

5-2019

The Correlates of the Maternal Fetal Attachment in the Democratic Republic of the Congo

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Tamba, Orphee L., "The Correlates of the Maternal Fetal Attachment in the Democratic Republic of the Congo" (2019). *Capstone Experience*. 81.

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Project Title: The Correlates of the Maternal-Fetal Attachment in the Democratic Republic of the Congo

Student and Committee Information

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Name of the Organization: Elizabeth Glaser Pediatric AIDS Foundation

Abstract

Maternal-fetal attachment is defined as the relationship of affection that exists between the pregnant woman and her fetus during pregnancy. It increases throughout the pregnancy and predicts not only the attachment style between the mother and the child but also the chances of optimal socioemotional development during infancy. The Maternal Antenatal Attachment Scale measures the Maternal-Fetal Attachment (MFA). Several versions of this scale have been adapted in various parts of the world. However, to date no study has been conducted on the validation of this scale in sub-Saharan Africa and the identification of factors associated with the MFA. This cross-sectional study aimed to investigate the psychometric properties of MAAS and to identify MFA correlates in the Democratic Republic of Congo. Data of 220 pregnant women were collected from January to March 2019 in the antenatal services of three hospitals in Kinshasa. The MAAS demonstrated acceptable psychometric properties. The two-factor structure of Condon's original scale was not confirmed. The exploratory factor analysis showed a four-factor structure with only one having an acceptable internal consistency. On the other hand, the global scale also presented an acceptable internal consistency after the withdrawal of questions 7 and 12. The binary logistic regression showed pregnant women with a partner with a high age, high parity, and positive HIV status were more likely to present a low attachment in comparison to their peers. A history of infertility, the pregnant women religion, and the method of conception did not influence the MFA. The Congolese version of the MAAS can be used to measure MFA. Identification of MFA correlates can inform policies and guide interventions to optimize social development during childhood.

Keywords: maternal-fetal attachment; maternal antenatal attachment scale; correlates; psychometrics properties; Democratic Republic of the Congo.

Introduction

Placement Site: **Elizabeth Glaser Pediatric AIDS Foundation**

Brief Organization Description:

The Elizabeth Glaser Pediatric AIDS Foundation (EGPAF) is a nonprofit organization dedicated to preventing pediatric HIV infection and eliminating pediatric AIDS through research, advocacy, and prevention and treatment programs.

Organization's Mission and Purpose:

The Elizabeth Glaser Pediatric AIDS Foundation seeks to end global pediatric HIV/AIDS through prevention and treatment programs, research, and advocacy.

Goal 1 – Services: Expand high quality, evidence-based, locally sustained HIV/AIDS programs and services, as well as strengthened health systems to end HIV/AIDS among children, adolescents, and families.

Goal 2- Research: Advance research and innovation to prevent, treat, and end HIV/AIDS among children, adolescents, and families.

Goal 3- Advocacy: Advocate for global, regional, national, and local policies and guidelines, resources, and political leadership to end HIV/AIDS among children, adolescents, and families.

Service learning activities

- Data collection implementation training with EGPAF and PNLs (Programme National de Lutte contre le VIH).
- Data reporting and designing of georeferenced maps for the DR Congo programs.
- Participation in the EGPAF project start-up model discussion

List of acronyms

AIDS	Acquired Immunodeficiency Syndrome
ANC	Antenatal care
CFA	Confirmatory Factor Analysis
DRC	Democratic Republic of the Congo
EFA	Exploratory Factor Analysis
EGPAF	Elizabeth Glaser Pediatric AIDS Foundation
HIV	Human Immunodeficiency Syndrome
IRB	Institutional Review Board
KSPH	Kinshasa School of Public Health
MAAS	Maternal Antenatal Attachment Scale
MFA	Maternal-Fetal Attachment
PHQ-9	Patient Health Questionnaire 9
PNLS	National AIDS Control Program
SGBV	Sexual Gender Based violence
UNMC	University of Nebraska Medical Center

Background

In 2015, the United Nations adopted the 2030 Agenda for 17 Sustainable Developmental Goals. The fourth goal aims to ensure inclusive and quality education for all and promote learning throughout life. One of the ten targets to achieve this goal is to ensure that all children have access to quality early childhood development, care, and pre-primary schooling in preparation for primary education by 2030 (United Nations, 2015a).

Childhood development is the maturational process resulting in an ordered progression of perceptual, motor, cognitive, language, socio-emotional, and self-regulation skills (McDonald Culp, 2010). It starts at conception, and the development of the young child's brain is dependent on balanced nutrition and certain childhood types of experiences (Britto et al., 2017).

In 2010, the sub-Saharan Africa region had the highest prevalence (66%) of children at risk of not reaching developmental potential (McCoy et al., 2016). The Democratic Republic of the Congo was among the ten countries with the largest number of children at risk of poor development (Lu, Black, & Richter, 2016). This situation may worsen since the country population is projected to increase fivefold by 2100 (United Nations, 2015b). The risks to child health and well-being go beyond stunting and poverty. Thus, the burden of children exposed to sub-optimal development is underestimated (Bornstein et al., 2012).

The acquisition of academic, behavioral, socio-emotional, and economic developmental competencies suggests that children reach their developmental potential in the presence of multiple support factors including health, nutrition, security and safety, responsive caregiving, and early learning. Essential to provide nurturing care, these factors work together and can be mutually reinforced over the child's development process (Black et al., 2016). Nurturing care

consists of a core set of inter-related components including: safety; attitudes; knowledge on caregiving; stimulation; responsiveness and behaviors (Bornstein, 1995; Marope & Yoshikawa, 2015).

There is a significant concern about the lack of attention to nurturing care during the time of rapid brain development and learning, and the formation of caregiver-child attachment for children under three years (Black et al., 2016). Family environment, with mothers playing a critical role, and daycare services are critical for nurturing care (Britto et al., 2017). During early childhood, maternal nurturing care protects early brain development, which attenuates the adverse effects of low socioeconomic status (Luby, 2015).

Literature review

Maternal-fetal attachment: definition, measures and correlates

Bowlby defines attachment as one specific and circumscribed aspect of the relationship between a child and caregiver that is involved with making the child safe, secure, and protected (Bowlby, 1982). Maternal-Fetal Attachment describes the relationship between a pregnant woman and her fetus (Rubin, 1976; Cranley, 1981). The level of prenatal attachment, as assessed by questionnaires (Cranley, 1981; Condon, 1993; Muller & Mercer, 1993), typically increases throughout the course of pregnancy and reaches the highest level during the third trimester of the pregnancy (Grace, 1989; Heidrich & Cranley, 1989; Laxton-Kane & Slade, 2002; Salisbury, Law, LaGasse, & Lester, 2003; J.L. Alhusen, 2008; Yarcheski, Mahon, Yarcheski, Hanks, & Cannella, 2009). Quickening is one of the most important factors that explain the peak in the attachment during the third trimester of the pregnancy (Mikhail et al., 1991; Bloom, 1995; Lerum W. & LoBiondo-Wood Geri, 2007). Attachment has two functions. The first role of

attachment ensures that the child receives essential care for survival by remaining close to the caregiver. The second function is to define the infant's cognitive and emotional development via brain organization, which depends on the quality of attachment and its associated sensory stimuli (Sullivan et al., 2011).

The identification of the MFA correlates is in constant progress. A systematic review reported factors that influence the MFA: increased levels of maternal-fetal attachment were associated with factors such as family support, greater psychological well-being, and having an ultrasound performed. An association was also found between depression, substance abuse, higher anxiety levels, and lower levels of maternal-fetal attachment (J.L. Alhusen, 2008). A cross-sectional study was conducted to describe the relationship between MFA and health practices during pregnancy with neonatal outcomes. Authors found a positive and significant association between maternal-fetal attachment, health practices, and neonatal outcomes (Maddahi et al., 2016).

Studies have also described the relationship between maternal-fetal attachment and depression during pregnancy. A study investigated a conceptual model in which it was hypothesized depression has negative effects on positive health practices and negative effects through maternal-fetal attachment. The authors concluded that depression had a negative relationship with MFA and a positive relationship with positive health practices (Lindgren, 2001). Another study examined pregnant women's stress, and depression and their impact on MFA and the fetal growth on a sample of 166 pregnant women. Results evidenced maternal emotional state, namely stress or depression could affect the maternal-fetal relationship and fetal growth (Kwon & Bang, 2011). Remarkably, a study evaluated the association between the MFA in the first and second trimesters of the pregnancy and depression. The authors observed no

direct correlation between depression in pregnant women and maternal-fetal attachment before quickening (Honjo et al., 2003).

Interestingly, studies have assessed the MFA among pregnant women living with HIV. A study investigated the maternal-fetal attachment in pregnant women living with HIV/AIDS in comparison with pregnant mothers without HIV. Although the increased risk of depression among pregnant women living with HIV may adversely impact the MFA, no difference was found on maternal-fetal attachment among the participants (Faria et al., 2013). A prospective study evaluated whether three desirable maternal health behaviors could be predicted from MFA, history of substance use, marital status, planned pregnancy status, and timing of HIV diagnosis among pregnant women with HIV/AIDS. The model predicted maternal health behaviors for pregnancy care, with MFA, marital living status, and planned pregnancy status as independent contributors (Hernandez, 2014). Based on previous findings, I hypothesized pregnant women living with HIV will present a low pattern of attachment compared to their HIV negative peers.

Maternal-fetal attachment and Maternal-infant attachment

MFA is a good predictor of maternal and infant patterns of attachment. A longitudinal study aimed to find whether early signs of maternal sensitivity could be found in mother and fetus relationship and postnatal maternal sensitivity during pregnancy. The authors reported that when maternal-fetal attachment quality increased, mothers were more sensitive and had higher quality interaction with their infants during caregiving and playtime (Maas et al., 2016). Another study assessed to what extent the maternal-fetal relationship predicts maternal engagement towards her baby. Results evidenced an association between maternal prenatal attachment during the third trimester of pregnancy, and postnatal maternal involvement. The results contributed

also to identifying women who will be more likely develop a sub-optimal attachment to their children (Siddiqui & Hägglöf, 2000).

Maternal-fetal attachment and child's later social and emotional outcomes

The Maternal-fetal attachment is a predictor of a child's later social and emotional outcomes. Studies have shown that women with high MFA had children characterized by a high degree of adaptability (the ability to adopt socially acceptable behavior in new environments), an easy approach (giving more positive responses in an unfamiliar environment or in the presence of new people, ...) in comparison of pregnant women who had a lower attachment (Priel & Besser, 2000; Davoudi, 2012). A longitudinal study analyzed the influence of MFA and infant developmental outcomes in early childhood among pregnant women with a low socioeconomic status. Results indicated that women with a high MFA during pregnancy had more secure attachment styles and tended to have children with optimal development during early childhood in contrast to women with low maternal-fetal attachment (Jeanne L. Alhusen, Hayat, & Gross, 2013). More recently, a study analyzed the association between paternal and maternal attachments and positive adolescent well-being. The findings demonstrated that parental-attachment predicts positive well-being later in adolescence (Rajendran & Juhari, 2018).

Study rationale

Condon developed Maternal antenatal attachment scale in 1993. Based on a sample of 112 pregnant women in Australia, the 19-item instrument questionnaire was designed to evaluate the constructs related precisely to maternal and fetal attachment. Since then, several studies have used the tool to measure maternal-fetal attachment. More specifically, some of the studies on maternal-fetal attachment have analyzed the psychometric properties of this instrument in

different countries such as France, Spain, Turkey, Holland, Hungary, Dutch, Italy (Busonera et al., 2016; Bussel, Spitz, & Demyttenaere, 2009; Denis, Callahan, & Bouvard, 2015; Golbasi, Ucar, & Tugut, 2015; Navarro-Aresti et al., 2016). These studies have confirmed the stability of the Condon's scale. No published study to date has been conducted in the sub-Saharan region. Moreover, the MAAS may not be culturally appropriate in the Democratic Republic of the Congo. Thus, based on the conclusions of the previous research, this study aims to investigate the psychometrics characteristics of the Maternal Antenatal Attachment Scale (MAAS) in the Democratic Republic of the Congo. Due to cultural differences, I hypothesized that the Congolese version of the MAAS may not confirm the stability of the scale in terms of both reliability and validity.

A further goal is to determine the correlates (maternal sociodemographic and pregnancy-related characteristics) associated with maternal-fetal attachment in pregnant women in Kinshasa. As previously noted, the association between maternal-fetal attachment and the gestational age, the neonatal outcomes, the emotional well-being of pregnant women during the post-partum, the future mother-child relationship, and child developmental outcomes later in life has been documented. However, published studies in the sub-Saharan Africa region have only assessed the determinants of maternal and infant attachment. A study was conducted to identify predictors of the maternal-infant pattern of attachment. Authors found that maternal intrusiveness and maternal remoteness, and early maternal depression predicted insecure infant attachment (Tomlinson, Cooper, & Murray, 2005). A randomized controlled trial confirmed that interventions directing mothers can improve the quality of the mother-infant relationship and security of infant attachment (Cooper et al., 2009). I have failed to find evidence of published studies about the correlates of MFA in the Sub-Saharan region to date. I anticipate that pregnant

woman age, planned pregnancy status, history of infertility, method of conception, duration of marriage, parity, fetus being named, relationship with in-laws, support from others/family (self-reported), partner age, relationship with the partner, partner attitude towards pregnancy, HIV status, ultrasound performed will predict MFA in pregnant women in Kinshasa.

Identifying the factors associated with the attachment pattern between the pregnant woman and her fetus will help broaden the possibilities of intervention during pregnancy, and therefore positively impact the child social-emotional outcomes.

METHODS

Goals, Study objectives, and Activities

1. **Goal 1:** Investigate the psychometrics properties of the Condon's MAAS in the DRC
 - **Research Objective 1:** Confirm the validity of Condon's two-factors model of the MAAS in the DRC.
 - **Activity 1:** Reverse-code (1 to 5) eligible questions (1, 3, 5, 6, 7, 9, 10, 12, 15, 16, 18)
 - **Activity 2:** Perform a Confirmatory Factor Analysis (CFA) of the 19-items questionnaire
 - **Research Objective 2:** Explore the internal consistency of the MAAS questionnaire
 - **Activity 1:** Perform a principal component analysis
 - **Activity 2:** Perform a reliability analysis
2. **Goal 2:** Identify the correlates of the MFA in the DRC
 - **Research Objective 1:** Summarize descriptive statistics of key sociodemographic and clinical characteristics
 - **Activity 1:** Compute MFA total score.

- **Activity 2:** Run descriptive statistics of the key sociodemographic and clinical characteristics.
- **Research Objective 2:** Identify the correlates of the MFA

Activity 1: Run Pearson correlation analysis between MFA total score, sociodemographic and clinical continuous variables.

- **Activity 2:** Run Chi-square tests to analyze association between MFA category (Low and High attachment) and the binary sociodemographic and clinical variables.
- **Activity 3:** Run binary logistic regression to calculate the predicted probability of having a high attachment based on selected predictors.

Study Design

This is a multicentric cross-sectional study of pregnant women in three facilities catchment areas in Kinshasa, DRC.

Study Population, Sample Size and Sampling Procedures

The study population is composed of pregnant women attending antenatal care in Kinshasa. Three health facility catchment areas in Kinshasa were part of the study: Maternité de Binza (Binza), Maternité de Kingasani (Kingasani) and CH Saint-Gabriel (Lemba).

Inclusion criteria

To be included in this study, the participants should meet all the following criteria:

- Be pregnant women attending antenatal care in selected facilities.
- Have already perceived fetal movements during the current pregnancy
- Have a documented HIV status

- Be able to understand Lingala
- Consent to participate in the study

Sites Selection

The study was conducted in Maternité de Binza (Binza), Maternité de Kingasani (Kisangani) and CH Saint-Gabriel (Lemba), Kinshasa DRC. These catchment areas were purposively selected based on factors of accessibility (excluding sites with impassable roads at sometimes during the year), high volume in ANC to ease recruitment efforts and sites belonging to the EGPAF and Global Funds supported health zones.

Sample Size and Sampling Procedures

We used a convenience method of sampling. The intended sample size was at least 10 participants per MAAS questionnaire item (19 items). The actual sample size was 220 pregnant women. The average age of pregnant women mean age was 28 ± 5.6 years. Their partner age mean was 36.4 ± 6.8 years. The youngest pregnant woman was 16 and the oldest was 42. The youngest and the oldest male partners were respectively 17 and 64 years. In average, pregnant women had almost 2 children; they were interviewed were the age of gestation was around 28 ± 6.6 weeks. The mean score of the MFA from the original scale was 76.4 ± 8 .

Study Procedures

During routine visits at prenatal care services in Kinshasa, recruiters (nurses who already know the HIV status of pregnant women) have contacted and screened pregnant women, using the eligibility criteria. Recruiters briefly introduced the study objectives and invited potential

participants to meet the interviewers. The recruitment process took in 5 to 10 minutes per pregnant woman. The nurses only introduced potential participants who agreed to meet the interviewers. Interviewers checked the eligibility criteria and invited the potential participants to take part in the study. Once a participant's informed consent was obtained, interviews were conducted in an undisclosed location, where the pregnant women felt comfortable, and their privacy was guaranteed. Interviewers only knew the HIV status of pregnant women who accepted to participate in the study. EGPAF communication team helped translate the English version of the MAAS in Lingala. Before collecting the study data, we first ensured the translated versions (Lingala) of the maternal antenatal attachment scale were comprehensible to pregnant women. During the pilot phase, each question was read to increase participants' understanding of the questionnaire. Questions were edited based on the feedback from the pilot phase.

Data collection and management

Data collection

Sociodemographic, clinical data, maternal-fetal attachment and other of interest were collected on a paper-based questionnaire. One of the three data collectors entered the collected forms into a Microsoft Access database and exported the file to Microsoft Excel 2016 for data quality check. Names and positions were not entered into the database, only the participant's unique study identification number. The database is maintained and analyzed at the Programme National de lutte contre le VIH in Kinshasa. After data quality check is performed, the Excel spreadsheet will be imported from SPSS software for analysis.

Study Instruments

Study investigators were responsible for the design of all data collections guides, training of the local language-speaking study interviewers, study implementation, conduct, data quality assurance, and data analysis. The interview guide was first be developed in English and then translated into Lingala to ensure that the questions are asked consistently and understood by participants. All participants were interviewed.

Study Variables

Dependent variable: Maternal-Fetal Attachment. Maternal–fetal attachment was measured using the maternal antenatal attachment scale (Condon, 1993). There are 19 items with five appropriate response options, for example: ‘Over the past two weeks my feelings about the baby inside me have been: a. Very positive b. Mainly positive c. Mixed positive and negative d. Mainly negative e. Very negative’. The Condon’s scale consists of two factors. The first factor represents the quality of the attachment (affective experiences such as closeness/distance, positive/negative feelings which arise when thinking about the fetus). The total scores range from 11 to 55, with 11 representing the lowest attachment. A score less than 28 indicates a detached or ambivalent attachment. The second factor characterizes the intensity (or quantity) of preoccupation with the fetus and assesses the amount of time pregnant women spend thinking about, talking to, dreaming about or palpating the fetus. It varies from 8 to 40. A low intensity of preoccupation is less than 20. The two factors are combined to yield a total score ranging from 19–95.

Independent variables: Age, planned pregnancy status, history of infertility, method of conception, duration of marriage, parity, fetus already named, relationship with in-laws, support from others/family (self-reported), partner age, relationship with the partner, partner attitude towards pregnancy, HIV status, ultrasound performed. Data were collected via questionnaires.

Data Management

All data were saved on password-protected computers and periodically backed up. All study documents containing participant information were in a locked location with controlled access at facilities during data collection and maintained at the Programme National de Lutte Contre le VIH (PNLS) for coding and analysis activities. Following study completion and all analyses, study documents will be stored for a period of at least five years. Any signed informed consent forms will be stored separately from other study documents (e.g., data collection guides).

Data Analysis

To investigate the psychometrics properties of the Condon's MAAS in the DRC, I first reverse-coded negatively worded statements (items 1, 3, 5, 6, 7, 9, 10, 12, 15, 16, 18) to align with the rest of the items and increase reliability (item-total correlations). Then, a Confirmatory Factor Analysis (CFA) of the original 19-items questionnaire was performed to confirm the validity of Condon's two-factor model of the MAAS in the DRC. The validity or construct validity refers to the degree to which a measure adequately represents the underlying construct that it claims to measure (Brown, 2000). Three fit indices were used to evaluate the validity of the constructs: Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (RMR), and Bentler-Bonett Index or Normed Fit Index (NFI). The cut-off for good fit of the RMSEA, SRMR, and NFI are expected to be respectively <0.08 , <0.08 , ≥ 0.95 (Kenny, 2015).

To further investigate the number of constructs and structure of MFA, an exploratory factor analysis was performed. The Kaiser-Meyer-Olkin measure of sampling adequacy (KMO=.70) and Bartlett's sphericity ($\chi^2=959$; $p<.001$) showed that the items were factorizable. The scree plot showed an important break after four factors (six eigenvalues higher than 1: 3.62,

2.38, 1.72, 1.39, 1.20, 1.03). The model accounted for 47.98% of the factor loadings and the cumulative variance. A principal component analysis with a forced extraction and an oblique rotation of the four factors was performed. The four factors intercorrelation coefficients were less than .5, which was suggestive of an orthogonal rotation. Question 7 cross-loaded in factors I and IV with an absolute value of the coefficients respectively of .56 and .58. It was then excluded. Question 12 did not load either with a minimum of .40. Reliability analyses were performed for each of the four factors and for the 17 remaining questions. Cronbach's alpha is a measure of internal consistency; it expresses how closely a set of items are linked as a group. Generally, Cronbach's alpha values are classified as follows: Excellent ($0.9 \leq \alpha$), Good ($0.8 \leq \alpha < 0.9$), Acceptable ($0.7 \leq \alpha < 0.8$), Questionable ($0.6 \leq \alpha < 0.7$), Poor ($0.5 \leq \alpha < 0.6$), and Unacceptable ($0.5 < \alpha$) (Kline, 2000; DeVellis, 2003; George, 2010.). The Cronbach's alpha was .70 (acceptable) for the 17 items, and .77 (acceptable), .68 (questionable), .51 (poor), and .30 (unacceptable) for the four subscales that emerged from the Exploratory Factor Analysis (EFA). The Condon's original scale showed a questionable internal consistency, with Cronbach's alpha of .64.

To identify the correlates of the MFA, descriptive statistics of pregnant women age, the partner age, parity, total score of the original MAAS (19 items), age of gestation, education level, marital status, religion, current occupation, HIV status, and relationship with in-laws were computed. Factor scores were saved. Independent sample t-tests were performed to detect significant differences in MFA scores between binary variables and dichotomized categorical variables. Pearson correlation analysis and Chi-squared tests analyzed the association between sociodemographic, clinical characteristics, and maternal-fetal attachment scores. Chi-square tests and independent sample t-tests were performed on the same variables to increase the chance of

detecting either association or significant differences between MFA scores and independent variables. MFA scores were used both as continuous and categorical variables (low MFA and high MFA), which decreases the degree of freedom and variance. I dichotomized MFA scores to perform the logistic regression and for a practicability reason in a clinical setting. The low maternal-fetal attachment was defined by the category of pregnant women who were in the lowest quartile of the MFA Score for the whole sample. The lowest quartile is of clinical interest (Condon & Corkindale, 1997). Finally, a binary logistic regression analysis was used to predict maternal antenatal attachment category (low MFA) from sociodemographic and clinical characteristics. The Wald backward stepwise approach was used to derive the most adjusted models as a calibration model to predict low maternal antenatal attachment. Independent variables with likelihood ratio p-value ≤ 0.10 were included in the full models prior to starting elimination of the specific variables one by one to get the most adjusted model. We used SPSS (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.) to conduct statistical analyses, except the CFA that was performed with the SAS software version 9.4 SAS Institute Inc 2013.

Ethical considerations

Informed Consent Procedures

All potential participants were informed of the study objectives and procedures and given the opportunity to ask questions and provide informed consent to participate in the study. Potential participants were informed that enrollment into this study was purely voluntary. They were also informed that they could choose not to participate or to end their participation in the study at any time without impacting their routine medical services. Written informed consents were obtained from all potentials participants prior performing any study procedures.

The consent forms were translated into the commonly spoken language in Kinshasa (Lingala). All study participants had the option of being consented either in Lingala. Study staff read the consent script to participants, or if participants were literate and choose to do so, they could read it themselves. Literate participants signed and dated the consent form. For those who were illiterate, a thumbprint was used to indicate consent; a witness observed the consent process, signed and dated the form to certify that the participant was read the consent on that day and voluntarily agreed to take part in the study. Interviews were conducted in undisclosed location to protect participant's confidentiality.

Serious Adverse Events Reporting

This study did not involve the implementation of any experimental activities. The most serious risk associated with this study was the possibility of unintended disclosure of HIV status or other medical information during the interviews. The investigators were trained and certified in ethics in research. They also signed a commitment form not to disclose the information they will collect, including the HIV status of participants. Any breaches of confidentiality should be reported to the ethics committee, and the study facility should be notified to provide support (as appropriate) to the participant.

Ethical Review

The Kinshasa School of Public Health Institutional Review Board in the DRC approved this protocol first, and then it was submitted and approved at University of Nebraska Medical Center IRB in the US. This study was conducted from September 3, 2018 to March 20th, 2019.

RESULTS

Table 1 reports descriptive statistics and internal consistency analysis of the original MAAS. A confirmatory factor analysis was performed to investigate the validity of the two-factors model of Condon's original scale, excluding item 7. Results did not support an evidence of a two-factor model consisting of the quality of attachment and the intensity of preoccupation (RMSEA > 0.08, SRMR > 0.08, and NFI < 0.95).

Table 1: Descriptive statistics and Internal Consistency analysis of the original MAAS (n=220)

Subscale	Item	<i>M</i>	<i>SD</i>	<i>s</i>	<i>k</i>	rs	<i>ar</i>
Intensity	1 ^a : I have thought about, or been preoccupied with the baby inside me	3.28	1.57	-.24	-1.52	.38**	.653
	2: When I have spoken about, or thought about the baby inside me I got feelings which were	4.14	1.19	-1.32	.65	.517**	.625
	4: I have had the desire to read about or get information about the developing baby. This desire is:	3.77	1.51	-.85	-.84	.51**	.629
	5 ^a : I have been trying to picture in my mind what the developing baby actually looks like in my womb	3.39	1.40	-.26	-1.26	.57**	.617
	8: I have found myself talking to my baby when I am alone	3.22	1.49	-.18	-1.39	.613**	.608
	14: I have taken care with what I eat to make sure the baby gets a good diet	2.95	1.71	.07	-1.70	.58**	.619
	17: I have had dreams about the pregnancy or baby	1.84	1.03	1.04	.17	.35**	.646
	18 ^a : I have found myself feeling, or rubbing with my hand, the outside of my stomach where the baby is	4.25	1.09	-1.29	.88	.45**	.635
Quality	3 ^a : My feelings about the baby inside me have been	4.76	.72	-3.67	14.24	.39**	.641
	6 ^a : I think of the developing baby mostly as	4.03	.78	-.10	-1.19	.26**	.652

9 ^a : When I think about (or talk to) my baby inside me, my thoughts:	4.91	.40	-6.22	47.56	.34**	.648
10 ^a : The picture in my mind of what the baby at this stage actually looks like inside the womb is	4.00	1.01	-1.39	2.04	.44**	.635
11: When I think about the baby inside me, I get feelings which are	4.74	.77	-3.13	9.60	.35**	.644
12 ^a : Some pregnant women sometimes get so irritated by the baby inside them that they feel like they want to hurt it or punish it:	4.77	.73	-3.46	11.94	.13*	.661
13: I have felt:	4.63	.84	-2.57	6.33	.45**	.635
15 ^a : When I first see my baby after the birth, I expect I will feel	4.85	.43	-3.57	16.68	.17*	.656
16 ^a : When my baby is born, I would like to hold him	4.00	1.35	-.70	-1.41	.22**	.670
19: If the pregnancy was lost at this time (due to miscarriage or other accidental event) without any pain or injury to myself, I expect I would feel	4.86	.51	-4.46	22.43	.24**	.652
7 ^a : Over the past two weeks I have felt that the baby inside me is dependent on me for its well-being:	4.03	1.55	-1.26	-.151	.11	.695
Total Scale	4.02	0.81	-1.110	1.393		

** Correlation is significant at the .01 level (2-tailed). * Correlation is significant at the .05 level (2-tailed). rs: correlation of the item with the rest of the scale ar: coefficient of reliability if the item is removed. ^a Reverse-coded items

Table 2 synthesizes the orthogonal factor analysis with the loading values (greatest |Beta|) and compares the constructs (factors) for both the current study and the original study. Five questions composed the first factor (Intensity of the feelings: 2, 4, 5, 6, and 18). Except for question 6 originally close to the quality of attachment construct, the four other questions loaded to the same factor as originally described. The second factor (the quality of the feelings) included three questions (9, 3, and 11), which loaded to the same construct as in Condon's study. Factors 3 and 4 showed poor internal consistencies but were underpinning respectively the concepts of interaction with the baby and dependence.

Table 2: Orthogonal Factor Analysis of the Congolese version of the MAAS

Item	Greatest Beta	This study Factors	Condon's Factors
4*: I have had the desire to read about or get information about the developing baby. This desire is:	.82	1, Intensity (Cronbach's $\alpha=.77$)	1, Intensity
5*: I have been trying to picture in my mind what the developing baby actually looks like in my womb:	.79	1	1
18*: I have found myself feeling, or rubbing with my hand, the outside of my stomach where the baby is	.61	1	1
6*: I think of the developing baby mostly as	.60	1	2, Quality
2*: When I have spoken about, or thought about the baby inside me I got feelings which were	.60	1	1
9*: When I think about (or talk to) my baby inside me, my thoughts:	.80	2, Quality of feelings (Cronbach's $\alpha=.68$)	2
3*: My feelings about the baby inside me have been	.75	2	2
11*: When I think about the baby inside me I get feelings which are	.74	2	2
10: The picture in my mind of what the baby at this stage actually looks like inside the womb is	.60	3, Present and future interaction with the baby (Cronbach's $\alpha=.51$)	2
15: When I first see my baby after the birth, I expect I will feel	.58	3	2
16: When my baby is born, I would like to hold him	.57	3	2
8*: I have found myself talking to my baby when I am alone	.50	3	1
19: If the pregnancy was lost at this time (due to miscarriage or other accidental event) without any pain or injury to myself, I expect I would feel	.49	3	2
13*: I have felt:	.41	3	2
14*: I have taken care with what I eat to make sure the baby gets a good diet	.63	4, Dependence (Cronbach's $\alpha=.30$)	1
1*: I have thought about, or been preoccupied with the baby inside me	.59	4	1
17*: I have had dreams about the pregnancy or baby	.50	4	1

*Question starts with: "Over the last two weeks".

Table 3 indicates that around 80% of pregnant women had at least a high school diploma. Around 7 pregnant women out of 10 identified herself as attending revival church services regularly. More than half (62%) of the pregnant women were house wives. At least half of the pregnant women were married monogamously. One out of 10 pregnant women were documented

HIV positive. 87% of pregnant women reported to have either a good or an excellent relationship with their in-laws.

Table 3: Sociodemographic and Clinical Characteristics of Pregnant Women (n=220)

	Frequency	Percent	Cumulative Percent
<i>Education level</i>			
Never attended school	1	.5	.5
Primary school	38	17.3	17.7
Secondary school	135	61.4	79.1
Higher education	46	20.9	100.0
Total	220	100.0	
<i>Religion</i>			
Catholic	27	12.3	12.3
Protestant	17	7.7	20.0
Kimbanguist	10	4.5	24.5
Muslim	2	.9	25.5
Revival Church	156	70.9	96.4
Other	8	3.6	100.0
Total	220	100.0	
<i>Occupation</i>			
House Wife	137	62.3	62.3
Student	4	1.8	64.1
Owns business	31	14.1	78.2

Civil service	12	5.5	83.6
Employed not Civil Service	16	7.3	90.9
Other	20	9.1	100.0
Total	220	100.0	
<i>Marital status</i>			
Single	7	3.2	3.2
Married monogamously	117	53.2	56.4
Living as married	69	31.4	87.7
Other	27	12.3	100.0
Total	220	100.0	
<i>HIV Status</i>			
Negative	197	89.5	89.5
Positive	23	10.5	100.0
Total	220	100.0	
<i>Relationship with In-Laws</i>			
Bad	5	2.3	2.3
Fair	3	1.4	3.6
Neutral	19	8.6	12.3
Good	91	41.4	53.6
Excellent	102	46.4	100.0
Total	220	100.0	

Table 4 compares the difference between the low attachment (the lowest quartile) and high attachment (the remainder) groups. The partners of pregnant women were older ($M=38$,

SD=8.0) in the low attachment category than were those in the high attachment category (M=35.8, SD=6.3), $t(218) = 2.25, p = .03$. The pregnant women in the low attachment category had more pregnancies reaching viable gestational age (M=2, SD=1.7) than did those in the high attachment category (M=1.5, SD=1.4), $t(218) = 2.28, p=.02$. They also experienced a larger number of abortion (M=.5, SD=.8) than did the pregnant women in the high attachment category (M=.4, SD=.7), $t(218) = .4, p=.04$. The average ages of both pregnant women and their pregnancy in the two categories were the same.

Table 4: Differences between Lowest Quartile on MFA Total Score (Low Attachment) and the Remainder (High-Attachment) (n=220)

Variables	Mean (SD) Low Attachment (n=59)	Mean (SD) High Attachment (n=161)	<i>t</i>	<i>p</i>
<i>Age of Gestation</i>	27.0 (6.0)	28.6 (6.7)	-1.52	.13
<i>Age</i>	28.9 (6.2)	28 (5.3)	.76	.45
<i>Partner age</i>	38.0 (8.0)	35.8 (6.3)	2.25	.03*
<i>Parity</i>	2.0 (1.7)	1.5 (1.4)	2.28	.02*
<i>Abortion</i>	.5 (.8)	.4(.7)	.40	.04*

* $p < .05$

Table 5: Differences on MFA Total Score by Binary Variables (n=220)

Variables		MFA Total Score				
		N	Mean	SD	<i>t</i>	<i>p</i>
<i>Pregnancy planned?</i>	No	92	66.4	8.2	-1.96	.05
	Yes	128	68.5	7.6		

<i>Fetus already named?</i>	No	123	66.4	8.2	-2.66	.009**
	Yes	97	69.2	7.3		
<i>HIV Status</i>	Negative	197	68.4	7.5	4.20	.001**
	Positive	23	61.3	9.0		
<i>Education Level</i>	Less than High School	174	67.7	7.7	0.25	.80
	At Least High School	46	67.4	8.8		
<i>Religion</i>	Non-Revival Church	155	67.8	8.4	0.51	.61
	Revival Church	65	67.2	6.9		
<i>Marital Status</i>	Non-Monogamous	103	66.7	8.3	0.51	.12
	Monogamous	117	68.4	7.5		
<i>Gestational Trimester</i>	I or II	105	66.5	8.2	-2.07	.03*
	III	115	68.7	7.5		
<i>Relationship with In-Laws</i>	Not Good	27	63.9	9.7	-2.63	.009**
	Good	193	68.1	7.5		

*: $p < .05$

** : $p < .01$

Table 5 reports differences on MFA total score by dichotomous and dichotomized categories. Pregnant women who reported to have already a name for their future baby tend to have higher attachment scores ($M=69.2$, $SD=7.3$) than did those who did not ($M=66.4$, $SD=8.2$), $t(218) = 2.66$, $p=.009$). Pregnant women who were at their third trimester of their pregnancy (age of gestation of more than 28 weeks) had higher attachment scores ($M=68.7$, $SD=7.5$) than their peers who were in either the first or the second trimester of their pregnancy ($M=66.5$, $SD=8.2$), $t(218) = -2.07$, $p=.03$).

Similarly, pregnant women with a documented HIV negative status had higher attachment scores ($M=68.4$, $SD=7.5$) than those who were documented HIV positive ($M=61.3$, $SD=9.0$), $t(218) = 4.20$, $p=.001$). Those who reported to be in good relationship (good or excellent) with their in-laws were more attached to their fetus ($M=68.1$, $SD=7.5$) than were those in a relationship that was not good ($M=63.9$, $SD=9.7$), $t(218) = -2.63$, $p=.009$). There was no difference in attachment scores based on religion, marital status, and educational level.

Table 6: Correlations Between MFA Total Score, Sociodemographic, and Clinical Characteristics (n=220)

	<i>MFA Total Score</i>	<i>Age</i>	<i>Partner age</i>	<i>Duration of Marriage</i>	<i>Parity</i>	<i>Gravidity</i>
<i>MFA Total Score</i>	1					
<i>Age</i>	-.072	1				
<i>Partner age</i>	-.183**	.731**	1			
<i>Duration of Marriage</i>	-.111	.568**	.433**	1		
<i>Parity</i>	-.210**	.609**	.466**	.691**	1	
<i>Gravidity</i>	-.139*	.625**	.528**	.639**	.852**	1
<i>Age of Gestation</i>	.166*	.079	.103	.062	.064	.052

** Correlation is significant at the .01 level (2-tailed). * Correlation is significant at the .05 level (2-tailed).

Table 6 summarizes the correlations between MFA scores, sociodemographic and clinical characteristics. Based on the results, MFA total scores were negatively correlated to partner age ($r=-.18$, $p<.01$), parity ($r=-.21$, $p<.01$), and gravidity ($r=-.14$, $p<.05$). Conversely, MFA total scores were positively correlated to age of gestation. There were no correlations between MFA

total scores and pregnant women age, duration of marriage, abortion, and the number of lost children.

Table 7: Associations Between MFA Total Score, HIV status, and Performance of Ultrasound (n=220)

Variables		<i>Attachment Categories</i>				Chi-Square	<i>p</i>
		<i>Low Attachment</i>		<i>High Attachment</i>			
		N	Percent (of Total)	N	Percent (of Total)		
<i>Ultrasound performed?</i>	<i>No</i>	29	13.2	30	13.6	3.76	.05
	<i>Yes</i>	56	25.5	105	47.7		
<i>HIV Status</i>	<i>Negative</i>	45	20.5	152	69.1	15.2	.001**
	<i>Positive</i>	14	6.4	9	4.1		

** $p < .001$

Table 7 presents the cross-tabulated frequencies of HIV status and performance of ultrasound by attachment categories. There is a significant association between attachment and HIV status, $X^2 (1, N = 220) = 15.2, p < .001$. The relation between performance of ultrasound and attachment was marginally significant $X^2 (1, N = 220) = 3.76, p = .05$.

Table 8: Logistic Regression Predicting Attachment from Age, Partner Age, Parity, History of Infertility, HIV Status, Religion, and Age of Gestation.

<i>Variables in the Equation</i>								
						<i>95% C.I. for EXP(B)</i>		
	<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>Sig.</i>	<i>Exp(B)</i>	<i>Lower</i>	<i>Upper</i>
Step 19 ^a Age	.121	.046	6.951	1	.008	1.129	1.032	1.235
<i>Partner Age</i>	-.082	.035	5.661	1	.017	.921	.860	.986
<i>Parity</i>	-.372	.133	7.823	1	.005	.690	.531	.895
<i>History of Infertility</i>	1.803	1.059	2.896	1	.089	6.066	.761	48.363
<i>Method of Conception</i>	-2.369	1.248	3.600	1	.058	.094	.008	1.081
<i>HIV Status</i>	-2.103	.527	15.927	1	.000	.122	.043	.343
<i>Religion</i>	-.615	.370	2.757	1	.097	.541	.262	1.117
<i>Age of Gestation</i>	.059	.024	6.295	1	.012	1.061	1.013	1.111

Variable(s) entered on step 1: Q208Age, Q209PW_PartAge, Q214DuratMariage, Q215Parity, Q216Gravidity, Q217Abortion, Q218ChildDeath, Q219GestatAgeVisit1, Q222UltraSound, Q223CurrPregPlanned, Q224HistoryInfert, Q225MethodConcept, Q226NumberLiveChild, Q227FetusNamed, Q228HIVStat, Q231PartnerAttitud, Q232PhysicallyHurts, Q233Threatens, EdCatBin, RelCat, MarstatCat, AbortCat, PartnAttCat, AgeOfGestation, GestAgeCAT, RelinLawCat.

Table 8 presents the logistic regression coefficients to predict attachment category, Wald test, and odds ratio for each of the predictors. Using a .05 criterion of statistical significance, age of gestation, partner age, parity, and the HIV status had significant main effects. When accounting for the other covariates, an increase in week of age of gestation was marginally associated with a 6% increase in odd of having a high attachment (OR=1.06 CI=1.01-1.11

$p < .05$). Conversely, an increase of one year in partner age marginally decreased by 8% the pregnant women odds of having a high attachment when other predictors were held constant (OR=1.01 CI=.86-.99 $p < .05$). More interestingly, when controlling for all other variables, pregnant women were 1.44 time more likely to have a low attachment when they had one more pregnancy that reached viable gestational age (OR=.69 CI=.53-.90 $p < .01$). Finally, the odds ratio for HIV status indicated that when holding all other variables constant, pregnant women with an HIV positive status were 8.3 times more likely to have a low attachment than were HIV negative pregnant women. In other words, having a HIV positive status decreased the odd of having a high attachment by 88%. (OR=0.12 CI=.04-.34 $p < .001$).

Discussion

The first aim of this study was to investigate the psychometric properties of the MAAS in the Democratic Republic of Congo. I hypothesized that the Condon's MAAS may not confirm the stability of the scale in terms of both reliability and validity. After a confirmatory factors analysis, the results could not support the validity of this model. Contrary to the two-factor structure of the Condon's study, our results from the exploratory factor analysis indicated rather a four-factor solution, with similarities for the first two factors, namely quality and intensity of the attachment. Comparable conclusions were published in a study with 117 primiparas on the validity of the MAAS questionnaire in France. The authors found a solution to four factors including the one corresponding to the intensity of the attachment as suggested by Condon (Denis et al., 2015).

The second aim of this study was to identify the correlates of maternal-fetal attachment in the Democratic Republic of Congo. I hypothesized that the HIV status may influence the level of

MFA. Our results indicated that pregnant women with a positive HIV status were 8 times more likely to have a low attachment pattern compared to HIV negative pregnant women. These results are probably due to the elevated prevalence of depression in people living with HIV (Owe-Larsson et al., 2009; Breuer et al., 2011; Gaynes et al., 2012). Several studies have found that pregnant women's groups with low attachment had a high prevalence of depression and anxiety (Condon & Corkindale, 1997; J.L. Alhusen, 2008). The present study found a significant correlation between the age of gestation and the attachment score: the longer the pregnancy the higher were the levels of the attachment. These results are consistent with the current literature (Laxton-Kane & Slade, 2002; Camarneiro & Justo, 2017). This study also identified parity as being inversely associated with attachment level between the pregnant woman and the fetus. Pregnant women with more pregnancies who reached the age of viability tended to have a significantly lower attachment score compared to those who had less. Two other studies on the socio-demographic characteristics of the attachment led to the same conclusion (Grace, 1989; Bussel et al., 2009).

Limitations

This study reveals three major limitations. First, the type of study (cross-sectional) does not allow to present a relationship of causality between the identified variables and the maternal-fetal attachment. Secondly, although there was a pilot phase to test the understanding of the questionnaire among pregnant women, there was no back-translation (Lingala to English) to assess compliance with the original questionnaire. The last limitation is on the number of HIV cases in the sample studied. Although acceptable, it limits the strength of conclusions about the role of HIV on the attachment.

Conclusion

The aim of this study was to investigate the psychometric properties and correlates of maternal-fetal attachment in pregnant women in the Democratic Republic of Congo. Condon's global scale can be used by removing questions 7 and 12. Parity and positive HIV status of the pregnant woman negatively influence her attachment to the fetus. Maternal-fetal attachment increases throughout pregnancy. Early identification of pregnant women with a considerable risk of low MFA may help design specific programs to enhance mother and fetus relationship, and therefore increase the likelihood of children to reaching their development potential.

Service Learning/Capstone Experience Reflection

During this project, I had the opportunity to learn how to develop and conduct a research project. I was able to design data collection tools that could help me answer my research questions.

During my time at the Elizabeth Glaser Pediatric AIDS Foundation, I learned how to analyze quantitative data from the projects in which I was involved. This experience was significant to me in that I was able to identify several research opportunities with the data collected monthly.

I have also learned innovative approaches to project management that are useful to any public health professional. This experience has been doubly beneficial to me. First, I feel more confident about my qualities as a public health project manager. Secondly, I have learned to identify and collaborate with the different stakeholders in the health sector. Public health field realities in sub-Saharan Africa are sometimes different from other parts of the world.

Acknowledgements

I am incredibly thankful to God, the potter of my life, for the breath of life, health, and hope that he has planted in my heart throughout this master's program.

I am also grateful to all members of my committee: Dr. Abbie Raikes, Dr. Chris Wichman and Dr. John Ditekemena for their support and guidance throughout this project. Your scientific qualities have helped me grow a lot in the field of research.

My sincere thanks to Dr. Meza, Dr. Tibbits, Dr. Maloney, and Dr. Toure for all their support and all the advice provided in the realization of this project. Thanks to Laura Vinson for her valuable contribution and support in the administrative management of this project.

The EGPAF warmly welcomed me and all its staff, especially Dr. Cady Nyombe for the time invested in my supervision particularly in the redaction of the research protocol. Thanks also to my data collectors: Jean Didier Bahati, Dr. God Thank you Noki and Dr. Fabrice Dunia.

I would not have benefited from this educational opportunity if the Fulbright Foreign Student's program and the US Embassy in the Democratic Republic of Congo did not allow me to continue my graduate studies in the United States. This prestigious program has helped me to think deeply about myself and my future. Special mention also to all my classmates and the Omaha community "Fulbrighters."

Thanks to my family: my mother Anne-Philippine Buanga, my sisters and my in-laws.

Finally, my sincere gratitude goes to the place of the greatest actors behind this project: my wife Orly Kalombo and my son Juan-Elyor Lusakumunu. I will never find the right words to express all my feelings about you. Your sacrifices far from me during these two years will remain in my heart.

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