Gestation age and birth weight variations in young children with communication and language impairment at an early intervention clinic

Lauren C. Fouché

Dissertation for MA (Speech-Language Pathology)

Department of Speech-Language Pathology and Audiology

Faculty of Humanities

University of Pretoria

2017

Supervisors:

Professor Alta Kritzinger

Dr Talita le Roux

Acknowledgements

Professor Alta Kritzinger, a great thanks to you for being such a wonderfully dedicated supervisor. Without you I would not have made it through this Master's degree, and would definitely not have been able to grow in my academic knowledge and abilities. Although this was a huge challenge, I always knew I could turn to you for encouragement, guidance and support. I have enjoyed working with you, thank you for making this journey memorable.

To Dr Talita le Roux, your calming demeanour and encouraging words helped me stay calm and level-headed throughout this journey. Thank you for your valuable input, guidelines and pep-talks where they were necessary, and for your willingness to help during the most uncalled for times. Working with you was an absolute pleasure, and I thank you for being a part of this journey.

To my family, who always gave me the push where necessary, and the encouraging words when they were needed. Thank you for your help with my editing, proof reading and rephrasing. I wouldn't have been able to do this without your love and support every step of the way.

And lastly to my Master's buddies, thank you for being there when I needed a shoulder to cry on, an objective viewpoint or just a coffee date "breather". You all made it that much more bearable.

Abstract

Background: South Africa presents with some of the highest preterm birth (PTB) and low birth weight (LBW) rates (14.17%), compared to some high-income countries. Numerous neurodevelopmental and congenital conditions are associated with LBW and PTB, with primary or secondary communication and language impairment as a common, but subtle characteristic. Speech-language therapists and other health professionals may encounter many older children in their caseloads whose disorders originate from LBW and PTB, but may fail to identify them as such.

Objectives: The purpose of this study was to describe the frequency of LBW/PTB as well as associated conditions in comparison to being born full-term (FT) in children at an early communication intervention clinic.

Methods: Retrospective data from 530 attendees of the clinic were captured and analysed according to two groups (LBW/PTB and FT with normal birth weight). Children were between three and 74 months old (mean = 28.47 months), and 91.9% presented with communication and language impairment after assessment at the clinic. The average gestation age for the LBW/PTB group was 35 weeks, which is considered late preterm (32–37 weeks).

Results: Almost 40% of the study sample was born with LBW/PTB, and late preterm gestation was the most prevalent. Factors associated with the LBW/PTB group were maternal prenatal risks, caesarean section delivery, small-for-gestation age, perinatal risks, and primary developmental conditions such as genetic conditions and global developmental delay. Although there was no significant difference between LBW/PTB and FT children with primary communication and language impairment, the LBW/PTB group showed both primary (27.8%) and secondary communication and language impairment (68.9%). Almost half (49.1%) of the entire study sample had severe communication and language delay.

Conclusion: The frequency of LBW/PTB in the clinic was high, drawing attention to the communication and language impairment and other developmental disorders of the group. Secondary communication and language impairment in this predominantly late LBW/PTB sample was prevalent, and associated with genetic conditions and global developmental delay. The finding is in agreement with some studies showing that primary communication and language impairment does not occur significantly more in children with LBW/PTB than in FT children.

Key words: low birth weight, preterm birth, language impairment, early communication intervention, associated conditions.

Plagiarism declaration

I, the undersigned student, acknowledge and declare that this dissertation is my own original work. Where secondary material has been used, this has been properly acknowledged and referenced in accordance with university requirements.

I understand what plagiarism is and am aware of the University of Pretoria's policy in this regard.

Name & Surname	Student number	Signature	Date
Lauren C. Fouché	12142078	________________,	____________

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ANSD	-	Auditory Neuropathy Spectrum Disorder
APA	-	American Psychiatric Association
ASD	-	Autism Spectrum Disorder
ASHA	-	American Speech-Language-Hearing Association
CHRIB	-	Clinic for High-Risk Babies
CLP	-	Cleft Lip and/or Palate
CP	-	Cerebral Palsy
ECI	-	Early Communication Intervention
ELBW	-	Extremely Low Birth Weight
FARR	-	Foundation for Alcohol Related Research
FASD	-	Foetal Alcohol Spectrum Disorder
FT	-	Full-Term
HIV	-	Human Immunodeficiency Virus
IQ	-	Intelligence Quotient
JCIH	-	Joint Committee on Infant Hearing
LBW	-	Low Birth Weight
MES	-	Middle Ear Status
NBW	-	Normal Birth Weight
NICU	-	Neonatal Intensive Care Unit
OM	-	Otitis Media
PTB	-	Preterm Birth
SNHL	-	Sensorineural Hearing Loss
VLBW	-	Very Low Birth Weight
WHO	-	World Health Organization

CHAPTER 1: INTRODUCTION

AIM OF CHAPTER

The aim of this chapter is to provide background on recent research findings regarding low birth weight (LBW) and preterm birth (PTB), associated conditions, the influence thereof on communication and language development, and to highlight the need for further research in order to better understand this connection. The chapter ends with the rationale and research aim.

1.1. BACKGROUND

1.1.1 Low birth weight and preterm birth in South Africa

As a developing country, South Africa presents with some of the highest low birth weight [LBW] (≤2500g) and preterm birth [PTB] (≤37 weeks gestational age) rates - as high as 14.17%, as opposed to 7% in high-income countries such as Europe and North America (Feresu, Harlow, & Woelk, 2015; Howson, Kinney, & Lawn, 2012; Pattinson, 2013). As a result of medical advances, the survival rates of infants born preterm and with LBW have increased significantly, also in South Africa. However, these infants remain at risk for a diversity of developmental difficulties, including communication and language impairment, which can be long-term (Pattinson, 2013; Van de Weijer-Bergsma, Wijnroks, & Jongmans, 2008). Severe developmental conditions associated with LBW and PTB, resulting in permanent disability, include cerebral palsy (CP), sensory impairments in vision and hearing, mental disability and seizure disorder (Allen, 2008; Mathisen, Carey, & Brien, 2012; Van de Weijer-Bergsma et al., 2008). Children with these disabilites may all present with secondary communication and language impairment. Additionally, neurodevelopmental areas such as attention, cognition, executive functioning, emergent literacy, sensory processing, gross and fine motor skills, communication and language, as well as feeding and swallowing, may be affected in children with LBW and PTB, resulting in less severe impairments, disorders and learning difficulties (Allen, 2008; Howson et al., 2012; Mathisen et al., 2012; Peranich, Reynolds, O'Brien, Bosch, & Cranfill, 2010). Preterm birth and LBW are now recognized as potential causes of swallowing and communication disorders in infants (Peranich et al., 2010). Due to the high prevalence of LWB/PTB in South Africa, speech-language therapists may encounter many children in the caseloads with older children whose disorders originate from PTB and LBW, but may fail to identify them as such. There may be a perception among clinicians that infants with PTB and LBW outgrow communication and language delay (Van Niekerk, Kirsten, Nel, & Blaauw, 2014). Research is required to better understand the prevalence of and co-occurring conditions associated with communication difficulties in preschool children who were also born preterm and with LBW.

1.1.2 Low birth weight, preterm birth and communication development

While preterm infants are expected to achieve normal growth and weight between the ages of two and three years (Rasmussen, Wong, Correa, Gambrell, & Friedman, 2006; Rugolo, 2005), recent studies indicate that many less severe developmental sequelae may persist throughout life (American Psychiatric Association [APA], 2013; Bailey & Sokol, 2008; Kihara & Nakamura, 2015; Nyarko, Lopez-Camelo, Castilla, & Wehby, 2013; Van de Weijer-Bergsma et al., 2008). The less severe sequelae include cognitive delay (scores of up to 20 points less on IQ measures), delayed communication and language development, academic difficulties, adaptive behaviour problems and motor difficulties (Davis, Ford, Anderson, & Doyle, 2007; Lee, Yeatman, Luna, & Feldman, 2011). Lee et al. (2011) found that, compared to children born FT preterm children may score up to 20 points less in IQ measures, which relates to language impairment. While cognitive delay has a clear impact on academic abilities, communication and language impairment may also influence later academic functioning (Paquette et al., 2015). It is therefore important to understand the characteristics of communication and language impairment in children born LBW/PTB. It appears that a distinction between primary and secondary communication and language impairment in children with LBW/PTB can be made.

When communication and language impairment is not accompanied by any other disability, such as CP, developmental delay, cognitive impairment and sensory impairment, it is considered a primary communication and language impairment (American Speech-Language-Hearing Association [ASHA], n.d.). On average, children born LBW/PTB show deficits in both receptive and expressive language abilities, which include vocabulary size, quality and understanding of language, as well as sentence comprehension (Davis et al., 2007; Schults, Tulviste, & Haan, 2013). Compared to their FT counterparts, children born preterm perform poorer in expressive language, auditory comprehension, grammar, vocabulary and articulation (Lee et al., 2011). The primary communication and language difficulties may persist throughout primary school, a period during which language development should stabilize and become more adult-like (Feldman, Lee, Yeatman, & Yeom, 2012; Schults et al., 2013).

It is now widely accepted that low gestational age and birth weight have an impact on children's communication and language development, showing that the lower the gestational age and birth weight, the greater the likelihood of language impairment (Pérez-Pereira, Fernández, Gómez-Taibo, & Resches, 2014). Significant differences in various aspects of communication and language development are evident from a very early age on between children with LBW/PTB, and FT children. By 12 months corrected age, delays in pre-linguistic markers are seen in children born LBW/PTB, such as recognition of objects and pictures, and following instructions while reduced vocabulary and sentence formation abilities become evident at two to three years of age (Pérez-Pereira et al., 2014; Rugolo, 2005). The study by Davis et al. (2007) indicated that eight to nine year old children who were born extremely preterm (<28 weeks) and with extremely LBW [ELBW] (<1000g) demonstrate persistent problems with academic achievement, adaptive behaviour and motor skills compared to children born FT. Cognitive and language impairments are among the most frequently reported negative outcomes of preterm birth, with one out of three children displaying significant language delay at three years of age (Paquette et al., 2015). Interpersonal skills, social functioning and academic achievement are further influenced by the delay in expressive and receptive language of LBW/PTB children, resulting in learning difficulties such as reading inaccuracies, inadequate comprehension when reading, and spelling impediments (Paquette et al., 2015; Pritchard et al., 2009; Rugolo, 2005). This often leads to children requiring special support, repeating a grade, or placed in special educational settings (Kelly, 2015). Failure to master basic skills early on in a child's development will result in difficulty with tasks that build upon those skills (Kelly, 2015).

It appears that the learning difficulties of children with LBW/PTB persist throughout school, and may worsen over time (Pritchard et al., 2009). A study conducted by Cooke (2004) showed that by age 25, individuals who were born preterm had lower levels of educational achievement, and were less likely to be employed after school, indicating that their early learning difficulties may have an ongoing impact on opportunities later in life.

It appears that the population of children with LBW/PTB is diverse and may include many conditions. Secondary communication and language deficits in children born LBW/PTB may also co-occur with a number of genetic syndromes or congenital conditions. Fetal Alcohol Spectrum Disorder (FASD), a congenital condition affecting 6% of the South African population (Foundation for Alcohol Related Research [FARR], 2016), is when the embryo or fetus is exposed to alcohol during gestation, which results in intrauterine growth restriction, LBW and preterm birth, and leads to neurodevelopmental abnormalities, attention deficits, learning difficulties or mental disability (Bailey & Sokol, 2008; Bertrand, 2009; Ceccanti et al., 2014; De Beer, Kritzinger, & Zsilavecz, 2010; Memo, Gnoato, Caminiti, Pichini, & Tarani, 2013). Children born with FASD are small-for-gestation age, which is associated with intrauterine growth restriction and often also accompanied by PTB (Bailey & Sokol, 2008).

Preterm birth and LBW have recently been identified as risk factors for autism spectrum disorder (ASD), a condition in which social interaction, communication and behaviour are disturbed (APA, 2013; Kihara & Nakamura, 2015). It appears that, although less than 6% of preterm births occur before 28 weeks gestation age, these are the infants who are at increased risk for developing ASD (Leavey, Zwaigenbaum, Heavner, & Burstyn, 2013). Infants born with cleft lip and/or palate (CLP) are at risk for a lower birth weight of up to 600 grams less than unaffected infants (Nyarko et al., 2013). The birth weight of infants born with CLP is a strong predictor of future health and personal fulfilment that may affect communication, education and economic performance (Nyarko et al., 2013). Similarly, infants who are HIV-exposed are at risk of very low birth weight (VLBW), atypical length and head circumference, neurodevelopmental deficits and feeding difficulties associated with HIV encephalopathy (Van Niekerk et al., 2014). Low birth weight could also be associated with Down syndrome (Rasmussen et al., 2006), which is characterized by a delay in psychomotor development, and these children are at increased risk for a variety of congenital anomalies, including heart defects, as well as communication and language delay (Polišenská & Kapalková, 2014; Weijerman et al., 2008).

It therefore appears that apart from certain genetic syndromes, congenital conditions and major disabilities associated with LBW/PTB, which have secondary communication and language impairment as an inherent characteristic, low gestation age and birth weight in itself are strongly associated with language impairment. It is thus clear that children may present with communication and language impairment as a primary concern, or they may present with communication and language impairment secondary to their primary disability. It therefore appears that there are three sub-populations of children born preterm and with LBW, with primary or secondary communication and language impairment, as depicted in Figure 1.

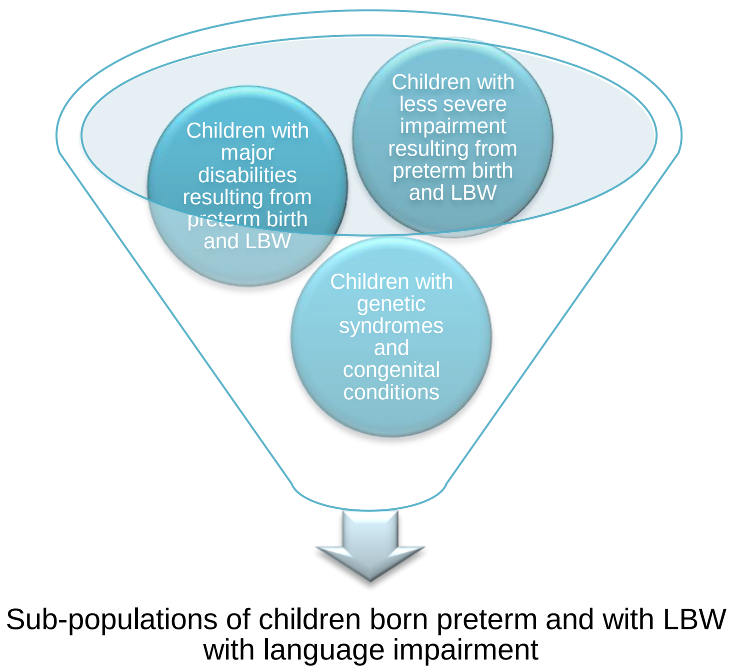

Figure 1: Three sub-populations of children born preterm and with LBW, with communication and language impairment

Figure 1 indicates that there appears to be three mutually exclusive sources, associated with communication and language impairment in children with LBW/PTB. These sources may therefore help describe the complexities of a child's impairments, such as learning disability. Figure 1 thus draws attention to the importance of investigating the population of LBW/PTB children comprehensively, as the origin (i.e. LBW/PTB) for the presenting problem may not be fully understood. An integrated perspective on the complexities of children with LBW/PTB and language impairment may change the perception of the prevalence thereof. The identification of sub-populations of children with LBW and PTB shows the effect that low gestation and birth weight may have on general development, communication and language. A description of perinatal conditions and sequelae that contribute to the complex developmental profile of children with LBW/PTB may assist in understanding the difficulties these children present with.

1.1.3 Complications associated with preterm birth, and the effect thereof on communication and language development

One of the major complications that LBW/PTB infants are at risk for is permanent childhood hearing loss. Neonatal illness and its treatment may contribute to cochlear and retro-cochlear damage which affects hearing. The prevalence of bilateral hearing loss in typically developing infants is one to three cases per 1000 newborns, and two to four cases per 100 newborns in the Neonatal Intensive Care Unit (NICU) population (Robertson, Howarth, Bork, & Dinu, 2009). Among extremely preterm infants, the rate of permanent hearing loss increases and ranges from 0.8 to 8% (Robertson et al., 2009). A study by Le Roux, Swanepoel, Louw, Vinck, and Tshifularo (2015) indicates that within their sample, 28.1% of the children with profound childhood hearing loss had

NICU admittance as a risk factor, and 15.1% had prematurity as a risk factor for permanent childhood hearing loss. This local study therefore revealed an increased risk of hearing loss in LBW/PTB infants in South Africa. The prevalence of permanent hearing loss increases with decreasing gestation age of the infant, with a subsequent increase in severity levels (Van Dommelen, Verkerk, & Van Straaten, 2015). A number of factors may cause hearing loss in children born LBW/PTB. Direct damage to the cochlear hair cells or auditory pathway may result in sensorineural hearing loss (SNHL) or auditory neuropathy spectrum disorder (ANSD). The damage may also occur as a result of exposure to ototoxic medication, hyperbilirubinemia, neuroinfections such as encephalitis and meningitis, intraventricular haemorrhage, mechanical ventilation, and asphyxia (Martinez-Cruz, Alonso-Themann, Poblano, & Ochoa-Lopez, 2012). Environmental noise within the NICU also has adverse effects on cochlear hair cells, resulting in hearing loss. Noise exposure in the NICU and the inability of cochlear hair cells to regenerate may lead to permanent and complete hearing loss in preterm infants (Rastogi, Mikhael, Filipov, & Rastogi, 2013). Although positive family history plays a role in SNHL and ANSD, studies have shown that a stay of 48 hours or longer in the NICU is a significant risk factor for permanent childhood hearing loss (Xoinis et al., 2007). This implies that a combination of biological and environmental factors increases the risk of hearing loss in the NICU.

Research indicates that LBW and PTB account for 42 to 47% of children with CP (Gleason & Devaskar, 2012). It appears that the lower the gestation age and birth weight, the higher the risk of CP in a child. Several studies indicate that infants born with VLBW (1500g and less), or infants born before 32 weeks gestation age, are between 40 and 100 times more likely to present with CP than FT infants with normal birth weight (Nosarti, Murray, & Hack, 2010). Although the diagnosis of CP can only become certain at two years of age, 17 to 48% of preterm infants demonstrate signs of neuromotor difficulties during infancy (Behrman & Butler, 2007). Children born with CP present with more disabling factors than just motor difficulties. These factors include cognitive impairments, executive dysfunction, speech difficulties such as dysarthria, dysphagia, language impairment and fine motor difficulties, resulting in disturbances in interaction and communication with peers, as well as in the classroom (Gleason & Devaskar, 2012; Soleymani, Joveini, & Baghestani, 2015).

As already indicated, there are a variety of biological, medical and environmental factors that may directly or indirectly affect language development amongst other developmental difficulties in LBW and PTB infants. Most infants with a low Apgar score at five minutes will be neurologically affected, which may also result in language difficulties (Arvedson & Brodsky, 2002). Additionally, male gender has shown to have a strong effect on language development, with language skills being less advanced than females (Korpilahti, Kaljonen, & Jansson-Verkasalo, 2016). Apart from the risk for hearing loss, a stay of five days or longer in the NICU exposes the infant to a number of factors which may have a negative effect on an infant’s neurological development (Joint Committee on Infant Hearing [JCIH], 2007; Milgrom et al., 2013; Xoinis et al., 2007). Various medical conditions may also indirectly affect the communication and language development of infants, such as bronchopulmonary dysplasia, intraventricular haemorrhage and periventricular leukomalacia. Bronchopulmonary dysplasia, a chronic lung disease, restricts oxygen flow in infants, resulting in delayed neurodevelopment, increased respiratory effort, hypoxic episodes, nutritional inadequacies, and inadequate growth during the first few years of life (Rugolo, 2005; Yin, Yuan, Ping, & Hu, 2016). Intraventricular haemorrhage or bleeding into, and enlargement of the ventricular space within the infant's brain, often results in CP and cognitive difficulty (Ment et al., 2015). Periventricular leukomalacia is recognized as the most common neurological damage in preterm infants, particularly affecting the development of intellectual and visual difficulties, and causing spastic diplegia (Kurahashi et al., 2016).

Environmental factors that play a role in the communication and language development of infants with LBW/PTB include the socioeconomic status of the family (Pérez-Pereira et al., 2014). Low socioeconomic status is associated with low levels of education and income, with longstanding evidence that a mother's low education level, particularly affects her children's development (Hoff, 2014). Low socioeconomic status increases the likelihood of PTB, higher infection rates, and poor nutrition during pregnancy, which may affect early brain development of the infant (Thomas, Forrester, & Ronald, 2013). Additionally, socioeconomic status may impact parent-child communication and the quality of interaction, which again affects neurological development and may lead to language delay (Thomas et al., 2013). It can be concluded that, biological factors, medical conditions and environmental factors all play a significant role in the complex neurological development of infants with LBW/PTB, which may result in language delay.

1.1.4 Rationale and research question

Characteristics of communication and language impairment in children born preterm and with LBW may include several aspects. Research found that these children have early deficits in expressive abilities, which include vocabulary size and quality (Feldman et al., 2012), as well as receptive language difficulties such as sentence comprehension and understanding of an extensive vocabulary (Schults et al., 2013). Children may present with primary communication and language impairment, or communication and language impairment secondary to their primary disability.

Preterm birth and LBW is a complex condition that may originate from different causal factors, and may result in a wide array of outcomes, affecting the child in various degrees of severity and persistence. Since it is a prevalent condition in South Africa (Pattinson, 2013), a description of the frequency of LBW/PTB, co-occurring conditions and developmental characteristics of children visiting an early communication intervention clinic, may create an increased awareness among speech-language therapists and healthcare professionals managing these children. The purpose of this study was to describe the frequency of LBW/PTB, as well as associated conditions in children at an early communication intervention clinic. This lead to the question: *When considering a group of children with communication and language delay at a specific early intervention clinic, how many of them are LBW/PTB and/or present with associated conditions as compared to those born full term (FT)?*

1.2 TERMINOLOGY

Terminology specific to this dissertation is as follows:

Communication and language impairment – used throughout the dissertation to refer to children with communication and language impairment. Early intervention services are provided to children who are within the pre-linguistic period, as well as those who have already started using spoken language. The term *communication and language impairment,* as used in Kaiser and Roberts (2011), is thus used to refer to the population receiving early communication intervention services, starting from birth (when communication starts developing) and into the preschool years when language is used. "*Impairment*" is used to describe this population, as communication and language *impairment* refers to an impaired ability to communicate using all modalities of communication (spoken and gestural) (ASHA, n.d.).

Low birth weight – infants born with a birth weight below 2500g, regardless of gestation age. The World Health Organization [WHO] classification system was used to describe the degrees of low birth weight, and the categories are as follows: low birth weight (<2500g), very low birth weight (<1500g), and extremely low birth weight (<1000g) (Howson et al., 2012; Wardlaw, Blanc, Zupan, & Ahman, 2004).

Preterm birth – infants born before 37 weeks' gestation age. The WHO classification system was also used to indicate the degrees of preterm birth, and the categories are as follows: extremely preterm (<28 weeks' gestation age), very preterm (28 – 32 weeks gestation age), and moderate to late preterm (32 – 37 weeks gestation age) (Howson et al., 2012; Wardlaw et al., 2004).

Summary

Chapter 1 highlights the diversity of complex difficulties of children with LBW/PTB, and how communication and language development is affected. The chapter ended with the rationale and the research question. The next chapter provides a detailed description of the methods used in the research study.

CHAPTER 2: METHODS

AIM OF CHAPTER

The aim of this chapter is to provide background on the methods used to conduct the study. The chapter describes the aims, design, ethical considerations, participant characteristics and setting of the study, materials used and procedures followed, and the statistical analysis performed.

2. METHODS

2.1 Aim

The aim of the study was to describe the frequency of LBW and PTB, in comparison to being born FT, as well as associated conditions in children at an early communication intervention clinic.

2.2 Research design

For the purpose of the study, a retrospective design was used. This design incorporates gathering and interpreting information from a database (Leedy & Ormrod, 2014), in this case clinical files from a clinic existing for 26 years. Advantages of retrospective studies are that they are inexpensive and not time consuming, as the data is already available for collection. Researchers are able to measure more than one outcome based on the data being collected. Disadvantages of retrospective research is that a large sample is needed in order to determine rare trends and outcomes, and the researcher is reliant on the recordings of other individuals, with the implication that data may be unreliable unless confirmed by multiple sources (Leedy & Ormrod, 2014). The study design was also a two-group comparison, as LBW/PTB children with communication and language delay were compared to children born FT at the same clinic. A descriptive, correlational component was included to examine how differences in one variable (children born FT versus LBW/PTB) were related to differences in one or more other variables (Leedy & Ormrod, 2014). Since quantitative data were collected, this study was conducted within a quantitative framework of research.

2.3 Ethical considerations

Permission to conduct this study and make use of data from files dating from 2001 to 2015 was obtained from the head of the Department of Speech-Language Pathology and Audiology, University of Pretoria (Appendix A). Ethical clearance was obtained from the Research Ethics Committee of the Faculty of Humanities, University of Pretoria (Appendix B). Families whose data were used in the study had provided written consent that their information may be used for research purposes at the initial assessment at the early communication intervention (ECI) clinic (Appendix C). As informed consent was already obtained and no direct contact was made with the families, no further consent was necessary.

Confidentiality was maintained and no identifying information of the families was used in the dissertation and ensuing publication (Leedy & Ormrod, 2014). Full acknowledgement of contributions other than the researcher's was given, and no personal credit was taken (Strydom, 2005). There was no plagiarism, and where the work of others was used, complete and correct citations were used.

Avoidance of harm

Due to the retrospective nature of this study, no physical or emotional harm was done to participants (Strydom, 2005). No contact was made with participants at any point throughout the study.

Autonomy and informed consent

Families of children visiting the clinic gave consent that their information may be used for research at the time of initial assessment. During data collection, the researcher made sure that informed consent had been given before collecting data from the file. In the case where informed consent was not given, the researcher excluded that file from the study.

Violation of confidentiality

Confidentiality and anonymity of all participants was maintained by the researcher at all times. Due to the retrospective nature of the study data from as many as possible attendees of the ECI clinic were included. Unique numbers were assigned to each participant, with all identifying information excluded (Strydom, 2005). Data were not accessible to anyone other than those involved in the research process (i.e., researcher, supervisors and statistician). No participant-specific information was included into the dissertation, or ensuing publication. Data will be stored at the

Department of Speech-Language Pathology and Audiology for 15 years, as per University of Pretoria regulation.

Release or publication of the findings

Findings from this study were released to the public in the form of a journal article. Both the journal article and dissertation will be made available electronically on UPSpace, the institutional research repository at the University of Pretoria, for future reference.

2.4 Participants and setting

In this study, participants were historical attendees of the ECI clinic at the University of Pretoria, whose data had accumulated across a period of 15 years. The clinic provides assessment and intervention services to young children and their families who visit the clinic due to concerns regarding the child’s communication and language development, and are referred by medical professionals who manage the children. Attendees of this clinic are preschool-aged children, and include individuals from a diversity of language and ethnic backgrounds within South Africa. Approximately 50 new clients were annually assessed at the ECI clinic, allowing for a total of 546 available files. The children were assessed by a team of two speech-language therapists and one audiologist, using a comprehensive assessment protocol in order to determine the nature and severity of communication and language difficulties.

Convenience sampling was used, with the implication that the sample cannot be generalized to the entire population of preschool children with communication and language impairment in South Africa. Convenience sampling is when the most readily available data are used for research (Leedy & Ormrod, 2014), in this case historical file data from the clinic. Attendees of the ECI clinic whose data were incomplete, whose families did not give informed consent, or whose files were missing were excluded. The total number of complete files that could be used for the research was 530. Some files had single entries missing, but in that case, the file was still included for the study. An annual client audit is conducted at the clinic, describing some of the characteristics of the cases for each specific year, and is included in the Annual Report of the department. The annual audit revealed client characteristics such a LBW and PTB which provided the direct impetus for the current study. Table 1 depicts the family and child demographics of the study sample.

Table 1: Demographical characteristics of study sample (n=530)

Demographics	% (n)
Ethnicity	
White	77.0 (406/530)
African	19.0 (101/530)
Asian	3.6 (19/530)
Coloured	0.4 (2/530)
Mother's age at birth of child	
Mean (SD)	29.45 (5.07) years
Mode	30 years
Range	17 – 52 years
Language exposure of child	
Monolingual	67.1 (349/520*)
Multilingual	32.9 (171/520*)
Home language	
Afrikaans	59.3 (313/528*)
English	22.2 (117/528*)
African languages (Northern Sotho, Setswana, etc.)	17.6 (93/528*)
Other (German, French, etc.)	0.9 (5/528*)
Day-care of child	
Stays at home with parent	35.2 (178/506*)
Attends preschool (half-day)	23.7 (120/506*)
Attends crèche (full-day)	18.0 (91/506*)
Stays at home with caregiver other than direct family member	15.6 (79/506*)
Stays with family member	7.5 (38/506*)
Health sector	
Private health care	77.0 (406/527*)
Public health care	23.0 (121/527*)
Residential setting	
Urban	94.9 (503/530)
Rural	5.1 (27/530)
Highest educational qualification of mother	
Tertiary qualification	52.7 (264/511*)
Grade 12 (Matric)	42.7 (218/511*)
≤ Grade 11	5.6 (29/511*)

**Due to incomplete patient files, results were based on available data for each variable*

As seen in Table 1, this diverse study sample consisted mainly of White (77%), Afrikaans speaking (59.3%) children who stayed at home with a parent during the day (23.7%), and were exposed to only one language (67.1%). The majority of the study sample came from an urban residential setting (94.9%), made use of private healthcare services (77%), with just more than half (52.7%) of the caregivers having completed tertiary education. Use of private healthcare and mothers' high education level suggest that the study sample was mostly from middle class families. The characteristics of the study may relate to the middle class urban setting of the university where the clinic operates from.

2.5 Material and apparatus

Data were entered into a Microsoft Excel spread sheet, which was stored on a Toshiba Satellite C50-B0490 Notebook. The spread sheet was used to obtain demographical and medical information, the case history, questionnaires containing documented risk factors, and communication assessment results (refer to data collection sheet entries in Appendix D).

2.6 Data collection procedures

Data sets of participants were captured according to year of initial assessment at the ECI clinic. Data were obtained from each participant’s case history form (Appendix E), and from the assessment results. The researcher systematically captured the information from each file, and entered it into the Microsoft Excel spread sheet. A pilot study of ten files was conducted in order to refine the data collection sheet. Data from all 530 participants were then captured into the spread sheet. All children visiting the clinic were already categorized according to their various developmental conditions, with a geographical distribution across South Africa, and a diversity of languages, culture and ethnic backgrounds.

2.7 Data analysis

STATA statistical software package (version 21) was used to analyze the data collected for the study. Data were presented according to two distinct groups: the LBW/PTB group, which included all children who were born preterm, or LBW, or were born preterm with LBW; and the FT / Normal Birth Weight group, which included children who were FT or post-term, with normal or high birth weight. For this distinction, the WHO classification system for PTB and LBW was used (Howson et al., 2012; Wardlaw et al., 2004). PTB was categorized into three gestational ages: extremely preterm (<28 weeks gestation age), very PTB (28 - <32 weeks gestation age), and moderate to late preterm (32–37 weeks gestation age); and LBW was categorized as: LBW (<2500g), very LBW (<1500g) and extremely LBW (<1000g) (Howson et al., 2012; Wardlaw et al., 2004). The frequency of LBW/PTB was determined using average of the LBW/PTB group within the entire study sample. The ECI clinic where data were collected provides intervention services to children who are within the pre-lingual period, as well as those who are busy acquiring language. The term communication and language impairment, as described by Kaiser and Roberts (2011), was used to refer to the population receiving early communication intervention services. The degrees of language impairment were used as recommended by Rossetti (2006), where mild refers to a 3-6 month delay, moderate refers to a 6-12 month delay, and severe refers to a 15 month or more delay. A criterion-referenced developmental assessment scale (Anderson, Fowler, & Nelson, 1978) was used to determine the children's developmental status regarding socio-emotional, perceptual-cognitive, play, gross and fine motor, and self-help skills.

In this study, primary communication and language impairment refers to a communication and language impairment as the only relevant factor, whereas secondary communication and language impairment is used when a child presented with a condition other than his/her communication and language difficulties, which may have communication and language impairment as a secondary outcome. Global developmental delay was used when a child does not meet his/her developmental milestones in several areas of intellectual functioning at the appropriate age (APA, 2013). Genetic or congenital conditions and autism occurring in the sample were diagnosed by an independent medical specialist.

Descriptive statistics were calculated for all variables, including means, standard deviations and proportions. The Chi-Squared test (Fischer's exact) was used to identify significant associations between variables, whereas Spearman's rank correlation was used to identify correlations between variables. Student's t-tests were used to determine significant differences in age, gestation age and birth weight between the two study groups. Associations between variables were compared for the two groups to determine significant differences between children born LBW/PTB, and children born FT with normal birth weight (NBW). A significance level of $p \leq 0.05$ was deemed significant.

2.8 Validity and Reliability

The validity of the study was enhanced through use of valid and reliable measures used to measure degrees of communication delay. The *Rossetti Infant Toddler Language Scale* (Rossetti, 2006) is an assessment tool which was developed for the use of gaining insight into the severity of a child's communication delay, and has as such been used in research (Claassen, Pieterse, van der Linde, Kruger, & Vinck, 2016). Furthermore, the large sample size also enhances the reliability of the study.

The study made use of data from the initial assessment at the ECI clinic, which are data regarding the history of the participants as reported by their parents in an interview and in a questionnaire. This data formed the core of the study, and thus enhanced the internal validity of the study.

Due to the retrospective nature of the study, patient files were not all complete for every variable considered. Results were therefore based on the available data for each variable.

Summary

This chapter described the retrospective nature of the study, and how the study was conducted through adhering to ethical principles. Participant characteristics, material, data collection and the procedures of data analysis were described. The research was written as a scientific journal article and submitted to the Communication Disorders Quarterly (See Appendix G, proof of submission). The article follows in Chapter 3. The article was written in the required style and formatting of the journal and may differ from the rest of the dissertation.

CHAPTER 3: ARTICLE

Gestation age and birth weight variations in young children with communication and language impairment at an early intervention clinic

Lauren C. Fouché (BComm Path), Alta Kritzinger (DPhil) and Talita le Roux (PhD)

Department of Speech-Language Pathology and Audiology, University of Pretoria, Pretoria, South Africa

Abstract

Background: South Africa presents with high preterm birth (PTB) and low birth weight (LBW) rates (14.17%). Numerous conditions characterized by communication and language impairment are associated with LBW/PTB. Speech-language therapists may fail to identify older children whose language impairment originates from LBW/PTB.

Objective: To describe the frequency of LBW/PTB, in comparison to full-term birth, and associated conditions in children at an early communication intervention (ECI) clinic.

Methods: Retrospective data of 530 children aged three-74 months were analysed, with 91.9% presenting with communication and language impairment.

Results: Almost 40% had LBW/PTB, and late PTB was the largest category. Factors associated with LBW/PTB were prenatal risks, caesarean-section delivery, small-for-gestation age, perinatal risks, and primary developmental conditions. Secondary communication and language impairment was prevalent, and associated with genetic conditions and global developmental delay.

Conclusion: The frequency of LBW/PTB was unexpectedly high, drawing attention to the origin of language impairment in almost 40% of the caseload at the ECI clinic.

Key words: low birth weight, preterm birth, language impairment, early communication intervention, associated conditions.

Introduction

As a developing country, South Africa presents with preterm birth [PTB] (<37 weeks gestational age) and low birth weight [LBW] (<2500g) rates as high as 14.17%, as opposed to 7% in high-income countries (Feresu et al., 2015; Howson et al., 2012; Pattinson, 2013). Developmental concerns within this population of children are diverse and can be long-term (Allen, 2008). Severe developmental disabilities associated with LBW/PTB include cerebral palsy (CP), sensory impairments of vision and hearing, mental disability and seizure disorder (Allen, 2008; Van de Weijer-Bergsma et al., 2008), and these may all result in secondary communication and language impairment. Additionally, neurodevelopmental functions such as attention, cognition, executive functioning, emergent literacy, sensory processing, gross and fine motor skills, communication and language, as well as feeding and swallowing, may be affected in children with LBW/PTB, resulting in less severe impairments and disorders (Allen, 2008; Howson et al., 2012; Mathisen et al., 2012). Communication and language impairment in children born preterm and with LBW may also co-occur secondary to various genetic syndromes or congenital conditions. One of these conditions is Foetal Alcohol Spectrum Disorder (FASD), a congenital disorder affecting 6% of the South African population (Foundation for Alcohol Related Research [FARR], 2016). Children born with FASD are small-for-gestation age, which is associated with intrauterine growth restriction and often also accompanied by PTB (Peranich et al., 2010). LBW/PTB has recently been identified as risk factors for autism spectrum disorder (Bailey & Sokol, 2008). Infants born with syndromic cleft lip and/or palate (CLP) are at risk for lower birth weight of up to 600 grams less than unaffected infants (Nyarko et al., 2013). Similarly, infants who are HIV-exposed are at risk of very LBW, atypical length and head circumference, and neurodevelopmental deficits and feeding difficulties associated with HIV-encephalopathy (Kihara & Nakamura, 2015). It has also been found that LBW could be associated with Down syndrome (Nyarko et al., 2013). LBW/PTB are thus recognized as potential causes of communication and swallowing disorders in young children with a wide variety of neurodevelopmental conditions (Mathisen et al., 2012).

Speech-language therapists and other health professionals may fail to identify LBW/PTB related disorders in their caseloads of older children. There might be a perception that infants with LBW/PTB outgrow early communication and language delay (Van Niekerk et al., 2014). Research is required to better understand the prevalence of and co-occurring conditions associated with communication, language and feeding difficulties in preschool children who were born preterm and with LBW.

While preterm infants are expected to achieve normal growth and weight between the ages of two and three years (Rasmussen et al., 2006), recent studies indicate that many developmental sequelae may persist throughout life (American Psychiatric Association [APA], 2013; Bailey & Sokol, 2008; Kihara & Nakamura, 2015; Nyarko et al., 2013; Van de Weijer-Bergsma et al., 2008). Communication and language impairments in children with LBW/PTB involve deficits in receptive and expressive language abilities, grammar, vocabulary and articulation (Feldman et al., 2012; Schults et al., 2013; Wolke, Samara, Bracewell, & Marlow, 2008). The language difficulties may persist throughout primary school, a period during which language development should stabilize and mature (Boyer et al., 2014; Wolke et al., 2008). It is not clear from these studies whether children with LBW/PTB present with primary communication and language impairment or communication and language impairment secondary to conditions associated with LBW/PTB.

Preterm birth and LBW is therefore considered as a complex condition that may originate from different causal factors, and may result in a wide array of outcomes, affecting the child in various degrees of severity and persistence. Since it is a prevalent condition in South Africa and other developing countries (Pattinson, 2013), a description of the frequency of LBW/PTB, co-occurring conditions and developmental characteristics of children with communication and language impairment, may create an increased awareness in speech-language therapists and healthcare professionals managing these children. The purpose of this study was therefore to describe the frequency of LBW/PTB, in comparison to being born FT, as well as associated conditions in children at an ECI clinic.

Methods

Study sample

A comparative, retrospective design was used. The study was conducted at an ECI university-based clinic. The clinic provides assessment and intervention services to young children and their families, who visit the clinic due to concerns regarding the child's communication and language development. On average, 50 new clients are annually assessed at the clinic. A uniform assessment protocol, including the *Rossetti Infant-Toddler Language Scale* (Rossetti 2006), was used for all play-based communication assessments, and informed consent was obtained from parents prior to each assessment. Institutional ethical clearance was obtained for the study before data collection was initiated.

All children who attended the ECI clinic between 2003 and 2015, and who had complete datasets available, were included in the study. The dataset equated to 530 participants and consisted of preschool children (mean = 28.47 months, mode = 13 months, SD =

14.66 months, range = 3 – 74 months), with a gender distribution of 333 (63%) males and 197 (37%) females. The male gender bias in the sample is a known risk factor in children with communication and language impairment (Korpilahti et al., 2016). Table 1 describes the family and participant demographics of the study sample.

Table 1: Demographical characteristics of study sample

Demographics	**% (n)**
Ethnicity	
White	77.0 (406/530)
African	19.0 (101/530)
Asian	3.6 (19/530)
Coloured	0.4 (2/530)
Mother's age at birth of child	
Mean (SD)	29.45 (5.07) years
Mode	30 years
Range	17 – 52 years
Language exposure of child	
Monolingual	67.1 (349/520*)
Multilingual	32.9 (171/520*)
Home language	
Afrikaans	59.3 (313/528*)
English	22.2 (117/528*)
African languages (Northern Sotho, Setswana, etc.)	17.6 (93/528*)
Other (German, French, etc.)	0.9 (5/528*)
Day-care of child	
Stays at home with parent	35.2 (178/506*)
Attends preschool (half-day)	23.7 (120/506*)
Attends crèche (full-day)	18.0 (91/506*)
Stays at home with caregiver other than direct family member	15.6 (79/506*)
Stays with family member	7.5 (38/506*)
Health sector	
Private health care	77.0 (406/527*)
Public health care	23.0 (121/527*)
Residential setting	
Urban	94.9 (503/530)
Rural	5.1 (27/530)
Highest educational qualification of mother	
Tertiary qualification	52.7 (264/511*)
Grade 12 (Matric)	42.7 (218/511*)
≤ Grade 11	5.7 (29/511*)

**Due to incomplete patient files, results were based on available data for each variable*

As seen in Table 1, the study sample was diverse, but consisted mainly of White (77%), Afrikaans speaking (59.3%) children who stayed at home with a parent during the day (23.7%), and were exposed to only one language (67.1%). The majority of the sample originated from an urban residential setting (94.9%), made use of private healthcare services (77%), with just more than half (52.7%) of the caregivers having completed tertiary education. Use of private healthcare and mothers' high education level suggest that the sample included mostly middle class families.

Data collection procedures and material

The patient register of the ECI clinic was reviewed in order to identify children who were assessed between 2003 and 2015. The clinical files of the children with complete data were drawn from the filing cabinets and then reviewed retrospectively. An electronic database was developed to organize and capture the data in a consistent format. Data collected included demographical and medical information, case history questionnaires containing documented risk factors, and communication assessment results.

Data analysis

STATA statistical software package (version 21) was used to analyze the data. Data were divided into two distinct groups: the LBW/PTB group, which included all children who were born preterm, or LBW, or were born preterm with LBW; and the NBW/FT group, which included children who were FT or post-term, with normal or high birth weight. For this distinction, the World Health Organisation classification system for PTB and LBW was used (Howson et al., 2012; Reidy et al., 2013). PTB was categorized into three gestational ages: extremely preterm (<28 weeks gestation age), very preterm birth (28 - <32 weeks gestation age), and moderate to late preterm (32–37 weeks gestation age); and LBW was categorized as: LBW (<2500g), very LBW (<1500g) and extremely LBW (<1000g) (Howson et al., 2012; Reidy et al., 2013). The ECI clinic where data were collected provides intervention services to children who are within the pre-lingual period, as well as those who are busy acquiring language. The term communication and language impairment, as described by Kaiser and Roberts (2011), was used to refer to the population receiving early communication intervention services. The degrees of language impairment were used as recommended by Rossetti (2006), where mild refers to a 3-6 month delay, moderate refers to a 6-12 month delay, and severe refers to a 15 month or more. A criterion-referenced developmental assessment scale (Anderson et al., 1978) was used to determine the children's developmental status regarding socio-emotional, perceptual-cognitive, play, gross and fine motor, and self-help skills.

In this study, primary communication and language impairment refers to a communication and language impairment as the only relevant factor, whereas secondary communication and language impairment is used when a child presented with a condition other than his/her communication and language difficulties, which may have communication and language impairment as a secondary outcome. Global developmental delay was used when a child does not meet his/her developmental milestones in several areas of intellectual functioning at the appropriate age (APA, 2013). Genetic or congenital conditions and autism occurring in the sample were diagnosed by an independent medical specialist.

Descriptive statistics were calculated for all variables, including means, standard deviations and proportions. Student's t-tests were used to determine significant differences between the two study groups. The Chi-Squared test (Fischer's exact) was used to identify significant associations between variables. Associations between variables were investigated for the two groups to determine if there were significant differences between children with LBW/PTB, and children born FT with normal birth weight (NBW). A significance level of $p \leq 0.05$ was deemed significant. Due to the retrospective nature of the study, patient files were not all complete for every variable considered. Results were therefore based on the available data for each variable.

Results

Frequency of low birth weight and preterm birth

Table 2 depicts the mean gestation age and birth weight for the two groups respectively.

Table 2: Frequency of low birth weight and preterm birth

	Low birth weight and/or preterm birth	Normal birth weight and full-term or post-term birth
Gestational age		
Number of children in data set (n=528; 2 missing values)	209 (39.4%)	319 (60.6%)
Mean gestational age in weeks (SD)	35.0 (3.4)	39.3 (1.1)
Range in weeks (min – max)	26 – 37 weeks	38 – 44 weeks
Birth weight		
Number of children in data set (n=521; 9 missing values)	206 (39.5%)	315 (60.5%)
Mean birth weight in grams (SD)	2303.3 (720.3)	3269.3 (402.2)
Range in grams (min – max)	620 – 2500 grams	2501 – 5100 grams

According to Table 2, 209 (39.4%) of the children were in the LBW/PTB group, and 319 (60.6%) in the NBW/FT group (n=528). The average gestation age for the LBW/PTB group was 35 weeks, which is considered late preterm (32–37 weeks), whereas the average for the NBW/FT group was 39.3 weeks, which is FT (38–41 weeks). The average birth weight for the LBW/PTB group was 2303.3g, which corresponds with infants born late preterm (Stolt et al., 2016), and 3269.3g for the NBW/FT group. The distribution of birth weight and gestation age across the study sample can be seen in Table 3.

Table 3: Distribution of birth weight and gestation age (n=530)

Birth weight category*	% (n)
< 1000g	2.6% (14/530)
< 1500g	3.6% (19/530)
< 2500g	21.5% (114/530)
≥ 2500g	72.3% (383/530)
Gestation age category**	**% (n)**
Extremely preterm (< 28 weeks)	2.5% (13/530)
Very preterm (28 – 32 weeks)	3.8% (20/530)
Late preterm (32 – 37 weeks)	27.0% (143/530)
Full term (38 – 41 weeks)	64.7% (343/530)
Post term (<42 weeks)	2.1% (11/530)

** Data on birth weight category was available for all children, however the exact birth weight was unknown for nine children (as indicated in Table 2).*
*** Data on gestation age category was available for all children, however the exact gestation age was unknown for two children (as indicated in Table 2).*

Table 3 shows that apart from NBW and FT birth being the most prevalent, 21.5% of the study sample had a birth weight of between 1500g and 2500g, and 27% had a gestation age within the late preterm range. This corresponds with the average birth weight and gestation age of the LBW/PTB group (Table 2), highlighting the prevalence of children born late preterm and with LBW, but not in the very LBW category in this sample. The difference in percentages between birth weight and PTB, which is expected to correspond, is due to infants being born small-for-gestation age (below the 10th percentile for gestation), thus their birth weight is lower than the expected weight for gestation age. Just more than 6% of the study sample had a birth weight of less than 1500g, and were born before 32 weeks' gestation age, showing that the majority of this sample with communication and language concerns presented with birth weights above 1500g, and were born later during the gestation period (after 32 weeks).

Communication and language impairment

Although all children in the sample attended the ECI clinic due to concerns regarding their communication and language development, only 91.9% were found to present with primary or secondary communication and language impairment after assessment at the clinic. Presence of communication and language impairment for a few children (4.2% of the sample) could not be determined due to a very young age, and the remaining 3.9% were found to have typical communication and language development. Table 4 indicates the distribution of the degrees of communication and language delay across the entire study sample, as well as distribution thereof between the two study groups.

Table 4: Degrees of communication and language delay across study sample

Degree of communication and language delay	**Distribution across entire study sample (n=528*)** % (n)	**Low birth weight and/or preterm birth group *(n=209)*** % (n)	**Normal birth weight and full-term or post-term birth group *(n=319)*** % (n)
None	6.25% (33/528)	3.3% (7/209)	8.2% (26/319)
Mild	21.02% (111/528)	23.5% (49/209)	19.4% (62/319)
Moderate	21.78% (115/528)	23.9% (50/209)	20.4% (65/319)
Severe	49.05% (259/528)	45.9% (96/209)	51.1% (163/319)
Cannot be determined due to age <3months	1.89% (10/528)	3.3% (7/209)	0.9% (3/319)

** data on the degree of communication and language delay were available for the entire sample, except for two children.*

According to Table 4, almost half (49.1%) of the entire study sample had severe communication and language delay. Within the LBW/PTB group, 93.4% of children had communication and language delay. Differences between the LBW/PTB group and the

NBW/FT group were minimal in all degrees of communication and language impairment, with differences of no more than 5.2% between groups. This indicates that LBW/PTB children within this sample did not present with more severe communication and language impairment than their FT peers.

Primary developmental conditions

The primary developmental conditions of the children in this study sample can be seen in Table 5. The *Established Risk Categories* according to Rossetti (2001) were used to categorize the different conditions found in the sample.

Table 5: Primary developmental conditions associated with preterm birth and low birth weight

Primary Developmental Conditions (n=530) (Primary condition child presents with at time of assessment)	**Low birth weight and/or preterm birth *(n=209)*** n (%)	**Normal birth weight and full-term or post-term birth *(n=321)*** n (%)	***p***
Genetic conditions (e.g. Pierre Robin sequence, Down syndrome, Velo-cardio-facial syndrome)	39 (18.7)	28 (8.7)	** <0.001
Global developmental delay	30 (14.4)	28 (8.7)	** 0.04
Autism spectrum disorder	16 (7.7)	54 (16.8)	** 0.002
Non-syndromic cleft lip and/or palate	45 (21.5)	90 (28.0)	* 0.09
Primary communication and language impairment	58 (27.8)	86 (26.8)	0.81
Neurological conditions (e.g. seizure disorder, cerebral palsy, microcephaly, unspecified brain disorder)	12 (5.7)	15 (4.7)	0.58
Hearing disorders (including auditory neuropathy spectrum disorder, conductive hearing loss and sensorineural hearing loss)	3 (1.4)	6 (1.9)	1.00
Foetal alcohol spectrum disorder	3 (1.4)	1 (0.3)	0.31
Feeding difficulties	2 (1.0)	1 (0.3)	0.57
STORCH infection (HIV-exposure, cytomegalovirus)	1 (0.5)	2 (0.6)	1.00
Recurrent otitis media			
Visual impairment	0	4 (1.2)	0.16
Post meningitis syndrome	0	3 (0.9)	0.28
Metabolic disorder	0	2 (0.6)	0.52
	0	1 (0.3)	1.00

**Marginal significance (0.05< p <0.1)* ***Significant (p<0.05)*

According to Table 5, genetic conditions (p = 0.001) and global developmental delay (p = 0.04) were more frequent in children with LBW/PTB than those born NBW/FT. Cleft lip and/or palate occurred more frequently in children born NBW/FT, but only marginally significantly. This finding shows that LBW/PTB does not occur more in children with non-syndromic cleft lip and/or palate, but when accompanied by a genetic condition, such as Pierre Robin sequence and Velo-cardio-facial syndrome, LBW/PTB can be expected. Autism spectrum disorder (p = 0.002) was highly associated with children born NBW/FT, but not in the LBW/PTB group. However, LBW/PTB occurred in 22.5% of the 70 children with autism spectrum disorder, presenting much higher than the South African LBW/PTB rate of 14.17%.

It is evident that primary communication and language impairment without any associated conditions was equally represented in both groups, and also the most prevalent developmental condition for both groups. No significant difference in the frequency of primary communication and language impairment was found between the two groups, indicating that primary communication and language impairment was not increased in the LBW/PTB sample. Within the sample of children with LBW/PTB, 27.8% presented with primary communication and language impairment, and 68.9% presented with secondary communication and language impairment. Almost all children with LBW/PTB assessed at the clinic presented with some form of communication and language impairment.

Preterm birth and LBW did not occur significantly more in any of the other primary developmental conditions. The conditions occurred too rarely in the sample to show any significant differences.

Risk factors associated with low birth weight and preterm birth

Table 6 depicts which risk factors were significantly associated with the LBW/PTB group. The different risk factors considered under prenatal, perinatal and family risks are supplied in Table 7. Factors showing no association with LBW/PTB in the sample were gender, ethnicity, family risk for communication and language impairment, feeding difficulties at the time of assessment, family risks (such as low education level of parents), use of public or private medical services, mono- or multi-lingual language exposure and child attendance of daycare.

Table 6: Associations between preterm birth and/or low birth weight and other risk factors

Other risk factors associated with LBW and or PTB	***P***
Small-for-gestational age	** < 0.001
Maternal prenatal risks	** < 0.001
Perinatal risks (feeding difficulties, twins and long NICU stay)	** < 0.001
Primary developmental condition at time of assessment (See Table 4)	** < 0.001
Caesarean section delivery	** 0.002
Primary and secondary communication and language impairment	** 0.03
Mild to moderate communication and language impairment	** 0.03
History of otitis media	* 0.05
Low Apgar score at birth	* 0.08
Surgical procedures early in life (Cleft repair, tonsillectomy, heart surgery, etc.)	* 0.06

**Marginal significance (0.05< p <0.1)* ***Significant (p<0.05)*

According to Table 6 the most significant risk factors associated with LBW/PTB in this study sample were small-for-gestation age, maternal prenatal risks, perinatal risks, the primary developmental condition (genetic conditions and global developmental delay), caesarean section delivery, and communication and language impairment, specifically in the mild to moderate category. Infants born small-for-gestation age are usually LBW, hence the association with the LBW/PTB group. Prenatal risk factors, such as medical conditions and treatment during pregnancy, high blood pressure, pre-eclampsia, smoking and alcohol use during pregnancy (See Appendix A) pose known risks for preterm labour and delivery of an infant, and were therefore significantly associated with LBW/PTB (Nyarko et al., 2013; Reidy et al., 2013; Rossetti, 2001; Wardlaw, Blanc, Zupan, & Ahman, 2004). Perinatal risks, such as length of stay in the NICU and feeding difficulties, were associated with LBW/PTB, as 126 (60.3%) of the children in the sample were admitted to the NICU. The primary developmental conditions associated with LBW/PTB were genetic conditions, and global developmental delay, as also indicated in Table 3. Elective caesarean section deliveries are known to contribute to late preterm birth (Howson et al., 2012). Caesarean births in South Africa has been reported to constitute 21% of births in general, and 43.1% of births amongst White women (Biswas, Su, & Mattar, 2013; Department of Health, 2007). Although male gender was predominant in this study sample, there was no significant association found with LBW/PTB.

Table 7: Prenatal, perinatal and environmental risks associated with LBW and PTB

Risk factors associated with LBW and PTB	**Low birth weight and/or preterm birth** n (%)	**Normal birth weight and full-term or post-term Birth** n (%)	***p***
Maternal prenatal Risks (n=526*)	*(n=207)*	*(n=319)*	
Mother older than 37 years	9 (4.3)	11 (3.4)	
High blood pressure, Pre-eclampsia, HELLP syndrome	26 (12.6)	13 (4.1)	<0.001
Medical conditions and treatment	82 (39.6)	89 (27.9)	
Smoking, alcohol and drugs	25 (12.1)	23 (7.2)	
Mental health conditions	9 (4.3)	3 (0.9)	
Placenta problems	15 (7.2)	2 (0.6)	
No risk	68 (32.9)	195 (61.3)	
Perinatal Risks[1] (n=530)	*(n=209)*	*(n=321)*	
Feeding difficulties	66 (31.6)	58 (18.1)	
Twins	13 (6.2)	6 (1.9)	<0.001
NICU stay ≥ 5 days	113 (54.1)	52 (16.2)	
NICU stay < 5 days	13 (6.2)	15 (4.7)	
No risk	70 (33.5)	217 (67.6)	
Family Risks (n=530)	*(n=209)*	*(n=321)*	
Poverty suspected	2 (1.0)	12 (3.7)	
Abuse / Neglect	3 (1.4)	1 (0.3)	
Foster care	5 (2.4)	5 (1.6)	
Low education levels of parents	2 (1.0)	4 (1.2)	0.61
Little or poor stimulation from caregivers	11 (5.3)	13 (4.1)	
Adolescent mother	1 (0.5)	2 (0.6)	
Postnatal hospitalization of infant	3 (1.4)	2 (0.6)	
Alcoholic caregivers	0	1 (0.3)	
No risk	195 (93.3)	294 (91.6)	

**Data unavailable for four children*

Discussion

Study results indicated that almost 40% of children assessed at an ECI clinic were born preterm with LBW. Almost all children in the LBW/PTB group (91.9%) had communication and language impairment. This high frequency occurrence is linked to the clinic's typical service users, i.e. young children with communication and language concerns., The majority of the preterm children in the sample were late preterm (35 weeks), with LBW (2303.3g). It is known that late preterm birth represents the largest group of children with LBW/PTB, occurring five times more than children born before 32 weeks gestation age (Saigal & Doyle, 2008). Due to late preterm infants being almost similar in size and weight to their FT peers, they are often treated in the same manner as a FT infant by both parents and medical professionals (Engle, Tomashek, & Wallman 2007). These infants are physiologically and metabolically immature, placing them at high risk for medical complications and infant mortality (Engle et al., 2007). Within this study sample, 95.8% of late PTB children presented with communication and language impairment.

The current study also highlights the many associated conditions and high prevalence of secondary communication and language impairment in preschool children with late PTB. It appears that research typically focuses on the language and communication outcomes of very preterm and extremely preterm children (Nosarti et al., 2010; Rayco-Solon, Fulford, & Prentice, 2005; Sansavini et al., 2015). Late PTB children can therefore easily be overlooked, as the focus of research is often on the population at greater risk for severe disability. Seizure disorder, cerebral palsy, and other neurological conditions occurred rarely in the sample and were not more prevalent in the LBW/PTB group than in the NBW/FT group.

Conditions known to be associated with LBW/PTB were genetic conditions and global developmental delay. Genetic conditions, such as Down syndrome which was the most common genetic condition found in the study sample (45/530; 8.4%), are linked to LBW/PTB (Rasmussen et al., 2006). Velo-cardio-facial syndrome, also known as

22q11.2 deletion syndrome, occurred in 4 (0.75%) children in the sample (Friedman et al., 2011; Rakonjac et al., 2016; Rosa et al., 2011; Shprintzen, 2005). Pierre Robin sequence is a genetic condition and occurred in 11 children within this sample (2.1%), with an incidence varying between 1 in 8500 and 1 in 14000 live births (Rathé et al., 2015). The condition starts developing during embryology, and is caused by a sequence of events caused by a small jaw (micrognathia), resulting in posterior placement of the tongue, which in turn prevents complete closure of the palate (de Buys Roessingh, Herzog, Cherpillod, Trichet-Zbinden, & Hohlfeld, 2008; Rothchild, Thompson, & Clonan, 2008). Global developmental delay, a diagnosis given to children under five years who have not met several developmental milestones at the appropriate age, and who cannot yet be reliably assessed for intellectual disability (APA, 2013), was frequently found in the sample (58/530; 10.9%). It appears that global developmental delay is the most frequently occurring developmental condition in children with LBW/PTB, and that it predicts language development (Rushe, 2010). Autism spectrum disorder has recently been identified as a risk for LBW/PTB (Kihara & Nakamura, 2015). In this study, 70 (13.2%) children had autism, and 16 (22.5%) of these children had LBW/PTB. This number is considerably higher than the national LBW rate in South Africa, therefore this study confirms the risk for LBW/PTB in children with autism spectrum disorder. All these associated conditions add to the complexity of children with LBW/PTB and can easily mask their low gestation age and birth weight. Therefore, most children with LBW/PTB within this study sample presented with multiple risk factors, communication and language impairment and often another developmental disorder as well.

Primary communication and language impairment did not occur more in the LBW/PTB group (27.8%) than in the NBW/FT group (26.8%). Rushe (2010) found that, when children with cognitive disability are excluded from comparisons, the prevalence of communication and language impairment between children born preterm and those born at term remains consistent. This perspective suggests that communication and language impairment in children with LBW/PTB occurs secondary to their cognitive disability. In contrast, Schults et al. (2013) found that more children with LBW/PTB present with primary communication and language impairment, with poorer expressive and receptive language, than their FT counterparts. Further research is required to better understand communication and language impairment in children with LBW/PTB.

Factors found to be most significantly associated with PTB and LBW in this study were small-for-gestation age, maternal prenatal risks, perinatal risks, and caesarean section delivery. Maternal prenatal risks were found to be significantly associated with LBW/PTB. Factors such as medical conditions and treatment during pregnancy, mental health conditions, placental problems such as pre-eclampsia, and smoking, alcohol and drug use during pregnancy are known risks for LBW/PTB (Allen, 2008; Nyarko et al., 2013; Reidy et al., 2013; Sansavini et al., 2015; Stolt et al., 2016). Perinatal risk factors were significantly associated with LBW/PTB in this study. In the study sample, perinatal risk factors included feeding difficulties, multiple pregnancy, and a period in a neonatal intensive care unit (NICU). Infants born preterm often present with feeding difficulties as their neurological systems are still underdeveloped (Mathisen et al., 2012; Nosarti et al., 2010; Rayco-Solon et al., 2005). It is also known that, for various reasons, multiple pregnancy often result in preterm birth before 32 weeks gestation age (Allen, 2008; Zhu, Tao, Hao, Sun, & Jiang, 2010).

Conclusion

The frequency of LBW/PTB was almost 40% in the study sample of children with communication and language impairment. In this predominantly late LBW/PTB sample, secondary communication and language impairment was prevalent, and found to be associated with genetic conditions and global developmental delay. The finding concurs with some studies suggesting that primary communication and language impairment is not more prevalent among children with LBW/PTB than amongst those born NBW/FT, but rather occurs as a secondary impairment. The large sample size of the study strengthens the reliability of the findings. Limitations of the study include the sample size being limited to a single ECI clinic within South Africa, thus not gaining insight applicable to the general population of children with communication and language impairment within South Africa. Furthermore, the LBW/PTB group were compared to FT children with communication and language impairment, not with typically developing children. Further research in the prevalence of communication and language impairment among preterm infants, and the distinction between primary and secondary communication and language impairment within this population may provide further insight into the impact that PTB/LBW has on communication and language development.

CHAPTER 4: RESEARCH IMPLICATIONS AND CONCLUSION

AIM OF CHAPTER

The aim of this chapter is to present the theoretical and practical implications of the study, discuss limitations and to make recommendations for further research.

In South Africa, LBW/PTB rates are as high as 14.17% (Feresu et al., 2015; Howson et al., 2012; Pattinson, 2013). Children born PTB/LBW are at higher risk for a diversity of developmental difficulties, including communication and language impairment (Pattinson, 2013; Van de Weijer-Bergsma et al., 2008). Studies show that many of the less severe developmental difficulties may persist throughout life (APA, 2013; Bailey & Sokol, 2008; Kihara & Nakamura, 2015; Nyarko et al., 2013; Van de Weijer-Bergsma et al., 2008). Communication and language impairment can co-occur with major or minor developmental disabilities, or occur in isolation, and can thus be distinguished into primary and secondary communication and language impairment in children with LBW/PTB. Apart from certain genetic syndromes, congenital disabilities and major disabilities associated with LBW/PTB, which have secondary communication and language impairment as an inherent characteristic, low gestation age and birth weight in itself is associated with language impairment (Peranich et al., 2010). It therefore appears that there are three sub-populations of children born LBW/PTB, with primary or secondary communication and language impairment (as depicted in Figure 1, Chapter 1). The identification of sub-populations of children with LBW/PTB amplifies the effect that low gestation age and birth weight may have on general development, communication and language. Infants and children with LBW/PTB represent a population in South Africa which speech-language therapists should pay close attention to.

This study aimed to determine the frequency of LBW/PTB in comparison with FT birth, among children with communication and language impairment, and to identify factors which are associated with LBW/PTB, communication and language delay.

4.1 Overview of research findings

This study found that almost 40% of the study population of children with communication and language impairment had LBW/PTB, and the majority of this population was born late preterm (35 weeks). Almost all children in the LBW/PTB group (91.9%) had communication and language impairment. Secondary communication and language impairment was found to be associated with genetic conditions and developmental delay, with developmental delay as the most frequently occurring developmental condition in children with LBW/PTB. Factors found to be most significantly associated with LBW/PTB were small-for-gestation age, maternal prenatal risks, perinatal risks, and caesarean section delivery. There was little or no difference between the sample groups, using the Rossetti (2006) categorizations of ‘mild, moderate, and severe’ language impairment. The NBW/FT subgroup presented with a higher rate of severe communication and language impairment (51.1%) than the LBW/PTB group (45.9%). Further analysis of the data may assist to interpret the finding.

4.2 Clinical implications of the study

This study may alert speech-language therapists and other healthcare professionals, such as occupational therapists, physiotherapists, community health nurses and general practitioners in South Africa about the high prevalence of LBW/PTB, and associated communication and language impairment to be expected in their caseloads. Furthermore, this study may increase awareness in professionals that LBW/PTB can affect communication and language development in children in the long-term, and provides a rationale for earlier monitoring of LBW/PTB children, leading to early identification and intervention.

Early identification and screening of communication and language impairment in infants and young children, and the timely provision of early intervention, may not only assist in limiting the negative consequences that communication and language impairment and LBW/PTB has on development, but may also limit the effect it may have on academic and social functioning later in life (Paquette et al., 2015). It is therefore important that these children are supported and monitored specifically during school-going years. As LBW/PTB is a known risk for communication and language impairment (Mathisen et al., 2012), it is important that such children are monitored from a young age and parent education and support be provided early on. An increased awareness among clinicians in contact with infants and young children can result in earlier developmental surveillance of LBW/PTB infants, timely identification of delayed development, and early intervention services provided at a younger age.

4.3 Study strengths and limitations

A major strength of this study was that all data came from one source, and were thus easily accessible and contributed to time efficiency. A consistent protocol was used for all participants, thus allowing for a systematic data capturing system. The large sample size of the study strengthens the reliability of the findings.

Limitations of the study include the setting being limited to only one ECI clinic within South Africa. This resulted in exclusions of a large percentage of the LBW/PTB population, such as those from more rural areas. As a result, study findings cannot be generalized to the larger South African population. Furthermore, the LBW/PTB group was compared to FT children with communication and language impairment, as opposed to typically developing children. Due to the retrospective nature of this study, some data were missing from the files.

4.4 Future research

Further research on the prevalence of communication and language impairment in children born with LBW/PTB may provide further insight into the impact that the condition has on communication and language development. Longitudinal studies, which monitor the outcomes for LBW/PTB children over time, may provide a means to distinguish between primary and secondary communication and language impairment in children with LBW/PTB, as well as define developmental sequelae of these children. Future studies may also provide a platform for a comparative study at other ECI clinics within South Africa, which could include LBW/PTB children with language and communication impairment from both rural and urban areas to generate a more representative sample of the South African population.

This study found that 22.5% of children with autism spectrum disorder were born LBW/PTB, which is considerably higher than the LBW/PTB rate in South Africa. Recent research has identified LBW/PTB as a risk for ASD, with increased emphasis on infants born before 28 weeks gestation age (Kihara & Nakamura, 2015; Leavey et al., 2013). Early identification of children with autism is important, as early intervention for ASD has proven to be effective (Kihara & Nakamura, 2015). Further research is required to understand the causes of LBW/PTB in children with autism.

4.5 Conclusion

While almost 40% of children seen at the early communication intervention clinic were LBW/PTB, 27% of children were born late preterm (35 weeks). As late PTB constitutes the majority of all preterm births (Saigal & Doyle, 2008), this study highlights that this particular subgroup is at risk for developing primary or secondary communication and language impairment. These children are often treated as equals to their FT/NBW peers due to similarities in size and weight (Engle et al., 2007), and could easily be overlooked by healthcare professionals managing them. Children born late preterm are at higher risk for readmission to the NICU during early infancy than their FT counterparts. They often present with more apnoeic attacks (between 4-7%) than infants born FT (less than 1-2%) due to underdeveloped central nervous systems, with a brain size only two thirds of a FT infant brain (Engle et al., 2007).

Reference list

Allen, M. C. (2008). Neurodevelopmental outcomes of preterm infants. *Current Opinion in Neurology*, *21*, 123–128.

American Psychiatric Association [APA]. (2013). *Diagnostic and statistical manual of mental disorders. [DSM-5]*. Washington, D.C.: American Psychiatric Association.

American Speech-Language-Hearing Association [ASHA]. (n.d.). Spoken language disorders. Retrieved November 22, 2016, from http://www.asha.org/Practice-Portal/Clinical-Topics/Spoken-Language-Disorders/

Anderson, D., Fowler, S., & Nelson, J. (1978). Developmental assessment schema. in W.H. Northcott (Ed.). In *Curriculum guide: Hearing impaired children (0-3 years) and their parents*. Washington DC: The Alexander Bell Association.

Arvedson, J. C., & Brodsky, L. (2002). *Pediatric swallowing and feeding: Assessment and management* (2nd Ed.). Canada: Singular Thomson Learning.

Bailey, B. A., & Sokol, R. J. (2008). *Is prematurity a part of fetal alcohol spectrum disorder? Expert Review of Obstetrics & Gynecology*. London: Expert Reviews Ltd.

Behrman, R. E., & Butler, A. S. (2007). *Preterm birth: Causes, consequences, and prevention*. Washington, D.C: The National Academic Press.

Bertrand, J. (2009). Interventions for children with fetal alcohol spectrum disorders (FASD): Overview of findings for five innovative research projects. *Research in Developmental Disabilities*, *30*, 986–1006. http://doi.org/10.1016/j.ridd.2009.02.003

Biswas, A., Su, L. L., & Mattar, C. (2013). Caesarean section for preterm birth and, breech presentation and twin pregnancies. Best practice & research. *Clinical Obstetrics & Gynaecology*, *27*(2), 209–19. http://doi.org/10.1016/j.bpobgyn.2012.09.002

Boyer, J., Flamant, C., Boussicault, G., Berlie, I., Gascoin, G., Branger, B., Roze, J. C. (2014). Characterizing early detection of language difficulties in children born preterm. *Early Human Development*, *90*(6), 281–286.

http://doi.org/10.1016/j.earlhumdev.2014.03.005

Ceccanti, M., Fiorentino, D., Coriale, G., Kalberg, W. O., Buckley, D., Hoyme, H. E., May, P. A. (2014). Maternal risk factors for fetal alcohol spectrum disorders in a province in Italy. *Drug and Alcohol Dependence*, *145*, 201–208. http://doi.org/10.1016/j.drugalcdep.2014.10.017

Claassen, D., Pieterse, J., van der Linde, J., Kruger, E., & Vinck, B. (2016). Risks for communication delays and disorders in infants in an urban primary healthcare clinic. *SAJCH South African Journal of Child Health*, *10*(1), 25–28. http://doi.org/10.7196/SAJCH.2016.v106i1.944

Cooke, R. W. I. (2004). Health, lifestyle, and quality of life for young adults born very preterm. *Archives of Disease in Childhood*, *89*(3), 201–206. http://doi.org/10.1136/adc.2003.030197

Davis, N. M., Ford, G. W., Anderson, P. J., & Doyle, L. W. (2007). Developmental coordination disorder at 8 years of age in a regional cohort of birthweight or very preterm infants. *Developmental Medicine & Child Neurology*, *49*, 325–330.

De Beer, M., Kritzinger, A., & Zsilavecz, U. (2010). Young children with fetal alcohol spectrum disorder - communication profiles. *South African Journal of Communication Disorders*, *57*, 33–42.

de Buys Roessingh, A. S., Herzog, G., Cherpillod, J., Trichet-Zbinden, C., & Hohlfeld, J. (2008). Speech prognosis and need of pharyngeal flap for non syndromic versus syndromic Pierre Robin Sequence. *Journal of Pediatric Surgery*, *43*(4), 668–674.

http://doi.org/10.1016/j.jpedsurg.2007.09.050

Department of Health. (2007). *South Africa demographic and health survey 2003*. (Medical Research Council, Ed.). Pretoria: OrcMacro.

Engle, W. A., Tomashek, K. M., & Wallman, C. (2007). “Late-Preterm” infants: A population at risk. *Pediatrics*, *120*(6), 1390–1401. http://doi.org/10.1542/peds.2007-2952

Feldman, H. M., Lee, E. S., Yeatman, J. D., & Yeom, K. W. (2012). Language and reading skills in school-aged children and adolescents born preterm are associated with white matter properties on diffusion tensor imaging. *Neuropsychologia*, *50*(14), 3348–3362. http://doi.org/10.1016/j.neuropsychologia.2012.10.014

Feresu, S. A., Harlow, S. D., & Woelk, G. B. (2015). Risk factors for low birthweight in Zimbabwean women: A secondary data analysis. *PLoS ONE*, *10*(6), 1–17. http://doi.org/10.1371/journal.pone.0129705

Foundation for Alcohol Related Research [FARR]. (2016). Press Release - International Fetal Alcohol Spectrum Disorder (FASD). Retrieved September 14, 2016, from http://www.farrsa.org.za/press-release-international-fetal-alcohol-spectrum-disorder-fasd/

Friedman, M. A., Miletta, N., Roe, C., Wang, D., Morrow, B. E., Kates, W. R., Shprintzen, R. J. (2011). Cleft palate, retrognathia and congenital heart disease in velo-cardio-facial syndrome: A phenotype correlation study. *International Journal of Pediatric Otorhinolaryngology*, *75*(9), 1167–1172.

http://doi.org/10.1016/j.ijporl.2011.06.013

Gleason, C. A., & Devaskar, S. U. (2012). *Avery's diseases of the newborn* (9th Ed.). Philadelphia: Elsevier Saunders.

Hoff, E. (2014). Interpreting the early language trajectories of chlidren from low SES and language minority homes: Implications for closing achievement gaps. *Developmental Psychology*, *49*(1), 4–14. http://doi.org/10.1037/a0027238

Howson, C., Kinney, M., & Lawn, J. (2012). *Born too soon: The global action report on preterm birth*. Geneva: World Health Organization.

Joint Committee on Infant Hearing [JCIH]. (2007). *Year 2007 Position Statement: principles and guidelines for early hearing detection and intervention programs*. *Pediatrics* (Vol. 120).

Kaiser, A. P., & Roberts, M. Y. (2011). Advances in early communication and language intervention. *Journal of Early Intervention*, *33*(4), 298–309.

Kelly, M. M. (2015). Educational implications of preterm birth: a national sample of 8- to 11-year-old children born prematurely and their full-term peers. *Journal of Pediatric Health Care*, 1–7. http://doi.org/http://dx.doi.org/10.1016/j.pedhc.2015.11.001

Kihara, H., & Nakamura, T. (2015). Early standard development assessment characteristics in very low birth weight infants later classified with autism spectrum disorder. *Early Human Development*, *91*(6), 357–359. http://doi.org/10.1016/j.earlhumdev.2015.03.012

Korpilahti, P., Kaljonen, A., & Jansson-Verkasalo, E. (2016). Identification of biological and environmental risk factors for language delay: The Let's Talk STEPS study. *Infant Behavior & Development*, *42*, 27–35. http://doi.org/10.1016/j.infbeh.2015.08.008

Kurahashi, H., Okumura, A., Kubota, T., Kidokoro, H., Maruyama, K., Hayakawa, M., Watanabe, K. (2016). Increased fetal heart rate variability in periventricular leukomalacia. *Brain and Development*, *38*(2), 196–203. http://doi.org/10.1016/j.braindev.2015.08.008

Le Roux, T., Swanepoel, D. W., Louw, A., Vinck, B., & Tshifularo, M. (2015). Profound childhood hearing loss in a South Africa cohort: Risk profile, diagnosis and age of intervention. *International Journal of Pediatric Otorhinolaryngology*, *79*(1), 8–14. http://doi.org/10.1016/j.ijporl.2014.09.033

Leavey, A., Zwaigenbaum, L., Heavner, K., & Burstyn, I. (2013). Gestational age at birth and risk of autism spectrum disorders in Alberta, Canada. *The Journal of Pediatrics*, *162*(2), 361–368. http://doi.org/10.1016/j.jpeds.2012.07.040

Lee, E. S., Yeatman, J. D., Luna, B., & Feldman, H. M. (2011). Specific language and reading skills in school-aged children and adolescents are associated with prematurity after controlling for IQ. *Neuropsychologia*, *49*(5), 906–913. http://doi.org/10.1016/j.neuropsychologia.2010.12.038

Leedy, P. D., & Ormrod, J. E. (2014). Historical research. In P. D. Leedy & J. E. Ormrod (Eds.), *Practical research: Planning and design* (10th Ed., pp. 173–187). Harlow: Pearson Education Limited.

Martinez-Cruz, C. F., Alonso-Themann, P. G., Poblano, A., & Ochoa-Lopez, J. M. (2012). Hearing loss, auditory neuropathy, and neurological co-morbidity in children with birthweight <750g. *Archives of Medical Research*, *43*, 457–463. http://doi.org/10.1016/j.arcmed.2012.08.007

Mathisen, B. A., Carey, L. B., & Brien, A. O. (2012). Incorporating speech-language pathology within Australian neonatal intensive care units. *Journal of Paediatrics and Child Health*, *48*, 823–827. http://doi.org/10.1111/j.1440-1754.2012.02549.x

Memo, L., Gnoato, E., Caminiti, S., Pichini, S., & Tarani, L. (2013). Fetal alcohol spectrum disorders and fetal alcohol syndrome: The state of the art and new diagnostic tools. *Early Human Development*, *89*(S1), S40–S43. http://doi.org/10.1016/S0378-3782(13)70013-6

Ment, L. R., Ådén, U., Bauer, C. R., Bada, H. S., Carlo, W. A., Kaiser, J. R., Lifton, R. P. (2015). Genes and environment in neonatal intraventricular hemorrhage. *Seminars in Perinatology*, *39*(8), 592–603. http://doi.org/10.1053/j.semperi.2015.09.006

Milgrom, J., Newnham, C., Martin, P. R., Anderson, P. J., Doyle, L. W., Hunt, R. W., Gemmill, A. W. (2013). Early communication in preterm infants following intervention in the NICU. *Early Human Development*, *89*(9), 755–762. http://doi.org/10.1016/j.earlhumdev.2013.06.001

Nosarti, C., Murray, R. M., & Hack, M. (2010). Conclusions: Integrative summary and future directions. In C. Nosarti, R. M. Murray, & M. Hack (Eds.), *Neurodevelopmental Outcomes of Preterm Birth* (pp. 251–264). Cambridge: Cambridge University Press.

Nyarko, K. A., Lopez-Camelo, J., Castilla, E. E., & Wehby, G. L. (2013). Does the relationship between prenatal care and birth weight vary by oral clefts? Evidence using South American and United States samples. *The Journal of Pediatrics*, *162*(1), 42–49. http://doi.org/10.1016/j.jpeds.2012.06.040

Paquette, N., Vannasing, P., Tremblay, J., Lefebvre, F., Roy, M., Mckerral, M., Gallagher, A. (2015). Early electrophysiological markers of atypical language processing in prematurely born infants. *Neuropsychologia*, *79*, 21–32. http://doi.org/10.1016/j.neuropsychologia.2015.10.021

Pattinson, R. (2013). *Saving Babies 2010-2011: Eighth report on perinatal care in South Africa*. (R. Pattinson, Ed.). Pretoria: Tshepesa Press. Retrieved from http://www.ppip.co.za/wp-content/uploads/Saving-Babies-2012-2013.pdf

Peranich, L., Reynolds, K. B., O'Brien, S., Bosch, J., & Cranfill, T. (2010). The roles of occupational therapy, physical therapy, and speech/language pathology in primary care. *The Journal for Nurse Practitioners*, *6*(1), 36–43. http://doi.org/10.1016/j.nurpra.2009.08.021

Pérez-Pereira, M., Fernández, P., Gómez-Taibo, M. L., & Resches, M. (2014). Language development of low risk preterm infants up to the age of 30 months. *Early Human Development*, *90*(10), 649–656. http://doi.org/10.1016/j.earlhumdev.2014.08.004

Polišenská, K., & Kapalková, S. (2014). Language profiles in children with down syndrome and children with language impairment: implications for early intervention. *Research in Developmental Disabilities*, *35*(2), 373–382.

http://doi.org/10.1016/j.ridd.2013.11.022

Pritchard, V. E., Clark, C. A. C., Liberty, K., Champion, P. R., Wilson, K., & Woodward, L. J. (2009). Early school-based learning difficulties in children born very preterm. *Early Human Development*, *85*(4), 215–224. http://doi.org/10.1016/j.earlhumdev.2008.10.004

Rakonjac, M., Cuturilo, G., Stevanovic, M., Jelicic, L., Subotic, M., Jovanovic, I., & Drakulic, D. (2016). Differences in speech and language abilities between children with 22q11.2 deletion syndrome and children with phenotypic features of 22q11.2 deletion syndrome but without microdeletion. *Research in Developmental Disabilities*, *55*, 322–329. http://doi.org/10.1016/j.ridd.2016.05.006

Rasmussen, S. A., Wong, L.-Y., Correa, A., Gambrell, D., & Friedman, J. M. (2006). Survival in infants with Down syndrome, Metropolitan Atlanta, 1979-1998. *The Journal of Pediatrics*, *148*, 806–812.

Rastogi, S., Mikhael, M., Filipov, P., & Rastogi, D. (2013). Effects of ventilation on hearing loss in preterm neonates: Nasal continuous positive pressure does not increase the risk of hearing loss in ventilated neonates. *International Journal of Pediatric Otorhinolaryngology*, *77*(3), 402–406. http://doi.org/10.1016/j.ijporl.2012.11.040

Rathé, M., Rayyan, M., Schoenaers, J., Dormaar, J. T., Breuls, M., Verdonck, A., Hens, G. (2015). Pierre Robin sequence: Management of respiratory and feeding complications during the first year of life in a tertiary referral centre. *International Journal of Pediatric Otorhinolaryngology*, *79*(8), 1206–1212.

http://doi.org/10.1016/j.ijporl.2015.05.012

Rayco-Solon, P., Fulford, A., & Prentice, A. (2005). Differential effects of seasonality on preterm birth and intrauterine growth. *American Journal of Clinical Nutrition*, *81*(1), 134–139.

Reidy, N., Morgan, A., Thompson, D. K., Inder, T. E., Doyle, L. W., & Anderson, P. J. (2013). Impaired language abilities and white matter abnormalities in children born very preterm and/or very low birth weight. *The Journal of Pediatrics*, *162*(4), 719–724. http://doi.org/10.1016/j.jpeds.2012.10.017

Robertson, C. M. T., Howarth, T. M., Bork, D. L. R., & Dinu, I. A. (2009). Permanent bilateral sensory and neural hearing loss of children after neonatal intensive care because of extreme prematurity: A thirty-year atudy. *Pediatrics*, *123*(5), e797–e807. http://doi.org/10.1542/peds.2008-2531

Rosa, R. F. M., Trevisan, P., Koshiyama, D. B., Pilla, C. B., Zen, P. R. G., Varella-Garcia, M., & Paskulin, G. A. (2011). 22Q11.2 Deletion syndrome and complex congenital heart defects. *Revista Da Associação Médica Brasileira (English Edition)*, *57*(1), 62–65. http://doi.org/http://dx.doi.org/10.1016/S2255-4823(11)70018-2

Rosenfeld, R. M., Culpepper, L., Doyle, K. J., Grundfast, K. M., Hoberman, A., Kenna, M. a., Yawn, B. (2004). Clinical practice guideline: otitis media with effusion. *Otolaryngology -- Head and Neck Surgery*, *154*(1S), S1–S41. http://doi.org/10.1016/j.otohns.2004.02.002

Rossetti, L. (2006). The Rossetti Infant-Toddler Language Scale. East Moline, IL: Lingui Systems.

Rossetti, L. M. (2001). *Communication intervention: Birth to three* (2nd Ed). Wisconsin: Singular Thomson Learning.

Rothchild, D., Thompson, B., & Clonan, A. (2008). Feeding update for neonates with Pierre Robin Sequence treated with mandibular distraction. *Newborn and Infant Nursing Reviews*, *8*(1), 51–56. http://doi.org/10.1053/j.nainr.2007.12.009

Rugolo, L. M. S. (2005). Growth and developmental outcomes of the extremely preterm infant. *Jornal de Pediatria*, *81*(1), 101–110.

Rushe, T. M. (2010). Language function after preterm birth. In C. Nosarti, R. M. Murray, & M. Hack (Eds.), *Neurodevelopmental outcomes of preterm birth* (pp. 176–184). Cambridge: Cambridge University Press.

Saigal, S., & Doyle, L. W. (2008). An overview of mortality and sequelae of preterm birth from infancy to adulthood. *Child: Care, Health & Development*, *34*(3), 407–408.

Sansavini, A., Bello, A., Guarini, A., Savini, S., Alessandroni, R., Faldella, G., & Caselli, C. (2015). Noun and predicate comprehension and production and gestures in extremely preterm children at two years of age: Are they delayed? *Journal of Communication Disorders*, *58*, 126–142. http://doi.org/10.1016/j.jcomdis.2015.06.010

Schults, A., Tulviste, T., & Haan, E. (2013). Early vocabulary in full term and preterm Estonian children. *Early Human Development*, *89*(9), 721–726.

http://doi.org/10.1016/j.earlhumdev.2013.05.004

Shprintzen, R. J. (2005). Velo-cardio-facial syndrome. *Progress in Pediatric Cardiology*, *20*(2), 187–193. http://doi.org/10.1016/j.ppedcard.2005.04.009

Soleymani, Z., Joveini, G., & Baghestani, A. R. (2015). The communication function classification system: Cultural adaptation, validity, and reliability of the Farsi version for patients with cerebral palsy. *Pediatric Neurology*, *52*(3), 333–337. http://doi.org/10.1016/j.pediatrneurol.2014.10.026

Stolt, S., Lind, A., Matomäki, J., Haataja, L., Lapinleimu, H., & Lehtonen, L. (2016). Do the early development of gestures and receptive and expressive language predict language skills at 5;0 in prematurely born very-low-birth-weight children? *Journal of Communication Disorders*, *61*, 16–28. http://doi.org/10.1016/j.jcomdis.2016.03.002

Strydom, H. (2005). Ethical aspects of research in the social sciences and human service professions. In R. Odendaal, W. von Gruenewaldt, D. Venter, M. Marchand, & A. Barnby (Eds.), *Research at grass roots. For the social sciences and human service professions* (3rd Ed., pp. 67–68). Pretoria: Van Schaik Publishers.

Thomas, M. S. C., Forrester, N. A., & Ronald, A. (2013). Modeling socioeconomic status effects on language development. *Developmental Psychology*, *49*(12), 2325–43. http://doi.org/10.1037/a0032301

Van de Weijer-Bergsma, E., Wijnroks, L., & Jongmans, M. J. (2008). Attention development in infants and preschool children born preterm: A review. *Infant Behavior and Development*, *31*, 333–351.

http://doi.org/10.1016/j.infbeh.2007.12.003

Van Dommelen, P., Verkerk, P. H., & Van Straaten, H. L. M. (2015). Hearing loss by week of gestation and birth weight in very preterm neonates. *The Journal of Pediatrics*, *166*(4), 840–844. http://doi.org/10.1016/j.jpeds.2014.12.041

Van Niekerk, E., Kirsten, G. F., Nel, D. G., & Blaauw, R. (2014). Probiotics, feeding tolerance, and growth: A comparison between HIV-exposed and unexposed very low birth weight infants. *Nutrition*, *30*, 645–653. http://doi.org/10.1016/j.nut.2013.10.024

Wardlaw, T., Blanc, A., Zupan, J., & Ahman, E. (2004). *Low birthweight: Country, regional and global estimates*. (UNICEF, Ed.). New York: WHO Publications.

Weijerman, M. E., van Furth, A. M., Vonk Noordegraaf, A., van Wouwe, J. P., Broers, C. J. M., & Gemke, R. J. B. J. (2008). Prevalence, neonatal characteristics, and first-year mortality of Down syndrome: A national study. *The Journal of Pediatrics*, *152*(1), 15–19. http://doi.org/10.1016/j.jpeds.2007.09.045

Wolke, D., Samara, M., Bracewell, M., & Marlow, N. (2008). Specific language difficulties and school achievement in children born at 25 weeks of gestation or less. *Journal of Pediatrics*, *152*(2), 256–262.

Xoinis, K., Weirather, Y., Mavoori, H., Shaha, S. H., & Iwamoto, L. M. (2007). Extremely low birth weight infants are at high risk for auditory neuropathy. *Journal of Perinatology*, *27*, 718–723. http://doi.org/10.1038/sj.jp.7211803

Yin, R., Yuan, L., Ping, L., & Hu, L. (2016). Neonatal bronchopulmonary dysplasia increases neuronal apoptosis in the hippocampus through the HIF-1 and p53 pathways. *Respiratory Physiology & Neurobiology*, *220*, 81–87. http://doi.org/10.1016/j.resp.2015.09.011

Zhu, P., Tao, F., Hao, J., Sun, Y., & Jiang, X. (2010). Prenatal life events stress: Implications for preterm birth and infant birthweight. *American Journal of Obstetrics and Gynecology*, *203*(1), 34.e1-34.e8. http://doi.org/10.1016/j.ajog.2010.02.023

APPENDIX A: PERMISSION FROM HEAD OF DEPARTMENT

TO CONDUCT STUDY

APPENDIX B: ETHICAL CLEARANCE

APPENDIX C: EXAMPLE OF INFORMED CONSENT TO PARENTS

APPENDIX D: DATA COLLECTION SHEET ENTRIES

Appendix D: Description of data collection sheet entries used for data collection

Entry	Description
File number	The file number was used for administration purposes to avoid duplicate entries.
Participant number	Each participant was allocated a unique number to be used as their identity.
Year of initial assessment	Year of assessment was recorded in order to categorize the information.
Age at assessment (in months)	Age of the child (in months)
Gender	Male / Female
Race	African, White, Coloured, Indian
Mother's age at birth	Age of the mother in years
Presence of communication and language impairment	Yes / No
Degree of communication and language impairment	Categorised according to Rossetti (2006): Mild (3-6m), Moderate (6-12m), Severe (15m or more) (as indicated in file)
Primary developmental condition	The *primary* developmental condition of the child – primary problem at the time of assessment.
Was the diagnosis confirmed?	This established whether the child's diagnosis (primary dev. condition) had been confirmed by a medical practitioner, or whether it was suspected.
Additional developmental condition	Conditions the child presented with other than, or secondary to the primary developmental condition (Paquette et al., 2015).
History of otitis media	Indicates whether the child had a history of OM, as this poses a risk for temporary hearing loss and delayed language development (Rosenfeld et al., 2004).
Number of otitis media episodes	How many episodes of OM the child had since birth (up to the date of assessment) as reported by the parents
Grommets at time of assessment	Presence of grommets at the time of assessment provided a reason for no tympanogram readings.
Middle ear status (Left and Right)	Tympanogram type for each ear: Type A, As, B, C or D
Were abnormal tympanometry measurements confirmed as OM by medical practitioner?	Provided information on whether middle ear status had been diagnosed by a medical practitioner as OM. This confirms whether the child had OM, and whether the risk for temporary hearing loss and communication delay was present.
Method of delivery at birth	Provided information on whether the infant was born via normal vaginal delivery, or via caesarean section.
Did the child have LBW?	Yes / No
Category of LBW	The WHO classification of LBW was used (Howson et al., 2012; Wardlaw et al., 2004): LBW, VLBW, ELBW.
Birth weight	Provided the birth weight of the infant (in grams).
PTB	Yes / No

Entry	Description
Degree of PTB	According to the WHO classification system (Howson et al., 2012; Wardlaw et al., 2004): Preterm, very preterm, extremely preterm
Gestational age	Provided gestational age in weeks
Small-for-gestation age?	Information on whether the infant was small for his/her gestation age or not. This indicates whether the infant was born with intra-uterine growth restriction, resulting in LBW.
APGAR score	The APGAR score provided the researcher with information on whether the child had birth asphyxia or not. Options: Normal (7-9), moderate asphyxia (4-6), severe asphyxia (0-3) (Arvedson & Brodsky, 2002).
Feeding difficulties at time of assessment	Yes / No / Not determined
Prenatal risk factors	Risk factors that related to the mother or foetus during pregnancy
Additional neonatal/perinatal risks other than LBW/PTB	Perinatal risk factors that may have had an influence on the child's communication development
Family risks for communication delay	Recording of family risks that may have contributed to the child's communication difficulties, such as poverty, abuse/neglect, foster care, education levels of parents, etc.
Family history of communication delay?	Tells the researcher whether there was a family history of communication delay, as this may be an inherited condition.
Postnatal medical conditions	Any medical conditions the child presented with after discharge from the NICU, as this may have had an effect on the communication development of the child.
Medical procedures	Provided information on whether the infant had any medical procedures (such as surgery), performed after birth, as this may have affected the development of the child.
Educational qualifications of primary caregiver	<Gr12, Matric, Tertiary. Low education levels of parents affect children's development (Hoff, 2014).
Medical services used	Public health care / private health care. Provided information on financial status of the family.
Occupation of mother	Occupation of the mother and father at time of assessment. This provided the researcher with information on the living circumstances and financial situation of the family.
Occupation of father	
Home language	African languages (Northern Sotho, Setswana, etc), Afrikaans, English and Other (such as German and French).
Language exposure	Monolingual / multilingual
Daycare	At home with primary caregiver, home with caregiver other than primary caregiver, family member, crèche, nursery school
Area of residence	The area of residence of the direct family. This provided information about the geographical distribution of families seen at the clinic.
Town of residence	This information provided information on the living circumstances of the family.
Urban / rural	Yes/No
Other comments	Any additional information that may have be relevant but did not fall under any of the other categories

APPENDIX E: CASE HISTORY FORM

APPENDIX F: PROOF OF ARTICLE SUBMISSION