Prenatal stimulation program to enhance postnatal bonding

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PREFACE

The article format has been selected for this study. The MCur student, Melissa van der Walt, conducted the research and wrote the manuscript under the supervision of Dr Welma Lubbe, Mrs Heleen Coetzee and Prof Hanlie Moss, the co-authors of the article. Dr Lubbe acted as supervisor and Mrs Coetzee and Prof Moss as co-supervisors.

The manuscript: “Prenatal stimulation program to enhance postnatal bonding” was written according to the instructions to authors and will be submitted to the *Africa Journal of Nursing and Midwifery*.

Permission was obtained from Dr Welma Lubbe for the article (manuscript) to be submitted for examination.

As yet, no permission was obtained from the editor of the journal for copyright.

DECLARATION FROM STUDENT THAT PLAGIARISM HAS BEEN AVOIDED

I, Mrs Melissa van der Walt, ID 8809290037080, student number: 20694709, hereby declare that I have read the North-West University’s “Policy on Plagiarism and other forms of Academic Dishonesty and Misconduct” (NWU, 2011).

I did my best to acknowledge all the authors that I have cited and I tried to paraphrase their words to the best of my ability, but still portraying the correct meaning of their words.

I also acknowledge that by reading extensively about the topic some information may have been internalised in my thinking, but tried my best to give recognition to the original authors of the ideas.

I declare that the dissertation is my own work although I respect the professional contribution made by my supervisors and I would like to give due recognition to them.

Mrs Melissa van der Walt

Date: December 2014

ABSTRACT

Background: The bonding process can start to develop as early as the planning of a pregnancy and can affect the relationship between mother and child through childhood. If proper bonding is not established, the child can present symptoms of depression, failure to thrive or delays in social and emotional, language or motor development. Stimulation programs implemented during pregnancy may positively affect the bonding process that act as a protective factor against negative outcomes in childhood, adolescence and adult life, for instance substance abuse, poor social coping skills and academic failure.

Objectives: To determine and describe the effectiveness of *The Baby Bond* comprehensive stimulation program on bonding six weeks post intervention.

Method: The researcher employed an experimental, pre-test-post-test randomised control group design in this study. Experimental and control groups randomly received the same pre- and post-test: the Prenatal Attachment Inventory within the third trimester of pregnancy and the Maternal Attachment Inventory six weeks post birth. *The Baby Bond* sensory stimulation program was added to standard antenatal care for the experimental group and the control group received a general stimulation program and standard antenatal care. The data was analysed with the SPSS program version 22.0 by the Statistical Consultation Services at the North-West University, Potchefstroom campus. SPSS was used to compile descriptive statistics from the experimental and control groups, Mann Whitney test and the effect size.

Results: The twelve participants that were included in this study were from a variety of ethnic origins, in stable relationships and their ages ranged from 20-34 years. In the results, no statistical significant changes were found between the two groups with the Mann Whitney test. The pre-intervention variables (mean = 66.45) were not significantly different from the post-intervention measurements (mean = 101.03). A medium practical significant difference was identified between the groups (d=0.52) which can indicate that some changes in bonding did take place when implementing the comprehensive sensory stimulation program: *The Baby Bond*.

Conclusion: *The Baby Bond* sensory stimulation program did not indicate a significant improved bonding as compared to general antenatal care between the mother and baby at six weeks after birth. However, future research in the optimal time for bonding interventions in larger sample sizes is needed, for more conclusive findings.

Key words: Attachment, bonding, neonatal period, perinatal period, stimulation programs.

OPSOMMING

Agtergrond: Die binding tussen die moeder en baba kan so vroeg as tydens die beplanning van swangerskap begin ontwikkel en kan die verhouding tussen die moeder en die baba dwarsdeur die kinderjare beïnvloed. Indien daar nie ‘n behoorlike binding gevestig word nie, kan die kind simptome van depressie toon, misluk om te floreer of vertragings in sosiale en emosionele, taal- of motorise ontwikkeling vertoon. Stimulasieprogramme wat tydens swangerskep geïmplementeer word, kan die bindingsproses positief beïnvloed wat as ‘n beskermende faktor dien.

Doelwitte: Om die effektiwiteit van die *The Baby Bond* omvattende stimulasieprogram op binding ses weke na intervensie te bepaal en te beskryf.

Metode: ‘n Eksperimentele, voor-toets-na-toets ewekansige kontrolegroepontwerp is vir die studie gebruik. Eksperimentele en kontrolegroepe het ewekansig dieselfde voor- en na-toets ontvang: die Prenatale Aanhegtingsinventaris in die derde trimester van swangerskap en die Moederlike Aanhegtingsinventaris ses weke na geboorte. *The Baby Bond* sensoriese stimulasieprogram is bygevoeg by die standaard antenatale sorg vir die eksperimentele groep en die kontrolegroep het ‘n algemene stimulasieprogram en standaard antenatale sorg ontvang. Die data is met die SPSS-program weergawe 22.0 geanaliseer deur die Statistiese Konsultasiedienste van die Noordwes-Universiteit, Potchefstroomkampus. SPSS is gebruik om beskrywende statistieke van die eksperimentele en kontrolegroepe, die Mann Whitney-toets en die effekgrootte saam te stel.

Resultate: Die twaalf deelnemers wat in hierdie studie ingesluit is, was van verskeie etniese oorspronge, in stabiele verhoudings en hulle ouderdomme het gewissel tussen 20-34 jaar. In die resultate is geen statisties beduidende veranderinge tussen die twee groepe met die Mann Whitney-toets gevind nie. Die pre-intervensieveranderlikes (gemiddeld = 66.45) was nie beduidend verskillend van die post-intervensiemetings (gemiddeld = 101.03) nie. ‘n Medium praktiese beduidende verskil kan tussen die twee groepe (d=0.52) gesien word, wat kan aandui dat sekere veranderinge in binding wel plaasgevind toe die omvattende sensoriese stimulasieprogram: *The Baby Bond* geïmplementeer is.

Gevolgtrekking: *The Baby Bond* sensoriese stimulasieprogram het nie ‘n beduidende verbeterde binding soos vergelyk met algemene voorgeboorte sorg, tussen moeder en baba ses weke na geboorte aangetoon nie. Toekomstige navorsing in die optimale tyd vir bindingsintervensies vir ‘n groter aantal deelnemers is egter nodig vir meer deurslaggewende bevindings.

Sleutelwoorde: Aanhegting, verbinding, neonatale periode, perinatale periode, stimulasie-programmme.

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LIST OF ABBREVATIONS

BFHI	Baby Friendly Hospital Initiative
HIV	Human Immunodeficiency Virus
IEEE	Institute of Electrical and Electronics Engineers
KMC	Kangaroo Mother Care
MAI	Maternal Attachment Inventory
MHaPP	Mental Health and Poverty Project
NRF	National Research Foundation
NWU	North-West University
PAI	Prenatal Attachment Inventory
PMHP	Perinatal Mental Health Project
SD	Standard deviation
StatsSA	Statistics South Africa
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organisation

CHAPTER 1: OVERVIEW OF THE STUDY

1.1 Introduction

Chapter one provides an outline of this study. The researcher will provide the background that led to the problem statement of this study, followed by the problem statement. The research question, aim and objectives that were derived from the problem statement will follow. Thereafter, the research design and methods and ethical considerations applicable to the study will be discussed. Lastly, the researcher will provide a conclusion to the study outline.

1.2 Background

Bonding is the loving relationship between the mother and the child that grows through their interactions (Myers, 2006:239). This bonding relationship has proved to be a pro-active protective factor in life (Bavolek & Rogers, 2012:7; Mackay, 2003:99-100). If this bonding relationship is established properly, children are able to build secure attachment relationships (Malekpour, 2007:82) that reduce the risk for educational difficulties, mental health- or behavioural problems (Flaherty *et al*., 2011:114; Klaus & Kennell, 1976:13; Lee & Lok, 2011:4; Malekpour, 2007:92).

In South Africa HIV, alcohol abuse, depression and low socio economic income often compromise the outcomes of pregnancies (Tomlinson *et al.* 2013:277). Therefore, by establishing a good prenatal attachment, the protective factor in life increases and this reduces the probability of negative outcomes in childhood, adolescence and adult life, for instance substance abuse, poor social coping skills and academic failure (Brandon *et al*. 2009:209).

Prenatal attachment can be enhanced through implementing a stimulation program that is sensitive to the developmental stages of the foetus (DiPetro, 2010:31). Various programs to establish bonding are available, but according to literature these programs are not comprehensive in nature, since they do not for example consider foetal development and do not include all the senses (Burke, 2007:84-125; Carolan *et al.*, 2012:174; Panthuraamphorn, 1998:136-142; Van de Carr & Lehrer, 1988:87).

Prenatal sensory stimulation programs like *The Baby Bond* can however be used to establish this bonding relationship before birth (Abasi *et al*., 2012; Elliot, 1999:4; National Abandoned Infants Assistance Resource Center, 2013; Panthuraamphorn, 1999:181; Van der Carr & Lehrer, 1988:101).

1.3 Problem statement

Pregnancy and prenatal well-being is an international health priority that has not received enough attention. The WHO (2014) indicated that research to this regard is urgently needed and necessary. Prenatal bonding can act as a protective factor to enhance the physical, cognitive and psycho-social development of a child (Myers, 2006:9). Various factors can challenge bonding, such as teen and unplanned pregnancies, lack of support systems, depressed parents, experiences of previous pregnancies, troubled past of parents, socio-economic and environmental circumstances and stress during pregnancy (Flaherty & Sadler, 2011:114-115,119; Klaus & Kennell, 1976:12; Myers, 2006:1156; Ossa *et al*., 2012:692-693). All South Africans, including families in the high income groups (Herman *et al*., 2009:342), are at risk of experiencing the abovementioned factors, due to socio economic challenges, such as unemployment (StatsSa, 2014), high divorce rates (StatsSa, 2011), high prevalence of single parent households (StatsSa, 2014), high crime rates (FactSheet & Guide, 2012/13) and other factors such as HIV, alcohol abuse and depression (Tomlinson *et al*., 2013:277). It was found that the Western Cape also have a high prevalence to these factors.

Literature describes existing prenatal stimulation programs to enhance bonding or they are available to the public, but they only incorporate selected sensory systems and do not focus on the development of the foetus. *The Baby Bond* is a unique prenatal sensory-based stimulation program that aims to stimulate all prenatal sensory systems in order to enhance prenatal and postnatal bonding. The effect of *The Baby Bond* sensory stimulation program on the bonding experienced by the mother at six weeks post birth, after it has been initiated during the third trimester of pregnancy, has however not yet been explored in a South African context.

1.4 Aim and objectives

Aim

To determine whether a selected comprehensive sensory antenatal stimulation program *The Baby Bond* contributes towards improved bonding six weeks after birth.

Objective

To determine and describe the effectiveness of *The Baby Bond* comprehensive sensory stimulation program on bonding between the mother and child in the Western Cape, private sector, six weeks after birth.

1.5 Research question

How effective is *The Baby Bond* sensory stimulation program with regards to bonding as bonding is experienced by the mother six weeks after the birth of her infant?

1.6 Definition of key concepts

The researcher derived the definitions from various literature sources:

Bonding: The relationship between the mother and the infant that starts to develop prenatally and continues after birth; it is characterised by the mother's feelings for her infant (Myers, 2006:239; 1156; Sadock *et al*., 2007:138).

Stimulation program (Prenatal): Consists of different modes of stimulation, such as auditory (talk to the foetus and play stimulating music), tactile (kicking games- when baby kicks mother taps on abdomen, movement of mother) and taste (from the mother's diet), that cause an effect on the foetus at different gestations of development (Burke, 2007:84-125; Van de Carr & Lehrer, 1988:91-93).

Perinatal period: This period extends from the 24th week of pregnancy to the end of the first week of life (Harrison, 2008:1).

Neonatal period: The neonatal period is divided into the early neonatal period (from birth to seven days) and the late neonatal period (begins on day eight and ends on day 28) (Harrison, 2008:1). Thus, the total neonatal period starts at birth and ends after a month (Harrison, 2008:1).

1.7 Research methodology

The researcher will use a quantitative approach in this study. A quantitative approach can be defined as a formal, objective, systematic study process to describe and test relationships and to examine cause-and-effect interactions among variables (Burns & Grove, 2009:716). The researcher will discuss the methodology in detail in Chapter 3.

1.7.1 Research design

The researcher employed an experimental pre-test-post-test randomised control group method in this study. Whatever happens in the one group should also be repeated in the other, with the exception of the treatment/intervention tested (Botma *et al*., 2010:121). The experimental group received *The Baby Bond* sensory stimulation program added to standard antenatal care and the control group received an alternative stimulation program, which is not as sensory comprehensive in nature, as well as standard antenatal care (Burns & Grove, 2009:263). This design was helpful to determine whether *The Baby Bond* sensory stimulation program has an effect on bonding as perceived by mothers six weeks after the birth of their infant.

1.7.2 Research method

The research method provides an overview of the population, sample, measuring instruments and data collection procedures (Botma *et al*., 2010:199).

1.7.2.1 Population

Botma *et al*. (2010:200) define the population as the individuals that meet the criteria the researcher plans to study. The target population of this study was pregnant women attending standard antenatal care in the private sector in the Western Cape, South Africa, with first singleton pregnancies considered low risk and healthy. The participants had to be within the physiological maternal age of 20-34 years (excluding teen pregnancies and advanced maternal age), with completion of secondary education (holds a matric certificate or equivalent) and be in a steady relationship. The pregnant women were in their third trimester (27 weeks to birth) of pregnancy.

1.7.2.2 Sample

According to Burns and Grove (2009:42) the sample is the subset of the population that is selected to participate in the study. In this study, the mediators within the population obtained the sample. Only 13 participants met the inclusion criteria and volunteered to participate in this study. One participant completed the PAI questionnaire, but delivered within one week thereafter, and as a result withdrew from the study. The final sample size was 12. The sample was randomly drawn for the experimental and control groups.

1.7.2.3 Measuring instruments

The researcher used two measuring instruments developed by E. Muller, namely the Prenatal Attachment Inventory (PAI) for prenatal assessment of attachment and the Maternal Attachment Inventory (MAI) for postnatal assessment of attachment, in this study. The experimental and control groups completed the questionnaires at pre-determined times. Apart from the PAI, all participants who volunteered to participate in the study completed a demographic information questionnaire. The researcher will discuss the instruments in Chapter 3.

1.7.2.4 Data collection

The researcher collected the data from the sample with the PAI and MAI instruments. The prenatal assessment of attachment was done, with both the experimental and control groups completing the PAI in the third trimester of pregnancy. The demographic information was also gathered at this stage.

The experimental group received an existing structured sensory stimulation program – *The Baby Bond Stimulation Program* (Annexure F- to implement as intervention, added to their standard antenatal care during the third trimester of pregnancy. The control group continued standard antenatal care with an added alternative stimulation program as intervention (Annexure G). The researcher will discuss the interventions in more detail in the literature review (chapter 2) and methodology chapter (chapter 3).

The second instrument was used to assess the postnatal maternal attachment in the experimental and control group. This was measured by completing the MAI six weeks after birth.

1.8 Rigour

According to Botma *et al*. (2010:84) rigour refers to the reduction of errors and weaknesses to ensure that the outcome of the study is an accurate reflection of the study. Rigour mainly entails validity and reliability (Klopper & Knobloch, 2009:3).

1.8.1 Validity

Validity refers to the degree to which the measurement represents a true value (Botma *et al*., 2010:174). Various factors influence the internal and external validity of a study, such as selection, history and mortality (Botma *et al*., 2010:174-177). The researcher considered these factors and discussed it in detail in Chapter 3.

1.8.2 Reliability

In this study, the instruments measured what it was supposed to measure. The reliability of the instruments was previously calculated (Muller, 1996:164; Muller, 1993:204), but the statistical department of NWU also calculated the reliability of these instruments as will be discussed in Chapter 3.

1.9 Ethical considerations

Ethical approval has been granted by the Health Research Ethics Committee, Faculty of Health Sciences of the North West University – NWU-00141-13-S1 (Annexure H). The researcher followed the ethical considerations as described in the Declaration of Helsinki, Nuremberg Code; and that of the medical research council that stipulate the procedure to follow with the handling of human subjects in medical research (Botma *et al*., 2010:3).

The researcher obtained consent to use the instruments in this study from Muller; this consent is attached in Annexure B. Permission was obtained from healthcare providers that act as mediators in the study. The researcher obtained informed consent from all the participants before any data was collected. The participants received both verbal and written information before voluntary consent was obtained. Voluntary participation and the right to withdraw at any time during the study without any prejudice were emphasised. Pregnant women are part of a vulnerable group in research, but in this study, no intervention was implemented that was detrimental to the participant.

The researcher considered and assured the participants of privacy, anonymity and confidentiality at all times, by numbering the inventories, instead of using names (Burns & Grove, 2009:194,196-197; Benatar *et al*., 2007:37). The results are (and will be) published or presented in such a fashion that all participants remain unidentifiable. The participants had an opportunity to indicate whether they wanted feedback on the research findings. After the examination, the researcher provided feedback to the participants that requested it. The documents will be kept under lock and key for six years, on a password-protected computer, at the School of Nursing Science, North-West University, Potchefstroom campus.

According to literature, a benefit of this study entails that by implementing the prenatal sensory stimulation program (*The Baby Bond*), bonding can be improved, and this may be beneficial to reduce future problems (e.g. social or behavioural). Literature further indicated that stimulation in the prenatal period can initiate development, such as foetal memory, language development and food preferences. Auditory stimulation can for example start to develop the child’s language development and foetal memory before birth.

The researcher planned to refer/suggest to the participants to attend different postnatal bonding programs, for example massaging, if the control group were to present with poorer bonding than the experimental group. However, it was not indicated in this study, due to the results that showed only a medium practical significance and no statistical significance between the groups.

Every participant had a fair opportunity to treatment, by implementing random sampling. The participants were chosen, because they are directly related to the research problem.

The researcher focused on protecting all participants from discomfort and harm, as this is a principle of beneficence. The research and the stimulation program did not intend to do any physical, psychological, social, economic, legal or dignity harm to the mother or foetus (Benatar *et al*., 2007:28; Botma *et al*., 2010:23). In this study, the participants experienced no discomfort due to the stimulation program, but if it was necessary, the participant would have been referred to her particular healthcare professional for assistance. The participant could withdraw at any time during the study.

The researcher aimed to comply with ethical considerations throughout the whole study, from the planning to the reporting of results. The researcher always considered the three main principles, i.e. respect for people, beneficence and justice (Botma *et al*., 2010:277).

1.10 Dissertation outline

This study has the following outline:

The dissertation consists of four chapters, of which the references will be provided at the end of the dissertation, except for chapter three where the referencing for the article will follow the author guidelines.

Chapter 1: Introduction

This chapter provides an overview of what was done in this study. It gives a brief background that leads to the problem statement and the aim of the study. The researcher provides a brief explanation of the methodology and design used in this study, as well as a description of the measures to ensure rigour and ethical considerations for this study. This chapter was written according to the NWU manual for postgraduate studies (2013:13).

Chapter 2: Literature review

Chapter 2 consists of the literature review and provides information on the available literature on this topic. The researcher identified the shortcomings of the literature. This chapter was written according to the NWU manual for postgraduate studies (2013:13).

Chapter 3: Article

Chapter 3 contains the article titled: 'Prenatal stimulation program to enhance postnatal bonding', to be submitted to the Africa Journal of Nursing and Midwifery. The article consists of the following sections: Introduction and background, problem statement, purpose of the study, definition of key terms, methodology, ethical considerations, results, discussion of results, conclusion, recommendations, limitations, acknowledgements and references for the article. The researcher followed the author guidelines, but for the purpose of the dissertation, the researcher did not adhere to the word count in order for the research to be described thoroughly. The article will be shortened according to the guidelines before submission for publication. The researcher inserted the tables in the text as per the journal guidelines. The text style in this chapter is different from the rest of the dissertation due to adherence to the guidelines. Referencing for this chapter was done according to the journal guidelines, and it is provided at the end of the chapter. The remainder of the references can be found at the end of the dissertation.

Chapter 4: Summary, conclusions, limitations and recommendations

Chapter 4 provides a summary and conclusion for the study. The limitations and recommendations identified in this study are also discussed. This chapter is written according to the NWU manual for postgraduate studies (2013:14).

1.11 Chapter conclusion

This chapter provided an overview of the study. A discussion on the background that led to the problem of the study and the problem statement were provided in this chapter. The research question, aim, objectives, research design, methods, ethical considerations and a chapter overview were provided.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

A good bond and relationship between a mother and child have been proved to be pro-active and protective factors in life (Bavolek & Rogers, 2012:7; Mackay, 2003:99-100). Bonding refers to the loving relationship between the mother and the growing child through their interactions (Myers, 2006:239). According to Myers (2006:239), bonding is necessary for developing affectionate ties that later affects the physical and psychological development of the child. This bonding relationship starts to develop from the moment the parents plan the pregnancy, right through the child's childhood (Young, 2013:11). Researchers proved that poor bonding can be linked to emotional and cognitive problems, such as depression and substance abuse, it can also result in poor growth in infancy, delayed social, emotional, language or motor development, mental disorders, physical abuse, attention deficit disorder and many more difficulties in childhood or adolescence (Benoit, 2004:544; Field, 1995:1,6-8; Honikman, 2011; Murray & Cooper, 1997:99-100; Papousek & von Hofacker, 1998:419-420; Perry, 2001:4). On the other hand, research suggests that a good prenatal attachment acts as a strong protective factor that reduces the probability of negative outcomes, such as substance abuse, poor social coping skills and academic failure in childhood, adolescence and adult life (Brandon *et al*., 2009:209).

Literature shows that bonding can be challenged by teen and unplanned pregnancies, lack of support systems, depressed parents, experiences of previous pregnancies, troubled pasts of parents, socio-economic and environmental circumstances and stress during pregnancy (Flaherty & Sadler, 2011:114-115,119; Klaus & Kennell, 1976:12; Myers, 2006:1156; Ossa *et al*., 2012:692-693). Sickel (2013:9-10) elaborates on this by indicating that various psychological and physical risk factors, such as a previous history of domestic violence, drug abuse, medical problems, quality of marital relationships, social support and socio-economic status can impact negatively on the bonding process.

The abovementioned challenges are more relevant in the South African context, where socio economic challenges, such as unemployment (StatsSa, 2014), high divorce rates (StatsSa, 2011), high prevalence of single parent households (StatsSa, 2012) and high crime rates (AfricaCheck, 2012/13) create a challenging environment to raise a child. The Perinatal Mental Health Project (PMHP) that forms part of the Mental Health and Poverty Project (MHaPP) that was launched September 2002 in the Western Cape, South Africa, used some of the abovementioned risk factors as focus for their project (Honikman, 2011). This PMHP

(2014) aims to deliver holistic mental healthcare to all women pre-and postnatal at the site of obstetric care. They found that antenatal distress, such as a lack of supportive partners, HIV, unwanted pregnancies, teen pregnancies, violence, abuse and recent negative life events, effect bonding between the mother and the child in the South African context (Honikman, 2011). The PMHP further indicates that antenatal distress can lead to postnatal distress, which revolves into further compromised bonding, that later leads to problems in infancy and childhood (Honikman, 2011).

Satyanarayana *et al*. (2011:352) found that the prevalence of antenatal distress is higher in developing countries than in developed countries. South Africa that is known as a developing country (International Statistical Institute) reports 19.14 births per 1000 of the population in 2013 (CIA World Factbooks, 2013). HIV, alcohol abuse, depression and low socio economic income often compromise the outcomes of pregnancies in South Africa (Tomlinson *et al*., 2013:279-281). It was interesting that research by Herman *et al*. (2009:342) elaborated on these findings when they found that not only women from low-income societies are psychologically at risk during pregnancy, but also high-income families. They are at higher risk for moderate to severe mental illnesses, such as anxiety disorder and depression. Substance abuse, such as alcohol and cannabis, are more prevalent in educated and high-income groups (Herman *et al*., 2009:342; Van Heerden *et al.*, 2009:360-361,363).

With the abovementioned in mind, the deduction can be made that even clients seeking private healthcare in South Africa may be regarded at risk for bonding problems. This is due to stressors experienced at work, stressful and challenging family relationships, depression related to the mentioned stressors and may, in addition, be influenced by the economic problems that are typically seen in South Africa. Added to that, clients accessing private healthcare are often taking part in infertility treatment, which may increase the stressors already mentioned. In a study by Wisner *et al*. (2013) the researchers found that pregnant women form an essential part of the mental health issues and concerns of the world. Almond (2009) indicated that the general and psychological wellness of pregnant women can be seen as a public health priority, which do not receive enough resources and attention to be pro-actively and preventatively treated.

Interventions that can pro-actively help to overcome the abovementioned prenatal risk factors and improve bonding are specific sensory stimulation programs like *The Baby Bond* (Abasi *et al*., 2012:818-819; Elliot, 1999:4; National Abandoned Infants Assistance Resource Center, 2013; Panthuraamphorn, 1999:181; Van der Carr & Lehrer, 1988:101). Van der Walt (2012) developed *The Baby Bond* sensory stimulation program to ensure bonding in the

maternal-infant relationship. This program is unique in the sense that it incorporates the developmental stages of the foetus and the implementation of stimulation at the appropriate gestational age. A research study concerning the effectiveness of this programme is relevant in South Africa and internationally, as the World Health Organisation (2014) indicated that they support programs that are based on literature and focuses on enhancing pregnancy and child-care outcomes, from conception through to the postpartum period.

Stimulation programs normally consist of different modes of stimulation, such as auditory (talk to the foetus, play stimulating music), tactile (kicking games, movement of the mother) and taste (through the mother's diet) that affect the foetus at different gestations (Burke, 2007:84-125; Van de Carr & Lehrer, 1988:91-93). It is important that the particular stimulations are applied at the correct gestational age (Van de Carr & Lehrer, 1988:92), since the neuronal wiring of the unborn foetus is subjected to critical periods where certain stimuli may be optimal or harmful. A healthy prenatal bond leads to a positive postnatal bond, and if this is established, it may lead to a positive influence that will have a long-term effect on the child's developmental outcomes, for example social and motor development (Malekpour, 2007:92).

In this literature review, bonding and how it is formed will be discussed. The researcher will also give attention to foetal development and critical periods for development, different stimulation techniques according to the foetal senses and the effect thereof on bonding and development post birth. This literature review will provide a summary of the available literature on this topic and will also be used as a basis for discussing the results.

2.2 The relationship between bonding and prenatal stimulation programs

2.2.1 Bonding defined

Attachment and bonding are often used interchangeably, but they are different phenomena. The researcher derived the following definitions from authoritative researchers in the field. Bonding refers to the mother's feelings for her infant and it differs from attachment in the sense that bonding is a one-way relationship from the mother towards her baby. The mother does not rely on her infant as a source of security (Kaplan & Saddock, 1991:107). This relationship is important as discussed in background. Attachment, on the other hand, is defined as an emotional relationship that exists between two people that is specific and endures time. It is characterised by the infant seeking out, clinging to, and wanting to be near a specific person (Kaplan & Saddock, 1991:106; Klaus & Kennel, 1976:2).

2.2.2 Development of bonding during pregnancy

During pregnancy, a variety of hormones, such as oxytocin, vasopressin, prolactin, opioids, norepinephrine, and more are present in the human body. Oxytocin is referred to as the bonding hormone (Palmer, 2002). Oxytocin receptors in the pregnant mother's brain (the part that promotes maternal behaviour) multiplies dramatically near the end of pregnancy, due to the elevated levels of oestrogen during pregnancy (Palmer, 2002). Fathers are also influenced by the oxytocin hormone through frequent contact with his wife at the end of his wife's pregnancy (Palmer, 2002) and this contributes towards more involvement with the infant and the infant showing more interest in the mother after birth (Palmer, 2002).

A study performed by Feldman *et al*. (2007:969) investigated the levels of plasma oxytocin in the first trimester, third trimester and first month postnatal and its connection with bonding. The results of the study indicated that high oxytocin levels are consistent throughout pregnancy and in the postpartum month, but the initial level predicts bonding (Feldman *et al*., 2007:969). Oxytocin is related to the mental and behavioural aspects of bonding, which supports information stating that high levels of oxytocin support an exclusive relationship. Specific stimulation actions from the mother, for example singing a special song for the baby during pregnancy and repeating it regularly even afterwards, form and enhance this exclusive relationship (Feldman *et al*., 2007:969).

Cortisol, the stress hormone, leads to compromised physical growth in the foetus, low birth weight, delayed neuro-motor development and shorter attention span after birth (Palmer, 2002). According to De Weerth and Buitelaar (2005:296) and Mulder *et al*. (2002:10), there are three possible ways for the stress hormone to affect the foetus: a) Stress results in elevated cortisol levels, which can cross the placental barrier and influence the foetal physiology. b) The maternal hypothalamus-pituitary-adrenal cortex system (HPA-axis) hormones can stimulate the placenta to produce a corticotropin-releasing hormone (CRH) that enters the foetal circulation. c) Maternal stress then results in increased cortisol and catecholamine levels, which in turn leads to reduced utero placental blood flow. This increased cortisol levels reduces the release of the oxytocin hormone that is responsible for bonding (Palmer, 2002). High or low levels of oxytocin control the infant's stress handling portion of the brain. The interaction between low levels of oxytocin and high levels of cortisol could have a negative impact on the bonding capacity of the mother and baby. In the long run, this could be a contributing factor to either securely attached or insecure characteristics in the adolescent and adult life (Palmer, 2002). According to Myers (2006:239), bonding is essential for developing affectionate ties that later affects the physical and psychological development of the child. In contrast, insecure characteristics could lead to difficulty in

forming lasting bonds, antisocial behaviour, aggression, mental illness and poor handling of stress (Palmer, 2002; Weinstok, 2005:304).

To enhance bonding, stimulation programs, that may positively affect the bonding process, can be implemented during pregnancy (Panthuraamphorn *et al.,* 1999:181; Van der Carr & Lehrer, 1988:101). An important aspect of all available stimulation programs is the fact that it is initiated during the second and third trimesters of pregnancy. This practice was supported by a study performed on Italian women with gestational ages between 21-36 weeks. This study indicated that the Prenatal Attachment Inventory [PAI (Italian version)] scores increased gradually with gestational age (Vedova *et al*, 2008:95). All articles reviewed also indicated that prenatal attachment is usually formed from the second trimester (Burke, 2007:84-125; Panthuraamphorn, 1998:139; Van de Carr & Lehrer, 1988:91-93; Vedova *et al.*, 2008:95). It is important that the particular stimulations are implemented at the correct gestational age, since the neuronal wiring of the unborn foetus is subjected to critical periods where certain stimuli may be optimal or harmful (Elliot, 1999:4). Therefore, the deduction can be made that, although the initial level of oxytocin predicts bonding, research regarding bonding and foetal developmental stages should also be considered. Thus, the researchers recommend that stimulation programs are only implemented from the third trimester, which is when the critical periods for optimal sensory system development are evident.

2.2.3 Bonding and attachment

As defined earlier, bonding is the relationship that forms between the mother and child that develops prenatally and continues after birth (Myers, 2006:39). Attachment is the emotional relationship that exists between the child and primary caregiver (Malekpour, 2007:82). In this study bonding and attachment is used interchangeably. Bonding involves a variety of interactions that can help to establish an emotional connection (attachment relationship) (Perry, 2001:2). This attachment can be categorised in two main groups, namely secure attachment and disorganised attachment (Malekpour, 2007:82).

Secure attachment is established when the caregivers respond in a positive and sensitive manner to the child's emotional needs (Benoit, 2004:543; Malekpour, 2007:82). According to Malekpour (2007:83-84) future relationships and trust in other people is based on a secure attachment between the mother and child. Therefore, it becomes evident that a child's adaptive capacities, such as empathy, cognitive development and emotional regulation, are formed on the basis of secure attachment (Malekpour, 2007:83).

Disorganised attachment can further be divided into three categories, namely insecure-avoidant, insecure-resistant and insecure-disorganised attachment (Benoit, 2004:543; Malekpour, 2007:82). Insecure-avoidant attachment happens when the caregivers are insensitive (no sympathy) and reject the child when in distress, this results in children not reacting when the parent leaves or return (Malekpour, 2007:87). Insecure-resistant attachment often occurs when the parents are not nurturing and protective; which often leads to relationship difficulties and withdrawal from others in later life (Malekpour, 2007:87-88). Insecure-disorganised attachment often occurs due to parents that have unresolved emotional issues and develops into developmental and behavioural issues in children. Therefore, it is necessary to establish good bonding between the mother and infant to ensure effective secure attachments that can act as a pro-active protection for future functioning and relationships.

In order to improve this mother-infant relationship, South Africa is currently focusing on the Baby Friendly Hospital Initiative (BFHI) and Kangaroo Mother Care (KMC) (Matsoso, 2013; DOH, 2011; UNICEF, 2014b). The BFHI has proven to be a method to enhance breastfeeding, facilitate skin-to-skin contact and to enhance maternal-infant bonding (UNICEF, 2014a). KMC provided benefits for the mother and infant, such as prolonged breastfeeding, improved physiological development, improved parent-infant bonding (the father can also implement KMC) and more empowered parents (Western Cape, 2003:6).

With the above mentioned in mind, the other main constructs of this study, namely foetal development and stimulation programs, will now be discussed in more detail. This will provide support from literature for applying certain types of sensory stimulation at the gestational ages when it will be the most effective.

2.3 Foetal development to highlight the development of bonding in utero

The foetus develops over a period of 40 weeks and the five main sense systems, somatosensory (touch); chemosensory (taste and smell); vestibular; auditory and visual, develop during this period. The following section will discuss the foetal development, with specific reference to the senses in the sequence of its development.

2.3.1 Somatosensory system

The somatosensory system oversees all sensation of pain, temperature and proprioception (Elliot, 1999:124, 126). The skin of the whole body reacts to touch stimulation at 13-14 weeks gestation, except the back of the trunk and the top of the head (Lecaneut & Schaal, 1996:2). In the third trimester (from 27 weeks), the touch receptors at the end of the touch-

sensitive sensory neurons, are able to translate the mechanical pressure into long-distance electrical signals that travel into the spinal cord and then up into the brain stem (Elliot, 1999:124-125). The primary touch-neurons synapses into the thalamus (the relay station for almost all forms of sensory information), and when they reach the thalamus the touch-communication neurons are activated (Elliot, 1999:125). The touch-communication neurons, whose axons reach the somatosensory region of the cortex, allow the foetus to perceive the sense of touch from 27 weeks gestation (Elliot, 1999:125); therefore, it is most effective to implement stimulation from the third trimester. According to Kenner and Lubbe (2007:228) the unborn foetus can be stimulated through touch, by stimuli such as 'the kicking game', deep pressure provided by massaging or applying lotion to the abdomen of the mother.

2.3.2 Chemosensory system

The chemosensory system includes the sense of smell and taste. The sucking reflex is established at 12 weeks and the taste buds all over the mouth are matured by 13 weeks (Lecaneut & Schaal, 1996:3). Thus, it is possible for the foetus' taste system to be stimulated by the mother's diet and the foetal urine (Chamberlain, 2009).

The olfactory system includes three major components: the olfactory epithelium, the olfactory bulb and the olfactory cortex (Shaker *et al*., 2012:1). The olfactory epithelium is the first neuron in smell perception and it has the form of hair, like cilia (Elliot, 1999:158). From 26 weeks gestation the cilia is able to trap the odour chemicals; binding them to specific receptors to convert the chemical information into electrical signals (Kimura *et al*., 2009:104; Elliot, 1999:158). The olfactory epithelium sends the electrical signals along short axons that synapse into the olfactory bulb (Elliot, 1999:158). The limbic system that controls emotions, drives and memories, is one of the direct targets of the olfactory bulb (Elliot, 1999:158). The stimulation of the limbic system, act as an indication of the strong emotional impact that odours have (Jackson, 2009:97).

The olfactory system starts to develop at six weeks and the foetus is able to smell at 28 weeks gestation (Browne, 2008:181). In order to avoid continued bathing of the nasal cavities by amniotic fluid, the nasal cavity is filled with a plug-like tissue between eight and twenty-four weeks of gestation (Browne, 2008:181). This ensures the prevention of contact and stimulation between the immature nasal epithelium and amniotic fluid (Elliot, 1999:163). The chemoreceptors are stimulated by the amniotic fluid or air-based neurons (Browne, 2008:181). The amniotic fluid holds characteristics of the mother's diet, and serves as the basis for taste and odour preferences experienced in-utero (Mennella & Ventura, 2011:155; Menella, 2006:635). According to Browne (2008:183) the mother's diet lays a foundation for

the infant's socialisation and attachment, due to the familiar odour that he/she was predisposed to in-utero. In conclusion, the foetal chemosensory system can be stimulated by the mother's diet. It would therefore be beneficial to encourage a balanced diet to all pregnant mothers.

2.3.3 Vestibular system

The vestibular system allows the foetus to perceive body movement and a degree of balance (Elliot, 1999:146). It starts to develop from as early as five weeks post conception and is fully functional at twenty-five weeks gestation (Bremner *et al*., 2012:7). The foetus is able to respond to movement stimulation at ten weeks after conception and when the vestibular system is fully matured, the foetus is able to sense his/her orientation with respect to gravity, allowing him/her to rotate in the proper position (head down) for birth (Elliot, 1999:151). The vestibular and auditory systems start developing together. The vestibular system progresses quicker, because the early start of vestibular activities plays an important role in the development of the nervous system (Elliot, 1999:149). The foetal vestibular system is thus stimulated through passive movement such as the mother walking, swaying, rocking and dancing throughout pregnancy, but external stimulation should only be included in stimulation programs from 25 weeks gestation according to development (Oeftering, 2000:6-8; Parncutt, 1993:255).

2.3.4 Auditory system

The auditory system of the foetus shows matured synapses between 24 and 28 weeks gestation, although the cochlea is already functional at 20 weeks gestation (Lecaneut & Schaal, 1996:4). According to Hepper and Shahidullah (1994:F82), the foetus already shows active listening from 19 weeks gestation. With the cochlea being functional at 19-20 weeks, the cilia can form synapses with the first neurons in the auditory system, enabling the foetus to hear low-pitched sounds from as early as 19-20 weeks gestation (Elliot, 1999:234-235). At 24 weeks, the ear is structurally complete (Chamberlain, 1997). At 34 weeks gestation the foetus has developed his/her own preference for music, due to the fact that the auditory freeholds (interpretation by the brain of what it hears) are the same than the adults' preferences (Foster & Verny, 2007:273). Exposure to internal maternal sounds stimulates the foetus constantly, for instance movements in maternal gut, blood rushing through veins and heartbeat (Lubbe, 2013:4). The best way of external auditory stimulation is by talking to the foetus gently; then after the fifth month playing stimulating music such as lullabies near the abdomen (Kenner & Lubbe, 2007:228).

2.3.5 Visual system

The visual system starts to develop last in the gestational sequence and continues to develop after birth. There are two different types of visual systems, namely; the magno ("where") and the parvo ("what") systems (Glass, 2002:2). The "where" system, that functions earlier than term birth, responds to light, movement, edge, and large high-contrast form (Glass, 2002:2). The "what" system is operational from two months of age and forms the essence of cortically mediated vision: sensitivity to finer detail, subtle contrast or shading, and processing and organizing those bits into meaningful information (Glass, 2002:2). The eyelids of the foetus remain fused until 26 weeks, and the muscle that is controlling the sphincter of the iris only develops at 32 weeks gestation to protect the retina against light (Lubbe, 2013:4). Premature stimulation may lead to aberrations of brain development, for example the full term infant is more auditory-dominant than visual-dominant, and if the visual attending is increased the responsivity to auditory input could decrease, which could impact language development (Glass, 2002:2; Hopson, 1998:47). Graven and Browne (2008:194) stated that the foetus needs no external visual stimulation or light before birth, because final myelination is not complete until middle childhood (Foster & Verny, 2007:274).

2.3.6 Neurodevelopment

During the second and third trimester, the spinal and central nervous system nociceptive nerve tracts establish myelination (Hatfield, 2014:S481). By 30 weeks gestation, the ascending nociceptive pathways to the brain stem and thalamus are complete (Hatfield, 2014:S481). The brain development is mature from 30 weeks of gestation and includes the sensory, limbic, motor and cognitive systems (Graven & Browne, 2008:196). Each of these systems develop in a sequence and works in integration with each other. The physical and social environment of the foetus plays an important role in support of brain development and the neurosensory systems (Graven & Browne, 2008:196). Neurological development can only develop or realise full potential, if the particular neurons are exposed to external stimulation, including sight, sound, maternal moods, and others (Yamada *et al*., 2013). Exposure to a range of maternal emotions assists the neurological development of the foetus (Polomeno, 1997:14); this can be due to the effect of the mother's mood on her autonomic nervous system and endocrine system that is responsible to release hormones such as endorphins (DiPetro *et al*., 1996:147; Underdown & Barlow, 2012:8; Stockwell, 2014; Van Leeuwen *et al*., 2009:13665).

In conclusion, the foetal brain develops during the gestational period and is activated by the stimulation of the different foetal sensory systems in a pre-set sequence, i.e. tactile (somatosensory), chemosensory, vestibular, auditory and visual (Yamada *et al*., 2013; Polomeno, 1997:14). Therefore, it became clear from the literature on foetal development, that all the senses, except vision, are matured enough to receive additional stimulation for foetal response from the third trimester (27 weeks) of pregnancy. Stimulation at the appropriate gestational stage can be very valuable in forming the relationship and pre- and postnatal bond between mother and infant (DiPetro, 2010:31).

Different stimulation techniques can be used to stimulate the different senses at the correct gestational age. With the abovementioned developmental goals of the foetus in mind, various stimulation programs and techniques have been developed. The researcher will now focus on the relevant stimulation techniques that can be used.

2.4 Stimulation techniques

2.4.1 Somatosensory stimulation techniques

Somatosensory and tactile stimulation can be used interchangeably. Tactile stimulation is one of the most popular techniques used in stimulation programs. Prenatal tactile stimulation promotes mother and child bonding through balancing the hormones oxytocin and cortisol, but it allows the foetus to react to outside stimuli such as pain, touch and temperature as explained previously (Panthuraamphorn, 1999:180). Mothers often stimulate the foetus by caressing her abdomen, without realising it (Lubbe, 2013:3).

Two forms of tactile stimulation are massage and patting on the abdomen. The mother can massage the baby when applying lotion, bathing or with deep pressure in the form of effleurage (Kenner & Lubbe, 2007:227; Lubbe, 2013:3). Rhythmic patting on the foetus' bum, patting the abdomen when the foetus moves (Panthuraamphorn, 1999:175) or the "kicking game" (Chamberlain, 1997) can be a pleasurable experience for the mother, father, family and the foetus. This can establish a routine practice to enhance the infant's emotional development and it is easy to continue after birth (Panthuraamphorn, 1999:180).

2.4.2 Auditory stimulation techniques

The uterus is not a quiet environment, for the unborn baby frequently hears the mother's heartbeat, sounds produced by the intestines and the mother's voice. The voices of the parents, heartbeats and music are common sounds that can be utilised to stimulate the auditory system (Carolan *et al.*, 2012:176-177; Kisilevsky *et al*., 2004:557).

Music can be an enjoyable experience for the mother. It reduces maternal stress (sedative and stimulative music) and therefore it encourages infant bonding. This is the case because the mother finds a way to communicate with her unborn child in times when she does not know what to say or as an additional tool of communication (Carolan *et al*, 2012:176-177). When stress is reduced, the mother is relaxed (lower cortisol levels) and respiration is low, this will cause the foetal heart rate to drop (DiPietro *et al*., 2008:18). This reaction can be explained by the foetal cardiac system that seems to be capable to adjust to external stimulation, due to the co-activation of the parasympathetic and sympathetic components of the autonomic nervous system that is responsible to release hormones such as endorphins. This reaction can improve bonding (DiPetro *et al*., 1996:147; Stockwell, 2014; Van Leeuwen *et al*., 2009:13665).

If the foetus hears the same music daily, he/she builds up foetal memory that can be transferred to the postnatal period (Van de Carr & Lehrer, 1988:96; Wilkin, 1996:165). This can be due to the response of the moulding of the neural network, pathways and midbrain that are formed by the stimuli (Joseph, 2002:88-89). Mothers often use music as a form of communication after birth; when the child is unsettled, the mother can sing a song, for instance lullabies, to the child to calm him/her down, because it has a sedative effect (Carolan *et al.*, 2012:174,178; Lorch *et al*., 1994:116).

A study that exposed the infants to four different types of music from 32 weeks gestation to 6 weeks postnatal, yielded results of infants more ready to listen, more receptive, more alert and active to music after birth than infants who were not exposed to this music (Wilkin, 1996:164,168). Near term foetuses showed an increase in body movements and increased heart rate when exposed to sedative music (Kisilevsky *et al*., 2004:557). Term foetuses are also able to identify a change in tempo of music, recognised by an increase in heart rate (Kisilevsky *et al*., 2004:557). Thus a more mature auditory system is capable to respond to different auditory stimuli, indicating that higher auditory perceptions begin before birth and hearing becomes more sensitive during development (Kisilevsky *et al*., 2004:557-558). Studies where a control and experimental group were used, proved that the maternal voice and the frequent hearing thereof, through the repetition of a nursery rhyme from 33-37 weeks gestation, resulted in the newly born recognising the mother's voice and showing increased memory of this particular rhyme (Chamberlain, 1997; Kisilevsky *et al*., 2009:70; Spence & Freeman, 1996:199). Different studies of prenatal voice and language stimulation indicate that neural networks are sensitive to the mother's voice and the native language, and that foetal memory and learning start before birth when the auditory system develops (Chamberlain, 1997; Kisilevsky *et al*., 2009:70; Spence & Freeman, 1996:199). Therefore,

the deduction can be made that auditory stimulation can facilitate bonding through different means of communication, such as talking, singing a song or reading a nursery rhyme.

2.4.3 Gustatory (Taste) stimulation techniques

There is a range of tastes in the amniotic sac, including lactic, pyruvic, citric acids, creatinine, urea, amino acids, protein and salts. The foetus is able to differentiate between tastes, since foetuses prefer sweet to bitter tastes (Lecaneut & Schaal, 1996:3; Chamberlain, 2009; Chamberlain, 1997). This preference is evident when the foetus reacts to bitter tastes by reduced swallowing of the amniotic fluid, indicating a dislike in taste (Lecaneut & Schaal, 1996:3). The placenta allows the chemical components (the aromatic signature) of the mother's diet to cross and join in the amniotic fluid (Browne, 2008:181; Chamberlain, 2009). Therefore, the amniotic fluid can serve as a flavour bridge to breast milk, since it carries the food flavours from the mother's diet (Hopson, 1998). This statement is supported by the research of Mennella *et al*. (2001:2), in which foetuses that were exposed to carrot juice or water prenatally, when the mothers drank 300ml four times a day, expressed positive facial expressions to food with a carrot taste after birth (Mennella *et al*., 2001:4). The exposure to certain types of food prenatally, can also create a preference for a certain flavour in solid foods during the weaning period (Mennella *et al*., 2001:1). A mother's diet stimulates the foetus' gustatory system prenatally, inevitably the foetus will experience the same taste when breastfeeding. This could encourage successful breastfeeding and bonding after birth. Thus, the mother can stimulate her foetus' gustatory system by eating a balanced diet or introducing foods that are acceptable in their culture, for example, spicy foods eaten during pregnancy will contribute that the child recognises the taste after birth (Mennella *et al*., 2001:5). This leads to early attachment between the mother and the infant, which can contribute to nurturing, nutrition and good relationships (Browne, 2008:184).

2.4.4 Olfactory stimulation techniques

Both the amniotic fluid and the mother's breast milk originate in the mothers blood system. The same principle as explained under stimulation techniques is applied for olfactory chemical components. Research affirms that the human foetus is able to detect and memorise odour information received by the mother's diet prenatally (Browne, 2008:181; Chamberlain, 2009; Schaal *et al.,* 2000:735). This statement is supported by the study of Schaal *et al.* (2000:730) in which the foetus was exposed to anise flavoured food and drinks (cookies, sweets, syrup) in the last two weeks of pregnancy. The results of the study indicated that selective perception and learning of the odour can be identified in the infant after birth (Schaal *et al*., 2000:735). This can help to explain why infants are predisposed to

the mother's breast milk, even if there is no previous exposure to it (Chamberlain, 2009). This can indirectly assist in supporting successful breastfeeding, as the newly born would be attracted to the mother's breast (Vaglio, 2009:279). This could be beneficial to bonding, as breastfeeding is believed to support the bonding process after birth (Himani *et al*., 2011:107).

2.4.5 Vestibular stimulation techniques

The vestibular senses play an important role in mental and neurological development (Elliot, 1999:154). The foetus himself/herself or the mother's movements can stimulate the vestibular system. According to Hopson (1998:45), the foetus is constantly exploring his/her environment by flexing and extending his/her body, moving his/her head, face and limbs.

Due to the early maturation of the vestibular system, the body movements are perceptive (Parncutt, 1993:260). Maternal movement such as exercise, dancing and aerobics can be beneficial to the mother during pregnancy, since it supports weight control; relaxation, flexibility and strength (McMurray *et al*., 1995:284; Oeftering, 2000:6-8). The developed vestibular system allows the foetus to experience rocking movements through the mother's activities (Oelftering, 2000:6-8; Parncutt, 1993:255).

Stimulation of all three semi-circular vestibular canals in infants prove to be enjoyable for infants; in addition, researchers observed a significant increase in motor skills when sitting, standing and crawling. Vestibular stimulation affects the foetus, for example rocking can lead to an increased foetal heart rate (Lecanuet & Jacquet, 2001:63-64).

Prenatal learning can influence postnatal perception and learning. This statement is supported by a study in which the infants of mothers who rocked in a rocking chair for 15 min a day during pregnancy, stopped crying when rocked in the chair after birth (Panthuraamphorn, 1999:180). The stimulation of the vestibular system helps to soothe the infant, but it is also critical for early neurodevelopment and affects the other sensory and motor abilities (Elliot, 1999:146,154,156). Therefore, when stimulating the vestibular system prenatally, behaviours will be learnt that can help to soothe the infant after birth (Esposito *et al*., 2013:739-740). This results in a calm mother and an increased opportunity for bonding (Palmer, 2002).

2.4.6 Visual stimulation techniques

Natural stimulation of the visual system ("where" system) happens in the womb, for the foetus sees light through the abdomen and the amniotic fluid from 26 weeks of gestation

(Foster & Verny, 2007:274; Glass, 2002:3-4). According to Glass (2002:2), overstimulation of the visual system before birth may cause a delay in other sensory system development, such as in the auditory system. Chronologically, the auditory system needs to mature before stimulation of the visual system commences (Glass, 2002:2). If the visual system is over stimulated by for instance flashing a torch on the abdomen, it may negatively impact language development later in life, since the visual system is not yet mature enough to handle the stimulation provided (Glass, 2002:2).

From the literature, it is clear that the prenatal stimulation discussed above, and thus stimulation programs can assist in the establishment of bonding prenatally and after birth (Browne, 2008:184; Esposito *et al*., 2013:739-740; Kisilevsky *et al*., 2009:70; Himani *et al*., 2011:107; Spence & Freeman, 1996:199; Panthuraamphorn, 1999:180). Table 1 provides a summary to demonstrate the different systems and the gestation at which the development starts, as well as the time in which a system is mature enough for selected stimulation. The different stimulation techniques for every system are also included.

Table 1: Summary of foetal stimulation in terms of sensory system development and maturation and appropriate types of stimulations

System	Gestation		Types of stimulation
	Onset of development	System mature for stimulation	
Somatosensory (Tactile)	13-14 weeks, whole body except back of trunk and top of the head (Lecaneut & Schaal, 1996:2).	Third trimester fully developed (Elliot, 1999:125).	'Kicking game' (Chamberlain,1997). Rhythmic patterning on the abdomen when foetus moves (Panthuraamphorn,1999:175). Deep pressure provided by massaging or applying lotion to the abdomen of the mother (Kenner & Lubbe, 2007:227; Lubbe, 2013:3).
Chemosensory (taste and smell)	Taste buds all over the mouth are matured at 13 weeks (Lecaneut & Schaal, 1996:3).	Foetus is able to smell at 28 weeks gestation (Browne 2008:181).	Stimulated by mothers' diet and foetal urine (Lecaneut & Schaal, 1996:3).
Vestibular	5 weeks of gestation (Bremner et al., 2012:7)	25 weeks of gestation (Bremner et al., 2012:7).	Stimulated by the mother's movement and by amniotic fluid (Oeftering, 2000:6-8; Parncutt, 1993:255;260)
Auditory	Functional from 20 weeks of gestation (Lecaneut & Schaal, 1996:7).	Preference to own music from 34 weeks of gestation (Foster & Verny, 2007:273).	Stimulated through mother's voice (Wilkin, 1996:169). Playing stimulating music near the abdomen (Lubbe, 2013:3).
Neural	Structural formation starts at three weeks and peaks at seven weeks (Stiles & Jernigan, 2010:335).	30 weeks of gestation (Graven & Browne, 2008:196).	Stimulated through stimulation of different sensory systems (Yamanda *et al*., 2013; Polomeno, 1997:141).
Visual	Eyes remain closed until 26 weeks of gestation (Lubbe, 2013:4).	Only fully developed after birth (Foster & Verny, 2007:274).	No stimulation (Glass, 2002:2).

Various stimulation programs are available that consist of similar stimulation techniques. A discussion on available programs will follow.

2.5 Prenatal stimulation programs

Since bonding is such an important developmental task, researchers have developed various programmes to ensure bonding in the maternal-infant relationship. The researcher explored the literature to identify the available prenatal stimulation programs. She found a variety of programs that often focuses on one or more senses. However, most of the stimulation programs focus on auditory development, including programs such as 'Make way for baby' and 'Lullabies'. Five available programs were identified that on face value seemed to correlate with what the researcher intended to measure/determine in this study, and these will be described in more depth to provide an overview of what is currently available with regards to bonding stimulation. The programs are: 1) Prenatal University, 2) Prenatal Infant Stimulation Program, 3) The 18 Hour Stimulation Program, 4) Lullabies, and 5) *The Baby Bond*.

(1) **Prenatal University**: Van de Carr and Lehrer (1988:99) developed and implemented a prenatal stimulation program based on the available evidence of foetal development at the time (Van de Carr & Lehrer, 1988:91-93). The stimulation program was developed for working parents, as only two five-minute sessions per day is utilised and is used widely in various countries (Van de Carr & Lehrer, 1988:87). The stimulation program is initiated at 20 weeks gestation and more complex stimulation is introduced from 32 weeks gestation (Van de Carr & Lehrer, 1988:87). The program focuses on the auditory, tactile and spatial senses (Van de Carr & Lehrer, 1988:87). Different stimulation techniques are used, including the kicking game, specific diet programs, playing recordings or singing a song (Van de Carr & Lehrer, 1988:95-97). Over a period of seven years of practical experience, follow-up visits and interviews with the parents, the researchers found that this program is effective in showing improvement in the infant performance (type of performance not identified), positive bonding between the parents and the child, and positive interaction between parent-child and parent-parent (Van de Carr & Lehrer, 1988:95-97). The article did not provide a sample size.

(2) **Prenatal Infant Stimulation Program**: The prenatal stimulation program, designed by Panthuraamphorn (1998), consists of two parts that are initiated at 18 weeks of gestation. Part one focuses on stimulating the mother, including breathing exercises and essential nutrition to support foetal brain growth, while part two provides

stimulation for the foetus, such as tactile stimulation in the form of massaging of the abdomen with water from a shower head; auditory stimulation through playing recordings of mothers singing to their foetuses. From 28 weeks gestation the mother plays a bell game when the child moves; the mother provides visual stimulation, which include shining a torch on the abdomen through coloured paper and vestibular stimulation is provided by means of the mother using a rocking chair when she feels like it (Panthuraamphorn, 1998:136-142). The researcher collected the data through questionnaires, measurements (height and head) and the Denver developmental screening tests at birth, as well as one, two and three months post birth (Panthuraamphorn, 1998:143,152-154). The study had a sample of 24, with 12 participants in the experimental group and the other 12 in the control group (Panthuraamphorn, 1998:142). Parents had to apply the program for two hours four times a month (Panthuraamphorn, 1998:142). The study results at one and two months after birth, have shown that the stimulation program enhances physical, cognitive and social development in the fine and gross motor performance, speech and language acquisition, height and head circumference (Panthuraamphorn, 1998:159).

(3) **The 18 Hour Stimulation Program**: Burke (2007:5) developed another stimulation program. In this 18 hour (3 day) stimulation program, the researcher introduced interventions in the second or third trimester, such as preparing parents for birth, diet education, exercises, parenting skills, music stimulation in association with movement and baby kicking experiences (Burke, 2007:84-125). The research assistant instructed the 18 hour program. The researcher collected the data from the 12 participants (Burke, 2007:34) and all the information from the inventories. The prenatal attachment inventory by Muller (1993) was used to measure the prenatal attachment of the mothers before and after interventions. The outcome of the study indicated that the program influenced the maternal emotional attachment, which increased gradually over time after birth (Burke, 2007:28).

(4) **Lullabies**: Stimulation programs, such as *Make way for Baby* (Manrique, 1997), use music stimulation. The foetuses were prenatally stimulated with lullaby music that the mothers sang (Carolan *et al*, 2012:174). The sample contained six participants that practiced and sang provided lullaby songs (Carolan *et al*, 2012:174). The mothers' experiences were measured through interviews three months after birth (Carolan *et al*, 2012:174). The lullaby singing reduced maternal stress, were used as a calming and

communication method prenatally and after birth, and proved some attachment enhancement prenatally (Carolan *et al*., 2012:178).

(5) **The Baby Bond**: Researchers developed *The Baby Bond* Sensory Stimulation Program from literature, taking the positive aspects from well researched stimulation programs, but adding a comprehensive component that focus on all the foetal senses and their critical developmental periods in utero, as well as on the critical sensitive times for influencing the development of bonding between a mother and her unborn infant. If implemented correctly, *The Baby Bond* was developed to support a routine practice that can be transferred to a postnatal practice, such as playing a recording every night during pregnancy when the mother relaxes, that can be used to soothe the infant at night time after birth. Since it was a theoretically developed program, ithas not yet been applied in practice. The next step would be to pilot the program in order to determine its effectiveness on bonding as experienced by mothers (Van der Walt, 2012).

Prenatal stimulation programs are widely available, some in the lay public arena and others as part of research interventions. The researcher found that all the interventions focused on different aspects, but a comprehensive sensory stimulation program focused on foetal development that intend to improve bonding, could not be found. Most of these stimulation programs started the stimulation in the second trimester, which is the correct time to establish bonding (Vedova *et al*., 2008:95), however, all the foetal senses are not yet fully developed at that gestational age (Table 1). The Prenatal infant stimulation program focuses on all the foetal senses as illustrated in Table 2 and can be used to enhance bonding. However, according to the development of the foetus, no stimulation of the visual system should be performed before birth (Table 1). A summary regarding the abovementioned stimulation programs and the foetal senses is tabulated (Table 2). The table serves as a comparison between the different stimulation programmes regarding its comprehensiveness of the stimulation of the foetal senses. The ✗ indicates that it is not included in the program, and ✓ indicates that it is included in the program. Second table of symbols indicate whether or not the programs considered the critical gestation of development.

Table 2: Comparison of programs regarding foetal senses

Foetal senses	Prenatal University	Prenatal infant stimulation program	The 18 hour stimulation program	Lullabies	The baby bond
Chemosensory	✓	✓	✓	×	✓
Auditory	✓	✓	✓	✓	✓
Somatosensory	✓	✓	✓	×	✓
Vestibular	×	✓	✓	×	✓
Visual	×	✓	×	×	×

From the discussion above and the critical periods of development in Table 1, it is clear that *The Baby Bond* is the only stimulation program that provides stimulation that is aligned with the stimulation of the foetal sensory systems according to the latest evidence of critical periods for development and stimulation.

2.6 Stimulation programs in the research

The researcher selected to use *The Baby Bond* sensory stimulation program in this research study, since it was the only stimulation program which indicated that all the sensory systems except vision is matured enough for stimulation from the third trimester in pregnancy (Table 1). This stimulation program was self-administered by the parents from the third trimester of pregnancy and is added to standard antenatal care provided by their health care practitioner, based on the principles in the Guidelines of Maternal Care in South Africa (DOH, 2007:19). *The Baby Bond* sensory stimulation program aims to stimulate the foetal senses and support neurodevelopment. *The Baby Bond* attempts to provide parents with a comprehensive sensory prenatal stimulation program and aims to improve the bonding between the foetus and the mother. *The Baby Bond* sensory stimulation program was developed in order to initiate the bonding process before birth in a structured manner. The program is self-implemented by the parents in their own time three times a day, for 5-10 minutes in order to make it more user-friendly and to introduce a routine. (Refer to annexure F – *The Baby Bond Stimulation Programme*).

Table 3 provides a summary regarding the types of stimulation in *The Baby Bond* stimulation program and the literature discussed above.

Table 3: The Baby Bond Sensory Stimulation program

Foetal Senses	Type of stimulation provided by *The Baby Bond*	Aims of *The Baby Bond* stimulation program
Chemosensory system	The stimulation program refers to the mother's diet that should be rich in protein, vitamins and minerals. Stimulation provided: No specific diet is given; mothers are just encouraged to follow a balanced diet that is rich in protein, vitamins and minerals as advised by their healthcare provider.	Aim: Stimulation of the foetal gustatory and olfactory system. Encourage successful breastfeeding by providing a familiar smell and taste pre-birth that will be recognised after birth. Prepare the foetus to accept important and 'new' flavours when starting solids during the weaning period.
Auditory	The stimulation program refers to auditory stimulation in the form of the mother's voice and music. Stimulation provided: The mother talks to her foetus in a low-pitched voice during the day. Playing music recordings twice or three times a day when sitting, lying and rocking, depending on the program. Examples of music that is provided in the stimulation program are lullabies, such as "Lions sleep tonight". Parents are however, encouraged to use any music that contains criteria of clear harmony and rhythm. Rhymes read by the father is also included once a day. According to the literature, these types of stimulations are effective in stimulating the auditory system.	Aim: To build up foetal memory that can be transferred to the postnatal period (Wilkin, 1995/1996:165; Spence & Freeman, 1996:199; Chamberlain, 1997; Kisilevsky *et al*., 2009:70). This memory will then be used as a form of communication after birth, if the child is unsettled the mother can sing a song, for example, lullabies, because it stimulates and sedates the child to calm him/her down and to stabilise heart rate and respiration (Carolan *et al.*, 2012:174,178; Lorch *et al*., 1994:116). This will assist in the bonding process. To assist in making babies more ready to listen, more receptive, more alert and active to music (Wilkin, 1996:164,168).
Somatosensory system (Tactile)	The stimulation program refers to tactile stimulation in the form of the mother touching her abdomen, massaging her abdomen lightly, playing the kicking game and tapping on the abdomen.	Aim: To allow the foetus to perceive the sense of touch (Elliot, 1999:125). It is also focused to provide a pleasurable experience for the

Foetal Senses	Type of stimulation provided by *The Baby Bond*	Aims of *The Baby Bond* stimulation program
	Stimulation provided: *The Baby Bond* recommends that the mother perform the abovementioned activities twice a day in different sessions. When the mother rocks or moves up and down in a harmonious pattern, the foetus is also stimulated by the womb and amniotic fluid. This is also a form of tactile stimulation. *The Baby Bond* recommends this to be done once a day.	mother, father, family and the infant. This can assist to establish a routine practice to enhance the infant's emotional development and it is easy to continue with after birth (Panthuraamphorn, 1999:180).
Vestibular system	The stimulation program refers to vestibular stimulation in the form of rocking in a rocking chair or moving in a harmonious pattern from left to right. Stimulation provided: *The Baby Bond* introduces this mentioned movement once a day. The mother is always stimulating the vestibular system when she walks. The foetus also stimulates his/her vestibular system by himself/herself when moving around, stretching and kicking in the womb.	Aim: Effects the behavioural state of the foetus (Lecanuet & Jacquet, 2001:63-64). To assist in prenatal learning that can influence postnatal perception and learning (Panthuraamphorn, 1999:180). The stimulation of the vestibular system helps to soothe, it is critical for early neurodevelopment and also effects the other sensory and motor abilities (Elliot, 1999:146,154,156).
Neural system	There is no specific stimulation technique included in the stimulation program, however each of the other system stimulations do address neural system stimulation as well. The absence of specific stimulations is supported by the literature, due to the stimulation of all the different senses. The neural system develops during these stimulations and continues to develop after birth (Yamada *et al*. 2013;	Aim: To support neurodevelopment through stimulation of the foetal senses.

Foetal Senses	Type of stimulation provided by *The Baby Bond*	Aims of *The Baby Bond* stimulation program
	Polomeno, 1997:14).	
Visual system	No visual stimulation is included in the stimulation program, as the visual system is not mature for stimulation (Glass, 2002:2).	Aim: To prevent over stimulation of the visual system (Glass, 2002:2).

2.7 Conclusion

Bonding can serve as a pro-active and protective factor in life (Bavolek & Rogers, 2012:7; Mackay, 2003:99-100). If bonding is established properly, secure attachment relationships can be formed (Malekpour, 2007:87) that could later effect the physical and psychological development of the child (Myers, 2006:239). Literature provides evidence that stimulation programs enhances physical, cognitive, emotional and social development, fine and gross motor performance, speech and language acquisition, head circumference, development of prenatal memory and learning (Chamberlain, 1997; Van de Carr & Lehrer, 1988:101; Panthuraamphorn, 1998:159), which in turn support bonding. Literature indicates that only the somatosensory, chemosensory, vestibular, auditory and neural senses should be stimulated. The researcher explored four stimulation programs previously used in research environments and they all shared the outcome of improved bonding when a stimulation technique was implemented during the second or third trimester of pregnancy. Unfortunately, they were limited in the following areas: they were not all focused on the developmental stages of the foetus and also not as comprehensive in nature. *The Baby Bond* sensory stimulation program was also explored and it was found that this program was developed based on the overlapping areas of the described programs, with added structure and sensory specific stimulation. *The Baby Bond* is therefore a holistic sensory stimulation program that should be tested as a stimulation intervention in order to determine whether the program is effective. The advantage of determining the effectiveness of *The Baby Bond* program is the addition of a more comprehensive bonding stimulation program to the current programmes available.

CHAPTER 3: MANUSCRIPT PREPARED FOR SUBMISSION TO AFRICA JOURNAL OF NURSING AND MIDWIFERY

Prenatal stimulation program to enhance postnatal bonding

Authors:

Melissa van der Walt

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Sarah J Moss

3.1 Permission to submit article for examination purposes

I, the supervisor, hereby declare that the input and the effort of Melissa van der Walt in writing this article reflect research done by her on this topic.

I hereby grant permission that she may submit this article for publication and for examination purposes in fulfilment of the requirements for the degree Magister Curationis in Community Nursing at the Potchefstroom Campus of the North-West University.

X

Supervisor
Dr Welma Lubbe

X

Co-supervisor
Mev Heleen Coetzee

X

Assistant Supervisor
Prof Sarah J Moss

3.2 Declaration by researcher

I hereby declare that this research, ‘Prenatal stimulation program to enhance postnatal bonding’ is entirely my own work and that all sources have been fully referenced and acknowledged.

_____

M.M. Van der Walt

_____

Date:

3.3 Declaration by language editor

26 November 2014

To whom it may concern

Dear Sir/Madam

This is to certify that I have language edited the article entitled “Prenatal stimulation program to enhance postnatal bonding” that forms part of the Magister Curationis dissertation of MM van der Walt. The text was checked for clarity and ease of reading, grammar, spelling and punctuation. The editor makes no pretension to have improved the intellectual content of the article and did not rewrite any text. The editor’s suggestions are to be accepted or rejected by the author.

Kind regards

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3.4 Declaration and author contributions

DECLARATION TO BE SIGNED BY THE CORRESPONDING AUTHOR AND SUBMITTED WITH EACH ARTICLE

I, Welma Lubbe (7409110016082), as corresponding author of the article (submitted to the AJNM) entitled **Prenatal stimulation program to enhance postnatal bonding**, hereby declare that this is an original article which has never been published previously and which is not under consideration for publication by any other journal. The data were collected from November 2013 to September 2014 by Melissa van der Walt for her Magister studies.

Signature: ..... Date:.....

Please specify the specific contributions of each author.

MM van der Walt conceptualised the study, collected baseline and end data, performed the intervention, analysed and interpreted the data and drafted the manuscript.
W Lubbe conceptualised and designed the study and manuscript, assisted with the writing, and critical review and approval of final version of the manuscript.
H Coetzee assisted with the design, draft and finalisation of the background section of the manuscript.
SJ Moss assisted with the design, interpretation of data and critical reviewing of the manuscript.

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3.5 Author guidelines for Africa Journal of Nursing and Midwifery

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3.6 Title page

PRENATAL STIMULATION PROGRAM TO ENHANCE POSTNATAL BONDING

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ABSTRACT

Prenatal stimulation programs enhance bonding that serves as a protective factor after birth. *The Baby Bond* sensory stimulation program is a comprehensive antenatal stimulation program implemented during the third trimester of pregnancy. The purpose of this study is to determine the effectiveness of *The Baby Bond* on bonding six weeks after birth.

This study employed an experimental, pre-test-post-test randomised control intervention design. All participants completed the Prenatal Attachment Inventory (PAI) as pre-test and received standard antenatal care. The experimental group received *The Baby Bond* and the control group an alternative stimulation program. At six weeks post birth the mothers completed the Maternal Attachment Inventory (MAI) as post-test.

The results indicated that the average age of the women was 27 years at 31.8 weeks of gestation at the pre-test. The total difference in the pre-test (PAI) of the experimental (66.45 ±7.04) and control group (66.36 ± 10.03) was not significant ($p = 1$). The mean difference for the post-test (MAI) for the experimental group (101.03 ± 3.62) was not significantly different to the control group (94.85 ± 11.87; $p = 0.53$). A medium practical significant difference ($d = 0.52$) was identified between the experimental and control groups. *The Baby Bond* stimulation program for bonding did not show any significant effect on bonding compared to standard antenatal care. However, the direction of the data indicate that a stimulation program seem to be advantageous to the bonding process experienced by the mother, therefore larger sample sizes should be investigated.

Key words: Attachment, bonding, neonatal period, perinatal period stimulation programs.

PRENATAL STIMULATION PROGRAM TO ENHANCE POSTNATAL BONDING

INTRODUCTION AND BACKGROUND INFORMATION

A good bond between a mother and child is a pro-active and protective factor (Bavolek & Rogers, 2012:7; Mackay, 2003:99-100). Bonding refers to the loving relationship between mother and child that grows through their interactions (Myers, 2006:239). Bonding starts at conception and continues throughout childhood (Young, 2013:11). Literature describes various psychological and physical risk factors that can challenge the bonding process, including a history of domestic violence, drug abuse, medical problems, quality of marital relationships, social support and socio-economic status (Sickel, 2013:9-10). The impact of poor bonding is evident in numerous ways, including emotional and cognitive problems, poor growth in infancy, substance abuse, mental disorders, abuse, attention deficit disorder and many more in childhood or adolescence (Honikman, 2011).

HIV, alcohol abuse, depression and low socio economic status often compromise pregnancy outcomes in South Africa (Tomlinson *et al*., 2013:277). In addition, literature indicates that high income families, especially women, are at higher risk for moderate to severe mental illnesses, such as anxiety disorder and depression (Herman *et al*., 2009:342) and substance abuse, including alcohol and cannabis, is also more prevalent in educated and high income groups (Herman *et al*., 2009:342; Van Heerden *et al*., 2009:360-361,363). All of these influence bonding during pregnancy and postnatally, irrespective of socio-economic status. Therefore, clients seeking private healthcare may be regarded equally at risk for bonding problems due to work stress, stressful and challenging family relationships, depression related to the mentioned stressors, and economic problems that are typically seen in South Africa. In addition, clients accessing private healthcare often receive infertility treatment, increasing the stressors already mentioned. If bonding is established properly, a child will develop secure attachments that could help overcome potential risk factors and improve society in the long term (Malekpour, 2007:83).

Mothers can improve bonding through interventions, for instance antenatal stimulation programs implemented at the appropriate gestational age (Elliot, 1999:4; Panthuraamphorn *et al*, 1999:181; Van der Carr & Lehrer, 1988:101). Various programs have been developed to ensure maternal-infant bonding, including the *The Baby Bond* sensory stimulation program that is based on literature and focus on critical sensory developmental stages of the foetus (Van der Walt, 2012). For the purpose of this study, bonding and attachment are used interchangeably, as described elsewhere (Van der Walt, 2014).

PROBLEM STATEMENT

Good bonding is essential for the development of a holistically healthy child. In South Africa, a multitude of factors impend the development of such bonding. Literature demonstrates that prenatal stimulation programs enhance postnatal bonding *The Baby Bond* sensory stimulation program is one such intervention that aims to enhance postnatal bonding. *The Baby Bond* was developed based on the latest available evidence for application during the third trimester however, the effectiveness on the maternal-infant bonding as perceived by mothers at six weeks after birth has not yet been explored in a South African context.

DEFINITION OF KEY TERMS

Attachment/Bonding is the relationship between the mother and the infant that starts to develop prenatally and continues after birth; it is characterised by the mother's feelings for her infant (Myers, 2006:239; 1156; Sadock *et al*., 2007:138).

The **neonatal period** is divided into the early neonatal period (from birth to seven days) and the late neonatal period (from eight days to 28 days) (Harrison, 2008:1).

The **perinatal period** extends from the 24th week of pregnancy to the end of the first week of life (Harrison, 2008:1).

A (prenatal) **stimulation program** consists of different modes of stimulation, such as auditory (talk to foetus and stimulating music), tactile (kicking games, movement of mother) and taste and smell (from the mother's diet), that affect the foetus at different stages of development (Burke, 2007:84-125; Van de Carr & Lehrer, 1988:91-93).

PURPOSE OF THE STUDY

The purpose of the research was to determine the effect of *The Baby Bond* sensory stimulation program compared to an alternative stimulation program on the bonding perceived by the mother six weeks post birth.

AIM OF THE STUDY

To determine if a selected comprehensive sensory antenatal stimulation program *The Baby Bond*, contributes towards improved bonding six weeks after birth.

OBJECTIVE OF THE RESEARCH

The objective of the research was to determine and describe the effectiveness of *The Baby Bond* sensory stimulation program on bonding as perceived by the mother six weeks post birth.

RESEARCH QUESTION

The research question was: How effective was *The Baby Bond* stimulation intervention with regards to bonding six weeks post birth?

RESEARCH DESIGN AND METHOD

Study design

The researcher employed an experimental, pre-test-post-test randomised control group method in this study (Stolberg *et al*. 2004:1539). Randomised control group design refers to eligible participants that are randomly assigned to the experimental and control groups (Stolberg *et al*, 2004:1540). A table of random numbers from 1-30 was used; utilising Stattrek.com as a random-number-generator to randomise the numbers from 1-30, before data collection was conducted. Even numbers between one and 15 were allocated for the control group and odd numbers for the experimental group (Burns & Grove, 2009:350). Both groups received the same previously validated pre- and post-tests (Botma *et al*, 2010:121): the Prenatal Attachment Inventory (PAI) and the Maternal Attachment Inventory (MAI) (Muller 1996:163; Muller, 1993:204). These instruments measure the same outcomes, although at different times of infant development.

Intervention studies imply that both the control and experimental groups should be treated similar with the exception of the intervention tested (Botma *et al*., 2010:121). This was best achieved through a pre-test, followed by a post-test after the intervention and strengthened by comparing the results between the control and experimental groups. The intervention was implemented during pregnancy, but the effect determined after birth. Participants in both groups received standard antenatal care, which can include: screening for pregnancy problems, assessing pregnancy risk, treating antenatal problems, providing medication and information to improve pregnancy outcomes, and physical and psychological preparation for childbirth and parenthood (DOH, 2007a:19). The experimental group then received *The Baby Bond* sensory stimulation program in addition to their standard care and the control group an alternative stimulation program.

Research site

Pregnant women living in Cape Town, Western Cape Province, South Africa who attended antenatal care at private service providers, such as gynaecologists and midwives in private practice, were identified as participants for this study. Cape Town was chosen as setting for its variety in cultures, ethnicity and relationship types (heterogeneous and homogeneous). Cape Town has a population of 3 740 026 (Statistics South Africa, 2011) with 62 143 live births per year (DOH, 2007b). The Helderberg district and Kuilsriver are sub-regions of the

Western Cape Province with potential participants suitable for the study. No specific birth statistics for these areas are available from Statistics South Africa.

Population

The researcher selected the Helderberg district due to the population profile that includes a high number of young families of childbearing age and is within reach of the researcher, ensuring the retaining of participants for follow-up visits. The population consisted of pregnant women attending standard antenatal care in the private sector of the Helderberg and Kuilsrivier areas with first singleton pregnancies that are considered low risk. The researcher assumed that mothers with recurring pregnancies may influence the intervention with experiences from previous pregnancies and they were therefore excluded. Participants were between 20-34 years of age (excluding teen pregnancy and advanced maternal age which are regarded as high risk pregnancies), had completed secondary education (holds a matric certificate or equivalent) and were in steady relationships. These criteria are similar to previous studies and effective to support bonding. Participants were between 27 and 36 weeks of gestation to ensure that mothers started the intervention during the period indicated as suitable for prenatal stimulation interventions in literature and they still had a period of four weeks to apply the intervention. Six months into data collection, it became evident, that despite a high number of the stated population, a much smaller number of potential participants met the inclusion criteria for the study. In order to increase the sample, the researcher contacted other facilities in Kuilsriver with a similar population profile.

Sample

This study aimed to pilot the intervention program with a sample of 30 women. The researcher checked and correlated this number with the Statistical Consultation Services at the North-West University (NWU), therefore 15 women in each group were considered sufficient for a pilot study (Ellis, 2013). However, only 13 women fit the inclusion criteria and gave informed consent to participate. One participant completed the PAI questionnaire, but delivered within one week thereafter and had to withdraw from the study. Other participants interested to participate were in age groups outside of the inclusion criteria. Most of the mediators that volunteered to liaise with clients, reported that the inclusion criteria were too strict, therefore they were only able to refer a limited number of potential participants. They reported that most of their clients were multi-gravidas and that women fall pregnant at a more advanced age due to attending to their careers first. The final sample therefore contained 12 participants, which is in accordance with this type of interventions described in literature (Burke, 2007:5; Phanthuraamphorn, 1998:142; Van der Carr & Lehrer, 1988:87).

Recruitment

The researcher recruited participants from private antenatal institutes in the Helderberg and Kuilsriver areas in the Western Cape. Antenatal healthcare providers were approached to act as mediators to identify suitable participants. Mediators included gynaecologists, general practitioners and midwives providing antenatal care. Two general practitioners and one midwife in the Helderberg area agreed to act as mediators. One mediator with clients in the Helderberg, Kuilsriver and Stellenbosch districts agreed to assist, but had to withdraw due to personal medical reasons.

Mediators received information brochures with the inclusion criteria and researcher's contact details to discuss with clients that met the inclusion criteria. They then provided the researcher with the contact information of individuals that volunteered to participate or provided potential participants with the researcher's details. The mentioned information brochures were also posted on various Facebook pages for mothers in the Helderberg area, and three potential participants contacted the researcher directly and volunteered participation in the study.

Measuring instruments

The researcher used two self-administered questionnaires to collect data from the sample: one for prenatal assessment of attachment (PAI) and one for postnatal assessment of attachment (MAI). E. Muller developed, validated and used both instruments in a previous study on prenatal and postnatal attachment (Muller 1996:163;

Muller, 1993:204). The researcher obtained permission to use the instruments from E. Muller. Both instruments test the same items, but at different times, resulting in different names for the instruments representing the time of administration (pre- or postnatal) (Muller, 1996:161). Items included in the instrument refer to maternal emotions and thoughts about her unborn child or new baby. Burke (2007:34) used the same instruments in a study and the results indicated improved emotional attachment when the stimulation program is provided. The instruments were found suitable for the current study; which aimed to determine the effect of a prenatal stimulation program on bonding after birth.

Demographic information

A demographic information questionnaire, collecting pregnancy information, personal details, and level of education, was completed on enrolment into the study to obtain information regarding the participants and to ensure compliance with the set inclusion criteria.

Prenatal Attachment Inventory (PAI)

The PAI consists of 21 items on a four-point Likert scale ranging from 4 -'almost always' to 1- 'almost never'; indicating maternal experiences (e.g. feelings, thoughts) during pregnancy (Muller, 1993:201,207). The scores are added to obtain the total score ranging from 21 to 84, the higher scores indicating higher levels of attachment (Gau & Lee, 2003:179). Reliability of the instrument was assessed by internal consistency. The Cronbach's alpha coefficient of the total instrument was 0.85 (Muller, 1993:204). The initial instrument (48 questions) was based on available literature and 11 experts assessed the content validity (Muller, 1993:201). The experts rated the items on a four-point scale from "1- not relevant" to "4- quite relevant" (Gau & Lee, 2003:179) and all the questions with a mean score less than three were eliminated from the questionnaire (Muller, 1993:201). The PAI had a strong correlation with the established Maternal Foetal Attachment Scale showing that the MAI is effective in measuring maternal foetal attachment (Muller, 1993:213).

The information in the instruments is generic and not focused on a certain context. However, the researcher could find no studies where this instrument has been used in South Africa, although the instrument has been used in a variety of studies internationally.

Maternal Attachment Inventory (MAI)

The MAI consists of 26 items on a four-point Likert scale ranging from (4) 'almost always' to (1) 'almost never', indicating the frequency of maternal engagement in activities or their feelings (Muller, 1996:163). All the answers are added, with higher total scores indicating higher maternal attachment. The inventory was developed in simple language and for self-administration. The initial instrument was derived from available literature and content validity was assessed by 12 experts (Muller, 1996:163) who rated the items on a four-point scale from "not relevant" to "quite relevant". All questions that had a mean score less than 3.5 were excluded (Muller, 1996:163). The Cronbach's alpha was 0.85, supporting good internal consistency (Muller, 1996:164). The instrument was tested in two phases and the results proved that there is good correlation between the MAI and other instruments used to measure maternal feelings and separation anxiety (Muller 1996:165). This confirms that the MAI is effective in measuring postpartum affectionate attachment (also referred to as bonding, as explained earlier).

Data collection procedures

Data was collected over a period of 10 months, November 2013 to September 2014, from all eligible participants that gave informed consent. All participants completed a demographic and PAI questionnaire as a pre-test. Individuals that met the inclusion criteria were assigned a number from the randomised table and were consequently allocated to the control or experimental group. Participants received *The Baby Bond* or an alternative stimulation program, depending on their number.

The participants and mediators were blinded to the intervention assigned to them, since both groups received standard antenatal care, and the researcher assigned participants to the relevant groups using the said random

table. Both interventions addressed maternal diet, everyday talking to the foetus and breathing exercises to calm the mother. The control group of five participants received an alternative intervention, which appeared similar if by any chance compared to *The Baby Bond*, since it also required interaction with the foetus, but at random times, intervals and suggested stimulation techniques.

The Baby Bond program was peer reviewed by a registered nurse and midwife; and an international certified childbirth/postnatal educator and doula. The program was also given to an expecting mother to review for clarity and feasibility. The researcher considered the feedback from both these reviewers and made according changes. The intervention program is summarised in Table 1.

Table 1: *The Baby Bond* Sensory Stimulation program

Foetal Senses	Type of stimulation provided by *The Baby Bond*
Chemosensory system	The stimulation program refers to the mother's diet that should be rich in protein, vitamins and minerals. Stimulation provided: Mothers are encouraged to follow a balanced diet that is rich in protein, vitamins and minerals as advised by their healthcare provider.
Auditory	The stimulation program refers to auditory stimulation in the form of the mother's voice and music. Stimulation provided: The mother talks to her foetus in a low-pitched voice during the day. Playing music recordings twice or three times a day when sitting, lying and rocking depending on the program. Examples of music in the stimulation program are lullabies, such as 'Lions sleep tonight'. Parents are however, encouraged to use any music that contains criteria of clear harmony and rhythm. Rhymes read by the father are also included once a day. These types of stimulations according to the literature discussed are effective in stimulating the auditory system.
Somatosensory system (Tactile)	The stimulation program refers to tactile stimulation in the form of the mother touching her abdomen, massaging her abdomen lightly, playing the kicking game and tapping on the abdomen. Stimulation provided: *The Baby Bond* recommends that the mother performs the abovementioned activities twice a day in different sessions. When the mother rocks or moves up and down in a harmonious pattern, the foetus is also stimulated by the womb and amniotic fluid. This is also a form of tactile stimulation. *The Baby Bond* recommends this to be done once a day.
Vestibular system	The stimulation program refers to vestibular stimulation in the form of rocking in a rocking chair or moving in a harmonious pattern from left to right. Stimulation provided: *The Baby Bond* introduces these mentioned movements once a day. Mother's are made aware that she is always stimulating the vestibular system when she walks. The foetus also stimulates his/her vestibular system by himself/herself when moving around, stretching and kicking in the womb.
Neural system	Stimulation of the other systems do address neural system stimulation as well. Literature supports the absence of specific stimulations, due to the stimulation of all the different senses. The neural system develops during these stimulations and continues to develop after birth (Yamada *et al*. 2013; Polomeno, 1997:14).
Visual system	No visual stimulation is included in the stimulation program, as the visual system is not mature enough to handle stimulation (Glass, 2002:2).

After completion of the intervention, all the participants delivered live infants and were followed up at six weeks post birth to complete the MAI post-test. All 12 participants completed the follow-up questionnaire, leading to a 100% response rate.

The researcher measured the compliance to the intervention through feedback from the mothers when they reported the number of days and time spent on each session of the program. The demographic data questionnaire includes the compliance questions. Thus, when the mothers completed the MAI they returned to this question.

Reliability and validity

The Statistical Consultation Services of the North-West University, Potchefstroom campus, calculated the reliability of these instruments. The 21 item PAI scored 0.75 when calculated, but due to question three ("I enjoy feeling the baby move") having a negative correlation on the total score, it was removed and recalculated. The Cronbach's alpha for the adjusted 20 item PAI was 0.77, which indicates good internal consistency. The 26 item MAI scored 0.94, but due to question 14 ("I tell others about my baby") having a negative correlation on the total score, it was removed and recalculated. The Cronbach's alpha for the adjusted 25 item MAI was then 0.95, again indicating good internal consistency.

The researcher aimed to be objective in data collection and data analysis, by allowing participants to complete the questionnaires in their own capacity and by using the NWU Statistical Consultation Services for data analysis.

Internal validity refers to the true reflection of the construct being studied; rather than the result of unmeasured variables (Klopper & Knobloch, 2009:6). Internal validity can be threatened by history, maturation, testing, instrumentation, selection bias, mortality, interactions with selection, resentful demoralization of respondents receiving less desirable treatments and statistical regression (Klopper & Knobloch, 2009:2; Burns & Grove, 2009:222-224). In order to prevent these threats, the abovementioned factors were considered. The plan was to select an optimal sample size, but due to constraints in the study, a smaller sample of 12 was used. The sample was randomly allocated to experimental and control groups, this helped to prevent selection bias. The researcher prevented demoralisation by explaining to all participants before they signed voluntary consent, that there will be a randomly assigned experimental and control group and that the control will receive a different, but not lesser stimulation program.

The researcher tried to prevent the influence of previously gained knowledge on the topic by including only first-time mothers attending standard antenatal care (clinical). The researcher tried to prevent the Hawthorne affect by ensuring that the control group is also implementing a simple form of a stimulation program, so that, when the groups might meet, no undesirable feelings will present. Hereby the researcher decreased the risk of resentful demoralisation of respondents receiving less desirable treatments.

The researcher used previously validated and tested measurement tools that helped to prevent the testing practice effect. The instruments were self-administered, thus no bias from the interviewer was relevant. Confidentiality and anonymity was assured by numbering the instruments and safekeeping of information, which also ensured participant honesty.

There was a risk for mortality, for there was a time lapse between completing the two instruments. Women can have unexpected complications during pregnancy, causing them not to participate anymore. A mortality of one participant took place in this study, since she could not complete the intervention for four weeks. Participants that delivered earlier, were still able to apply the intervention for four weeks, therefore they completed the MAI.

Data analysis

The Statistical Consultation Services at the North-West University, Potchefstroom campus have been involved with the electronic capturing of data by EpiData, analysing it with the SPSS (Statistical Package for Social

Sciences) program version 22.0 (Ellis, 2014) and provided assistance to the researcher in interpreting the results (Ellis, 2014). SPSS was used to compile descriptive statistics from the experimental and control groups. The Mann Whitney test was performed to determine the significant differences between pre- and post-tests. The effect size was then calculated with a small effect $d = 0.2$; moderate effect $d = 0.5$ and large effect $d = 0.8$ (Field, 2013:80). The level of significance was set at $p \leq 0.05$.

ETHICAL CONSIDERATIONS

Ethical approval has been granted by the Health Research Ethics Committee, Faculty of Health Sciences at the North West University – NWU-00141-13-S1. The researcher followed the ethical considerations as described in the Declaration of Helsinki, Nuremberg Code and the medical research council that stipulate the handling of human subjects in medical research (Botma *et al*., 2010:3).

Participants received verbal and written information before voluntary consent was obtained (Benatar *et al*., 2007:17). The researcher emphasised voluntary participation and the right to withdraw at any time without any prejudice (Burns & Grove, 2009:202; Benatar *et al*., 2007:22,33). By numbering the inventories, instead of using names, the researcher considered and assured privacy, anonymity and confidentiality at all times, (Burns & Grove, 2009:194,196-197; Benatar *et al*., 2007:37). Results are published or presented in such a fashion that all participants will remain unidentifiable. The participants had an opportunity to express whether they wanted feedback on the research findings. The data will be kept under lock and key on a password-protected computer, at the School of Nursing Science, North-West University Potchefstroom campus for six years.

RESULTS

The aim of this study was to determine the effect of a sensory intervention program, *The Baby Bond*, implemented during the third trimester of pregnancy on bonding six weeks post birth.

The results obtained from the demographic questionnaire (Table 2) indicated a sample of 12 participants from various ethnic origins, seven participants in the experimental group and five in the control group. The group allocation is uneven due to the randomisation of participants at different enrolment times. The inclusion criteria requested mothers between 20 and 34 years, but due to a low number of eligible participants, one participant was 17 when she volunteered to participate, but turned 18 the next month when she started with the program. Participant ages thus ranged from 17-34 years. Eight participants were married and four in stable relationships. Table 2 illustrates the demographic data with regard to the frequency. The participants volunteered to participate at different gestational ages in the pregnancy with gestations varying from 24–36 weeks. Both groups had a similar demographic profile**.**

Table 2: Demographic data of the study participants

Variables	Frequency (n)	Experimental (n)	Control (n)
Sample size	12	7	5
Ethnicity			
Caucasian	8	5	3
Non-Caucasian	4	2	2
Marital status			
Married	8	5	3
Single (Stable relationship)	4	2	2

Age (years)			
17-29	7	4	3
30-34	5	3	2
	N	***Mean***	***SD***
Gestational age (weeks)	12	31.8	3.6

Comparison between PAI and MAI

Table 3 illustrates the frequency of answers from all 12 participants during the pre-test (PAI) and Table 4 illustrates the answers of the 12 participants, presented as control and experimental groups, in the post-test (MAI).

Table 3: A summary of the answers of the Prenatal Attachment Inventory given by the participants

	QUESTIONS	ALMOST ALWAYS	OFTEN	SOMETIMES	ALMOST NEVER
1	I wonder what my baby looks like	5	3	3	1
2	I imagine calling my baby by name	4	6	0	2
3	I enjoy feeling the baby move	11	0	1	0
4	I think that the baby already has a personality	6	4	1	1
5	I let other people put their hands on my tummy to feel the baby move	3	6	2	1
6	I know things I do make a difference to the baby	10	2	0	0
7	I plan the things I will do with my baby	5	5	1	1
8	I tell others what the baby does inside me	7	4	1	0
9	I imagine what part of the baby I'm touching	5	4	2	1
10	I know when the baby is asleep	6	5	1	0
11	I can make my baby move	5	1	5	1
12	I buy/ make things for the baby	7	3	1	1
13	I feel love for the baby	9	1	1	1
14	I try to imagine what the baby is doing in there	6	5	1	0
	Prenatal emotional attachment				
15	I like to sit with my arms around my tummy	5	7	0	0
16	I dream about the baby	3	2	6	1
17	I know why the baby is moving	3	4	4	1
18	I stroke the baby through my tummy	6	4	2	0
19	I share secrets with the baby	1	2	4	5
20	I know the baby hears me	7	3	2	0
21	I get very excited when I think about the baby	8	3	1	0

The questions that scored the highest (8 and more participants) in PAI and indicated good attachment, included the questions: "I enjoy feeling the baby move"," I know things I do make a difference to the baby", "I feel love for the baby" and "I get very excited when I think about the baby". Question 11 stated that: "I can make my baby move". The answers to this question were very balanced as five participants answered "almost always", one "often", five "sometimes" and one "almost never". "I share secrets with my baby" was one of the aspects that the mothers did not do, as one said "always" and two said "often". Table 4 provides the responses of participants during the post-test (MAI).

Table 4: A summary of the answers of Maternal Attachment Inventory

	QUESTIONS	ALMOST ALWAYS	OFTEN	SOMETIMES	ALMOST NEVER
1	I feel love for my baby	6/5	0	1/0	0
2	I feel warm and happy with my baby	6/5	0	1/0	0
3	I want to spend special time with my baby	6/4	0/1	1/0	0
4	I look forward to being with my baby	6/4	1/1	0	0
5	Just seeing my baby makes me feel good	5/5	2/0	0	0
6	I know my baby needs me	7/5	0	0	0
7	I think my baby is cute	7/4	0/1	0	0
8	I'm glad this baby is mine	6/5	0	1/0	0
9	I feel special when my baby smiles	7/5	0	0	0
10	I like to look into my baby's eyes	6/5	1/0	0	0
11	I enjoy holding my baby	6/4	1/1	0	0
12	I watch my baby sleep	3/3	4/1	0/1	0
13	I want my baby near me	5/3	1/2	1/0	0
14	I tell others about my baby	5/5	1/0	1/0	0
15	It's fun being with my baby	4/4	2/0	1/1	0
16	I enjoy having my baby cuddle me	6/4	1/1	0	0
17	I'm proud of my baby	6/5	1/0	0	0
18	I like to see my baby do new things	7/5	0	0	0
19	My thoughts are full of my baby	4/5	2/0	1/0	0
20	I know my baby's personality	5/3	0/1	2/1	0
21	I want my baby to trust me	7/5	0	0	0
22	I know I am important to my baby	6/4	0/1	1/0	0
23	I understand my baby's signals	2/3	5/2	0	0
24	I give my baby special attention	4/5	3/0	0	0
25	I comfort my baby when he/she is crying	7/5	0	0	0
26	Loving my baby is easy	6/5	0	1/0	0

The top number represents the experimental group and the bottom number represents the control group, for example: **experimental/control**

From the 26 questions in the MAI, eight and more participants chose 'almost always' for 24 of the questions, indicating high attachment. The other two questions were: "I watch my baby sleep" and "I understand my baby's signals". No participant answered 'almost never' for any question.

The answers to the PAI and MAI inventories are summarised in Table 5. It illustrates the answers from all 12 participants in both the experimental and control groups.

Table 5: Pre- (PAI) and post-test (MAI) for the total group and the experimental and control groups

Variables	Total group		Experimental		Control		Man-Whitney U-test
	Mean	***SD***	***Mean***	***SD***	***Mean***	***SD***	
PAI	66.41	7.97	66.45	7.04	66.36	10.03	1.000
MAI	98.45	8.28	101.03	3.62	94.85	11.87	0.53

PAI = Prenatal Attachment Inventory; MAI = Maternal Attachment Inventory

A non-parametric test, Mann Whitney, was used to establish the difference between the two groups (Table 5) (Field, 2013:878). This helped to indicate whether there are any statistical differences between pre- and postnatal bonding in the different groups. The test resulted in p = 1.0 for PAI (no significant difference between

groups) and p = 0.530 for MAI. The results indicate an increased MAI score, but the increase was not significantly more than in the control group. This indicates that *The Baby Bond* sensory stimulation program did not have any more benefits towards bonding than the alternative program.

Effect size and practical difference

Cohen's *d* was calculated by dividing the difference in the mean scores by the standard deviation of the control group. The value measures the effect as *d* = 0.2 (small), *d* = 0.5 (medium) and *d* = 0.8 (large) (Field, 2013:80). Although no statistical significant changes occurred, a medium practical significant difference is evident between the groups (Field: 2013:82). The Cohen's *d* value of 0.52 in the MAI indicates a medium effect between the groups.

DISCUSSION OF RESULTS

From the literature it is evident that prenatal stimulation programs enhance bonding (Burke, 2007:28; Carolan *et al*., 2012:178; Van de Carr & Lehrer, 1988:95-97), serving as pro-active and protective factors. Bonding leads to secure attachments between mother and child that could enhance the physical and psychological development of the infant (Honikman, 2011). *The Baby Bond* sensory stimulation program was implemented during the third trimester of pregnancy as a pro-active method to enhance postnatal bonding. *The Baby Bond* sensory stimulation program is comprehensive in nature and takes the development of the fetus into considerarion . The stimulation program used in this study has the same characteristics as the prenatal stimulation programs that proved to be effective in bonding; these characteristics are the duration of sessions, intervals of stimulation and types of stimulation. The demographic information such as level of education, age and gravida, is similar to previous studies in literature (Burke, 2007:28; Carolan *et al*., 2012:178; Van de Carr & Lehrer, 1988:95-97).

The findings indicated that the intervention had a moderate effect on the bonding six weeks post birth. The researcher noted a difference in the mean scores of the PAI and the MAI for the experimental group, the study results however, indicated no statistical significance and a medium practical significance between the groups. A medium change, that could be improved bonding, was identified in the experimental group. Literature supports this, as previous studies indicated that a stimulation program enhances bonding (Burke, 2007:28; Carolan *et al*., 2012:178; Van de Carr & Lehrer, 1988:95-97). Literature further expands on the positive effect of prenatal stimulation programs in the longer run, since it yield a variety of benefits such as social and motor development (Malekpour, 2007:92), foetal memory (Van der Carr and Lehrer, 1998:96) and taste preferences (Mennella *et al*., 2001:5).

The stimulation programs presented to the experimental and control groups, were implemented in the third trimester according to the correct gestation age and development of the foetus to reduce over stimulation, harm or discomfort (Browne, 2008:181; Elliot, 1999:125; Foster & Verny, 2007:273; Graven & Browne, 2008:169). However, the researcher made provision to manage any possible discomfort due to the stimulation program, by referring the participant to her particular healthcare professional for assistance. No discomfort was reported by any of the participants, therefore the stimulation programs can be considered safe to implement during the third trimester of pregnancy. Previous studies support this by indicating that stimulation programs can be implemented from the second trimester (Burke, 2007:84-125; Panthuraamphorn, 1998:139; Van de Carr & Lehrer, 1988:91-93; Vedova *et al.*, 2008:95).

This study aimed to implement *The Baby Bond* sensory stimulation program for a minimum period of four weeks at frequencies of three stimulations per day for 5-10 minutes each day. Similar frequencies were used in previous studies (Van der Carr & Lehrer, 1988:87). The period of implementation is different from previous studies for *The Baby Bond* sensory stimulation program is only implemented from the third trimester, due to foetal development, while other programs are implemented in the second trimester (Browne, 2008:181; Elliot, 1999:125; Foster & Verny, 2007:273; Graven & Browne, 2008:196).

The participants did not accurately complete the questions regarding their participation in the study, completed with the MAI. Participants answered differently to the question: "how often did you follow the stimulation

program?" Some answered in sentences, others said sometimes, others three times a day and others every day. This results in no conclusive statistics on the implementation of the stimulation program.

The researchers can deduce that the duration of intervention and the small sample size could be the reasons why this study did not yield the same positive results than previous studies. Since *The Baby Bond* antenatal sensory stimulation program did indicate a moderate effect on the bonding six weeks post birth, further studies with larger samples are indicated to provide more conclusive results. Mediators indicated that the inclusion criteria should be adapted to include higher maternal ages for primigravidas. International literature indicating more advanced maternal ages for first time pregnancies support this adaptation (Matthews & Hamilton, 2014).

CONCLUSION

In conclusion, the researchers found that *The Baby Bond* sensory stimulation program did not significantly increase bonding six weeks post birth, however it indicated a moderate effect, supporting further studies with larger samples. The subjective nature of the questionnaires may have also contributed to the lack of conclusive results. The mediators identified the maternal age for first pregnancies used in this study as a limitation in the selection criteria. Presenting an antenatal stimulation program during the third trimester is useful and applying the intervention at a frequency of three times a day seems to be practical for participants and justifiable to show an effect towards improved bonding. It is clear that *The Baby Bond* did not do any harm, however further studies are indicated to determine the statistical and practical significance of the program.

RECOMMENDATIONS

Researchers should repeat research on *The Baby Bond* sensory stimulation program with adapted inclusion criteria, such as a higher maternal age for first time mothers, based on the latest evidence to ensure that these are still low-risk participants. A larger sample size may provide more data to indicate greater statistical significance and different contexts may be compared. Additional qualitative data may provide a rich description of the bonding phenomena, especially post birth. Sensory stimulation programs should be presented during the third trimester of pregnancy for a minimum period of four weeks at frequencies of three stimulations per day of 5-10 minutes each. Additional measures for compliance to the stimulation programme should be built into the design of future studies.

LIMITATIONS OF THE STUDY

Women tend to start with families at an age that was traditionally regarded as high risk (>35 years), therefore, mothers of a high maternal age were excluded from the study. A larger sample may have been reached if this age was adapted. Finally, it was challenging to accurately determine compliance with the stimulation intervention.

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CHAPTER 4: CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

4.1 Introduction

In the previous chapters the aim, objectives, purpose, research design, method, statistical analysis, results and the practical and statistical significance of the study were discussed. In this chapter, the researcher examines the conclusions, limitations and recommendations of the study.

4.2 Conclusion of the study

The aim of the study was to determine whether a selected comprehensive sensory antenatal stimulation program, *The Baby Bond*, contributes towards improved bonding six weeks after birth. In order to achieve the aim, an objective was set: to determine and describe the effectiveness of *The Baby Bond* comprehensive sensory stimulation program on bonding between the mother and child in the Western Cape private sector, six weeks after birth. A research question for this study was also stated: How effective is *The Baby Bond* sensory stimulation program with regards to bonding as it is experienced by the mother six weeks after the birth of her infant?

From the literature review, it was clear that stimulation programs can improve bonding, especially when implemented from the third trimester and taking foetal development into consideration. Literature indicated that stimulation techniques included in *The Baby Bond* sensory stimulation program are sufficient to support neurodevelopment and bonding. Therefore, the researcher could conclude, that in theory, the *The Baby Bond* sensory stimulation program will enhance prenatal bonding.

The objective was met through implementing *The Baby Bond* sensory stimulation program in the experimental group and an alternative program in the control group during the third trimester of pregnancy. The effectiveness of *The Baby Bond* was measured six weeks after delivery. The PAI and MAI were used as measuring instruments in this study and proved to be reliable. The demographic information questionnaire was used to identify whether participants met the selection criteria. The conclusion that emerged from the results indicated that, although a medium effect was achieved in the experimental group, a medium practical significance and no statistical significance was identified.

The research question of this study was: How effective is *The Baby Bond* sensory stimulation program with regards to bonding as it is experienced by the mother six weeks after the birth of her infant?

The study results indicate a medium practical significance and no statistical significance. The experimental group showed some change, but further research is necessary to fully answer the research question.

4.3 Limitations of the study

The researcher identified the following limitations of the study:

- It was challenging getting appointments with mediators in order to reach participants.
- Despite meeting with eight mediators, they only referred 12 participants due to the inclusion criteria.
- It was challenging to find participants that met the inclusion criteria. The mediators indicated that the inclusion criteria were too narrow, since modern mothers fall pregnant later as they first establish careers. Could only be identified after the research.
- The lack of good compliance data of the intervention period was a limitation of this study. Future research should ensure compliance to the intervention programme by means of daily reporting on the required data.
- The questions posed to the participants were based on subjective responses, which may influence the perception of the mother. Since it was subjective responses, it would be valuable to add interviews to determine maternal perceptions in future research.

4.4 Recommendations

The researcher suggests the following recommendations:

Recommendations for future research

- The study can be expanded to the public sector with more participants. This would enable researchers to compare the private sector to another sector in order to identify whether the results will differ in different contexts.

- According to the mediators, the inclusion criteria were too narrow, therefore, further research on the criteria could be done in order to determine how the inclusion criteria should be expanded, since women plan pregnancies much later now.

- The researcher recommends the use of another form to measure compliance, such as a daily ticking sheet for the experimental group, as the one in the current study was not effective and could not be used.

- Interviews could also be added as a measuring instrument to evaluate the experience of the program in order to see if the program should not be adjusted.

Recommendations for practice and education

- More health promotion and education on bonding, neurodevelopment and sensory stimulation should be provided in antenatal clinics to encourage bonding as soon as pregnancy has been confirmed.

- Implementation of *Baby Bond* programme with feedback system.

- It could be recommended, from the medium effect, that *The Baby Bond* sensory stimulation program could be included in the curriculum to raise awareness among student midwifes.

- Awareness regarding prenatal stimulation can be raised in antenatal classes.

4.5 Summary

In this chapter, the researcher provided feedback on this study by means of referring back to the aim of this study. Thereafter she provided the limitations, recommendations and offered a conclusion. From this study, an article will be submitted to African Journal of Nursing and Midwifery.

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ANNEXURE A: (DEMOGRAPHIC DATA)

The demographic data was obtained with the prenatal attachment inventory and was used for both instruments.

Name and surname:	
Date of birth:	
Age:	
Ethnicity:	
Marital status:	
Level of education:	
Occupation:	
How many children do you have?	
Gestational age:	
When was your last antenatal visit?	
At what gestational age did you start with the stimulation program?	
How long have you implemented the stimulation program?	
MAI ONLY: How often did you follow the stimulation program?	

ANNEXURE B: (PERMISSION TO USE INSTRUMENTS)

From: Melissa Noble [meliznoble@yahoo.com]
Sent: 03 November 2014 03:32 PM
To: Melissa Sass
Subject: Fw: PAI and MAI
Attachments: PAI final version.DOC; MAI.DOC

Melissa,

I am not sure what you mean about the rigor of the instruments. Have you found the original articles describing their development and testing? There are several other articles in publication regarding the PAI, but not quite so many using the MAI.

I am sending you copies of the instruments attached. You also have my permission to use them. If you give me more information about your notion of rigor, I may be able to help. But I think the published literature, including articles from countries using translated versions of the instruments will be more impressive to those reviewing your work.

Mary E. (Betsy) Muller

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Clinical Practice Specialist
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Madera, CA 93636
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ANNEXURE C: (PRENATAL ATTACHMENT INVENTORY)

The Prenatal Attachment Inventory

The following sentences describe thoughts, feelings, and situations women may experience during pregnancy. We are interested in your experiences during the past month. Please mark under the word that applies to you.

		ALMOST ALWAYS	OFTEN	SOMETIMES	ALMOST NEVER
1	I wonder what my baby looks like				
2	I imagine calling my baby by name				
3	I enjoy feeling the baby move				
4	I think that the baby already has a personality				
5	I let other people put their hands on my tummy to feel the baby move				
6	I know things I do make a difference to the baby				
7	I plan the things I will do with my baby				
8	I tell others what the baby does inside me				
9	I imagine what part of the baby I'm touching				
10	I know when the baby is asleep				
11	I can make my baby move				
12	I buy/ make things for the baby				
13	I feel love for the baby				
14	I try to imagine what the baby is doing in there				
	Prenatal emotional attachment				
15	I like to sit with my arms around my tummy				
16	I dream about the baby				
17	I know why the baby is moving				
18	I stroke the baby through my tummy				
19	I share secrets with the baby				
20	I know the baby hears me				
21	I get very excited when I think about the baby				

Scoring: A=4, B=3, C=2, D=1. All items are added for a single score.

The instrument will be used as the author has provided it.

ANNEXURE D: (MATERNAL ATTACHMENT INVENTORY BY MARY E MULLER)

The following sentences describe thoughts, feelings, and situations new mothers may experience. Tick under the word that applies to you. Almost always | Often | Sometimes | Almost never

	QUESTIONS	ALMOST ALWAYS	OFTEN	SOMETIMES	ALMOST NEVER
1	I feel love for my baby				
2	I feel warm and happy with my baby				
3	I want to spend special time with my baby				
4	I look forward to being with my baby				
5	Just seeing my baby makes me feel good				
6	I know my baby needs me				
7	I think my baby is cute				
8	I'm glad this baby is mine				
9	I feel special when my baby smiles				
10	I like to look into my baby's eyes				
11	I enjoy holding my baby				
12	I watch my baby sleep				
13	I want my baby near me				
14	I tell others about my baby				
15	It's fun being with my baby				
16	I enjoy having my baby cuddle me				
17	I'm proud of my baby				
18	I like to see my baby do new things				
19	My thoughts are full of my baby				
20	I know my baby's personality				
21	I want my baby to trust me				
22	I know I am important to my baby				
23	I understand my baby's signals				
24	I give my baby special attention				
25	I comfort my baby when he/she is crying				
26	Loving my baby is easy				

Scoring: A=4, B=3, C=2, D=1. All items are added for a single score.

The instruments will be used as the author has provided it.

ANNEXURE E: (PARTICIPANTS CONSENT)

INFORMATION SHEET

Study: Prenatal stimulation program to enhance postnatal bonding.

Supervisor: Dr W Lubbe
Co-Supervisor: Mrs H Coetzee
Assistant Supervisor: Prof SJ Moss

Dear Participant

CONSENT TO BE A RESEARCH PARTICIPANT

I, Melissa van der Walt, a MCUR student from the North-West University working on a study regarding a prenatal stimulation program (The Baby Bond) to enhance postnatal bonding and I would like to invite you to give consent and participate in this study. To follow is information about the study so that you can make an informed decision.

(1) PURPOSE OF THE STUDY

The purpose of this study is to pilot if an existing (peer-reviewed) prenatal stimulation program – *The Baby Bond* - can enhance bonding between mother and child in the Western Cape private sector six weeks after birth. You are being asked to participate in this study because you are staying in the Helderberg area, with a first singleton pregnancy that is considered low risk, are between the ages of 20 and34 years, in a healthy steady relationship (homo/ hetero) and currently in the third trimester of pregnancy (27weeks- birth). Your emotions and thoughts about your unborn child or new baby are very valuable to me.

(2) PROCEDURE

If you agree to participate in this study, it will be expected that you do one/all of the following:

- All participants will be randomly assigned to two groups, e.g. Group A and Group B. Each of the two groups will be given different stimulation program to implement in the last trimester of pregnancy to support bonding in the period directly after birth.

- Complete questionnaires (on your emotions and thoughts) and implement the stimulation program, which will be provided to you.

The two questionnaires will be completed at different stages of the research, prenatally (PAI) and six weeks postnatal (MAI). The questionnaires are:

- PAI (Prenatal Attachment Inventory)

- MAI (Maternal Attachment Inventory)

Each participant will complete the questionnaires anonymously at a time most suited to her. The questionnaires will take approximately 20 minutes to complete. The questionnaires will be kept in a safe place.

(3) RISKS/DISCOMFORTS

The stimulation programs that are chosen for Group A and Group B are developed according to the development of the foetus and therefore implemented according to the correct gestation to reduce over stimulation, harm or discomfort. However, if any discomfort may be present due to the stimulation program, the participant will be referred to her particular healthcare professional for assistance.

(4) BENEFITS

Your (Group A and Group B) participation in implementing the stimulation programs and completing the questionnaires at appointed times, will help to determine if prenatal stimulation programs influence the bonding after birth. This information can help to establish better relationships between mothers and infants that can reduce problems in later stages of life. The start of language development, foetal memory, taste preferences, etc. are also benefits derived from implementing stimulation programs in the prenatal period.

(5) COSTS

There will be no cost to you as a result of your participation in this study.

(6) PAYMENT

You will receive no payment for participation.

(7) QUESTIONS

You are welcome to ask any questions to me (Melissa van der Walt) before you decide to give consent. You are also welcome to contact me if you have any further questions concerning you consent at 0847018207.

(8) FEEDBACK OF FINDINGS

The findings of the research will be shared with you if you are interested. You are welcome to indicate on the attached document if you would like to receive a report of the study after it has been completed. I will be sharing the findings with you as soon as it is available.

CONSENT FORM

PARTICIPATION IN THIS RESEARCH IS VOLUNTARY.

You are free to decline to be in this study, or to withdraw at any point even after you have signed the form to give consent without any consequences.

Should you be willing to participate you are requested to sign below:

I _____ hereby voluntarily consent to participate in the abovementioned study. I am not coerced in any way to participate and I understand that I can withdraw at any time should I feel uncomfortable during the study. I also understand that my name will not be disclosed to anybody who is not part of the study and that the information will be kept confidential and not linked to my name at any stage. I also understand what I might benefit from participation as well as what might be the possible risks and should I need further discussions someone will be available.

_____ _____

Date Signature of the participant

_____ _____

Date Signature of the person obtaining consent

Participant's particulars for feedback regarding the research

I would like to receive a report of the research: "How will a prenatal stimulation program, presented in the private sector of the Western Cape Province and aimed at bonding, effect the mother-infant relationship at six weeks postnatal?", after it has been completed.

Name: _____ Cell: _____

Address:

ANNEXURE F: (THE BABY BOND STIMULATION PROGRAM)

PRENATAL STIMULATION PROGRAM

THE BABY BOND

What is prenatal stimulation?

It is a technique that uses different stimuli, such as auditory (talk to fetus, playing stimulating music), tactile (kicking games, movement of mother), taste (by the mother's diet), etc. that cause an effect on the fetus sense's at different gestations of development (Burke, 2007:84-125; Van de Carr & Lehrer, 1988:91-93).

Why do we do this?

The relationship between the mother and fetus already starts in the womb. This loving relationship between the parents and the child that grows through their interactions is referring to bonding. To strengthen this developing relationship prenatal stimulation programs are implemented during the antenatal period.

This stimulation is both pleasurable for mother and unborn child. The fetus learns to associate the senses with certain experiences, for example when the mother relaxes in front of the television watching her favourite soap, the unborn child associates the music and lower heart rate with calmness. Therefore after birth the child may recognise that particular music and be calmed.

Researchers found that prenatal stimulation helps to improve IQ, fine and gross motor development, alertness, social skills and babies even sleep better.

When should I begin doing this?

Stimulation programs can already be started in the second trimester for the sensory organs are starting to be developed, but most of the sensory organs are only fully functional from the third trimester in pregnancy. In order for the stimulations to be optimal, the stimulations should only be implemented from the third trimester.

The Stimulation Program

Stimulations are becoming a trend in the society, everyone wants to give their child an opportunity to optimal health and cognitive development. Stimulation programs are believed to do just that, but also increasing the interaction between mother and baby. This ensures a pleasant experience for mother and baby and teaches babies to recognise sensory experiences and detect similarities.

The stimulations are recommended to be done three times a day for 5 minutes, more or less at the same time (for example morning, afternoon and evening). This helps to create an ideal environment for maximal development and the baby recognises the pattern.

The mother

The mommy is a very important source of stimulation to her unborn baby. The unborn baby is stimulated by various factors inside and outside the womb. Therefore it is important that the mother is receiving the correct diet full of protein, vitamins and minerals. The protein helps the babies' brain to develop and the mother's diet is stimulating the unborn baby's taste buds and olfactory system.

It is also important that the mother is relaxed and her environment is stimulating. The mother can do breathing exercises (breathing in and out through the nose) for 5- 10 times, sit comfortable and visualize the unborn baby as a human, burn a candle (vanilla candles) and listen to stimulating music to relax her when necessary.

The best auditory stimulation is the mother's voice; therefore it is recommended that the mother talk to the baby during the day.

In the morning (wake up time)

You are going to stimulate your babies' tactile and auditory system. By doing this you are going to give your baby the opportunity to be able to associate the music with a massage and a particular time of day. After the baby is born you can still use the same music and massage as a daily wake up routine that is suitable for you.

Place yourself in a comfortable position: Sit up in your bed or in a comfortable chair with pillows under you, for extra comfort. (Avoid lying down on your back to ease breathing and ensure sufficient blood flow to your baby)

Choose music: The uterus is not a quiet environment, for the mother's heartbeat, sound of intestines and mother's voice is frequently audible for the unborn baby. Therefore the chosen recording should be clear with harmony and rhythm that is supportive, to avoid over stimulation. Examples of recordings are the jungle book, the lion sleeps tonight, sea waves, lullabies, etc.

- ♥ Switch on the recording and put your hands on your tummy while you are relaxing.
- ♥ Start massaging your tummy by moving your hands slowly around the abdomen and stop to press with your finger points when you feel a body part of your baby directly under your skin. Softly no hard pressure is necessary.
- ♥ You can also change the massage by using the thumbs. Move around the abdomen making a movement of thumb over thumb. The speed can vary.
- ♥ Continue until the recording is finished.

Afternoon stimulation (Fun time)

In this session you are going to stimulate the baby's vestibular system, auditory and tactile senses. It will be fun to invite the daddy to join this session.

- ☼ Sit in a rocking chair or stand in an upright position: Now move up and down in the chair or from left to right if standing in a harmonious pattern. Music can be added to this stimulation.
- ☼ If you are done, you can either listen to music and tab on the tummy on the rhythm of the recording
  or
- ☼ You can play the kicking game: Tapping on the tummy every time the baby moves, for more or less 3 minutes. This is also fun for the father.

Ps: If you wish you can alternate the activities, for example on Monday you can stand and move from left to right in a harmonious pattern on music, followed by tapping on the tummy on the rhythm of the recording and on Tuesday you rock in a rocking chair followed by playing the kicking game.

- ☼ Now you can just sit back and relax and allow daddy to read nursery rhymes or tell the baby stories. This helps the child to learn the characteristics of the father's voice, allowing him to recognise the father after birth and also improves language and speech development.

Click on the links for examples of nursery rhymes:

http://www.nurseryrhymes.com/ for English,

http://www.yourparenting.co.za/tools/free-downloads/nursery-rhymes/afrikaanse-rympies for Afrikaans.

Bed time (Allow your baby to wind down)

In this session you are going to stimulate the auditory and tactile senses of your baby. Choose a similar time every night, in order for the baby to learn to associate it with bed time, even after birth the same routine can be used.

- Sit in a comfortable position: Sit up in your bed or in a comfortable chair with pillows under you, for extra comfort. (Avoid lying down on your back to ease breathing and ensure sufficient blood flow to your baby)

- Put on your chosen recording and start to do the breathing exercise, by breathing in and out of the nose for 5-10 times. Try to relax and forget about the stress of the day.

- Put your hands on your tummy, start visualizing your baby (you can even visualise your baby as a character in happy story) and focus your emotions on the baby.

- Take some body lotion or oil that prevents stretch marks and apply it to your hands. Put your hands on your tummy again, start with nice slow circular movements, moving down from your rib cage, scooping and going up to rib cage again. It is important to remember there is no right or wrong, as long as you enjoy it. This helps to relieve the tension of the ligaments.

- Now bring your hands to rest again. Start sliding your hands gently from top to bottom (towards the legs), top to bottom around the stomach. The palms are flat and the fingers are together. This helps to improve lymph drainage and helps to reduce swelling.

Remember to relax, this helps to lower the heart rate and helps the child to wind down and adapt to a sleepy environment.

Note: If any of the stimulations causes any discomfort, you should stop immediately and consult your medical practitioner.

ANNEXURE G: (ALTERNATIVE STIMULATION PROGRAM)

What is prenatal stimulation?

It is a technique that uses different stimuli, such as auditory (talk to foetus, playing stimulating music), tactile (kicking games, movement of mother), taste (through the mother's diet), etc. that have an effect on the foetus' senses at different gestations of development (Burke, 2007:84-125; Van de Carr & Lehrer, 1988:91-93).

Why do we do this?

The relationship between the mother and the foetus already starts in the womb. This loving relationship between the parents and the child that grows through their interactions is referring to bonding. To strengthen this developing relationship, prenatal stimulation programs are implemented during the antenatal period.

This stimulation is pleasurable for both the mother and the unborn child. The foetus learns to associate the senses with certain experiences, for example when the mother relaxes in front of the television, watching her favourite soap, the unborn child associates the music and lower heart rate with calmness. Therefore, after birth the child may recognise that particular music and be calmed.

Researchers found that prenatal stimulation helps to improve IQ, fine and gross motor development, alertness, social skills and babies even sleep better.

When should I begin doing this?

Stimulation programs can already be started in the second trimester, for the sensory organs are starting to develop, but most of the sensory organs are only fully functional from the third trimester of pregnancy. In order for the stimulations to be optimal, the stimulations should only be implemented from the third trimester.

The Stimulation Program

Stimulations are becoming a trend in society; everyone wants to give their child an opportunity to optimal health and cognitive development. Stimulation programs are believed to do just that, but it also increases the interaction between mother and baby. This ensures a pleasant experience for mother and baby and teaches babies to recognise sensory experiences and detect similarities.

The stimulations are recommended to be done three times a day for 5 minutes, more or less at the same time (for example morning, afternoon and evening). This helps to create an ideal environment for maximal development and the baby recognises the pattern.

The mother

The mommy is a very important source of stimulation to her unborn baby. The unborn baby is stimulated by various factors inside and outside the womb. Therefore, it is important that the mother is receiving the correct diet full of protein, vitamins and minerals. The protein helps the baby's brain to develop and the mother's diet is stimulating the unborn baby's taste buds and olfactory system.

It is also important that the mother is relaxed and her environment is stimulating. The mother can do breathing exercises (breathing in and out through the nose) for 5-10 times, sit comfortable and visualise the unborn baby as a human, burn a candle (vanilla candles) and listen to stimulating music to relax her when necessary.

The best auditory stimulation is the mother's voice; therefore, it is recommended that the mother talk to the baby during the day.

ANNEXURE H: (ETHICS APPROVAL)

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To whom it may concern

Faculty of Health Sciences
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Fax: 018-299 2088
Email: Minrie.Greeff@nwu.ac.za

26 November 2013

Dear Dr. Lubbe

Ethics Application: NWU-00141-13-S1 "Prenatal stimulation program to enhance postnatal bonding"

Thank you for amending your application, all ethical concerns have been addressed and ethical approval is granted.

Yours sincerely

Prof. Minrie Greeff
Ethics Sub-committee Vice Chairperson

Original details: Prof. Minrie Greeff(10187308) C:\Users\13210572\Documents\ETIEK\2013 ETHICS\NWU-00141-13-S1b.docm
26 November 2013

File reference: NWU-00141-13-S1

ANNEXURE I (DECLARATION STATISTICAL CONSULTANT)

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20 November 2014

Re: Thesis, Ms MM van der Walt, student number: 20694709

We hereby confirm that the Statistical Consultation Services of the North-West University analysed the data involved in the study of the above-mentioned student and assisted with the interpretation of the results. However, any opinion, findings or recommendations contained in this document are those of the author, and the Statistical Consultation Services of the NWU (Potchefstroom Campus) do not accept responsibility for the statistical correctness of the data reported.

Kind regards

Dr SM Ellis (Pr. Sci. Nat)
Head: Statistical Consultation Services

Original details: Monique van Deventer(12256307) Q:\Algemeen - nie konsultasie\Stylblaaie_Style sheets\Brief verhandeling_Eng.docm
23 April 2014