.org/10.1111/tmi.12640>
- Nahm, F. S. (2022). Receiver operating characteristic curve: overview and practical use for clinicians. *Korean journal of anesthesiology*, 75(2005-7563 (Electronic)), 25-36. <https://doi.org/https://doi.org/10.4097/kja.21209>
- Naidoo, N., & Khan, N. B. (2022). Analysis of barriers and facilitators to early hearing detection and intervention in KwaZulu-Natal, South Africa. *South African Journal of Communication Disorders; Vol 69, No 1 (2022)DO - 10.4102/sajcd.v69i1.839*. <https://sajcd.org.za/index.php/sajcd/article/view/839>
- Nascimento, L., Rodrigues, A., Joventino, E., Vieira, N. F., Pinheiro, P., & Ximenes, L. (2015). Validation of Educational Video to Promote Self-Efficacy in Preventing Childhood Diarrhea. *Health*, 07, 192-200. <https://doi.org/10.4236/health.2015.72022>

- National Department of Health. (2023). *Standard Treatment Guidelines and Essential Medicines List for South Africa*. T. N. D. o. Health. <https://knowledgehub.health.gov.za/elibrary/paediatric-hospital-level-stgs-and-eml-5th-edition-2023>
- National Institute for the Deaf. (2022). *What you need to know about Deaf culture!* Retrieved 05 September from <https://nid.org.za/news/what-you-need-to-know-about-deaf-culture/>
- Ndebele, M. (2015). Socio-economic factors affecting parents' involvement in homework: Practices and perceptions from eight Johannesburg public primary schools. *Perspectives in Education*, 33(3), 72 -91.
- Neumann, K., Chadha, S., Tavartkiladze, G., Bu, X., & White, K. R. (2019). Newborn and Infant Hearing Screening Facing Globally Growing Numbers of People Suffering from Disabling Hearing Loss. 5, 1(2409-515X (Electronic)), 7. <https://doi.org/International> journal of neonatal screening
- Niemensivu, R., Roine, R. P., Sintonen, H., & Kentala, E. (2018). Health-related quality of life in hearing-impaired adolescents and children. *Acta Oto-Laryngologica*, 138(7), 652-658. <https://doi.org/10.1080/00016489.2018.1438661>
- Nunes-Araújo, A. D. d. S., Balen, S. A., Pereira Junior, A., & Barbosa, I. R. (2021). Hearing screening in schoolchildren: accuracy of different criteria used to analyze transient evoked otoacoustic emissions. *Revista CEFAC*, 23.
- Nunes, A., Balen, S., Pereira, A., & Barbosa, I. (2021). Hearing screening in schoolchildren: accuracy of different criteria used to analyze transient evoked otoacoustic emissions. *Revista CEFAC*, 1, 1. <https://doi.org/10.1590/1982-0216/20212362021>
- O'Hoski, S., Sibley, K. M., Brooks, D., & Beauchamp, M. K. (2015). Construct validity of the BESTest, mini-BESTest and briefBESTest in adults aged 50 years and older. *Gait & Posture*, 42(3), 301-305. <https://doi.org/https://doi.org/10.1016/j.gaitpost.2015.06.006>
- Okur, E. O., Arik, M. I., Okur, I., Gokpinar, H. H., & Gunel, M. K. (2022). Dual-task training effect on gait parameters in children with spastic diplegic cerebral palsy: Preliminary results of a self-controlled study. *Gait & Posture*, 94, 45-50. <https://doi.org/https://doi.org/10.1016/j.gaitpost.2022.02.020>
- Oliveira, M., Fernandes, A., & Sawada, N. (2008). Educational handbook for self care in women with mastectomies: a validation study. *Texto & Contexto - Enfermagem*, 17, 115-123.
- Onusko, E. (2004). Tympanometry. *American Family Physician* 70(9), 1713 - 1720.
- Orendorz-Frączkowska, K., & Kubacka, M. (2019). The development of postural control in 6-17 old years healthy children. Part I Postural control evaluation in modified Clinical Test for The Sensory Interaction on Balance in 6-17 old year children (mctsib). *The Polish otolaryngology*, 74(2300-8423 (Electronic)), 1- 7. <https://doi.org/10.5604/01.3001.0013.2965>
- Ostadimoghaddam, H., Mirhajian, H., Yekta, A., Sobhani Rad, D., Heravian, J., Malekifar, A., & Khabazkhoob, M. (2015). Eye problems in children with hearing impairment. *Journal of Current Ophthalmology*, 27(1), 56-59. <https://doi.org/https://doi.org/10.1016/j.joco.2015.10.001>
- Overgaard, K. R., Oerbeck, B., Wagner, K., Friis, S., Øhre, B., & Zeiner, P. (2021). Youth with hearing loss: Emotional and behavioral problems and quality of life. *International Journal of Pediatric Otorhinolaryngology*, 145, 110718. <https://doi.org/https://doi.org/10.1016/j.ijporl.2021.110718>
- Ozolins, U., Hale, S., Cheng, S. X., Hyatt, A., & Schofield, P. (2020). Translation and back-translation methodology in health research - a critique. *Expert Review of Pharmacoeconomics & Outcomes Research*, 20. <https://doi.org/10.1080/14737167.2020.1734453>
- Panteli, D., Legido-Quigley, H., Reichebner, C., Ollenschläger, G., Schaefer, C., & Busse, R. (2019). Clinical Practice Guidelines as a quality strategy. In (pp. 233-264).
- Pascoe, M., Mahura, O., & Dean, J. (2020). Health resources for South Africa: A scoping review. *Health SA Gesondheid*, 25(0). <https://doi.org/10.4102/hsag.v25i0.1378>
- Patel, H., Malawade, M., Butte-Patil, S., Khairnar, P., Gawade, S., & Student, I. (2017). *Comparison of balance in children with and without hearing impairment*. www.ijhbr.com

- Paudel, S., Bhandari, L., & Bhandari, D. B. (2017). Disability: A Case Screening Program Approach. *Journal of Biosciences and Medicines*, Vol.05No.02, 12, Article 74009. <https://doi.org/10.4236/jbm.2017.52002>
- Pavlou, M., Whitney, S., Alkathiry, A. A., Huett, M., Luxon, L. M., Raglan, E., Godfrey, E. L., & Eva-Bamiou, D. (2016). The Pediatric Vestibular Symptom Questionnaire: A Validation Study. *J Pediatr*, 168, 171-177 e171. <https://doi.org/10.1016/j.jpeds.2015.09.075>
- Pehera, N. K., Khanna, R. C., Marlapati, R., & Sannapaneni, K. (2019). Prevalence of ophthalmic disorders among hearing-impaired school children in Guntur district of Andhra Pradesh. *Indian journal of ophthalmology*, 67(4). https://journals.lww.com/ijo/fulltext/2019/67040/prevalence_of_ophthalmic_disorders_among.18.aspx
- Pendergrass, K. M., Newman, S. D., Jones, E., & Jenkins, C. H. (2019). Deaf: A Concept Analysis From a Cultural Perspective Using the Wilson Method of Concept Analysis Development. *Clin Nurs Res*, 28(1), 79-93. <https://doi.org/10.1177/1054773817719821>
- Perreault, M., Haibach-Beach, P., Lieberman, L., & Foster, E. (2020). Relationship Between Motor Skills, Balance, and Physical Activity in Children with CHARGE Syndrome. *Journal of Visual Impairment & Blindness*, 114(4), 315-324. <https://doi.org/10.1177/0145482X20939469>
- Peters, B. T., Mulavara Ap Fau - Cohen, H. S., Cohen Hs Fau - Sangi-Haghpeykar, H., Sangi-Haghpeykar H Fau - Bloomberg, J. J., & Bloomberg, J. J. (2012). Dynamic visual acuity testing for screening patients with vestibular impairments. *Journal of vestibular research : equilibrium & orientation*, 22(1878-6464 (Electronic)), 145–151. <https://doi.org/10.3233/VES-2012-0440>
- Pillay, M., Tiwari, R., Kathard, H., & Chikte, U. (2020). Sustainable workforce: South African Audiologists and Speech Therapists. *Human Resources for Health*, 18(1), 47. <https://doi.org/10.1186/s12960-020-00488-6>
- Pinquart, M. (2020). Health-Related Quality of Life of Young People With and Without Chronic Conditions. *Journal of pediatric psychology*, 45(7), 780-792. <https://doi.org/10.1093/jpepsy/jsaa052>
- Pontecorvo, E. A.-O., Higgins, M., Mora, J., Lieberman, A. M., Pyers, J., & Caselli, N. K. (2023). Learning a Sign Language Does Not Hinder Acquisition of a Spoken Language. *Journal of speech, language, and hearing research : JSLHR*, 66(1558-9102 (Electronic)), 1291–1308. https://doi.org/https://doi.org/10.1044/2022_JSLHR-22-00505
- Qiu, W. W., Stucker, F. J., & Welsh, L. W. (1998). Clinical interpretations of transient otoacoustic emissions. *American Journal of Otolaryngology*, 19(6), 370-378. [https://doi.org/https://doi.org/10.1016/S0196-0709\(98\)90039-4](https://doi.org/https://doi.org/10.1016/S0196-0709(98)90039-4)
- Quevedo, L., Aznar-Casanova, J. A., & Silva, J. A. d. (2018). Agudeza Visual Dinámica. *Trends in Psychology*, 26.
- Raj, P., & Gupta, A. (2017). Vestibular Dysfunction in Children with Sensorineural Hearing Loss: A Cross-sectional Study. *Indian Journal of Otolaryngology* 23, 74-77. https://doi.org/10.4103/indianjotol.INDIANJOTOL_76_16
- Rajendran, V., & Roy, F. G. (2010). Comparison of health related quality of life of primary school deaf children with and without motor impairment. *Italian journal of pediatrics*, 36(1824-7288 (Electronic)), 75.
- Rajendran, V., & Roy, F. G. (2011). An overview of motor skill performance and balance in hearing impaired children. *Italian Journal of Pediatrics* 37(33).
- Ramazanzadeh, N., Ghahramanian, A., Zamanzadeh, V., Onyeka, T. C., Valizadeh, L., & Ghaffarifar, S. (2023). Translation, cross-cultural adaptation and evaluation of the Iranian Persian version of student survey on writing nursing care plan. *Nursing Open*, 10(8), 5476-5484. <https://doi.org/https://doi.org/10.1002/nop2.1786>
- Rasesemola, R. M., Matshoge Gp Fau - Ramukumba, T. S., & Ramukumba, T. S. (2019). Compliance to the Integrated School Health Policy: Intersectoral and multisectoral collaboration. *Curationis*, 42(2223-6279 (Electronic)), e1–e8. <https://doi.org/10.4102/curationis.v42i1.1912>

- Resende, L. M., Ferreira Jdos, S., Carvalho, S. A., Oliveira, I. S., & Bassi, I. B. (2012). Tympanometry with 226 and 1000 Hertz tone probes in infants. *Braz J Otorhinolaryngol*, 78(1), 95-102. <https://doi.org/10.1590/s1808-86942012000100015>
- Revicki, D. A., Kleinman, L., & Cella, D. (2014). A history of health-related quality of life outcomes in psychiatry. *Dialogues in clinical neuroscience*, 16(1958-5969 (Electronic)), 127–135. <https://doi.org/https://doi.org/10.31887/DCNS.2014.16.2/drevicki>
- Reynard, P., Ortega-Solís, J., Tronche, S., Darrouzet, V., & Thai-Van, H. (2024). Guidelines of the French Society of Otorhinolaryngology and Head and Neck Surgery (SFORL) for vestibular rehabilitation in children with vestibular dysfunction. A systematic review. *Archives de Pédiatrie*, 31(4), 217-223. <https://doi.org/https://doi.org/10.1016/j.arcped.2024.02.006>
- Rhee, H., Belyea, M., & Mammen, J. (2017). Visual analogue scale (VAS) as a monitoring tool for daily changes in asthma symptoms in adolescents: a prospective study. *Allergy, Asthma & Clinical Immunology*, 13(1), 24. <https://doi.org/10.1186/s13223-017-0196-7>
- Rigal, T., Parodi, M., Brisse, F., Denoyelle, F., Loundon, N., & Simon, F. (2024). Translation and validation of the PVSQ and DHI-PC questionnaires for pediatric dizziness. *European annals of otorhinolaryngology, head and neck diseases*, 141(1), 5-12. <https://doi.org/10.1016/J.ANORL.2023.05.001>
- Rine, R. M. (2018). Contemporary Concepts in Pediatric Vestibular Assessment and Management: Vestibular Rehabilitation for Children
- Seminars in hearing*, 39(3), 334– 344. <https://doi.org/10.1055/s-0038-1666822>
- Rine, R. M., & Braswell, J. (2003). A clinical test of dynamic visual acuity for children. *International Journal of Pediatric Otorhinolaryngology*, 67(11), 1195-1201. <https://doi.org/https://doi.org/10.1016/j.ijporl.2003.07.004>
- Rine, R. M., Braswell, J., Fisher, D., Joyce, K., Kalar, K., & Shaffer, M. (2004). Improvement of motor development and postural control following intervention in children with sensorineural hearing loss and vestibular impairment. *International Journal of Pediatric Otorhinolaryngology*, 68(9), 1141-1148. <https://doi.org/10.1016/j.ijporl.2004.04.007>
- Rine, R. M., & Wiener-Vacher, S. (2013). Evaluation and treatment of vestibular dysfunction in children. *NeuroRehabilitation*, 32, 507-518. <https://doi.org/10.3233/NRE-130873>
- Rogers, C. (2024). International Pediatric Balance Network. In S. Mbhele (Ed.). South Africa.
- Roksandic, I., Pavkovic, I. M., & Kovačević, J. (2018). THE CHARACTERISTICS OF BEHAVIOR OF DEAF AND HARD-OF-HEARING LEARNERS IN DIFFERENT TYPES OF SCHOOL ENVIRONMENT. *Journal Human Research in Rehabilitation*.
- Rutka, M., & Palac, M. (2020). Reproducibility of the Kids Balance Evaluation Systems Test (KidsBESTest) and Mini Kids-BESTest for children with Down syndrome. *Physiotherapy and Health Activity*, 28, 22- 29. <https://doi.org/10.32087/pha-2020-0004>
- Sadri, F., Sadri, I., Krneta, Ž., Trbojević Jocić, J., & Batez, M. (2021). Relationship between cognitive abilities and manual coordination and balance in preschool children. *Exercise and Quality of Life*, 13(1), 31-38. <https://doi.org/10.31382/eqol.210604>
- Said, E. A. F. (2013). Clinical balance tests for evaluation of balance dysfunction in children with sensorineural hearing loss. *The Egyptian Journal of Otolaryngology*, 29(3), 189-201.
- Salvador-Carulla, L., & Garcia-Gutierrez, C. (2011). The WHO construct of health-related functioning (HrF) and its implications for health policy. *BMC Public Health*, 11(4), S9. <https://doi.org/10.1186/1471-2458-11-S4-S9>
- Salvador-Carulla, L., Lucas, R., Ayuso-Mateos, J. L., & Miret, M. (2014). Use of the terms "Wellbeing" and "Quality of Life" in health sciences: a conceptual framework. *The European Journal of Psychiatry*, 28, 50-65. http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S0213-61632014000100005&nrm=iso
- Schedler, S., Abeck, E., & Muehlbauer, T. (2021). Relationships between types of balance performance in healthy individuals: Role of age. *Gait & Posture*, 84, 352-356. <https://doi.org/https://doi.org/10.1016/j.gaitpost.2021.01.008>

- Schlumberger, E., Narbona, J., & Manrique, M. (2004). Non-verbal development of children with deafness with and without cochlear implants. *Developmental Medicine & Child Neurology*, 46(9), 599-606. <https://doi.org/https://doi.org/10.1111/j.1469-8749.2004.tb01023.x>
- Schwebel, D. C., & Brezaussek, C. M. (2010). Brief report: unintentional injury risk among children with sensory impairments. *Journal of pediatric psychology*, 35(1), 45-50.
- Seedat, T., Khoza-Shangase, K., & Sebothoma, B. (2018). Vestibular assessment and management in adults: current practice by South African audiologists. *Hearing, Balance and Communication*, 16, 1-13. <https://doi.org/10.1080/21695717.2018.1463757>
- Seleka, H. A., & Masoabi, C. S. (2024). Educators' perspective on parental involvement in homework at a rural primary school in Palala. *South African Journal of Childhood Education; Vol 14, No 1 (2024)DO - 10.4102/sajce.v14i1.1586*. <https://sajce.co.za/index.php/sajce/article/view/1586>
- Sember, V., Grošelj, J., & Pajek, M. A.-O. (2020). Balance Tests in Pre-Adolescent Children: Retest Reliability, Construct Validity, and Relative Ability. LID - 10.3390/ijerph17155474 [doi] LID - 5474. *International journal of environmental research and public health*, 17(1660-4601 (Electronic)), 5474. <https://doi.org/10.3390/ijerph17155474>
- Senekal, M., Seme, Z., de Villiers, A., & Steyn, N. P. (2015). Health status of primary school educators in low socio-economic areas in South Africa. *BMC Public Health*, 15(1), 186. <https://doi.org/10.1186/s12889-015-1531-x>
- Sewpersad, V. (2014). Co-morbidities of hearing loss and occupational therapy in preschool children. *South African Journal of Occupational Therapy*, 44(2), 28-32.
- Sharma, S. D., Cushing, S. L., Papsin, B. C., & Gordon, K. A. (2020). Hearing and speech benefits of cochlear implantation in children: A review of the literature. *International Journal of Pediatric Otorhinolaryngology*, 133, 109984. <https://doi.org/https://doi.org/10.1016/j.ijporl.2020.109984>
- Shavel, K. E., Hrybovska, I., Stepanchenko, N., Pityn, M., Danylevych, M., Kashuba, Y., & Marionda, I. (2021). The Physical Condition of Deaf Primary School-Age Children and How to Correct it Using Physical Education Methods. *Revista Romaneasca pentru Educatie Multidimensionala*.
- Shenton, R. (2024). *Rachel Shenton Quotes*. BrainyQuote.com. Retrieved 14 December from https://www.brainyquote.com/quotes/rachel_shenton_893545
- Shinde, N., Kanabar, D. J., & Miles, L. J. (2022). Narrative review of the prevalence and distribution of acute pain in children in the self-care setting. *Paediatric and Neonatal Pain*, 4(4), 169-191. <https://doi.org/https://doi.org/10.1002/pne2.12085>
- Shirley Ryan AbilityLab. (2013a). *Mini Balance Evaluation Systems Test*. Shirley Ryan AbilityLab. Retrieved 16 November from
- Shirley Ryan Abilitylab. (2013b, 14 November 2013). *Pediatric clinical test of sensory interaction in balance* Retrieved 29 December from
- Shumway-Cook, A., Brauer, S., & Woollacott, M. (2000). Predicting the Probability for Falls in Community-Dwelling Older Adults Using the Timed Up & Go Test. *Physical Therapy*, 80(9), 896-903. <https://doi.org/10.1093/ptj/80.9.896>
- Siedlecki, S. L. (2020). Understanding Descriptive Research Designs and Methods. *Clin Nurse Spec*, 34(1), 8-12. <https://doi.org/10.1097/NUR.0000000000000493>
- Singh, A., Heet, H., Guggenheim, D. S., Lim, M., Garg, B., Bao, M., Smith, S. L., Garrison, D., Raynor, E. M., Lee, J. W., Wrigley, J., & Riska, K. M. (2022). A Systematic Review on the Association between Vestibular Dysfunction and Balance Performance in Children with Hearing Loss. *Ear and Hearing*, 43(3), 712-712. <https://doi.org/10.1097/AUD.0000000000001131>
- Skrebneva, I., & Fordham, L. (2024). Nothing for us without us: Student-identified approaches that can support the inclusion of deaf students in South African secondary schools. *Deafness & Education International*, 26(3), 213-231. <https://doi.org/10.1080/14643154.2024.2336943>
- Smith, R. J. H., Bale Jr, J. F., & White, K. R. (2005). Sensorineural hearing loss in children. [https://doi.org/10.1016/S0140-6736\(05\)71047-3](https://doi.org/10.1016/S0140-6736(05)71047-3)

- Smits-Engelsman, B., Verbecque, E., Denysschen, M., & Coetzee, D. (2022). Exploring Cultural Bias in Two Different Motor Competence Test Batteries When Used in African Children. *International journal of environmental research and public health*, 19(11).
- Smits-Engelsman, B. C. M., Smit, E., Doe-Asinyo, R. X., Lawerteh, S. E., Aertssen, W., Ferguson, G., & Jelsma, D. L. (2021). Inter-rater reliability and test-retest reliability of the Performance and Fitness (PERF-FIT) test battery for children: a test for motor skill related fitness. *BMC Pediatrics*, 21(1), 119. <https://doi.org/10.1186/s12887-021-02589-0>
- Sokolov, M., Gordon, K. A., Polonenko, M., Blaser, S. I., Papsin, B. C., & Cushing, S. L. (2019). Vestibular and balance function is often impaired in children with profound unilateral sensorineural hearing loss. *Hear Res*, 372, 52-61. <https://doi.org/10.1016/j.heares.2018.03.032>
- Sommerfleck, P. A., Piraíno, R. M., & Bisogno, J. P. (2023). Cross-cultural adaptation of the Dizziness Handicap Inventory – child/adolescent to Spanish version. Analysis of its application in children. *Acta Otorrinolaringologica (English Edition)*, 74(1), 23-30. <https://doi.org/10.1016/J.OTOENG.2023.01.002>
- South African Government. (2011). *Health Professions Act: Regulations: Defining scope of profession of audiology*. Retrieved 04 November from <https://www.gov.za/documents/notices/health-professions-act-regulations-defining-scope-profession-audiology-29-aug>
- South African Government. (2024). *South Africa at a glance*. Retrieved 13 August from <https://www.gov.za/about-sa/south-africa-glance>
- Southard, V. (2020). Development Of Normative Data Using The Mini-BESTest On Children Ages 7-17. *Physical Medicine, Rehabilitation and Disabilities*, 6(2), 1-6. <https://doi.org/10.24966/pmr-8670/100049>
- Soylemeza, E., Ertugrulb, S., & Doganc, E. (2019). Assessment of balance skills and falling risk in children with congenital bilateral profound sensorineural hearing loss. *International Journal of Pediatric Otorhinolaryngology*, 116, 75- 78. <https://doi.org/10.1016/j.ijporl.2018.10.034>
- Statistics South Africa. (2020). *Poverty in Perspective*. https://www.parliament.gov.za/storage/app/media/1_Stock/Events_Institutional/2020/womens_charter_2020/docs/19-02-2021/20210212_Womens_Charter_Review_KZN_19th_of_Feb_afternoon_Session_Final.pdf
- Staykova, M. P. (2019). Rediscovering the Delphi Technique: A Review of the Literature. *Advances in Social Sciences Research Journal*, 6(1), 218–229. <https://doi.org/https://doi.org/10.14738/assrj.61.5959>
- Stepanchenko, N. I., Hrybovska, I. B., Danylevych, M. V., & Hryboskyy, R. V. (2020). Aspects of psychomotor development of primary school children with hearing loss from the standpoint of Bernstein's theory of movement construction. *PEDAGOGY OF PHYSICAL CULTURE AND SPORTS*, 24(3), 151-156. <https://doi.org/10.15561/26649837.2020.0308>
- Stough, C. O., Cordts, K. P., Delaney, M., & Davis, A. (2016). Overweight and obesity among children who are deaf: Quantitative and qualitative findings. *Children's Health Care*, 45(1), 109-125. <https://doi.org/10.1080/02739615.2015.1038678>
- Strode, A. E., & Slack, C. M. (2015). Child research in South Africa: How do the new regulations help? *South African medical journal = Suid-Afrikaanse tydskrif vir geneeskunde*, 105(0256-9574 (Print)), 899–900. <https://doi.org/10.7196/SAMJ.2015.v105i11.9838>
- Stroebel Leoni, C. E., Hay, J., & Bloemhoff Hermanus, J. (2016). Physical education in South Africa : have we come full circle? *South African Journal for Research in Sport, Physical Education and Recreation*, 38(3), 215-228. <https://doi.org/10.10520/EJC199881>
- Stucki, G., Bickenbach, J., Gutenbrunner, C., & Melvin, J. (2017). Rehabilitation: The health strategy of the 21st century. *Journal of Rehabilitation Medicine*, 50(4), 309-316. <https://doi.org/10.2340/16501977-2200>
- Subara-Zukic, E., McGuckian, T. B., Cole, M. H., Steenbergen, B., & Wilson, P. H. (2024). Locomotor-cognitive dual-tasking in children with developmental coordination disorder [Original

- Research]. *Frontiers in psychology*, 15. <https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2024.1279427>
- Suresh J, S. S. (2023). Assessment of Motor Skills and Overall Well-Being in Children with Developmental Coordination Disorder. *Journal for ReAttach Therapy and Developmental Diversities*, 6(10s(2)), 936-943. <https://jrtdd.com/index.php/journal/article/view/1463>
- Sutherland, C., Nel, E., Nel, A., & Hill, T. (2024). Countering urban binaries within a third space: Durban, South Africa's experience as a counter-city. *Cities*, 152, 105165. <https://doi.org/https://doi.org/10.1016/j.cities.2024.105165>
- Svensson, I., Gao, C., Halder, A., Gard, G., & Magnusson, M. (2018). Standing balance on inclined surfaces with different friction. *Industrial health*, 56(1880-8026 (Electronic)), 292–299.
- Tamura, S., Miyata, K., Hasegawa, S., Kobayashi, S., Shioura, K., & Usuda, S. (2024). Pooled Minimal Clinically Important Differences of the Mini-Balance Evaluation Systems Test in Patients With Early Subacute Stroke: A Multicenter Prospective Observational Study. *Physical Therapy*, 104(4), pzae017. <https://doi.org/10.1093/ptj/pzae017>
- Tan, T. A.-O., Guo, Y. Y., Ho, D. J., Sanwari, N. A. B., Quek, P. H., Tan, R. S., Yap, F. S., Yang, M., & Yeung, M. A.-O. (2023). Reference Values, Determinants and Regression Equation for the Timed-Up and Go Test (TUG) in Healthy Asian Population Aged 21 to 85 Years. . *International journal of environmental research and public health*, 20(1660-4601 (Electronic)). <https://doi.org/10.3390/ijerph20095712>
- Tanna, R. J., Lin, J. W., & De Jesus, O. (2021). Sensorineural Hearing Loss. <https://www.ncbi.nlm.nih.gov/books/NBK565860/>
- Tenny, S., Kerndt, C. C., & Hoffman, M. R. (2023). *Case Control Studies*. StatPearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK448143/>
- The Health Professions Council of South Africa. (2018). *Guidelines for Early Hearing Detection and Intervention (EHDI)*. [https://www.hpcs.co.za/Uploads/SLH/Guidelines%20for%20Early_Hearing_Detection_and_Intervention_\(EHDI\)_2018.pdf](https://www.hpcs.co.za/Uploads/SLH/Guidelines%20for%20Early_Hearing_Detection_and_Intervention_(EHDI)_2018.pdf)
- Tiwari, D. (2018). Assessment of Postural Control, Dizziness and Musculoskeletal Impairments in Post-Concussion Children and Adolescents.
- Tupetz, A., Friedman, K., Zhao, D., Liao, H., Isenburg, M. V., Keating, E. M., Vissoci, J. R. N., & Staton, C. A. (2021). Prevention of childhood unintentional injuries in low- and middle-income countries: A systematic review. *PLoS One*, 15(12), e0243464. <https://doi.org/10.1371/journal.pone.0243464>
- Tupetz, A., Friedman, K., Zhao, D. A.-O., Liao, H., Isenburg, M. A.-O., Keating, E. M., Vissoci, J. R. N., & Staton, C. A.-O. (2020). Prevention of childhood unintentional injuries in low- and middle-income countries: A systematic review. *PLoS One*, 15(1932-6203 (Electronic)), e0243464. <https://doi.org/10.1371/journal.pone.0243464>
- van Beethoven, L. (2024). *Ludwig van Beethoven Quotes*. Quotefancy. Retrieved 14 December from
- Van der Walt, A., van der Walt, B., & Vermeerbergen, M. (2021). Combining Forces: The South African Sign Language Bible Translation Project. *Stellenbosch Papers in Linguistics Plus*, 61(0). <https://doi.org/10.5842/61-0-920>
- Van Hecke, R., Danneels, M., Dhooge, I., Van Waelvelde, H., Wiersema, J. R., Deconinck, F. J. A., & Maes, L. (2019). Vestibular Function in Children with Neurodevelopmental Disorders: A Systematic Review. *Journal of Autism and Developmental Disorders*, 49(8), 3328-3350. <https://doi.org/10.1007/s10803-019-04059-0>
- Van Hecke, R., Deconinck, F. J. A., Wiersema, J. R., Clauws, C., Danneels, M., Dhooge, I., Leyssens, L., Van Waelvelde, H., & Maes, L. (2021). Balanced Growth project: A protocol of a single-centre observational study on the involvement of the vestibular system in a child's motor and cognitive development. *BMJ Open*, 11(6). <https://doi.org/10.1136/bmjopen-2021-049165>
- van Stiphout, L., Hossein, I., Kimman, M., Whitney, S. L., Ayiotis, A., Strupp, M., Guinand, N., Pérez Fornos, A., Widdershoven, J., Ramos-Macías, Á., Van Rompaey, V., & van de Berg, R. (2022).

- Development and Content Validity of the Bilateral Vestibulopathy Questionnaire. *Frontiers in neurology*, 13(1664-2295 (Print)), 852048. <https://doi.org/10.3389/fneur.2022.852048>
- Vance, R. C., Healy, D. G., Galvin, R., & French, H. P. (2015). Dual Tasking With the Timed “Up & Go” Test Improves Detection of Risk of Falls in People With Parkinson Disease. *Physical Therapy*, 95(1), 95-102. <https://doi.org/10.2522/ptj.20130386>
- Varni, J. W., Limbers, C. A., & Burwinkle, T. M. (2007). How young can children reliably and validly self-report their health-related quality of life?: An analysis of 8,591 children across age subgroups with the PedsQL™ 4.0 Generic Core Scales. *Health and Quality of Life Outcomes*, 5(1), 1. <https://doi.org/10.1186/1477-7525-5-1>
- Verbecque, E., Da Costa, P. H. L., Vereeck, L., & Hallemans, A. (2015). Psychometric properties of functional balance tests in children: a literature review. *Developmental medicine and child neurology*, 57(6), 521-529. <https://doi.org/10.1111/dmcn.12657>
- Verbecque, E., Klingels, K., Rameckers, E., Ferguson, G., & Smits-Engelsman, B. (2021). The construct of balance control in primary school-aged children: Unidimensional and task-specific. *Human Movement Science*, 79, 102847. <https://doi.org/https://doi.org/10.1016/j.humov.2021.102847>
- Viergever, K., Kraak, J. T., Bruinewoud, E. M., Ket, J. C. F., Kramer, S. E., & Merkus, P. (2021). Questionnaires in otology: a systematic mapping review. *Systematic Reviews*, 10(1), 119. <https://doi.org/10.1186/s13643-021-01659-9>
- Vitkovic, J., Le, C., Lee, S. L., & Clark, R. A. (2016). The Contribution of Hearing and Hearing Loss to Balance Control. *Audiol Neurotol*, 21(4), 195-202. <https://doi.org/10.1159/000445100>
- Walicka-Cupryś, K., Przygoda, Ł., Czenczek, E., Truszczyńska, A., Drzał-Grabiec, J., Zbigniew, T., & Tarnowski, A. (2014). Balance assessment in hearing-impaired children. *Research in Developmental Disabilities*, 35(11), 2728-2734. <https://doi.org/10.1016/j.ridd.2014.07.008>
- Wallander, J. L., & Koot, H. M. (2016). Quality of life in children: A critical examination of concepts, approaches, issues, and future directions. *Clinical Psychology Review*, 45, 131-143. <https://doi.org/https://doi.org/10.1016/j.cpr.2015.11.007>
- Wang, Y., Wang, L., Jing, Y., Yu, L., & Ye, F. (2020). Association Between Hearing Characteristics/Prognosis and Vestibular Function in Sudden Sensorineural Hearing Loss With Vertigo. *Front Neurol*, 11, 579757. <https://doi.org/10.3389/fneur.2020.579757>
- Weber, M. D., Draghi, T. T. G., Rohr, L. A., Cavalcante Neto, J. L., & Tudella, E. (2023). Health-related quality of life in children with developmental coordination disorder: a systematic review. *Health and Quality of Life Outcomes*, 21(1), 62. <https://doi.org/10.1186/s12955-023-02146-6>
- Wilkinson, E., & Morford, J. P. (2020). How Bilingualism Contributes to Healthy Development in Deaf Children: A Public Health Perspective. *Maternal and Child Health Journal*, 24(11), 1330-1338. <https://doi.org/10.1007/s10995-020-02976-6>
- Wille, N., Badia, X., Bonsel, G., Burström, K., Cavrini, G., Devlin, N., Egmar, A. C., Greiner, W., Gusi, N., Herdman, M., Jelsma, J., Kind, P., Scalone, L., & Ravens-Sieberer, U. (2010). Development of the EQ-5D-Y: a child-friendly version of the EQ-5D. *Quality of life research: an international journal of quality of life aspects of treatment, care and rehabilitation*, 19(1573-2649 (Electronic)), 875–886. <https://doi.org/https://doi.org/10.1007/s11136-010-9648-y>
- Wolter, N. E., Gordon, K. A., Campos, J., Vilchez Madrigal, L. D., Papsin, B. C., & Cushing, S. L. (2021). Impact of the sensory environment on balance in children with bilateral cochleovestibular loss. *Hear Res*, 400, 108134. <https://doi.org/10.1016/j.heares.2020.108134>
- Woolf, S. H., Grol R Fau - Hutchinson, A., Hutchinson A Fau - Eccles, M., Eccles M Fau - Grimshaw, J., & Grimshaw, J. (1999). Clinical guidelines: potential benefits, limitations, and harms of clinical guidelines. (0959-8138 (Print)).
- World Bank Group. (2024). *Poverty and Equity Briefs*. The World Bank. Retrieved 10 September from <https://www.worldbank.org/en/topic/poverty/publication/poverty-and-equity-briefs>

- Position paper on the language rights of deaf children, (2016). <https://wfdeaf.org/news/resources/wfd-position-paper-on-the-language-rights-of-deaf-children-7-september-2016/>.
- World Health Organization. (2013). How to use the ICF: A practical manual for using the International Classification of Functioning, Disability and Health (ICF). *Exposure draft for comment*. Geneva: WHO, 13.
- World Health Organization. (2016). *Childhood hearing loss: strategies for prevention and care*. <http://www.who.int>
- World Health Organization. (2018). *Addressing the rising prevalence of hearing loss*. World Health Organization.
- World Health Organization. (2021). *Hearing screening: considerations for implementation*. <https://www.who.int/publications/i/item/9789240032767>
- World Health Organization. (2024). *Deafness and hearing loss*. World Health Organization Retrieved 06 December from <https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss>
- World Medical Association. (2013). World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. *Jama*, 310(20), 2191-2194. <https://doi.org/10.1001/jama.2013.281053>
- Wunderlich, A., Wollesen, B., Asamoah, J., Delbaere, K., & Li, K. (2024). The impact of cognitive-motor interference on balance and gait in hearing-impaired older adults: a systematic review. *European Review of Aging and Physical Activity*, 21(1), 17. <https://doi.org/10.1186/s11556-024-00350-x>
- Yan, J., Luan, F., Wang, M., Dong, W., Zhang, X., Li, M., & Cao, Y. (2022). Prospective association between standing balance and cognitive function in middle-aged and older Chinese adults. *Frontiers in psychology*, 13(1664-1078 (Print)), 931216. <https://doi.org/10.3389/fpsyg.2022.931216>
- Yang, J., Liu, Y., Zhang, Q., Yu, L., Murofushi, T., Jahn, K., & Duan, M. (2023). Editorial: Vestibular disorders in children. *Frontiers in neurology*, 14(1664-2295 (Print)). <https://doi.org/https://doi.org/10.3389/fneur.2023.1142504>
- Yanovich, E., & Bar-Shalom, S. (2022). Static and Dynamic Balance Indices among Kindergarten Children: A Short-Term Intervention Program during COVID-19 Lockdowns. . *Children (Basel, Switzerland)*, 9(2227-9067 (Print)), 939. <https://doi.org/https://doi.org/10.3390/children9070939>
- Yassin, O., Elshafey, M., Hamdy, B., Gamal, R., & Abdelazeim, F. (2020). Comprehensive evaluation of vestibular dysfunction in deaf children. *Journal of Critical Reviews* 7(18), 3586- 3594.
- Yıldırım Gökay, N., Demirtaş, B., Özbal Batuk, M., Yücel, E., & Sennaroğlu, G. (2024). Auditory performance and language skills in children with auditory brainstem implants and cochlear implants. *European Archives of Oto-Rhino-Laryngology*, 281(8), 4153-4159. <https://doi.org/10.1007/s00405-024-08594-0>
- Yingyongyudha, A., Saengsirisuwan, V., Panichaporn, W., & Boonsinsukh, R. (2016). The Mini-Balance Evaluation Systems Test (Mini-BESTest) Demonstrates Higher Accuracy in Identifying Older Adult Participants with History of Falls Than Do the BESTest, Berg Balance Scale, or Timed Up and Go Test [Article]. *Journal of Geriatric Physical Therapy*, 39(2), 64-70. <https://doi.org/10.1519/JPT.0000000000000050>
- Yousefi, J., Ajalloueyan M Fau - Amirsalari, S., Amirsalari S Fau - Hassanali Fard, M., & Hassanali Fard, M. The specificity and sensitivity of transient otoacoustic emission in neonatal hearing screening compared with diagnostic test of auditory brain stem response in tehran hospitals. (2008-2142 (Print)).
- Zaidman-Zait, A., Curle, D., Jamieson, J. R., Chia, R., & Kozak, F. K. (2017). Health-Related Quality of Life Among Young Children With Cochlear Implants and Developmental Disabilities. *Ear and*

- Hearing, 38(4). https://journals.lww.com/ear-hearing/fulltext/2017/07000/health_related_quality_of_life_among_young.2.aspx
- Zarei, H., Norasteh, A. A., Lieberman, L. J., Ertel, M. W., & Brian, A. (2023). Balance Control in Individuals with Hearing Impairment: A Systematic Review and Meta-Analysis. *Audiology and Neurotology*, 29(1), 30-48. <https://doi.org/10.1159/000531428>
- Zhou, G., Kenna, M. A., Stevens, K., & Greg Licameli, G. (2009). Assessment of Saccular Function in Children With Sensorineural Hearing Loss. *Arch Otolaryngol Head Neck Surg*, 135(1), 40-44.
- Zhou, Y., & Qi, J. (2022). Effectiveness of Interventions on Improving Balance in Children and Adolescents With Hearing Impairment: A Systematic Review. *Front Physiol*, 13, 876974. <https://doi.org/10.3389/fphys.2022.876974>
- Zohrabi, M. (2013). Mixed Method Research: Instruments, Validity, Reliability and Reporting Findings. *Theory and Practice in Language Studies*, 3(2). <https://doi.org/10.4304/tpls.3.2.254-262>
- Zwicker, J. G., Harris, S. R., & Klassen, A. F. (2013). Quality of life domains affected in children with developmental coordination disorder: a systematic review. *Child: Care, Health and Development*, 39(4), 562-580. <https://doi.org/https://doi.org/10.1111/j.1365-2214.2012.01379.x>
- Zylka, J., Lach, U., & Rutkowska, I. (2013). Functional Balance Assessment With Pediatric Balance Scale in Girls With Visual Impairment. *Pediatric Physical Therapy*, 25(4). https://journals.lww.com/pedpt/fulltext/2013/25040/functional_balance_assessment_with_pediatric.17.aspx

Appendices

Appendix A: Characteristics and degree of hearing loss in paediatrics (Clark, 1981)

Decibel (dBHL)	Degree of hearing loss
-10–15	Normal
16–25	Slight
26–40	Mild
41–55	Moderate
56–70	Moderately severe
71–90	Severe
91 and above	Profound

Appendix B: Confidentiality agreement



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Fax: 021 406-6323

CONFIDENTIALITY AGREEMENT FORM

To whom it may concern

I (full name/s) _____ as part of my involvement/employment by Ms S. Mbhele (researcher) for her PhD Research study on: *“A descriptive study investigating functional balance in deaf school-aged children: Towards the adaptation and validation of subjective questionnaires”*, supervised by Dr C. Rogers and Dr Y. Saman, at the Department of Health and Rehabilitation sciences, Faculty of Health Sciences, agree to the following terms:

- I shall not divulge any participant information and/or contents of the study to persons outside of the research project
- Any confidential information, record sheet or field notes will be submitted to the researcher at the end of my involvement in the study
- This information includes:
 - Participant personal identifying information, assessment results and intervention plans, medical information
 - Financial or operational information related to the study
 - Study findings and contents of the study

This is an agreement between the undersigned and breach of this agreement is an infringement of ethical conduct.

Signature:

Signature of witness:

Name:

Date:

Name:

Date:

Appendix C1: Invitation to participate for SASL interpreters



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INVITATION AND INFORMED CONSENT FORM

Greetings,

My name is Sphilile Mbhele and I am a student at the University of Cape Town doing a PhD research study on: *“A descriptive study investigating functional balance in deaf school-aged children: Towards the adaptation and validation of subjective questionnaires”*. I am inviting you to be a part of this study!

What is the study about?

I am trying to find out about deaf children and how balance issues can impact them in their daily lives. We know some children with deafness can get dizzy and even fall, but there are no tools yet in sign language to ask them about how this may affect them. I am hoping to adapt two tests from the English language into South African Sign Language (SASL), this is where I would appreciate your and your child's help.

We want to try out a set of questions in sign language to see if a child has dizziness or balance problems and if these problems stop them from doing everyday things like playing, running and jumping. So, I would like to take two questionnaires, which are already available in English and change them so that they are also available in SASL. Next, we will do simple balance tests like standing on one leg, standing on foam and also do a test of the mind and that of the eyes. This is to see if they have any problems with their balance. The information we get from these tests, we will compare with the information we have received from the SASL questionnaires.

What will happen in the study?

I need your assistance in translating these two questionnaires. There will be a process whereby you will translate the tools which are written in English to creating the video version in South African Sign Language (SASL) and thereafter, back-translated from SASL to English. I will assist and facilitate this process to ensure that it is streamlined and easy to understand.

If you accept the invitation to be a part of this study, you will also be part of a panel that will serve to look and discuss the two tests that have been adapted. You will then discuss sentence structure, grammar, contextual, linguistic and cultural appropriacy of the tools, and make recommendations for any changes to be made. Your feedback in this process is very important to make sure that the tests are appropriate and easily understandable by deaf children. After the meeting and discussions, the videos will be amended to include the recommendations. These will be the final versions of the videos which will be used in the study

What else do you need to know?

I have sent my idea of what will happen in this study to the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee (HREC reference number 265/2023) and the Department of Basic Education (ref: 2/4/8/112) for them to make sure that everything that will happen in this study is safe for everyone involved. It is important to understand that it is your choice to be a part of the study, if for any reason you are no longer comfortable to continue, it is okay for you to withdraw from the study; nothing bad will happen. I will make sure to keep your information safe and secure, and also make sure that the study does not put you in harm's way.

What will happen to the after the tests have been adapted?

The tests will first be used with a small group of children in order to identify any possible challenges. Thereafter, if/when the challenges have been sorted, the tests will be used in all children who meet the study criteria. It matters to the researcher that we give children with deafness an opportunity to express themselves about the balance difficulties through these tools and that the tools are able to accurately capture their experiences. The results of the study will be shared with the children, their parents, the Department of Basic Education and the public as well.

What is needed from you?

For this study, I need your permission to be a part of this study. You will be paid for your professional services in this study and no payment is received from participation in the study.

What happens if I get hurt taking part in this study?

This research study is covered by an insurance policy taken out by the University of Cape Town. Therefore, if you suffer a bodily injury because you are taking part in the study, the university will pay for all reasonable medical costs required to treat your bodily injury, according to the SA Good Clinical Practice Guidelines 2006 (based on the Association of the British Pharmaceutical Industry Guidelines). The university will pay without you having to prove that the research was responsible for your bodily injury. You may ask the researcher for a copy of these guidelines. The university will not pay for harm incurred during the study, if you:

- Use medicines or other substances that are not allowed
- Do not follow the researcher's instructions
- Do not take reasonable care of yourself

It is important to follow the researcher's instructions and to report any incidences immediately. If you are harmed and the university pays for the necessary medical costs, usually you will be asked to accept that insurance payment as full settlement of the claim for medical costs. However, accepting this offer of insurance cover does not mean you give up your right to make a separate claim for other losses based on negligence, in a South African court.

Who can I contact and how?

If you have questions about the study, you can contact:

Student: Sphilile Mbhele

Cell No: 065 971 9562

Email: sphililembhele@gmail.com

Supervisor: Dr Christine Rogers

Tell: 021 406 6315/6628

Email: Christine.rogers@uct.ac.za

Who can I contact and how?

If you have concerns about your rights and welfare, please contact the Human Research Ethics Committee on:

Human Research Ethics Committee
E-Floor in the Old Main Building
E53 – Room 46
Groote Schuur Hospital
Observatory, 7925
Tel: 021 650 1236
Email: hrec-enquiries@uct.ac.za

Please complete the following:

I, _____ (full name/s) for the study on the: “*A descriptive study investigating functional balance in deaf school-aged children: Towards the adaptation and validation of subjective questionnaires*”

Statement	Tick the box you agree with	
	Yes	No
1. I have read and understand everything in this document		
2. I know that I am not forced to participate in the study and I can withdraw at any time		
3. I understand what the study is about and I understand my role in the study		
4. I know who to contact if I have concerns or questions		

I, therefore, consent to participate in the study.

Signature:

Date:

Appendix C2: Invitation to panel experts



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INVITATION AND INFORMED CONSENT FORM

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My name is Sphilile Mbhele and I am a student at the University of Cape Town doing a PhD research study on: *“A descriptive study investigating functional balance in deaf school-aged children: Towards the adaptation and validation of subjective questionnaires”*. I am inviting you to be a part of this study!

What is the study about?

I am trying to find out about the impact balance problems may have in children living with deafness. The study involves a screening for balance related symptoms, testing for balance difficulties and then finding out how these symptoms affect children in their daily lives. This is all in attempts to validate and adapt tools that are suitable for deaf school-age children. I am hoping to adapt two tests from the English language into South African Sign Language (SASL), this is where I would appreciate your help.

What will happen in the study?

If you accept the invitation to be a part of this study, you will be part of a panel that will serve to look and discuss the two tests that have been adapted. You will then discuss sentence structure, grammar, contextual, linguistic and cultural appropriacy of the tools, and make recommendations for any changes to be made. Your feedback in this process is of paramount importance to make sure that the tests are appropriate and easily understandable by the children.

What else do you need to know?

I have sent my idea of what will happen in this study to the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee (HREC REF: 265/2023) and the Department of Basic Education for them to make sure that everything that will happen in this study is safe for everyone involved. It is important to understand that it is your choice to be a part of the study, if for any reason you are no longer comfortable to continue, it is okay for you to withdraw from the study; nothing bad will happen. I will make sure to keep your information safe and secure, and also make sure that the study does not put you in harm's way.

What will happen to the after the tests have been adapted?

The tests will first be used with a small group of children in order to identify any possible challenges. Thereafter, if/when the challenges have been sorted, the tests will be used in all children who meet the study criteria. It matters to the researcher that we give children with deafness an opportunity to express themselves about the balance difficulties through these tools and that the tools are able to accurately capture their experiences. The results of the study will be shared with the children, their parents, the department of Basic Education and the public as well.

What happens if I get hurt taking part in this study?

This research study is covered by an insurance policy taken out by the University of Cape Town. Therefore, if you suffer a bodily injury because you are taking part in the study, the university will pay for all reasonable medical costs required to treat your bodily injury, according to the SA Good Clinical Practice Guidelines 2006 (based on the Association of the British Pharmaceutical Industry Guidelines). The university will pay without you having to prove that the research was responsible for your bodily injury. You may ask the researcher for a copy of these guidelines. The university will not pay for harm incurred during the study, if you:

- Use medicines or other substances that are not allowed
- Do not follow the researcher's instructions
- Do not take reasonable care of yourself

It is important to follow the researcher's instructions and to report any incidences immediately. If you are harmed and the university pays for the necessary medical costs, usually you will be asked to accept that insurance payment as full settlement of the claim for medical costs.

However, accepting this offer of insurance cover does not mean you give up your right to make a separate claim for other losses based on negligence, in a South African court.

What is needed from you?

For this study, I need your permission to be a part of this study. There will be no payment is received from participation in the study.

Who can I contact and how?

If you have questions about the study, you can contact:

Student: Sphilile Mbhele

Supervisor: Dr Christine Rogers

Cell No: 065 971 9562

Tell: 021 406 6315/6628

Email: sphililembhele@gmail.com

Email: Christine.rogers@uct.ac.za

Who can I contact and how?

If you have concerns about your rights and human welfare, please contact the Human Research Ethics Committee on:

Human Research Ethics Committee

E-Floor in the Old Main Building

E53 – Room 46

Groote Schuur Hospital

Observatory, 7925

Tel: 021 650 1236

Email: hrec-enquiries@uct.ac.za

Please complete the following:

I, _____ (full name/s) for the study on the: “*A descriptive study investigating functional balance in deaf school-aged children: Towards the adaptation and validation of subjective questionnaires*”

Statement	Tick the box you agree with	
	Yes	No
1. I have read and understand everything in this document		
2. I know that I am not forced to participate in the study and I can withdraw at any time		
3. I understand what the study is about		
4. I know who to contact if I have concerns or questions		

I, therefore, consent to participate in the study.

Signature:

Date:

.....

Appendix D1: Information document and informed consent



UNIVERSITY OF CAPE TOWN
Department of Health and Rehabilitation Sciences
Division of Communication Sciences and Disorders
F46 Old Main Building, Groote Schuur Hospital, Observatory, 7925
Telephone: 021 406-6402
Fax: 021 406-6323

INFORMATION SHEET AND INFORMED CONSENT FORM

Hello,

My name is Sphilile Mbhele and I am a qualified Audiologist (UKZN), studying under the supervision of Dr C. Rogers and Dr Y. Saman, at the Department of Health and Rehabilitation Sciences, Faculty of Health Sciences. I am a student at the University of Cape Town doing a PhD research study on the: *“A descriptive study investigating functional balance in deaf school-aged children: Towards the adaptation and validation of subjective questionnaires”*.

What is the study about and what will happen in the study?

With this study, I am trying to find out about balance problems in children with deafness. This will be done by first making tools that they can easily understand and then finding out how balance problems affect them. Your child forms a big part of this study. Your child will be asked to watch a video where a series of questions will be asked; then tick their answers on a questionnaire. If their score on the questionnaire shows that they possibly have issues with their balance, they will move on to the second aspect of the study where I will first ask your child a few questions. Information about their ears- any pain or liquid coming out of the ears for example will be asked. After that, I will look into their ears to check if they are okay by shining a light inside and also putting a bit of air in their ears. These tests will not be painful or uncomfortable for your child, but your child will feel a change in pressure in their ears. Thereafter, I am then going to test their eyes by asking them to read a chart on the wall, balance by asking them to complete activities like standing on one leg, standing on a foam mat, walking in a straight line etc. They will also be asked to point to different picture cards to test their

minds. This is because all these things work together to keep us in balance. Parts of the study will be video-recorded.

After that, they will be asked to watch a second video and respond by ticking in a questionnaire which has 25 questions to find out how the balance problem is affecting them in their everyday life. That is why I am asking you for permission to test your child. If you give permission for your child to see me, I will look in the records to see what your child's hearing is like which is available at the school. Then also ask your child for permission as well. I will be working with a sign-language interpreter who will make sure that your child understands everything that will be done.

What else do you need to know?

I will first send my idea of what will happen in this study to the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee and the Department of Education for them to make sure that everything that will happen in this study is safe for everyone involved. It is important to understand that it is your choice as well as your child to be a part of the study. If for any reason you are no longer comfortable for your child to continue, it is okay for the child to withdraw from the study; nothing bad will happen. I will make sure to keep your child's information safe and secure, and also make sure that the study does not put them in harm's way.

What will happen to the results?

The results from the big study will be collected then I will look and try to understand what these results mean. They will also be shared with you and I will also write a report to submit to the university. I will thereafter, share the findings through written papers and presentations and conferences, these findings will not include the personal information of your child. We will make sure that we keep your child's name unknown and also not share their results with anyone.

What happens if your child gets hurt taking part in this study?

This research study is covered by an insurance policy taken out by the University of Cape Town. So, if your child gets hurt during the study, the university will pay for all the reasonable medical costs needed to treat your child. This is following the SA Good Clinical Practice Guidelines 2006 (based on the Association of the British Pharmaceutical Industry Guidelines).

The university will pay without you having to prove that it was the study that was responsible for your child's injury. You are free to ask the researcher for a copy of these guidelines. The university will not pay if your child gets hurt during the study by:

- Using medicines or other substances that are not allowed
- If they do not follow the researcher's instructions
- If they do not take reasonable care of themselves

It is very important for your child to follow the researcher's instructions and to report any problems immediately. If your child is harmed and the university pays for the necessary medical costs, usually you will be asked to accept that insurance payment as full settlement of the claim for medical costs. But, accepting this offer of insurance cover does not mean you give up your right to make a separate claim for other losses based on negligence, in a South African court.

What is needed from you?

For this study, I need your permission to allow your child to be a part of this study and I will still ask for your child's permission as well before including them in the study. You will not need to pay for anything in this study and your child will not be paid for their participation as well. However, your child will be given refreshments after the tests and a small token of my appreciation for their participation.

Who can I contact and how?

If you have questions about the study, you can contact:

Student: Sphilile Mbhele

Cell No: 065 971 9562

Email: sphililembhele@gmail.com

Supervisor: Dr Christine Rogers

Tell: 021 406 6315/6628

Email: Christine.rogers@uct.ac.za

Who can I contact and how?

If you have concerns about your and your child's rights and human welfare, please contact the Human Research Ethics Committee on:

Human Research Ethics Committee
 E-Floor in the Old Main Building
 E53 – Room 46
 Groote Schuur Hospital
 Observatory, 7925
 Tel: 021 650 1236
 Email: hrec-enquiries@uct.ac.za

Please complete the following:

I, _____ (full name/s of legal guardian/parent) of
 _____ (full name of child) for the study on the: “*A descriptive study investigating functional balance in deaf school-aged children: Towards the adaptation and validation of subjective questionnaires*”.

Statement	Tick the box you agree with	
	Yes	No
1. I have read and understand everything in this document		
2. I understand that the researcher will need to look at my child's medical records from the school		
3. I know that I am not forced to let my child participate in the study and they can withdraw at any time		
4. I understand what the study is about		
5. I know who to contact if I have concerns or questions		

I, therefore, consent for my child to participate in the study.

Signature:

Date:

.....

Appendix D2: Information document and informed consent (IsiZulu translation)



UNIVERSITY OF CAPE TOWN
Department of Health and Rehabilitation Sciences
Division of Communication Sciences and Disorders
F46 Old Main Building, Groote Schuur Hospital, Observatory, 7925
Telephone: 021 406-6402
Fax: 021 406-6323

IMININGWANE NGOCWANINGO, NESIVUMELWANO

Mzali othembekile

Igama lami ngingu is Sphilile Mbhele, Nishimura eNyuvesi yaseKapa phecelezi University of Cape Town, lapho engisebenza ngaphansi kuka Dr C. Rogers no- Dr Y. Saman. Ngifundela ukuthola iziqu zePhD ngokwenza ucwaningo olunesihloko esithi “*A descriptive study investigating functional balance in deaf school-aged children: Towards the adaptation and validation of subjective questionnaires*”.

Lolucwaningo lumayelana nani?

Ngalolucwaningo ngifisa ukwazi kabanzi ngesimo sebhalansi (balance) ezinganeni ezinenkinga yokungezwa emadlebeni. Lokhu ngizokwenza ngokuqala ngenze amathuluzi angasetshenziswa izingane ezingezwa kahle emadlebeni asebenziseke kalula. Okulandelayo, ngizobe sengizama ukuthola ukuthi izinkinga zebhalansi zinamuphi umthelela ezimpilweni zezingane ezingewa kahle emadlebeni. Ingane yakho iyigxenye ebaluleke kakhulu kulolucwaningo.

Ngizodlala ividiyo ezobe ichaza kabanzi ngocwaningo ibese ibuze imibuzo embalwa. Kulapho ke, ingane yakho izobe isicelwa ukuba ibhale impendulo yayo ephepheni esizolinika yona. Uma ingane yakho isiqedile ukuphendula imibuzo, ngizoba sengibala, ngihlanganisa zonke izimpendulo zayo ukuze kube nenombolo ezoba umphumela. Lenombolo izosazisa uma ingane yakho inenkinga yebhalansi. Okulandelayo, ngizobuza ingane yakho imibuzo mayelana nezindlebe zayo, njengokuthi ike iphume yini udoti emadlebeni noma ike izwe ubuhlungu yini. Emuva kwalokho, ngizobe sengimuxilanga amadlebe ngokukhanyisa ithoshi ngiphinde ngifake umoya omncane endlebeni. Lokhu akuzoba buhlungu, ngikwenzela ukubheka ukuthi indlebe isebenza kahle yini. Ngizoqhubeka ngixilonge amahlo, ngokucela ingane yakho ukuthi

ifunde ishadi oluzobe lubekwe odongeni, bese ngimucela enze imidlalo enjengokuma ngomlenze owodwa, ukuma phezu kwesipontshi njalo njalo. Okokugcina ngizomubukisa izithombe ukubheka ukusebenza kahle komqondo. Lokhu ngikwenza ngoba zonke lezizinto zihlangana ukuqiniseka ukuthi siyakwazi ukuba nebhhalansi. Sizohopha nge vidiyo ukuze sibe nobufakazi bemiphumela etholakele.

Uma konke lokhu sekuqediwe, ingane yakho izocelwa ukuba ibuke ividiyo yesibili ebuza imibuzo bese kudingeka ngane yakho iphendule, igwalise ifomu ezolinikwa. Ngalembuzo yesibili sifisa ukwazi ukuthi kungaba inkinga yebhalansi inamuphi umthelela empilweni yengane yakho. Kungakho ke, nicela imvume kuwe ukuba ingane yakho ibe ingxenye yalolucwaningo. Uma ungipha imvume, ngizoqala ngibheke ifayela lengane yakho elitholakala esikoleni, ukuze ngibone ukuthi kunjani ukuzwa kwakhe. Emuva kwalokho, ngizoyicela nayo ingane yakho ukuba ibe yingxenye yalolucwaningo. Ngizosebenzisana notolika osebenzisa ulimi lokukhuluma ngezandla ukuqinisekisa ukuthi ingane yakho iyazwisisa okuzokwenziwa. Ngizobuye ngisebenzisane nodokotela wemisipha ozoqinisekisa ukuthi konke esizokwenza kuzokwenzeka kahle futhi ngokushesha.

Ikuphi okunye okumele ngikwazi?

Ngizoqale ngithumele umbono wami walolugcwaningo eNyuvesi yase Kapa (University of Cape Town Faculty of Health Sciences Human Research Ethics Committee) nakuMnyango weZemfundo ukuzo baqinisekise ukuthi lolucwaningo luphephile futhi lusemngangathweni. Kubalulekile ukuthi wazi kuyilungelo lakho nelengane yakho ukuba yingxenye yalolucwaningo. Uma kufika isikhathi lapho ingane yakho ingasafisi ukuqubeka, ivumelekile ukuyeka. Akukho okubi okuzokwenzeka. Mina ngizoqinisekisa ukuthi imininingwane yengane yakho iphephile futhi ivikelekile. Lolucwaningo aluhlosile ukulimaza ingane yakho, futhi sizoqinisekisa ukulandelwa kwemigomo yokuphepha.

Kuzokwenzakalani ngemiphumela?

Imiphumela yalolucwaningo ngizoyithatha, ngiyihlaziye futhi ngiyihlanganise. Ngizobe sengiyithumela kuwe ukuze wazi ingane yakho inayo yini inkinga yebhalansi noma cha. Ngaphezu kwalokho, ngizobhala umbiko wemiphumela etholakele ngaloluchwaningo, bese ngiyithumela eNyuvesi yaseKapa okuyiyo engifunda kuyo. Ngizophinde ngibhale amaphepha ngiphinde ngiye kokhuluma nabalingani bami ngelamiphumela. Ngesikhathi kwenzeka konke

lokhu, ngeke imininingwane yangane yakho ifakwe, ngizoqinisekisa ukuthi igama, isikole afunda kuso kanye nalo lonke ulwazi oluphathelele negane yakho ngizolugcina luyimfihlo.

Kuzokwenzekani uma ingane yami ilimala kulolucwaningo?

Lolucwaningo luvikelwe umshwalense othathwe iNyuvesi yaseKapa. Uma kwenzeka ingane yakho ilimala, inyuvesi izokhokhela zonke izindleko eziphathelele nalokulimala. Ikwenza lokhu phezu kwemigomo ebekwe yi-SA Good Clinical Practice Guidelines 2006 (ebhalwe phezu kwemigomo ye-Association of the British Pharmaceutical Industry Guidelines). Uvumelekile ukucela lemgomo ukuze ubenayo. Umshwalense uzokhokha ngaphandle kokuba ucele ingane yakho ukuba iveze ukufakazi bokulimala kulolucwaningo. Kodwa, umshwalense awuzokwazi ukukhokhela izindleko zokulimala uma:

- Ingane yakho isebenzisa imithi engagunyaziwe kulolucwaningo
- Ingane yakho ingalaleli imiyalelo nezeluleko umcwaningi
- Ingane yakho ingazinakekeli

Kubalulekile ukuthi ingane yakho ilalele futhi yenze njengokusho komcwaningi, nokuthi isho ngokushesha uma khokhona inkinga. Uma ingane yakho ilimala, umshwalense ukhokha, uzocelwa ukuthi wamukele lokhu njengesixazululo. Kodwa azi ukuba lesisixazululo asisho ukuthi angeke wakwazi ukuyokhalaza, ufake isicelo enkantolo yase-South Africa.

Ikuphi engikudinga kuwe?

Ngalolucwaningi, ngidinga imvume yakho yokuba ingane yakho ibe ingxenye nelunga lalolucwaningo. Akuzodinga ukhokhe mali, futhi nengane yakho ayizukhokhelwa mali ngokuzibandakanya kulolucwaningo. Kodwa ngizoqinisekisa ukuba ingane yakho iyathola okuya ethunjini uma sesiqedile futhi ithole okuncane okuvela kimi, ukumubonga ngokuba yingxenye yalolucwaningo.

Ngixhumana nobani? Kanjani?

Uma unemibuzo ngalolucwaningo, ungaxhumana no:

Umcwaningi: Sphilile Mbhele

Cell No: 065 971 9562

Email: sphililembhele@gmail.com

Umpathi: Dr Christine Rogers

Tell: 021 406 6315/6628

Email: Christine.rogers@uct.ac.za

Ngixhumana nobani? Kanjani?

Uma ukhathazekile ngamalungelo akho noma omntwana wakho, xhumana ne-Human Research Ethics Committee:

Human Research Ethics Committee

E-Floor in the Old Main Building

E53 – Room 46

Groote Schuur Hospital

Observatory, 7925

Tel: 021 650 1236

Email: hrec-enquiries@uct.ac.za

Gcwalisa lapha ngokuphelele:

Mina, _____ (igama lomzali/umnakekeli eligcwele) ka-
 _____ (igama eligcwele lengane yakho) ngocwaningo olunesihloko esithi “*A descriptive study investigating functional balance in deaf school-aged children: Towards the adaptation and validation of subjective questionnaires*”.

Isitatimende	Maka ibhokisi ovumelana nalo	
	Yebo	Cha
1. Ngifundile ngaqonda yonke imininingwane ebhalwe lapha		
2. Ngiyaqonda ukuthi umcwaningi kuzodinga abheke ifayela yengane yami esesikoleni		
3. Ngiyazi angiphqiwe ukuvumela inane yami ibe yingxenye yalolucwaningo, ivumelekile ukuyeka nanoma inini uma ifisa		
4. Ngiyaqonda ukuthi lolucwaningo lumayelana nani		
5. Ngiyazi ukuthi ngizoxhumana nobani uma nginenkinga noma nginemibuzo		

Ngakhoke, ngiyavuma ukuba ingane yami ibe yingxenye yalolucwaningo.

Sayina:

Usuku:.....

Appendix E1: EQ-5D-Y Proxy version questionnaire



Health Questionnaire

English version for South Africa

Proxy version of the EQ-5D-Y: 1

How the proxy would describe the child's health.

Under each heading, please tick the ONE box that you think best describes the child's health TODAY.

MOBILITY (*walking about*)

No problems walking about ☐

Some problems walking about ☐

A lot of problems walking about ☐

LOOKING AFTER HIM/HERSELF

No problems washing or dressing him/herself ☐

Some problems washing or dressing him/herself ☐

A lot of problems washing or dressing him/herself ☐

DOING USUAL ACTIVITIES (*for example: going to school, hobbies, sports, playing, doing things with family or friends*)

No problems doing his/her usual activities ☐

Some problems doing his/her usual activities ☐

A lot of problems doing his/her usual activities ☐

HAVING PAIN OR DISCOMFORT

No pain or discomfort ☐

Some pain or discomfort ☐

A lot of pain or discomfort ☐

FEELING WORRIED, SAD OR UNHAPPY

Not worried, sad or unhappy ☐

A bit worried, sad or unhappy ☐

Very worried, sad or unhappy ☐

The best health
you can
imagine

100

We would like to know how good or bad you think the child's health is
TODAY.

95

This scale is numbered from 0 to 100.

90

100 means the best health you can imagine.

85

0 means the worst health you can imagine.

80

Please mark an X on the scale to indicate how you think the child's
health is TODAY.

75

Now, write the number you marked on the scale in the box below.

70

65

60

55

50

45

40

35

30

25

20

15

10

5

0

Appendix E2: EQ-5D-Y Proxy version questionnaire



Uhlu Lwemibuzo Yezempilo

I-version yesiZulu yase Ningizimu Afrika

(Zulu version for South Africa)

Isiguqulelo sommeleli se-EQ-5D-Y: 1

Kungabe ummeleli angayichaza kanjani impilo yengane.

Esihlokweni ngasinye, sicela ubeke isiphambano ebhokisini ocabanga ukuthi lichaza kangcono impilo yengane NAMHLANJE.

UKUNYAKAZA (*ukuzihambahambela*)

Azikho izinkinga ukuzihambahambela ☐

Kunezinkinga ezithile ukuzihambahambela ☐

Kunezinkinga eziningi ukuzihambahambela ☐

UKUZINAKEKELA

Azikho izinkinga zokuthi azigeze noma azigqokise ☐

Kunezinkinga ezithile zokuthi azigeze noma azigqokise ☐

Kunezinkinga eziningi zokuthi azigeze noma azigqokise ☐

UKWENZA IZINTO EZIJWAYELEKILE (*isibonelo: ukuya esikoleni, ukwenza izinto azithandayo, imidlalo, ukudlala, ukwenza izinto nomndeni wakhe noma nabangani*)

Azikho izinkinga ukwenza izinto zakhe ezijwayelekile ☐

Kunezinkinga ezithile ukwenza izinto zakhe ezijwayelekile ☐

Kunezinkinga eziningi ukwenza izinto zakhe ezijwayelekile ☐

UKUBA NEZINHLUNGU NOMA UKUNGAPHATHEKI KAHLE

Abukho ubuhlungu noma ukungaphatheki kahle ☐

Kunobuhlungu noma ukungaphatheki kahle okuthile nje ☐

Ubuhlungu noma ukungaphatheki kahle okukhulu ☐

UKUZIZWA UNEXHALA, UJABHILE NOMA UDANGELE

Alikho ixhala, ukujabha noma ukudangala ☐

Ixhala, ukujabha noma ukudangala okulingene nje ☐

Ixhala, ukujabha noma ukudangala okukhulu ☐

	Isimo sempilo esihle kakhulu ongasicabanga
Singathanda ukwazi ukuthi ucabanga ukuthi isimo sempilo sengane sihle noma sibi kangakanani NAMHLANJE.	100
	95
Lesi sikali sinezinombolo ezisuka ku-0 ziya ku-100.	90
	85
U-100 usho impilo <u>enhle</u> kakhulu ongahle uyicabange.	80
U-0 usho impilo <u>embi</u> kakhulu ongahle uyicabange.	75
Sicela ubeke isiphambano esikalini ukukhomba ukuthi ucabanga ukuthi impilo yengane yinhle noma yimbi kangakanani NAMHLANJE.	70
	65
Manje, bhala inombolo oyimake esikalini ebhokisini elingezansi.	60
	55
	50
	45
	40
	35
	30
	25
	20
	15
	10
	5
	0

Appendix F: The Paediatric Vestibular Symptom Questionnaire (PVSQ) (Pavlou et al., 2016)

The following questions ask about how often you feel dizziness and unsteadiness. Please circle the best answer for you.				
How often in the past month have you felt the following?				
1. A feeling that things are spinning or moving around				
3 MOST OF THE TIME	2 SOMETIMES	1 ALMOST NEVER	0 NEVER	? DON'T KNOW
2. Unsteadiness so bad that you actually fall				
3 MOST OF THE TIME	2 SOMETIMES	1 ALMOST NEVER	0 NEVER	? DON'T KNOW
3. Feeling sick				
3 MOST OF THE TIME	2 SOMETIMES	1 ALMOST NEVER	0 NEVER	? DON'T KNOW
4. A light-headed or swimmy feeling in the head				
3 MOST OF THE TIME	2 SOMETIMES	1 ALMOST NEVER	0 NEVER	? DON'T KNOW
5. Feeling of pressure in the ear (s)				
3 MOST OF THE TIME	2 SOMETIMES	1 ALMOST NEVER	0 NEVER	? DON'T KNOW
6. Blurry vision, difficulty seeing things clearly, and / or spots before the eyes				
3 MOST OF THE TIME	2 SOMETIMES	1 ALMOST NEVER	0 NEVER	? DON'T KNOW
7. Headache or feeling of pressure in the head				
3 MOST OF THE TIME	2 SOMETIMES	1 ALMOST NEVER	0 NEVER	? DON'T KNOW
8. Unable to stand or walk without holding on to something or someone				
3 MOST OF THE TIME	2 SOMETIMES	1 ALMOST NEVER	0 NEVER	? DON'T KNOW
9. Feeling unsteady, about to lose balance				
3 MOST OF THE TIME	2 SOMETIMES	1 ALMOST NEVER	0 NEVER	? DON'T KNOW
10. A fuzzy or cotton wool feeling in the head				
3 MOST OF THE TIME	2 SOMETIMES	1 ALMOST NEVER	0 NEVER	? DON'T KNOW
11. Do any of these symptoms stop you doing what you want to do? If yes, which ones?.....				

Questionnaire copy not to scale.

Appendix G: The Dizziness Handicap Inventory for Children/Adolescents (DHI-CA)
(Tiwari, 2018)

Subscales	Questions	Responses		
		Yes	Sometimes	No
1- Physical	Does lifting your head up worsen dizziness?			
2- Emotional	Because of the dizziness, do you feel frustrated (a)?			
3- Functional	Because of the dizziness do you stay away from school?			
4- Physical	Does walking around the supermarket looking at the shelves worsen the dizziness?			
5- Functional	Because of the dizziness, do you have difficulty with getting up from the bed?			
6- Functional	Do you stay away from birthdays, parties, movies, video game arcades because of the dizziness.			
7- Functional	Because of the dizziness, do you have difficulty with reading?			
8- Physical	Do games, sports, riding a bicycle, riding on roundabouts/merrygorounds worsen the dizziness?			
9 – Emotional	Because of the dizziness, are you afraid to leave the house?			
10 – Emotional	Because of the dizziness, do you feel ashamed (a) in front of others?			
11- Physical	Do fast movements of the head worsen your dizziness?			
12- Functional	Because of the dizziness, do you stay away high places?			
13 – Physical	If you turn in bed while you are lying down (a) does it worsen your dizziness?			
14 – Functional	Because of the dizziness, do you find it difficult to jump, run, play ball games, ride a bicycle?			
15 – Emotional	Because of the dizziness, are you afraid that people will think you are not well?			
16 – Functional	Because of the dizziness, it is difficult for you to walk about alone (a)?			
17 – Physical	Does walking on the sidewalk, passing or going over a ground full of holes worsen the dizziness?			
18 – Emotional	Because of the dizziness, do you have difficulty with concentrating on your school activities?			
19 – Functional	Because of the dizziness, are you unable to walk about in the dark?			
20 – Emotional	Because of the dizziness, are you afraid to stay at home alone?			
21 - Emotional	Because of the dizziness, do you feel harmed (a) in comparison with your colleagues?/ companions?			
22 – Emotional	Because of the dizziness, do you quarrel with your friends, companions or persons in your family?			
23 – Emotional	Because of the dizziness, do you feel sad, without wanting to do anything?			
24 – Functional	Does your dizziness hamper, interfere in your studies?			
25 – Physical	If you lower your head or body, does the dizziness worsen?			

Appendix H: Case record form



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CASE RECORD FORM

Biographical information						
Gender	M		F		Age:	Participant number:
Full Name/s:					Ax Date:	
Date of Birth:					Examiner:	

Case history												
Tick which is most relevant to the participant												
Aural fullness	L	R	Discharge/infection	L	R	Ear pain	L	R	Speech problems	Hearing issues	L	R
Recent cold/flu	Yes	No	Other:									

Assessment procedures

Otoscopic Examination									
Tick most results for each ear									
Right ear	NAD	Impacted wax	Foreign body	Perforation	Discharge	Cholesteatoma	Scarred TM	Inflamed TM	Other:
Left ear	NAD	Impacted wax	Foreign body	Perforation	Discharge	Cholesteatoma	Scarred TM	Inflamed TM	Other:

Tympanometry						
Tick results for each ear						
Right ear	A	As	Ad	B	C	Other:
Left ear	A	As	Ad	B	C	Other:

Transient Evoked Otoacoustic Emission (TEOAE)

Tick results for each ear

Right ear		Left ear	
Pass	Refer	Pass	Refer
Other:		Other:	

Static Visual acuity

Tick results for each eye

Right eye		Left eye	
Pass	Refer	Pass	Refer
VA: __ / __ line		VA: __ / __ line	

Dynamic Visual acuity

Tick results below

No drop	Drop 1 line	Drop 2–4 lines	Drop in 5–6 lines
---------	-------------	----------------	-------------------

The modified Clinical Test of Sensory Interaction for Balance (mCTSIB)

Enter score below and tick results below

Score: ____/120 seconds	NAD: All systems available to maintain balance	Condition 1: poor gaze stabilization or use of somatosensory cues
	Condition 2: visually dependent to maintain balance	Condition 3 & 4: visual and/or vestibular system not used to maintain balance

Mini-Best Test

Enter score below and tick results

Score: ____/28	Good balance (24>)	Poor balance (<24)
----------------	--------------------	--------------------

Questionnaires

PSVQ

Enter score below and tick results

Score: ____/10	NAD (<0.68)	Vestibular symptoms (>0.68)
----------------	-------------	-----------------------------

DHI- CA

Enter score below and tick results

Score: ____/100	NAD (<16)	Mild handicap (16–34)
	Moderate handicap (36–52)	Severe handicap (54>)

EQ-5D-Y Proxy version

Enter score below and tick results

Score: _____	NAD	Mobility	Looking after themselves	Doing usual activities
Total Health: _____ /100	Having pain/discomfort	Feeling worried, sad or unhappy	Missing scores	

Management plan

Tick the most relevant box

Discharge		Refer for diagnostic ax	
Rescreen		Referred to Audiologist	
Refer to local clinic		Referral to other professionals	
Comments:			

Examiner signature:

Appendix I: Otoscope Examination

Instrument

- Welch Allyn Pocket Otoscope
- Speculi

Procedure (Mankowski & Raggio, 2021)

- Ensure that the otoscope is fully charged before use and that speculi are disinfected for every child
- Hold the otoscope in a pen-like fashion, with three fingers holding the instrument, and the pinkie finger extended to touch the child's head for stability
- First observe the pinna and pre- and post-auricular area for any malformations/disorders
- for older children (7 years and above), pull the pinna upward and backward
- Thereafter, insert the otoscope into the ear canal, manipulate the pinna if necessary and observe the tympanic membrane
- Take note of:
 - The condition of the external acoustic meatus, it must be clear and/ with minimal cerumen
 - The colour of the tympanic membrane, it must be a grayish colour
 - The tympanic membrane must appear translucent such that it reflects light from the otoscope (light reflex) and the landmarks (umbo, handle of malleus, pars tensa, and the pars flaccida) must be visible
- The above-mentioned features are characteristic of a normal otoscopic examination
- If the observation differs, it should be noted as abnormal and a referral to a healthcare practitioner will be made

Appendix J: Tympanometry

Instrument

- MAICO easyTymp portable tympanometer
- Probe tips
- Alcohol swabs

Procedure (Onusko, 2004)

- A tone of 226 Hz probe tone at +200 daPa will be used as this is appropriate for children over the age of 6 months of age (Resende et al., 2012)
- This test will assess one ear at a time
- Choose the preferred ear
- A suitable probe tip will be selected based on the approximate size of the child's ear canal and fitted on the tympanometer
- The examiner will manipulate the pinna and snugly insert the probe into the external auditory meatus
- Keep the tympanometer steady while the instrument introduces both sound and pressure into the external auditory meatus
- The tympanometer will produce a signal tone to indicate the completion of the test
- The tympanometer will then produce a graph/diagram called a tympanogram
- The same procedure will be followed for the opposite ear

Norms (Gelfand, 2009)

- Ear canal volume: 0.35ml to 1.25ml
- Middle ear pressure: -100 daPa to 50 daPa
- Static compliance: 0.65ml to 1.75ml

Interpretation: types of tympanograms associated with the 226Hz probetone (Gelfand, 2009; Resende et al., 2012)

- Type A- distinct peak can be observed with the pressure close to zero 0 unit and usually considered normal

- Type As- consists of a shallow peak, below 0.65ml indicating reduced mobility, fluid in the ear or otosclerosis
- Type Ad- consists of a very high peak, above 1.75ml, which can indicate a flaccid tympanic membrane or ossicular discontinuity
- Type B- characterised by a relatively flat peak with a normal ear canal volume, it can indicate middle ear infection, cholesteatoma, cerumen impaction or perforation of the tympanic membrane
- Type C- distinctive peak that appears after -100daPa , indicating negative pressure in the middle ear space. This is associated with Eustachian tube dysfunction, tympanic membrane retraction or middle ear infection

Children obtaining tympanograms B and C will be referred to a healthcare practitioner

Appendix K: Transient Evoked Otoacoustic Emission

Instrument

- Probe tips
- MAICO ERO SCAN OAE screener
- Alcohol swabs

Procedure (Nunes-Araújo et al., 2021)

- Child will be seated in a quiet test room
- A probe tip suitable for the child's acoustic auditory meatus will be selected
- A click stimulus will be introduced into the ear to evoke an OAE at frequencies of 1000, 1500, 2000, 3000 and 4000Hz for each ear
- The response will be recorded

Norms (Nunes-Araújo et al., 2021; Qiu et al., 1998)

- Pass- present OAEs indicating hearing thresholds are < 25dB
- Refer- absent response indicating hearing loss of >30dB and in conductive hearing loss (outer and middle ear alterations)

Sensitivity and Specificity (Nunes-Araújo et al., 2021; Yousefi et al.)

The sensitivity of TEOAE for identifying hearing loss is 66.7% and the specificity of it 98.8% in neonates. In school-aged children values improve, sensitivity is 76.92%, specificity is 84.2170% and the accuracy is 82.85%.

Appendix L: Static visual acuity

Purpose: This test evaluates the ability to perceive objects at a given distance thus evaluating visual function

Time: 30 minutes

Equipment:

- Snellen chart
- Flash light
- Tape measure
- Comfortable chair

Procedure: (Azzam & Ronquillo, 2023; Ertekin et al., 2016; Metsing et al., 2020)

- The researcher will ensure that there is good lighting, and that the chart is pasted on a white background
- The child will be seated 6 metres away from the chart. The distance will be measured and marked beforehand, thereafter a chair will be placed
- One eye will be tested at a time, while the other eye is covered with either the child's hand or they will be given a card to block the eye
- For those children who already use spectacles, the test will be conducted with and without the spectacles
- The child will be asked to look at the chart from the top, and then from left to right. They will then be instructed to read each line on the Snellen chart
- The child's visual acuity will be recorded for each eye

Recording:

- Visual acuity = chart distance (6m)/number written next to the line. This indicates the normative values for which that line can be read by someone with normal vision
- Normal visual acuity: if the child is able to correctly identify 6/6 line, if they are able to correctly identify 6/6 line correctly with less than 2 letters incorrectly identified, it is recorded as 6/6 (-2)
- Reduced visual acuity: if the child can only identify lines greater than 6 (6/6).

Appendix M: Dynamic visual acuity

Time: 10 minutes

Equipment:

- Snellen chart
- Metronome
- Tape measure
- Comfortable sized chair

Purpose: This procedure indirectly assesses the function of the Vestibulo–ocular reflex (VOR), which helps maintain steady vision during head movements (Rine & Wiener-Vacher, 2013).

Procedure: (Martin et al., 2012)

- The researcher will ensure that there is good lighting, and that the chart is pasted on a white background
- The child will be seated 3 metres away from the chart. The distance will be measured and marked beforehand, thereafter a chair will be placed
- The child's head will be held on either side, then tilted forward in a 30-degree angle and passively moved from side to side (15 degrees) at a velocity of 2 Hz
- The child will start identifying symbols in the middle line (20/200)
- Record the last line where the child identified all the symbols correctly
- The child will be asked to identify symbols during this head movement until the child misses 3 or more symbols in a line and this line is recorded

Interpretation (Erdinest & London, 2022; Rine & Wiener-Vacher, 2013)

- Normal DVA: a reduction of 3 lines or less from static visual acuity
- Vestibular canal hypofunction: a reduction of 3 or more lines

Reliability: (Martin et al., 2012; Rine et al., 2004): For horizontal DVA, the sensitivity is 0.88%, the specificity 97%, positive and negative predictive values were 100%. The inter-tester reliability was 0.84 and test-retest reliability was 0.94.

Appendix N: Procedure and tools for the mCTSIB

- The tools and procedures are freely available for download at <https://synergycare.com/downloads/standardizedtests/ACP%20-%20mCTSIB.pdf>

m-CTSIB Modified Clinical Test for Sensory Integration of Balance

Equipment: Stopwatch, compliant surface

Purpose: Assess complex sensory system to assist in determining which sensory system the individual relies upon (visual, somatosensory, vestibular) and provides a means to quantify postural control under various sensory conditions. This is a modification of the CTSIB by eliminating the use of the visual conflict dome.

Procedure: The individual is asked to stand barefoot (or with acceptable shoes) with their hands at their side during the 4 different conditions. Begin timing each trial using a stopwatch. The trial is over when the participant:

- Opens their eyes in an eyes-closed condition
- Raises arms from sides
- Loses balance & requires manual assistance
- Maintains balance for full 30 seconds.

If they cannot maintain the position for 30 seconds, 2 additional trials are given.

Condition 1: Eyes Open, firm surface		
Total Time	/30 secs	
Total Time	/30 secs	
Total Time	/30 secs	Mean Score:
Condition 2: Eyes closed, firm surface		
Total Time	/30 secs	
Total Time	/30 secs	
Total Time	/30 secs	Mean Score:
Condition 3: Eyes open, foam surface		
Total Time	/30 secs	
Total Time	/30 secs	
Total Time	/30 secs	Mean Score:
Condition 4: Eyes closed, foam surface		
Total Time	/30 secs	
Total Time	/30 secs	
Total Time	/30 secs	Mean Score:
TOTAL SCORE: ____/120 secs (mean score used for each condition if >1 trial is performed)		

This test provides insight into whether each of the sensory systems available for balance is being used effectively. Failure to maintain balance in Condition 2 indicates that the patient is visually dependent; they are not using somatosensory input to maintain balance when eyes are closed. Failure to maintain balance in Conditions 3 & 4 indicate that the visual and/or vestibular system is not being used to maintain balance.



Interpretation of mCTSIB (free download on https://media.lanecce.edu/users/howardc/PTA204L/204Lm_ctsib_interpretation.pdf)

FALL PROOF PROGRAM: CENTER FOR SUCCESSFUL AGING, CAL STATE FULLERTON

Modified Clinical Test of Sensory Interaction on Balance – Modified (CTSIB- Interpretation of Test Results

Condition	Possible Impairments	Recommended Exercises
1. Eyes Open, Firm Surface (3/3 systems available)	1. Poor gaze stabilization 2. Poor use of surface cues 3. Lower body weakness	Teach visual “spotting.” Balance activities with reduced/occupied/absent vision. LB exercises against resistance (i.e., gravity/theraband/weights).
2. Eyes Closed, Firm Surface (2/3 systems available) No vision available	1. Poor use of surface cues?*	Increase awareness of surface information through verbal cuing during standing exercises. Balance activities with reduced/occupied/absent vision.
	2. Lower body weakness	LB exercises against resistance (i.e., gravity/theraband/weights)
	3. Fear-of-falling	Confidence-building activities.
* Review medical history to determine if any medical condition indicating progressive or permanent loss of sensation from feet, ankles is evident.		
3. Eyes Open, Foam Surface (2/3 systems available) Somatosensory information reduced	1. Poor use of vision? 2. Lower body weakness 3. Poor COG control	Gaze stabilization techniques. Balance activities performed on compliant, or moving surfaces. Seated – standing - moving. (Do not add visual task) LB exercises against resistance (i.e., gravity/theraband/weights) Standing COG activities on compliant surfaces of different thickness.
4. Eyes Closed, Foam Surface (1/3 systems available) Somatosensory reduced & vision unavailable	1. Poor use of vestibular inputs?*	Balance activities performed on compliant/moving surfaces. Vision reduced/occupied/absent.
	2. Fear-of-falling in high sway condition	Voluntary sway activities to build confidence.
	3. Lower body weakness	LB exercises against resistance. (i.e., gravity/theraband/weights)
* Review medical history to determine if any chronic or progressive medical condition affecting vestibular system (i.e., meniere’s disease) exists before performing first set of exercises.		

Appendix O: Mini Balance Evaluation Systems Test (Mini-BESTest)

Mini-BESTest: Balance Evaluation Systems Test

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ANTICIPATORY

SUB SCORE: / 6

1. SIT TO STAND

Instruction: "Cross your arms across your chest. Try not to use your hands unless you must. Do not let your legs lean against the back of the chair when you stand. Please stand up now."

(2) Normal: Comes to stand without use of hands and stabilizes independently.

(1) Moderate: Comes to stand WITH use of hands on first attempt.

(0) Severe: Unable to stand up from chair without assistance, OR needs several attempts with use of hands.

2. RISE TO TOES

Instruction: "Place your feet shoulder width apart. Place your hands on your hips. Try to rise as high as you can onto your toes. I will count out loud to 3 seconds. Try to hold this pose for at least 3 seconds. Look straight ahead. Rise now."

(2) Normal: Stable for 3 s with maximum height.

(1) Moderate: Heels up, but not full range (smaller than when holding hands), OR noticeable instability for 3 s.

(0) Severe: ≤ 3 s.

3. STAND ON ONE LEG

Instruction: "Look straight ahead. Keep your hands on your hips. Lift your leg off of the ground behind you without touching or resting your raised leg upon your other standing leg. Stay standing on one leg as long as you can. Look straight ahead. Lift now."

Left: Time in Seconds Trial 1: _____ Trial 2: _____

Right: Time in Seconds Trial 1: _____ Trial 2: _____

(2) Normal: 20 s.

(2) Normal: 20 s.

(1) Moderate: < 20 s.

(1) Moderate: < 20 s.

(0) Severe: Unable.

(0) Severe: Unable

To score each side separately use the trial with the longest time.

To calculate the sub-score and total score use the side [left or right] with the lowest numerical score [i.e. the worse side].

REACTIVE POSTURAL CONTROL

SUB SCORE: / 6

4. COMPENSATORY STEPPING CORRECTION- FORWARD

Instruction: "Stand with your feet shoulder width apart, arms at your sides. Lean forward against my hands beyond your forward limits. When I let go, do whatever is necessary, including taking a step, to avoid a fall."

(2) Normal: Recovers independently with a single, large step (second realignment step is allowed).

(1) Moderate: More than one step used to recover equilibrium.

(0) Severe: No step, OR would fall if not caught, OR falls spontaneously.

5. COMPENSATORY STEPPING CORRECTION- BACKWARD

Instruction: "Stand with your feet shoulder width apart, arms at your sides. Lean backward against my hands beyond your backward limits. When I let go, do whatever is necessary, including taking a step, to avoid a fall."

(2) Normal: Recovers independently with a single, large step.

(1) Moderate: More than one step used to recover equilibrium.

(0) Severe: No step, OR would fall if not caught, OR falls spontaneously.

6. COMPENSATORY STEPPING CORRECTION- LATERAL

Instruction: "Stand with your feet together, arms down at your sides. Lean into my hand beyond your sideways limit. When I let go, do whatever is necessary, including taking a step, to avoid a fall."

Left

Right

(2) Normal: Recovers independently with 1 step (crossover or lateral OK).

(2) Normal: Recovers independently with 1 step (crossover or lateral OK).

(1) Moderate: Several steps to recover equilibrium.

(1) Moderate: Several steps to recover equilibrium.

(0) Severe: Falls, or cannot step.

(0) Severe: Falls, or cannot step.

Use the side with the lowest score to calculate sub-score and total score.

SENSORY ORIENTATION

SUB SCORE: / 6

7. STANCE (FEET TOGETHER); EYES OPEN, FIRM SURFACE

Instruction: "Place your hands on your hips. Place your feet together until almost touching. Look straight ahead. Be as stable and still as possible, until I say stop."

Time in seconds: _____

(2) Normal: 30 s.

(1) Moderate: < 30 s.

(0) Severe: Unable.

8. STANCE (FEET TOGETHER); EYES CLOSED, FOAM SURFACE

Instruction: "Step onto the foam. Place your hands on your hips. Place your feet together until almost touching. Be as stable and still as possible, until I say stop. I will start timing when you close your eyes."

Time in seconds: _____

- (2) Normal: 30 s.
- (1) Moderate: < 30 s.
- (0) Severe: Unable.

9. INCLINE- EYES CLOSED

Instruction: "Step onto the incline ramp. Please stand on the incline ramp with your toes toward the top. Place your feet shoulder width apart and have your arms down at your sides. I will start timing when you close your eyes."

Time in seconds: _____

- (2) Normal: Stands independently 30 s and aligns with gravity.
- (1) Moderate: Stands independently <30 s OR aligns with surface.
- (0) Severe: Unable.

DYNAMIC GAIT

SUB SCORE: _____ / 10

10. CHANGE IN GAIT SPEED

Instruction: "Begin walking at your normal speed, when I tell you 'fast', walk as fast as you can. When I say 'slow', walk very slowly."

- (2) Normal: Significantly changes walking speed without imbalance.
- (1) Moderate: Unable to change walking speed or signs of imbalance.
- (0) Severe: Unable to achieve significant change in walking speed AND signs of imbalance.

11. WALK WITH HEAD TURNS – HORIZONTAL

Instruction: "Begin walking at your normal speed, when I say 'right', turn your head and look to the right. When I say 'left' turn your head and look to the left. Try to keep yourself walking in a straight line."

- (2) Normal: performs head turns with no change in gait speed and good balance.
- (1) Moderate: performs head turns with reduction in gait speed.
- (0) Severe: performs head turns with imbalance.

12. WALK WITH PIVOT TURNS

Instruction: "Begin walking at your normal speed. When I tell you to 'turn and stop', turn as quickly as you can, face the opposite direction, and stop. After the turn, your feet should be close together."

- (2) Normal: Turns with feet close FAST (≤ 3 steps) with good balance.
- (1) Moderate: Turns with feet close SLOW (≥ 4 steps) with good balance.
- (0) Severe: Cannot turn with feet close at any speed without imbalance.

13. STEP OVER OBSTACLES

Instruction: "Begin walking at your normal speed. When you get to the box, step over it, not around it and keep walking."

- (2) Normal: Able to step over box with minimal change of gait speed and with good balance.
- (1) Moderate: Steps over box but touches box OR displays cautious behavior by slowing gait.
- (0) Severe: Unable to step over box OR steps around box.

14. TIMED UP & GO WITH DUAL TASK [3 METER WALK]

Instruction TUG: "When I say 'Go', stand up from chair, walk at your normal speed across the tape on the floor, turn around, and come back to sit in the chair."

Instruction TUG with Dual Task: "Count backwards by threes starting at _____. When I say 'Go', stand up from chair, walk at your normal speed across the tape on the floor, turn around, and come back to sit in the chair. Continue counting backwards the entire time."

TUG: _____ seconds; Dual Task TUG: _____ seconds

- (2) Normal: No noticeable change in sitting, standing or walking while backward counting when compared to TUG without Dual Task.
- (1) Moderate: Dual Task affects either counting OR walking ($>10\%$) when compared to the TUG without Dual Task.
- (0) Severe: Stops counting while walking OR stops walking while counting.

When scoring item 14, if subject's gait speed slows more than 10% between the TUG without and with a Dual Task the score should be decreased by a point.

TOTAL SCORE: _____ / 28

Item 14: due to limited spoken language, modification to the TUG dual task was made.

TUG-manual: the child is required to perform the TUG and walk while holding a full cup of water. The automatic index (presented as a percentage) also applies to this dual task (Shumway-Cook et al., 2000; Vance et al., 2015).

Mini-BESTest Instructions

Subject Conditions: Subject should be tested with flat-heeled shoes OR shoes and socks off.

Equipment: Temper® foam (also called T-foam™ 4 inches thick, medium density T41 firmness rating), chair without arm rests or wheels, incline ramp, stopwatch, a box (9" height) and a 3 meter distance measured out and marked on the floor with tape [from chair].

Scoring: The test has a maximum score of 28 points from 14 items that are each scored from 0-2.

"0" indicates the lowest level of function and "2" the highest level of function.

If a subject must use an assistive device for an item, score that item one category lower.

If a subject requires physical assistance to perform an item, score "0" for that item.

For **Item 3** (stand on one leg) and **Item 6** (compensatory stepping-lateral) only include the score for one side (the worse score).

For **Item 3** (stand on one leg) select the best time of the 2 trials [from a given side] for the score.

For **Item 14** (timed up & go with dual task) if a person's gait slows greater than 10% between the TUG without and with a dual task then the score should be decreased by a point.

1. SIT TO STAND	Note the initiation of the movement, and the use of the subject's hands on the seat of the chair, the thighs, or the thrusting of the arms forward.
2. RISE TO TOES	Allow the subject two attempts. Score the best attempt. (If you suspect that subject is using less than full height, ask the subject to rise up while holding the examiners' hands.) Make sure the subject looks at a non-moving target 4-12 feet away.
3. STAND ON ONE LEG	Allow the subject two attempts and record the times. Record the number of seconds the subject can hold up to a maximum of 20 seconds. Stop timing when the subject moves hands off of hips or puts a foot down. Make sure the subject looks at a non-moving target 4-12 feet ahead. Repeat on other side.
4. COMPENSATORY STEPPING CORRECTION-FORWARD	Stand in front of the subject with one hand on each shoulder and ask the subject to lean forward (Make sure there is room for them to step forward). Require the subject to lean until the subject's shoulders and hips are in front of toes. After you feel the subject's body weight in your hands, very suddenly release your support. The test must elicit a step. NOTE: Be prepared to catch subject.
5. COMPENSATORY STEPPING CORRECTION - BACKWARD	Stand behind the subject with one hand on each scapula and ask the subject to lean backward (Make sure there is room for the subject to step backward). Require the subject to lean until their shoulders and hips are in back of their heels. After you feel the subject's body weight in your hands, very suddenly release your support. Test must elicit a step. NOTE: Be prepared to catch subject.
6. COMPENSATORY STEPPING CORRECTION- LATERAL	Stand to the side of the subject, place one hand on the side of the subject's pelvis, and have the subject lean their whole body into your hands. Require the subject to lean until the midline of the pelvis is over the right (or left) foot and then suddenly release your hold. NOTE: Be prepared to catch subject.
7. STANCE (FEET TOGETHER); EYES OPEN, FIRM SURFACE	Record the time the subject was able to stand with feet together up to a maximum of 30 seconds. Make sure subject looks at a non-moving target 4-12 feet away.
8. STANCE (FEET TOGETHER); EYES CLOSED, FOAM SURFACE	Use medium density Temper® foam, 4 inches thick. Assist subject in stepping onto foam. Record the time the subject was able to stand in each condition to a maximum of 30 seconds. Have the subject step off of the foam between trials. Flip the foam over between each trial to ensure the foam has retained its shape.
9. INCLINE EYES CLOSED	Aid the subject onto the ramp. Once the subject closes eyes, begin timing and record time. Note if there is excessive sway.
10. CHANGE IN SPEED	Allow the subject to take 3-5 steps at normal speed, and then say "fast". After 3-5 fast steps, say "slow". Allow 3-5 slow steps before the subject stops walking.
11. WALK WITH HEAD TURNS- HORIZONTAL	Allow the subject to reach normal speed, and give the commands "right, left" every 3-5 steps. Score if you see a problem in either direction. If subject has severe cervical restrictions allow combined head and trunk movements.
12. WALK WITH PIVOT TURNS	Demonstrate a pivot turn. Once the subject is walking at normal speed, say "turn and stop." Count the number of steps from "turn" until the subject is stable. Imbalance may be indicated by wide stance, extra stepping or trunk motion.
13. STEP OVER OBSTACLES	Place the box (9 inches or 23 cm height) 10 feet away from where the subject will begin walking. Two shoeboxes taped together works well to create this apparatus.
14. TIMED UP & GO WITH DUAL TASK	Use the TUG time to determine the effects of dual tasking. The subject should walk a 3 meter distance. TUG: Have the subject sitting with the subject's back against the chair. The subject will be timed from the moment you say "Go" until the subject returns to sitting. Stop timing when the subject's buttocks hit the chair bottom and the subject's back is against the chair. The chair should be firm without arms. TUG With Dual Task: While sitting determine how fast and accurately the subject can count backwards by threes starting from a number between 100-90. Then, ask the subject to count from a different number and after a few numbers say "Go". Time the subject from the moment you say "Go" until the subject returns to the sitting position. Score dual task as affecting counting or walking if speed slows (>10%) from TUG and or new signs of imbalance.

Tools and procedure (freely available on <https://www.sralab.org/rehabilitation-measures/mini-balance-evaluation-systems-test>)

Norms: (Southard, 2020)

Group	Number (n)	Average Age	Gender		BMI (kg/m ²)	Mini-BES Test Scores			
			Boys	Girls		Mean	SD	Min	Max
Group 1 (Ages 7-10)	29	8.59 ± 1.18	16	13	16.04 ± 4.45	23.8	1.7	20	27
Group 2 (Ages 11-13)	35	11.74 ± 0.78	12	23	18.04 ± 5.05	25.0	1.6	21	27
Group 3 (Ages 14-17)	37	15.11 ± 1.26	18	19	21.58 ± 2.52	25.4	1.7	21	28
Total	101	12.07 ± 2.85	46	55	18.82 ± 4.65	24.8	1.8	20	28

Table 1: Group demographics and MiniBEST scores.

Reliability: It was found that this tool has excellent reliability in assessing balance function with a interrater reliability of ICC= 0.98 and a test-retest reliability of ICC= 0.96 (Godi et al., 2013).

Appendix P: Certification of the EQ-5D-Y proxy version questionnaires



EuroQol Research Foundation

Certified Translation: English for South Africa

This is to certify that a qualified language consultant recruited locally in South Africa in 2012 by MAPI Institute and under contract to the EuroQol Research Foundation reviewed the EQ-5D-Y English for the UK 'source' version to establish its appropriateness for use in South Africa. MAPI Institute specialize in the cultural adaptation and linguistic validation of Patient Reported Outcome instruments and have considerable experience in this area in a wide range of therapeutic areas.

The translation followed established EuroQol Research Foundation methodology for this type of adaptation¹, i.e. the source version was reviewed by an In-country language consultant, who was a native speaker of the target language, and modifications were introduced as recommended by the language consultant. Back translations of modifications were made, as necessary. The version was then tested on 5 English-speaking children between the ages 9 and 13 years who were living in South Africa. Children had a spread of socio-demographic characteristics and included both patients and healthy individuals.

All steps in the adaptation process were taken in full cooperation with members of the EuroQol Research Foundation's translation review team, who reviewed reports provided by MAPI Institute after each stage of the process. All adaptation work was performed by members of the translation team to the best of their abilities as translators and researchers experienced in the field of health-related quality of life research. This version is, to the best of my knowledge, a valid and accurate adaptation of the corresponding original document.

Name: Michael Herdman, Chair, EuroQol Version Management Committee

Signature:

Date: June 2017

Signed by candidate

¹ Herdman M, Fox-Rushby J, Rabin R, Dada X, Gelai C. Producing other language versions of the EQ-5D. In: Brooks R, Rabin R, de Charro F (eds). The measurement and valuation of health status using EQ-5D. A European perspective. Kluwer Academic Publishers. 2003.

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Phone +31 (0)884400190 : E mail: userinformation@euroqol.org



EuroQol Research Foundation

Certified Translation: Zulu for South Africa

This is to certify that a qualified language consultant recruited locally in South Africa in 2012 by MAPI Institute and under contract to the EuroQol Research Foundation reviewed the EQ-5D-Y English for the UK 'source' version to establish its appropriateness for use in South Africa. MAPI Institute specialize in the cultural adaptation and linguistic validation of Patient Reported Outcome instruments and have considerable experience in this area in a wide range of therapeutic areas.

The translation followed established EuroQol Research Foundation translation methodology¹, which was developed with the aim of achieving semantic equivalence to the original and to ensure the new version would be easily understandable to members of the target population.

As a substantial amount of content in the EQ-5D-Y is identical to that of the EQ-5D-3L it had already been translated into Zulu for South Africa, the EuroQol Research Foundation requested that MAPI Institute use all pre-existing text in Zulu for South Africa that was also relevant for EQ-5D-Y as long as the translated text was considered appropriate for children.

For non-overlapping text, the methodology required two independent forward translations into the target language by native speakers, production of a reconciled version of the two forward translations, and two independent back-translations of Zulu the reconciled version by native English speakers who were fluent in the target language. A second reconciled version was produced after the back translation stage and tested on 0 Zulu-speaking children between the ages 8 and 14 years who were living in South Africa. Children had a spread of socio demographic characteristics and included both patients and healthy individuals.

All translation steps were taken in full cooperation with members of the EuroQol Research Foundation's translation review team, who reviewed reports provided by MAPI Institute after each stage of the process. All translation work was performed by members of the Zulu translation team to the best of their abilities as native speakers of Zulu (or English in the case of the back-translators), and as translators and researchers experienced in the field of health-related quality of life research. This translation is, to the best of my knowledge, a valid and accurate translation of the corresponding original document.

Name: Michael Herdman, Chair, EuroQol Version Management Committee

Signature:

Date: June 2017

Signed by candidate

¹ Herdman M, Fox-Rushby J, Rabin R, Badia X, Selai C. Producing other language versions of the EQ-5D. In: Brooks R, Rabin R, de Charro F (eds). The measurement and valuation of health status using EQ-5D: A European perspective. Kluwer Academic Publishers. 2003.

Appendix Q: Human Research Ethics Committee clearance



UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee



Room 45 E-52-E-Floor- Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: hrec-submissions@uct.ac.za
Website: www.health.uct.ac.za/home/human-research-ethics

04 August 2023

HREC REF: 265/2023

Dr C Rogers

Department of Health & Rehab Sciences
F-45 ONB
Email: Christine.rogers@uct.ac.za
student: Mbheles2@ukzn.ac.za

Dear Dr Rogers

PROJECT TITLE: A DESCRIPTIVE STUDY INVESTIGATING FUNCTIONAL BALANCE IN DEAF SCHOOL-AGED CHILDREN: TOWARDS THE ADAPTATION AND VALIDATION OF SUBJECTIVE QUESTIONNAIRES- (DOCTORAL CANDIDATE-MS SPHILILE MBHELE)

Thank you for your response letter addressing the issues raised by the Faculty of Health Sciences Human Research Ethics Committee (HREC).

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 August 2024.

Please submit a progress form, using the standardised Annual Report Form (FHS016) if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.

(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

The HREC acknowledge that the student: Ms Sphilile Mbhele will also be involved in this study.

Please quote HREC REF 265/2023 in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

Signed by candidate

PROFESSOR M BLOCKMAN
CHAIRPERSON, FACULTY OF HEALTH SCIENCES HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637. Institutional Review Board (IRB) number: IRB00001938 NHREC-registration number: REC-210208-007

HREC/ref 265.2023

Appendix R: KwaZulu-Natal Department of Education permission



KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

OFFICE OF THE HEAD OF DEPARTMENT

Private Bag X9137, PIETERMARITZBURG, 3200
Anton Lembede Building, 247 Burger Street, Pietermaritzburg, 3201
Tel: 033 392 1063

Email: Phindile.duma@kzndoe.gov.za

Enquiries: Phindile Duma

Ref.:2/4/8/112

Ms S Mbhele
29 Malton Road
Malton Mews
SEAVIEW
4094

Dear Ms Mbhele

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"A DESCRIPTIVE STUDY INVESTIGATING FUNCTIONAL BALANCE IN DEAF SCHOOL-AGED CHILDREN: TOWARDS THE ADAPTION AND VALIDATION OF SUBJECTIVE QUESTIONNAIRES"**, in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 17 August 2023 to 31 August 2026.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Phindile Duma at the contact numbers above.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

UMLAZI DISTRICT
PINETOWN DISTRICT

Signed by candidate

Mr GN Ngcobo
Head of Department: Education
Date: 21 August 2023

GROWING KWAZULU-NATAL TOGETHER

Appendix S: Adapted Pediatric Vestibular Symptom Questionnaire (PVSQ)



UNIVERSITY OF CAPE TOWN
Department of Health and Rehabilitation Sciences
Division of Communication Sciences and Disorders
F46 Old Main Building, Groote Schuur Hospital, Observatory, 7925
Telephone: 021 406-6402
Fax: 021 406-6323

Paediatric Vestibular Symptom Questionnaire (PVSQ): Visual Analogue Scale

Adapted from (Pavlou et al., 2016) to include a Visual Analogue Scale as part of the response mode

The following questions ask about how often you feel dizziness and unsteadiness. **Tick the best answer for you in the scale below.** How often in the past month have you felt the following?

NB: A video will play demonstrating the question, then you will tick the face that shows how you feel

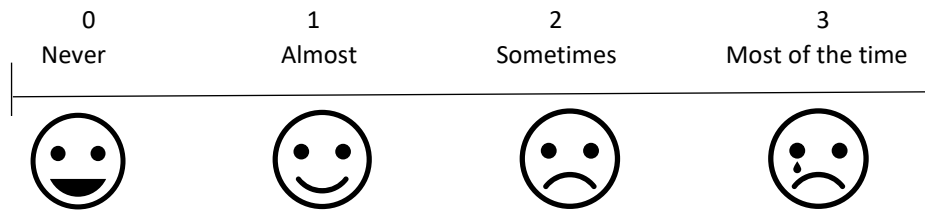
- **A feeling that things are spinning or moving around**

0	1	2	3
Never	Almost	Sometimes	Most of the time

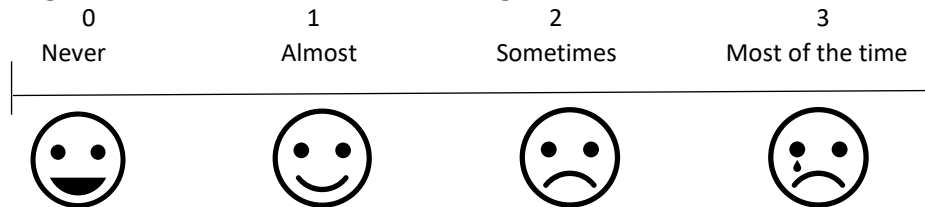
- **Unsteadiness so bad that you actually fall**

0	1	2	3
Never	Almost	Sometimes	Most of the time

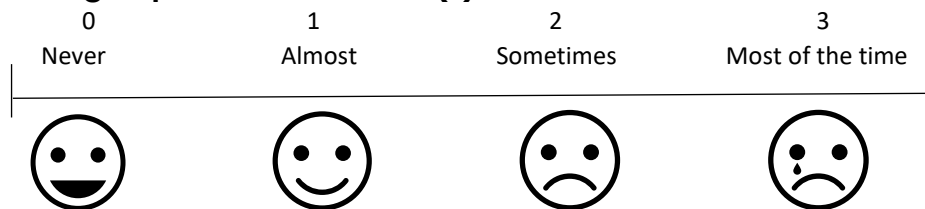
- **Feeling sick**



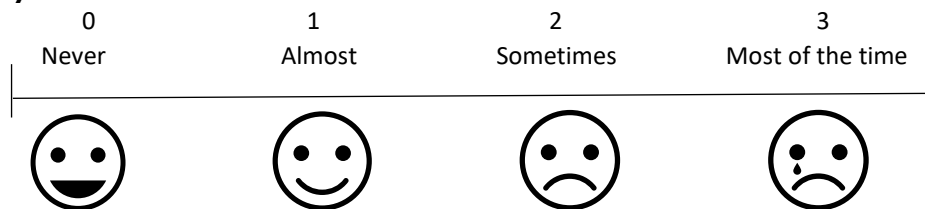
- **A light-headed or swimmy feeling in the head**



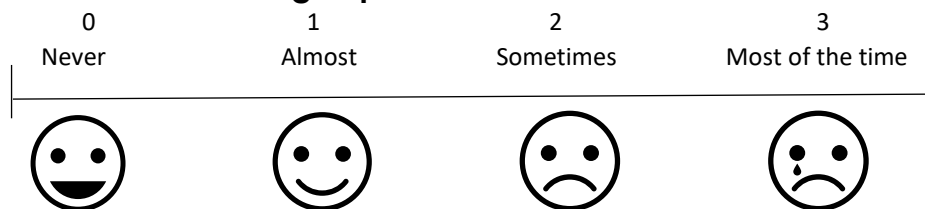
- **Feeling of pressure in the ear(s)**



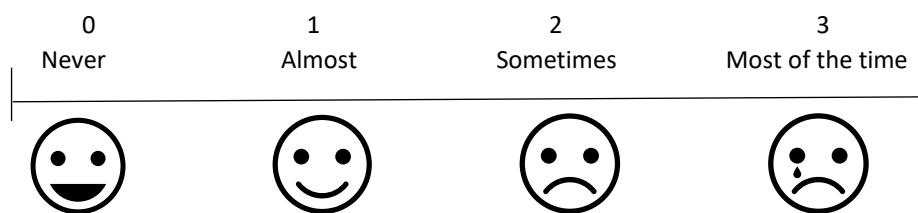
- **Blurry vision, difficulty seeing things clearly, and/or spots before the eyes**



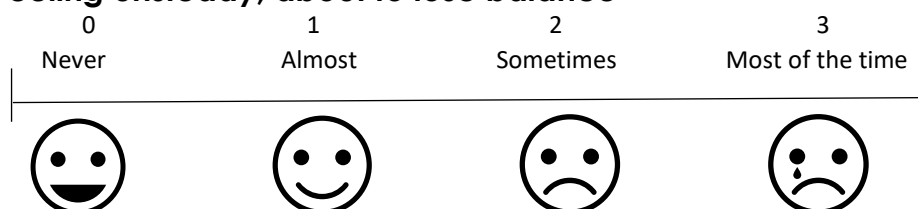
- **Headache or feeling of pressure in the head**



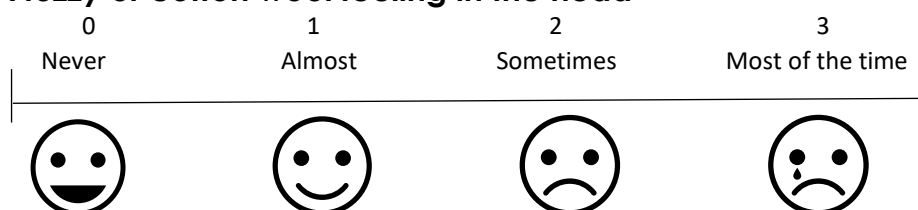
- **Unable to stand or walk without holding on to something or someone**



• **Feeling unsteady, about to lose balance**



• **A fuzzy or cotton wool feeling in the head**



Score: _____ /10

Appendix T: Adapted Dizziness Handicap Inventory Child/Adolescent (DHI-CA)



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Dizziness Handicap Inventory Child/Adolescent (DHI-CA): Visual Analogue Scale

Adapted from Tiwari (2018) to include Visual Analogue Scale as part of the response mode

The following questions ask about how often you feel dizziness and unsteadiness. **Tick the best reaction for you below.**

NB: A video will play demonstrating the question, then you will tick the face that shows how you feel

Subscales	Questions	Yes	Sometimes	No
Physical	Does lifting your head up worsen dizziness?			
Emotional	Because of the dizziness, do you feel frustrated			
Functional	Because of the dizziness, do you stay away from school?			
Physical	Does walking around the supermarket looking at the shelves worsen the dizziness?			
Functional	Because of the dizziness, do you have difficulty with getting up from the bed?			

		  
Functional	Do you stay away from birthdays, parties, movies, video game arcades because of the dizziness	  
Functional	Because of the dizziness, do you have difficulty with reading?	  
Physical	Do games, sports, riding a bicycle, riding on roundabouts/merry-go-rounds worsen the dizziness?	  
Emotional	Because of the dizziness, are you afraid to leave the house?	  
Emotional	Because of the dizziness, do you feel ashamed in front of others?	  
Physical	Do fast movements of the head worsen your dizziness?	  
Functional	Because of the dizziness, do you stay away high places?	  
Physical	If you turn in bed while you are lying down does it worsen your dizziness?	  
Functional	Because of the dizziness, do you find it difficult to jump, run, play ball games, ride a bicycle?	  
Emotional	Because of the dizziness, are you afraid that people will think you are not well?	  

Functional	Because of the dizziness, it is difficult for you to walk about alone?	  
Physical	Does walking on the sidewalk, passing or going over a ground full of holes worsen the dizziness?	  
Emotional	Because of the dizziness, do you have difficulty with concentrating on your school activities?	  
Functional	Because of the dizziness, are you unable to walk about in the dark?	  
Emotional	Because of the dizziness, are you afraid to stay at home alone?	  
Emotional	Because of the dizziness, do you feel harmed in comparison with your friends?	  
Emotional	Because of the dizziness, do you quarrel with your friends, or persons in your family?	  
Emotional	Because of the dizziness, do you feel sad, without wanting to do anything?	  
Functional	Does your dizziness hamper, interfere in your studies?	  
Physical	If you lower your head or body, does the dizziness worsen?	  

Appendix U: Video-Recorded PVSQ and DHI-CA questionnaire

Kindly receive the link to the video which is on Google Drive:

https://drive.google.com/file/d/1lhaqaDEdT_ZzzoycfFGhCiIWv_tFcLfh/view?usp=sharing

Appendix V: Feedback form



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FEEDBACK FORM

Dear Participant

You have taken part in our pilot study investigating functional balance in deaf school-aged children.

Therefore, we kindly your input/feedback from your experience during this process. Please complete the following questions as elaborately as possible

- How was your experience with completing the Paediatric Vestibular Symptom Questionnaire (PVSQ)?

- Comment on how this experience can be improved for future purposes

- How was your experience with completing the Dizziness Handicap Inventory for Children/Adolescents (DHI-CA)?

- Comment on how this experience can be improved for future purposes

- Comment on the process of the assessments that were conducted?

- General comments and/ suggestion

Singapore Statement on Research Integrity

Preamble. The value and benefits of research are vitally dependent on the integrity of research. While there can be and are national and disciplinary differences in the way research is organized and conducted, there are also principles and professional responsibilities that are fundamental to the integrity of research wherever it is undertaken.

PRINCIPLES

Honesty in all aspects of research
Accountability in the conduct of research
Professional courtesy and fairness in working with others
Good stewardship of research on behalf of others

RESPONSIBILITIES

1. Integrity: Researchers should take responsibility for the trustworthiness of their research.

2. Adherence to Regulations: Researchers should be aware of and adhere to regulations and policies related to research.

3. Research Methods: Researchers should employ appropriate research methods, base conclusions on critical analysis of the evidence and report findings and interpretations fully and objectively.

4. Research Records: Researchers should keep clear, accurate records of all research in ways that will allow verification and replication of their work by others.

5. Research Findings: Researchers should share data and findings openly and promptly, as soon as they have had an opportunity to establish priority and ownership claims.

6. Authorship: Researchers should take responsibility for their contributions to all publications, funding applications, reports and other representations of their research. Lists of authors should include all those and only those who meet applicable authorship criteria.

7. Publication Acknowledgement: Researchers should acknowledge in publications the names and roles of those who made significant contributions to the research, including writers, funders, sponsors, and others, but do not meet authorship criteria.

8. Peer Review: Researchers should provide fair, prompt and rigorous evaluations and respect confidentiality when reviewing others' work.

9. Conflict of Interest: Researchers should disclose financial and other conflicts of interest that could compromise the trustworthiness of their work in research proposals, publications and public communications as well as in all review activities.

10. Public Communication: Researchers should limit professional comments to their recognized expertise when engaged in public discussions about the application and importance of research findings and clearly distinguish professional comments from opinions based on personal views.

11. Reporting Irresponsible Research Practices: Researchers should report to the appropriate authorities any suspected research misconduct, including fabrication, falsification or plagiarism, and other irresponsible research practices that undermine the trustworthiness of research, such as carelessness, improperly listing authors, failing to report conflicting data, or the use of misleading analytical methods.

12. Responding to Irresponsible Research Practices: Research institutions, as well as journals, professional organizations and agencies that have commitments to research, should have procedures for responding to allegations of misconduct and other irresponsible research practices and for protecting those who report such behavior in good faith. When misconduct or other irresponsible research practice is confirmed, appropriate actions should be taken promptly, including correcting the research record.

13. Research Environments: Research institutions should create and sustain environments that encourage integrity through education, clear policies, and reasonable standards for advancement, while fostering work environments that support research integrity.

14. Societal Considerations: Researchers and research institutions should recognize that they have an ethical obligation to weigh societal benefits against risks inherent in their work.

The Singapore Statement on Research Integrity was developed as part of the 2nd World Conference on Research Integrity, 21-24 July 2010, in Singapore, as a global guide to the responsible conduct of research. It is not a regulatory document and does not represent the official policies of the countries and organizations that funded and/or participated in the Conference. For official policies, guidance, and regulations relating to research integrity, appropriate national bodies and organizations should be consulted. Available at: www.singaporestatement.org

Appendix X: Referral letter



UNIVERSITY OF CAPE TOWN
Department of Health and Rehabilitation Sciences
Division of Communication Sciences and Disorders
F46 Old Main Building, Groote Schuur Hospital, Observatory, 7925
Telephone: 021 406-6402
Fax: 021 406-6323

REFERRAL LETTER

Name of participant: _____

Date: _____

DOB: _____

Dear Dr/Sir/Madam

This student had an evaluation as part of a research study on the above-mentioned date. This evaluation was conducted by Ms. S. Mbhele (Audiologist)

Assessment results

Recommendations:

Kindly see attached results for your perusal. If you have any further questions, please do not hesitate to contact me.