PSYCHOMETRIC ANALYSIS OF IOWA INFANT FEEDING ATTITUDE SCALE TO IMPROVE CLINICAL USE AND EFFICACY AMONG PRENATAL WOMEN IN CANADA

By © Nouf Majed AlKusayer

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ABSTRACT

Breastfeeding is the optimal source of nutrition for newborns, and yet the rates of breastfeeding initiation and continuation in Canada, and specifically Newfoundland and Labrador (NL) are low. Maternal attitudes toward breastfeeding is the best predictor of breastfeeding behaviour, and can be assessed using the validated 17-item Iowa Infant Feeding Attitude Scale (IIFAS). This thesis aimed to 1) reduce the IIFAS to a more manageable length while maintaining its validity and reliability and 2) determine optimal cut-off scores for both the original and reduced IIFAS with the objective being to increase its clinical usefulness in various settings. A 13-item psychometrically and conceptually sound IIFAS is proposed. Cut-off scores of 60 on the original scale and 45 on the reduced item IIFAS scale are the optimal cut-off scores to identify intention to breastfeed and infant feeding outcomes at one month postpartum in mothers in their 3rd trimester of pregnancy.

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DEDICATION

To my dear parents,

Majed AlKusayer & Yosra AlShamlan,

for their unwavering love and support

through *this* and all my adventures

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LIST OF ABBREVIATIONS

AHRQ : Agency for Healthcare Research and Quality

AUC : Area Under Receiver Curve

BAPT : Breastfeeding Attrition Prediction Tool

CI : Confidence Interval

EBF : Exclusive Breastfeeding

EFA : Exploratory Factor Analysis

EFF : Exclusive Formula Feeding

FDA : Food and Drug Administration

FiNaL : Feeding infants in Newfoundland and Labrador

GRABS : Gender-Role Attitudes toward Breastfeeding Scale

GSIYCF : Global Strategy for Infant and Young Child Feeding

HREA : Health Research Ethics Authority of Newfoundland and Labrador

IIFAS : Iowa Infant Feeding Attitude Scale

KMO : Kaiser-Meyer-Olkin

MF : Mixed Feeding

MRF : Memorial University's Medical Research Endowment Fund

NL : Newfoundland and Labrador

NLSCY : National Longitudinal Survey of Children and Youth

NPHS : National Population Health Survey

OR : Odd Ratio

ROC : Receiver Operating Characteristic

SD : Standard Deviation

SIDS : Sudden Infant Death Syndrome

SPSS : Statistical Package for the Social Science

TPB : Theory of Planned Behavior

UNICEF : United Nations Children's Fund

USA : United States of America

WHO : World Health Organization

PRESENTATIONS AND PUBLICATIONS

ABSTRACT ACCEPTED ✓

1) **Nouf M. AlKusayer,** William K. Midodzi, Leigh Anne Newhook, Julia Temple Newhook, Janet Murphy-Goodridge, Lorraine Burrage, Nicole Gill, Beth Halfyard, Laurie K. Twells. *Precision Remodeling and Cut-off Determination of the Iowa Infant Feeding Attitude Scale to Improve Clinical Use and Efficacy among Prenatal Women in Canada.*

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Chapter 1: Introduction

1.1 Background and Rationale

1.1.1 Breastfeeding: the optimal nutrition

Breastfeeding is a process of milk transfer from a mother's breast to her baby, requiring a combination of both the mother's innate ability to produce milk and her child's ability to latch and suck in order for the baby to obtain the full nutritional benefits of breastmilk (Royal College of Midwives, 2002). It is well established that breastfeeding is highly beneficial for both the mother and her newborn, and that breastmilk's full nutritional profile cannot be obtained from commercially prepared infant formula (Gale et al., 2012). It provides newborns with the optimal nutrition required for the first six months of life, including vital minerals, vitamins, and critical immunoglobulins required for healthy growth and development (World Health Organization [WHO], 2016). According to the Food and Drug Administration (FDA), breastmilk has the quintessential makeup of easily digestible substances, including water, vitamins, amino acids, and fatty acids (Williams, 1995). Breastmilk is a rich source of vitamin E and vitamin A, as well as trace amounts of both vitamin K and vitamin D. As previously described by Riordan, in *Breastfeeding and Human Lactation*, breastmilk is "similar to unstructured living tissue" because of its nutrient transfer capabilities and its beneficial immunological, biochemical, and anti-inflammatory properties (Riordan, 2005). As such, breastfeeding has been described as the "gold standard" against which all other infant-feeding methods are compared (Walker, 2010).

There are multiple international bodies that actively promote the benefits of breastfeeding, including the WHO, United Nations Children's Fund (UNICEF) (WHO, 2016; Pound & Unger, 2012; WHO, 2009), the International Lactation Consultants Association (Spatz & Lessen, 2011), and the International Pediatric Association (FIGO Committee for Safe Motherhood, 2011). The WHO and UNICEF recommend initiating breastfeeding within the first hour after birth followed by exclusive breastfeeding with no added solid food, formula, or water for the first six months (WHO, 2016). Within Canada, the Dietitians of Canada, the Canadian Paediatric Society, and Health Canada have regularly worked together to produce national evidence-based guidelines concerned with infant health and nutrition (Maclean & Millar, 2005). In 2004, Health Canada revised their recommended total duration of breastfeeding from four months to align with WHO recommendation of six months (Maclean & Millar, 2005).

According to the Global Strategy for Infant and Young Child Feeding (GSIYCF), developed by WHO and UNICEF, by the age of six months old breastmilk is no longer sufficient for a newborn's nutritional needs. Therefore, infants should receive nutritionally adequate and safe complementary foods while supplementary breastfeeding may continue for up to two years of age or beyond (WHO, 2009). Complementary food refers to home or commercially prepared, age-appropriate food that can be gradually introduced into the infant's diet (WHO, 2009). With remarkable unanimity, Health Canada and other international bodies such as The Royal College of Midwives concur with the GSIYC's recommendations (The Royal College of Midwives, 2004).

1.1.2 Benefits of breastfeeding

The process of breastfeeding conveys numerous health benefits to the infant, including a reduction in the frequency and severity of neonatal respiratory infections (Chien & Howie, 2001), lowered risk of bacterial meningitis, otitis media (ear infection) (Ip et al., 2007), and necrotizing enterocolitis (James & Lessen, 2009), and improved protection against sudden infant death syndrome (SIDS). The impact of breastfeeding on adverse neonatal events highlights the role that breastmilk plays in developing the neonatal immune system (Belderbos et al., 2012). According to the Canadian Paediatric Society, exclusive breastfeeding is associated with the reduced incidence and severity of infectious diseases (Boland, 2005). The benefits and significance of breastfeeding have been also found to extend into adulthood. Breastfed infants have shown to have a lower risk of developing chronic diseases later in life, including childhood and adolescent obesity, type 1 and type 2 diabetes mellitus, allergies, leukemia, hypercholesterolemia, and heart disease (Binns, Lee, & Scott, 2001; Mackin, 2015). A number of studies highlight that breastfeeding enhances cognitive development and neurobehavioral outcomes. Specifically, breastfed babies have higher intelligence test scores compared to those who were not breastfed (Ip et al., 2007; Anderson, Johnstone, & Remley, 1999; Feldman & Eidelman, 2003; Mortensen, Michaelsen, Sanders, & Reinisch, 2002).

The benefits of breastfeeding also extend to the mother as it reduces the incidence of postpartum hemorrhage and minimizes the risk of developing breast cancer, ovarian cancers, and osteoporosis (Mackin, 2015). Breastfeeding women tend to return to their pre-pregnancy weight faster than women who are not breastfeeding since breastmilk production

generally requires 400-700 calories per day, which is equivalent to the energy needed to ride a bicycle for approximately an hour (Mackin, 2015). Breastfeeding has also been shown to enhance maternal well-being and psychological health, achieved as a result of improved sleep quality, and reduced blood pressure (James & Lessen, 2009). Furthermore, both oxytocin, the 'bonding' hormone, and prolactin, the 'mothering' hormone, are released during breastfeeding to stimulate milk production, to enhance feelings of attachment and emotional bonding between mother and infant, and to accelerate maternal recovery from childbirth (Creasy, 1997).

In addition to the maternal and newborn health benefits associated with breastfeeding, other economic and environmental benefits have been documented. Sustainability, completeness, and readiness features make breastmilk the most cost-effective and non-replicable source of nutrition for newborns. In 2010, the Agency for Healthcare Research and Quality (AHRQ) conducted a detailed pediatric cost analysis assessment of the economic benefits of breastfeeding. At that time, the United States (US) reported a breastfeeding initiation rate of 74% and the rate of exclusive breastfeeding for the first six months of life was 12.3%. The report concluded that if 90% of US mothers followed the current evidence-based recommendation of exclusive breastfeeding for six months, this would be associated with an estimated cost-savings of $13 billion dollars due to direct and indirect reduced medical costs (Bartick & Reinhold, 2010). Furthermore, the improved maternal and neonatal health outcomes as a result of breastfeeding translate later to economic workplace benefits for parents who return to work, including greater productivity, less employee absenteeism, reduced employee turnover to care for sick

children, and fewer health claims (U.S. Department of Health and Human Services, 2011). Furthermore, the natural process of breastmilk production does not require manufacturing infrastructure or equipment, fuel to be prepared, or transportation to be shipped and delivered; it is the most environmentally-friendly mode for infant feeding. Breastfeeding has a great potential for saving global resources and energy as well as reducing the human carbon footprint (U.S. Department of Health and Human Services, 2011).

1.1.3 Past and current breastfeeding trends in Canada

The breastfeeding initiation rate in Canada has increased dramatically nearly doubling, during the past several decades. In 1963, only 38% of Canadian women reported they initiated breastfeeding after birth, compared to 75% in 1982. The increase in rates happened in two distinct waves, the first which occurred between 1973 and 1978 due to a Nestle formula boycott and the second which occurred between 1981 and 1982 due to improvement in federal regulations of formula promotion and advertising (Mcnally, Hendricks, & Horowitz, 1985; Nathoo & Ostry, 2009). Following 1988, in which the initiation rate in Canada was 76% (Langner & Steckle, 1991), national breastfeeding rates were not available until 1994 when Statistics Canada produced a report conducted by the National Population Health Survey (NPHS) and the National Longitudinal Survey of Children and Youth (NLSCY) (Statistics Canada, 1995). Since then, national breastfeeding initiation rates have continued to increase from 81.6% in 2001 to 87.0% in 2005 (Gionet, 2013). The most recent breastfeeding initiation rate was 89%, reported in 2011-2012 (Gionet, 2013).

The rates of breastfeeding duration (ie. exclusive breastfeeding to 6 months) have

shown little increase over the past several decades, and still remain low relative to breastfeeding initiation rates in most regions of Canada. The proportion of Canadian women exclusively breastfeeding for the recommended six months was 17.3% in 2003 and 25.9% in 2010 (Health Canada, 2012). The most recent reported rate of exclusive breastfeeding for six months was 24.2% or one in four Canadian women in 2012 (Statistics Canada, 2014).

Across the provinces, breastfeeding initiation rates vary widely; in 2011-2012, Newfoundland and Labrador (NL) reported initiation rates of 57%, while British Columbia had a rate of 96% (Gionet, 2013). The rate of mothers initiating breastfeeding in NL has consistently been the lowest in Canada, but with improvements observed in the early 2000s. The rate for exclusively breastfeeding for six months in NL is equally as low at 18.0%, compared to the national average of 24.2% (Statistics Canada, 2014).

1.1.4 Predictors for breastfeeding intent, initiation, and duration

Breastfeeding is a complex and a multifactorial behaviour that is influenced by both the mother and her newborn. It is shaped by an interplay of biological, socioeconomic, psychosocial, and cultural factors. A significant body of research exists which provides evidence of the specific factors associated with successful initiation of breastfeeding, continuation of breastfeeding, and early cessation of breastfeeding among women. Several maternal factors found to impact breastfeeding initiation and/or duration behaviours include, but are not limited to, age (Maclean & Millar, 2005), household income (Maclean & Millar, 2005; Persad & Mensinger, 2008), parity (Arora, Mcjunkin, Wehrer, & Kuhn, 2000; Bentley, Dee, & Jensen, 2003; Li, Fein, Chen, & Grummer-Strawn, 2008), marital

status (Bailey & Wright, 2011; Maclean & Millar, 2005), province of residence, rural or urban area (Al-Sahab, Lanes, Feldman, & Tamim, 2010; Maclean & Millar, 2005), level of education (Al-Sahab et al., 2010; Arora et al., 2000), and ethnicity (Jones, Kogan, Singh, Dee, & Grummer-Strawn, 2011).

An analysis of breastfeeding practices amongst the Canadian population particularly, revealed that older, married (including common-law), more educated, non-smoking, and immigrant women are more likely to initiate and continue exclusive breastfeeding (Gionet, 2013). Women from higher income households who reside in urban areas also appear to initiate and continue breastfeeding behaviours compared to women in poorer socio-economic areas (Gionet, 2013). Although breastfeeding initiation rates do not change significantly as a pure function of maternal age, mothers aged 24 years or younger have the lowest breastfeeding duration rate (14.3%), compared to older mothers between 25-34 and 35-55 (24.6% and 31.2%, respectively) (Public Health Agency of Canada, 2009; Health Canada, 2012). While cultural beliefs, values, and expectations also have been noted to have potential impacts on maternal feeding decisions and practices, in NL, only 1.8% of the population in NL are immigrants (Statistics Canada, 2016) and therefore age and cultural background may not be important factors to explain the lower rates in this geographical area.

There is increasing evidence to support the critical role of maternal attitudes, beliefs, and knowledge, as stronger predictors for breastfeeding intent, initiation and duration compared to non-modifiable factors like socioeconomic, demographic, and biological variables (Kloeblen-Tarver, Thompson, & Miner, 2002; Shaker, Scott, & Reid,

2004). A considerable body of research has demonstrated that psychosocial factors like women's' beliefs and attitudes toward infant feeding have a significant role in determining maternal infant feeding choices and decisions after delivery (Chambers, McInnes, Hoddinott, & Alder, 2007; de la Mora, Russell, Dungy, Losch, & Dusdieker, 1999). Mothers with positive attitudes toward breastfeeding are more likely to report that breastfeeding is healthier and more convenient, and are more likely to adhere to breastfeeding recommendations and initiate breastfeeding early after the birth of their child(ren) (Dennis, 2002). In contrast, women who report a negative attitude toward breastfeeding are more likely to believe that breastfeeding will limit their lifestyle and are therefore more likely to choose to formula feed over breastfeeding after delivery (Dennis, 2002). In addition, women with positive breastfeeding attitudes tend to breastfeed for longer periods of time than women with negative attitudes (de la Mora et al., 1999; Thulier & Mercer, 2009). These findings are in line with the Theory of Reasoned Action, which suggests that individuals' behavior is primarily determined by their predetermined intentions to perform it (Fishbein, 1980). In turn, intentions are influenced by a combination of attitudes toward performing a behavior and individuals' perception of social pressure imposed on them to perform the behavior. Therefore, maternal attitudes towards infant feeding are likely to be a critical predictor of actual feeding behaviours and therefore may be important targets for indicating subgroups of patients which are more likely to deviate from the recommended guidelines. In addition, the most beneficial factor of utilizing attitudes and beliefs for predicting mothers' infant feeding decisions is that they are adaptable in response to behavioural-based interventions and support, making these psychosocial factors excellent targets for research and clinical support tools.

1.1.5 Breastfeeding attitude measurement tools

While it is difficult to directly measure a complex construct such as a personal attitude, researchers have developed different behavioural, cognitive, and affective components that account for intention and, consequently, behavior, that constitute overall attitudes (Bagozzi & Burnkrant, 1978). There are three main scales that have been developed specifically for measuring attitudes toward infant feeding: the Breastfeeding Attrition Prediction Tool, the Gender-Role Attitudes toward Breastfeeding Scale, and the Iowa Infant Feeding Attitude Scale.

The Breastfeeding Attrition Prediction Tool (BAPT) was developed with the primary aim of identifying mothers who are more likely to wean their infants from breastfeeding early. Janke (1992) based BAPT on the Theory of Planned Behavior (TPB) as a means to measure maternal attitudes, subjective norms, and perceived behavioural control toward breastfeeding (Janke, 1992). In other words, according to the TPB, women intend to breastfeed if they have pre-determined positive attitudes toward breastfeeding, if they believe that others would approve their breastfeeding practices (i.e. subjective norms), and if they believe that breastfeeding is easy to perform (i.e. perceived behavioural control) (Ajzen, 2011; Janke, 1992). A high score achieved on a BAPT reflects a more positive attitude, and more a positive perception of social opinion and behavioural control surrounding breastfeeding. The original BAPT scale consisted of 86 items with a 6-point Likert-type scale (Janke, 1992; Lewallen, 2006). The predictive validity of the BAPT scale for identifying mothers who are likely to stop breastfeeding was examined and found to be adequate in three studies by Janke et al. The original scale was then reduced to 42 items

with a 5-point Likert-type scale by Dick et al. in 2002 (Dick et al., 2002). This modified version was tested among prenatal women intending to breastfeed for at least two months and was proven to have good validity and reliability (Cronbach's alpha (α) = 0.78). The modified version was re-assessed among prenatal women and was found to have acceptable reliability and validity (Cronbach's alpha (α) = 0.67) (Evans, Dick, Lewallen, & Jeffrey, 2004). Overall, the BAPT scale has not been tested or used among culturally-diverse populations, making its clinical utility limited. In addition, its length has proven to be difficult to manage in clinical settings.

The Gender-Role Attitudes toward Breastfeeding Scale (GRABS) scale, developed for use in clinical practice by Kelley et al. in 1993, was created to evaluate infant feeding attitudes among first-time mothers at 8 weeks postpartum (Kelley, Kviz, Richman, Kim, & Short, 1993). Specifically, this scale provides an understanding of how delicate and demanding gender roles shape breastfeeding attitudes and actual practices. Because it consists of only six questions in a 5-point Likert format, it was found to be very easy to administer in clinical settings. A higher total score on the GRABS reflects a more positive breastfeeding attitude. The scale was shown to have acceptable validity and reliability (Cronbach's alpha (α) = 0.74) among the primiparous sample in which the scale was tested (Kelley et al., 1993). However, since its development, no study has assessed the scale's validity or psychometric properties which make its validity, reliability, and generalizability still questionable.

The Iowa Infant Feeding Attitude Scale (IIFAS) was developed by de la Mora et al. in 1999 to assess maternal attitudes towards infant breastfeeding in an effort to explain the

low breastfeeding rates in US at the time (de la Mora et al., 1999). The IIFAS is a self-administered questionnaire taken during pregnancy or soon after delivery that consists of seventeen items each with a five point Likert scale response ranging from 1 = strongly disagree to 5 = strongly agree. Approximately half of the IIFAS items are worded to favour breastfeeding and the remaining are worded to favour formula feeding. The total possible scores range from 17 to 85, with the lower scores being reflective of positive attitude towards formula feeding and the higher scores being reflective of positive attitude towards breastfeeding**.** The IIFAS tool can accurately predict whether a mother is more likely to breastfeed or more likely to formula feed, as well as the estimated total duration of breastfeeding (de la Mora et al., 1999).

The creation of the IIFAS was done through three independent studies in which de la Mora and her colleagues identified seventeen items that have demonstrated the most reliability and validity for characterizing maternal feeding attitudes as well as predicting the duration of breastfeeding (de la Mora et al., 1999). The first study with the IIFAS was conducted in the American Midwest. A sample of 125 postpartum women were administered a questionnaire; the first section was concerned with how mothers planned to feed their newborns (i.e. partial/exclusive breastfeeding, or exclusive formula feeding) and the following section consisted of ten dimensions to further assess the relative efficacy of formula and breastfeeding modes. Five aspects of the survey were related to the breastmilk and formula milk characteristics (i.e. cost, mother's physical shape, sexual pleasure, mental–physical comfort, and nutritional product) and the other five aspects were related to the process of infant feeding (i.e., parental role, physical closeness, infant food intake,

ease of feeding, and nighttime feeding). The final component of the survey included 26 IIFAS scale items, in which half were favourable to breastfeeding and the other half were favourable to formula feeding. The scale was then reduced to 17 items to optimize reliability and utility (Appendix A). The statistical analysis indicated that the 17 item IIFAS was a valid and reliable scale with a good internal consistency (Cronbach's alpha (α) = 0.86). Similarly, the second study, conducted in an independent sample to replicate the reliability and validity measures of the first study, showed the 17 item IIFAS to be a reliable measure of maternal attitude (Cronbach's alpha (α) = 0.85). The reliability in the third study was found to be lower than the previous studies (Cronbach's alpha (α) = 0.68) but remained at an acceptable level. There was greater variability in the total IIFAS scores among women participated in the first two studies, when compared to the third study. The discrepancy in the IIFAS scores and reliability could be explained by the differences in sample characteristics between the first two studies, which included women who may or may not have chosen to breastfeed, and the third study, which included only breastfeeding women.

Since its development, the IIFAS has been used to assess attitudes to infant feeding in different populations including, prenatal and postnatal women (Sittlington, Stewart-Knox, Wright, Bradbury, & Scott, 2007), low socioeconomic status women (Dungy, McInnes, Tappin, Wallis, & Oprescu, 2008), fathers (Scott, Shaker, & Reid, 2004), university students (Marrone, Vogeltanz-Holm, & Holm, 2008), and public health providers (Mulcahy, Phelan, Corcoran, & Leahy-Warren, 2012). This tool has been shown to be a valid and reliable measure in several communities around the world, including the United States (Mora et al., 1999), Japan (Nanishi & Jimba, 2014), and Scotland (Dungy et

al., 2008), among others. Translated versions of IIFAS have also been developed in Arabic, Chinese and Romanian; these versions also demonstrated acceptable levels of internal consistency, with Cronbach's alphas of 0. 64, 0.62, and 0.63 respectively (Charafeddine et al., 2016; Dai, Guan, Li, You, & Lau, 2013; Wallis et al., 2008). A study led by Drs. Twells and Newhook was the first and only study that validated and used the IIFAS in a Canadian population of expectant mothers (Twells et al., 2016).

In summary, there is limited research testing the psychometric properties, validity, and reliability of the BAPT and GRABS compared to the IIFAS and its proven applicability across age, socio-economic, educational levels, and ethnic groups. In fact, two systematic reviews, published in 2007 and 2010, addressed breastfeeding assessment tools and recommended the use of the IIFAS to measure maternal infant feeding attitude (Chambers et al., 2007; Ho & Mcgrath, 2010). Its ease of administration, use, and scoring as well as the simplicity of language make the IIFAS a valuable tool to use in a clinical setting (Dungy et al., 2008). However, while the IIFAS remains the most highly recommended scale for the purpose of assessing maternal attitudes towards infant feeding, its length still creates barriers to its feasibility and administration in a clinical setting where health care providers have limited time and other patient care priorities.

1.2 Summary of research gaps

This research project was conducted to address some of the limitations and research gaps that currently exist in the breastfeeding modification and prediction literature. While several studies have been conducted using the original 17-item IIFAS to assess maternal

attitudes toward infant feeding, none of the other studies done in North America have attempted to reduce the number of items of the original IIFAS. A reduction in scale items, while maintaining its reliability and predictive validity, would make it easier to administer and more feasible in a clinical and research setting. Furthermore, the original IIFAS studies conducted by de la Mora et al. did not specify cut-off scores or thresholds to indicate positive, neutral, or negative attitudes toward breastfeeding or formula feeding. Previous studies that have referred to specific ranges of scores that depict positive, neutral, or negative attitudes have drawn inconsistent conclusions. For example, one study used an IIFAS score of 51 to refer to a "neutral" infant feeding attitude (Sittlington et al., 2007), while another study conducted by Dungy and his colleagues suggested that scores should be divided into the following ranges; 70 to 85 refers to "positive to breastfeeding", a range of 49 to 69 indicates a "neutral" attitude, and a range of 17 to 48 refers to "positive to formula feeding" (Dungy et al., 2008). However, these scores or proposed attitude ranges have not been further tested or validated. This lack of consensus in categorizing attitudes toward infant feeding may result in various interpretations of scores and therefore impacts the validity of the scale.

In addition, despite the growing evidence supporting the prominent role of behavioural factors in determining maternal breastfeeding practices, there is limited research focused on the impact of mothers' attitudes on breastfeeding practices and outcomes, specifically in Canada. Rather, there is extensive research on the impact of the non-modifiable factors on infant feeding decisions. Overall, there is great need for a clinically manageable, usable and validated tool which can assess attitudes to infant feeding

and also predict maternal feeding behaviours in order for a wide range of health professionals to develop and target relevant interventions including education to mothers in an effort to protect and promote breastfeeding improving the health of infants and mothers.

1.3 Purpose

The primary purpose of this study is to determine if the number of items on the 17 item IIFAS measurement tool can be reduced while still maintaining its psychometric validity and accuracy. The secondary purpose of this study is to determine the optimal cut-off scores for the original and reduced IIFAS versions in order to better predict a mother's infant feeding choice.

1.4 Area of investigation

This research explores data collected during the prenatal and postnatal phases of a province-wide longitudinal cohort study, the Feeding infants in Newfoundland and Labrador (FiNaL) study. The FiNaL study data collection period ran from August 2011 and June 2016. Women in their third trimester were enrolled in the prenatal phase of FiNaL study. Questionnaires that included the IIFAS were administered prenatally and at 1-3 months postpartum. The breastfeeding data reported in the postnatal phase of the FiNaL study were used to verify the predictive validity of the reduced IIFAS proposed scale and cut-off scores. Ethical approval for this study (Appendix B) was obtained from the Health

Research Ethics Authority of Newfoundland and Labrador, reference (HREA # 20162701).

1.5 Significance of the study

In an effort to improve the low breastfeeding rates in Newfoundland and Labrador, this psychometric assessment and remodelling of the IIFAS tool may help to facilitate and optimize the utility and feasibility of its use in clinical settings. Despite the many factors that influence maternal decisions to breastfeed, there is growing evidence that women's positive attitudes toward breastfeeding are associated with breastfeeding success and longer breastfeeding duration. The total sum score of the IIFAS scale, together with the identified and validated cut-off scores will help to assess future breastfeeding practices and will better inform health professionals about overall maternal attitudes toward infant feeding in our province and should be generalizable to similar populations with low breastfeeding rates. This study will advance the current empirical knowledge to help researchers examine relevant factors shaping women's attitudes towards breastfeeding. As a result, this project will identify gaps in clinical interventions and educational breastfeeding promotion campaigns.

1.6 Program of research for thesis

This thesis is comprised of two studies aimed at addressing the limitations and current knowledge gaps surrounding maternal breastfeeding attitudes and behaviours in the literature.

In the first study, a quantitative, cross-sectional design approach will be followed to assess the psychometric properties of the 17-item IIFAS as well as to develop a reduced version of IIFAS that is as reliable and valid as the original scale. Using statistical analysis, theoretical insights and contextual understanding of the IIFAS scale was used to reduce the scale to as short a length as possible. The predictive validity of the reduced version will be evaluated using a longitudinal design approach and will use data collected in the FiNaL study's 1-3 months postnatal follow-up.

The second study will determine an optimal cut-off score for both the original IIFAS and reduced version of IIFAS, constructed in the first study, through a cross-sectional design approach in order to identify scores which distinguish between mothers who are at risk of formula feeding and those who are more likely to breastfeed. The identified cut-off scores will be validated against the breastfeeding practices reported at 1-3 months postpartum in the FiNaL study.

1.7 Research Objectives

1. To assess the psychometric properties of the 17-item IIFAS measurement tool;

2. To develop a shorter version of IIFAS with the most clinically useful and meaningful items, while maintaining its original validity and accuracy;

3. To evaluate the psychometric properties of the shorter version of IIFAS and its ability to predict intention to breastfeed, controlling for other covariates;

4. To determine optimal cut-off scores for the original and reduced IIFAS that

differentiate between women who intended to breastfeed from those who did not intend to breastfeed and

5. To evaluate the predictive ability of the cut-off scores in identifying women who exclusively breastfeed and those who exclusively formula fed.

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Chapter 2: Research Study #1

Psychometric Assessment and Precision Remodelling of the Iowa Infant Feeding Attitude Scale to Improve Clinical Use and Efficacy among Prenatal Women in Canada

Nouf M. AlKusayer, BSc, MSc (c)[1], William K. Midodzi, PhD[1], Leigh Anne Newhook, MD, MSc, FRCPC[2], Julia Temple Newhook, PhD[1], Janet Murphy-Goodridge, RN, MN, IBCLC[3], Lorraine Burrage, RN, MN[3], Nicole Gill, MSc[4], Halfyard B, MSc, PhD (c)[4], Laurie K. Twells, PhD[1,5]

[1] Faculty of Medicine, Memorial University, Health Sciences Centre [2] Janeway Pediatric Research Unit, Discipline of Pediatrics, Memorial University of Newfoundland [3] Perinatal Program NL, Janeway Children's Health & Rehabilitation Centre [4] Health Analytics and Evaluation Services, Newfoundland and Labrador Centre for Health Information [5] School of Pharmacy, Memorial University

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2.1 Abstract

Background: The 17-item Iowa Infant Feeding Attitude Scale (IIFAS) has been widely used to assess maternal attitudes toward infant feeding and to predict breastfeeding intention. The IIFAS has been validated among prenatal women located in Newfoundland and Labrador (NL) in Canada, though its length may prove challenging to complete in the clinical setting.

Objectives: This study aimed to reduce the number of items from the original 17-item IIFAS scale while maintaining reliability and predictive validity.

Methods: The original IIFAS was validated in expectant women in NL (n= 793) and later explored in a large population (n=1283). An exploratory factor analysis (EFA) using principle component analysis with varimax rotation was performed to explore the underlying factor structure of the IIFAS tool. The internal consistency of both the 17-item and reduced 13-item version was assessed using Cronbach's α and item total correlation. The Area Under Receiver Curve (AUC) and linear regression model were then used to assess predictive validity.

Results: Our findings revealed that a 13-item IIFAS had high internal consistency (Cronbach's α = 0.870). Three themes or factors were extracted from the EFA, resulting in the removal of four items. The reduced 13-item scale demonstrated an excellent ability to predict intent to breastfeed (AUC = 0.914).

Conclusion: The reduced 13-item version of the original IIFAS is a psychometrically sound instrument which maintains its accuracy and validity when measuring maternal

feeding attitudes during pregnancy and can be more time-efficient in clinical settings compared to the 17-item IIFAS.

Keywords

breastfeeding, breastfeeding attitudes, IIFAS , scale reduction, psychometric evaluation, Canada

2.2 Background

Human breastmilk is recognized as the ultimate source of nutrition for newborns development and growth (Riordan, 2005). Breastfeeding is beneficial as breastmilk is full of nutritional components which cannot be obtained from commercially prepared infant formula (Dennis, 2002). The World Health Organization (WHO) recommends that infants should exclusively breastfeed – that is, fed no added solid food, formula, or water - for the first six months of life and that breastfeeding should continue for up to two years of age (WHO, 2016). However, in Newfoundland and Labrador (NL), the breastfeeding initiation rate for newborns has been consistently low; the current breastfeeding initiation rate in NL is 72.0%, compared to the 90.3% Canadian average (Baby-Friendly Newfoundland and Labrador, 2016; Statistics Canada, 2016). The provincial rate of exclusive breastfeeding for six months after birth is very low (18% in NL vs. 24% in Canada) (Statistics Canada, 2014).

A variety of factors influence a woman's decision to breastfeed including age, education, ethnicity, income, employment status, partner support, and commercial pressure (Dennis, 2002; Earle, 2002; Riordan, 2005). There is increasing evidence to support the prominent role of psychosocial factors in predicting breastfeeding intention, initiation, and duration, including attitudes, knowledge, and beliefs toward infant feeding, compared to alternative biological, demographic, and socio-economic factors (Kloeblen-Tarver, Thompson, & Miner, 2002; Scott, Shaker, & Reid, 2004). Particularly, women with positive attitudes toward breastfeeding are more likely to believe in its benefits and,

consequently, to adhere to breastfeeding recommendations, compared to women who report negative attitudes toward breastfeeding (Dennis, 2002).

The Iowa Infant Feeding Attitude Scale (IIFAS) was developed by De la Mora et al. in the late 1990's to assess maternal attitudes towards infant breastfeeding in an effort to explain the low breastfeeding rates in United States at the time (Mora, Russell, Dungy, Losch, & Dusdieker, 1999). Since its development, the IIFAS has been shown to be a strong predictor of breastfeeding intention, initiation, and duration (Chambers, McInnes, Hoddinott, & Alder, 2007). The scale has been administered in several countries and shown to have robust internal consistency in various populations (Lau, Htun, Lim, Ho-Lim, & Klainin-Yobas, 2016; Shaker, Scott, & Reid, 2004; Sittlington, Stewart-Knox, Wright, Bradbury, & Scott, 2007). A study by Twells et al. in 2014 validated the use of the 17-item IIFAS to assess maternal attitudes towards infant feeding specifically in a Canadian population, showing strong internal consistency (Cronbach's alpha= 0.87). Two systematic reviews, published in 2007 and 2010, addressed breastfeeding assessment tools and ultimately recommended the use of the IIFAS as the best tool to measure infant feeding attitudes in the clinical setting (Chambers et al., 2007; Ho & Mcgrath, 2010).

Previous validation studies have not performed factor analysis to examine the tool's construct validity, or the degree to which each of the 17 items in the original IIFAS scale accurately measure breastfeeding outcomes (Charafeddine et al., 2016; Dungy, McInnes, Tappin, Wallis, & Oprescu, 2008; Shaker et al., 2004; Sittlington et al., 2007; Twells et al., 2016). Of all the studies that validated or used the English 17-items IIFAS measurement scale among pregnant women, this is the first cohort study to attempt to reduce the number

of IIFAS items in order to empirically create the most brief, meaningful, and clinically useful set of itemized questions. Specifically, this study aimed to assess the psychometric properties of and develop a reduced version of the IIFAS scale, which maintained the reliability of the original 17-item scale as well as to assess the predictive ability of this reduced IIFAS version to predict the intent to breastfeed, controlling for other covariates.

2.3 Methods

2.3.1 Design

This study explored IIFAS data on infant feeding attitudes in a prospective, longitudinal, province-wide cohort study – the Feeding Infants in Newfoundland and Labrador (FiNaL) Study, which was conducted between August 2011 and June 2016. Upon consent, pregnant women were enrolled in the study during their third trimester (Phase 1 of the study) and were followed up at 1 to 3 months (Phase 2) and 6 to 12 months postpartum (Phase 3). The primary objective of the FiNaL study was to assess the infant and young child feeding practices among a representative sample of pregnant women in NL. At each phase, self-administered questionnaires were used to gather information on sociodemographic factors, social support, breastfeeding knowledge, and attitudes to infant feeding. Dwelling area was categorized to urban and rural according to Statistics Canada's classification (Statistics Canada, 2011). The study herein utilized data collected during Phase 1 of the FiNaL study. The study was approved by the Health Research Ethics Authority in Newfoundland and Labrador (HREA #20162701).

2.3.2 Sample

A total of 1283 pregnant women participated in the prenatal phase (Phase 1) of the FiNaL study, including the validation cohort participants (n= 793). The initial sample size was estimated based on representative sample of pregnant individuals residing in each of the four health regions across the province of NL; Eastern Health, Western Health, Labrador-Grenfell Health, and Central Health. The participants were English-speaking, pregnant (in their third trimester), and aged 19 years or older. Participants were recruited from prenatal classes and offices of family physicians, obstetricians, nurse practitioners, and public health nurses. The questionnaires were completed over the phone, on paper and mailed to the research team, or online using Survey Monkey.

2.3.3 Measurements

The original English IIFAS version was included in the prenatal and postnatal questionnaires. The IIFAS, a self-administered scale, consists of 17 items, each with five Likert-type responses ranging from 1 = strongly disagree to 5 = strongly agree. Eight of the 17 items are worded to favour breastfeeding and the remaining items are worded to favour formula feeding. Items favouring formula feeding were reverse coded before the sum of IIFAS score was obtained. The total scores ranged between 17 and 85, with a lower score being reflective of a positive attitude towards formula feeding and a higher score being reflective of a positive attitude towards breastfeeding (Mora et al., 1999).

2.3.4 Data analysis

All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) version 23 (IBM Corporation, New York, USA). Descriptive analysis

included demographic and sociodemographic characteristics of participants as well as the distribution of factors related to lifestyle, prenatal services and previous breastfeeding experience. A baseline analysis was performed on the overall sample as well as within groups stratified by their reported intent to breastfeed. A Chi-square test was used to examine the association between the characteristics and the intent to breastfeed. A p-value less than 0.05 was considered statistically significant.

2.3.4.1 Reliability

Cronbach's alpha coefficient (α) was used to assess the internal consistency of the 17-item IIFAS measurement tool against a reduced version. Internal consistency of the reduced scale was also evaluated using the item-total correlation, which refers to the linear association between a single item and the total sum score of all other items.

2.3.4.2 Exploratory Factor Analysis

A Kaiser-Meyer-Olkin (KMO) test, a measure of sampling adequacy, and Bartlett's test of sphericity, a test for the presence of linear relationship among the items, were first performed to determine the suitability of the data for factor analysis (Tabachnick & Fidell, 2007). A series of exploratory factor analyses, using principal component factor extraction, were then undertaken to explore the factor structure of the IIFAS scale, verify the construct validity, and expose a smaller set of items that explained a substantial amount of the variation in the IIFAS scale. Varimax rotation, an orthogonal rotation method, was used in order to maximize the variance of the loading weights for each factor and minimize the variance around the factor, assuming no correlation between factors (Hair, Tatham,

Anderson, & Black, 1998). Eigenvalues, which refers to the total amount of variance explained by each factor, were calculated and used with scree plot to primarily select the number of critical factors to be extracted from the IIFAS scale.

2.3.4.3 Predictive validity

Logistic regression was employed to compare the ability of the original 17-item IIFAS against the reduced version of IIFAS to predict the intention to breastfeed. All the assumptions of logistic regression were confirmed prior to analysis.

The standard criteria for tests employed in this paper were as follows: 1) a Cronbach's α of 0.70 or greater was an acceptable measure of internal consistency (Loewenthal, 2001; Nunnally, 1978); 2) a corrected item-total correlation of at least 0.30 was indicative of an acceptable fit of each item with the overall scale (Nunnally, 1978); 3) a KMO of 0.60 demonstrated a sufficient sampling adequacy (Tabachnick & Fidell, 2007); 4) a significant Bartlett's statistic (χ^2) with a p-value < 0.05 indicated that the items were correlated, in favour of analyzing the data with a factor analysis method (Tabachnick & Fidell, 2007); 5) factors with a loading of 0.40 or greater on principal component analysis were retained for factor analysis (Guadagnoli & Velicer, 1988; Hair et al., 1998); and 6) a factor with an eigenvalue less than 1 meant that the item was removed from the IIFAS scale to create a more efficient and useful reduced version for clinical use.

2.4 Results

The characteristics of the study participants are presented in Table 2.1. Of the 1283 women who were enrolled in the study, the majority of participants were Caucasian

(89.0%), partnered (86.6%), and non-smokers (62.6%). A majority of the participants (n=1061, 82.7%) reported intention to breastfeed after delivery. Women who intended to breastfeed were more likely to be partnered and have past breastfeeding experience, an annual household income of more than $80,000 CAD, and a minimum of a post-secondary education. Statistically significant differences (p-value < 0.001) in IIFAS scores were observed between women who intended to breastfeed (Mean = 67.98, SD = 8.30) and women who did not intend to breastfeed (Mean = 52.46, SD = 7.91). Figure 2.1 presents the overall distribution for the total 17-item IIFAS.

The psychometric properties of the IIFAS are presented in Table 2.2. The mean score of the Likert-scale responses for each of the 17 items was greater than the neutral value of 3, ranging between 3.16 and 4.67. A majority of the participants reported that they felt a strong disagreement with IIFAS *items 1 and 8*, which state that benefits of breastfeeding last only as long as the baby is breastfeed and that women should not breastfeed in public places. On the other hand, women expressed their strong agreement with *items 12 and 13* which are related to the nutritional superiority of breastfeeding compared to formula, as well as *item 16*, which stated that breastfeeding is cheaper than formula, and *item 3*, which emphasized the psychological benefits and capacity to promote a sense of bonding between mother and baby.

The KMO coefficient was 0.899, which indicated that there were a sufficient number of items to be allocated to each of the three author-derived categories or factors within the IIFAS scale. The principle component method extracted three overall psychometric factors with eigenvalues above 1 and Cronbach's α greater than 0.60,

accounting for 43.0% of the overall variance in scores. As shown in Table 2.3, a total of seven items loaded on the first factor, in which loadings ranged from 0.476 to 0.828. Based on the content of the correlated items, the first factor was named as "favourable to breastfeeding". *Item 14*, which states that formula is as healthy for an infant as breastmilk, was the only item that did not theoretically fit the category. The examination of the content of the five items in the second factor reflected 'convenience', with loadings ranging from 0.426 to 0.657. The third factor, named as 'favourable to formula feeding', consisted of five items, with loadings ranging from 0.435 to 0.669. Only *item 5*, which states that "Formula fed babies are more likely to be overfed than breastfed babies" did not theoretically match the content of the remaining four items. Three out of the 17 items were found to have moderate degree of cross-loading, and could have been removed for factorial purity, but it was decided to retain them because they were deemed to be relevant and important to the study's theoretical concepts.

While the statistical analysis provided a foundation for identifying which items to remove from the original IIFAS scale without impacting accuracy or validity, further conceptual understanding of the IIFAS and theoretical insight also played a role in deciding which items to remove from or keep within the scale. The final reduced version of the IIFAS consists of 13 items. Figure 2.2 shows the distribution of the total scores of the 13-item IIFAS. The psychometric properties of the 13-item scale are shown in Table 2.4. The distribution for the total 13-item IIFAS.

In terms of internal consistency and predictive validity of the IIFAS scales, the Cronbach's α of the original 17-item IIFAS scale was 0.868, indicating a highly reliable

scale. Consistent with this, the item-total correlations were positive and greater than the recommended minimum criterion of 0.30. The reduced version of IIFAS also demonstrated a relatively higher internal reliability ($\alpha = 0.870$) with all the item-total correlations greater than 0.30. Results from the logistic regression analysis, presented in Table 2.5, showed that the 13-item IIFAS in both the unadjusted and the adjusted models had a higher ability to predict the intention to breastfeed than the original 17-item IIFAS. In addition, the AUC was found to be 0.914 for both the 17-item IIFAS (Figure 2.3) and the 13-item IIFAS (Figure 2.4), further demonstrating the retained efficacy and precision of the reduced scale.

2.5 Discussion

This is the first study to attempt to reduce the original 17- item IIFAS scale to a more manageable and clinically feasible tool which can be used prenatally as a reliable measure to predict feeding attitude. It is also the first study to examine both the reliability and predictive validity of a shorter, reduced IIFAS against the original version. This study resulted in a more clinically manageable 13-item IIFAS which retains its validity and capacity to significantly predict intent to breastfeed and infant feeding mode at one month postpartum.

Our findings support the existing body of evidence that maternal infant feeding attitude is a significant and powerful predictor of breastfeeding intention (Mora et al., 1999). A post-secondary level of education, past breastfeeding experience, as well as being partnered were found to be associated with the intention to breastfeed (Jefferson, 2012; Mora et al., 1999). Due to the fact that a majority of the NL population is Caucasian

(80.9%), which is reflected in demographics of the study population, it is important to note that previous research has demonstrated that Caucasian women often report their partner or husband as the most influential support person (Losch, Dungy, Russell, & Dusdieker, 1995). The majority of women were aware of the nutritional superiority of breastfeeding; they strongly agreed that breastmilk is the ideal food for babies (Mean = 4.36) and that it is more easily digested than formula (Mean = 4.19). While the original IIFAS items can be categorized into two main factors (favourable towards breastfeeding and favourable towards formula feeding), the contents of the reduced version were re-categorized into three factors; favourable towards breastfeeding, convenience, and favourable to formula feeding. These three factors were identified in previous studies as important predictive factors for breastfeeding behaviour (Lau et al., 2016; Tomás-Almarcha, Oliver-Roig, & Richart-Martinez, 2016).

We found that our statistical analysis and resulting reduced IIFAS model supported the known theoretical uses of the tool for predicting breastfeeding attitudes. However, thoughtful judgements beyond the indications of the statistical results were made when moving or excluding items from the original scale. Despite the statistical indication that it was not relevant or predictive of maternal behaviours, the authors decided to keep *item 8*, "women should not breastfeed in public places" and to place it under the 'convenience' factor because perception about breastfeeding in public can potentially be deterrent to breastfeeding, especially in Newfoundland and Labrador where previous qualitative research has demonstrated that breastfeeding in public was strongly believed to be "unacceptable" and embarrassing (Bonia et al., 2013). Previous literature shows that embarrassment or uncertainties regarding the public perception of breastfeeding constitute

an important barrier for choosing to breastfeed and breastfeeding continuation (McCann, Baydar, & Williams, 2007; Stewart-Knox, Gardiner, & Wright, 2003). Interestingly, the majority of women in our population strongly disagreed with the statement, reflecting their overwhelming recognition of their right to breastfeed in public, a finding that has been echoed in previous qualitative studies (Li et al., 2004; Spurles & Babineau, 2011). This may imply that breastfeeding is valued at the societal and political levels and that breastfeeding in public has been effectively addressed in recent promotional breastfeeding campaigns. It must be noted that perception about breastfeeding in public alone does not fully translate to a woman's personal comfort of breastfeeding in public. However, women's neutral beliefs or disagreement do strongly indicate that they are less or not likely to breastfeed in public; emphasizing that the inclusion of this statement in the scale is critically important. In addition, *item 14*, "formula is as healthy for an infant as breastmilk," loaded originally under 'favourable to breastfeeding', was moved to the 'favourable to formula feeding' factor, which was theoretically more appropriate. In fact, with this change, the Cronbach's α of 'favourable to formula feeding' factor for the 13-item scale compared to the 17-item improved from 0.601 to 0.669.

Items 4, 11, 16 and 17, were omitted from the original scale. *Item 4*, "breastmilk is lacking in iron", had a corrected item-total correlation of 0.343. A Canadian study, conducted in Alberta, assessed the psychometric properties of the 17-item IIFAS and found that this item had a low item-total correlation (Jessri, Farmer, Maximova, Willows, & Bell, 2013). Interestingly, approximately 32% of the participants in our population gave a neutral response to this statement. This item requires specific knowledge not only about the chemical components of breastmilk but also about the functional significance of iron to

infants and does not appear to correlate with breastfeeding intention or behaviours. *Item 16*, regarding the cost of breastfeeding vs. formula feeding, saw the highest rate of agreement (almost 96% of the women agreed or strongly agreed that breastfeeding is cheaper than formula). This item was removed from the reduced version due to the almost universal acceptance of this statement and therefore insignificant impact on breastfeeding behaviours. *Item 17* in the IIFAS, "A mother who occasionally drinks alcohol should not breastfeed her baby," was removed as it has consistently been shown to have low item-total correlation coefficient (< 0.30) and to be of little predictive importance (Charafeddine et al., 2016; Dai, Guan, Li, You, & Lau, 2013; Jessri et al., 2013; Lau et al., 2016; Nanishi & Jimba, 2014; Scott et al., 2004). Moreover, *item 11*, "Fathers feel left out if a mother breastfeeds", did not appear to influence maternal breastfeeding decisions and intentions (Giugliani, Caiaffa, Vogelhut, Witter, & Perman, 1994; Scott et al., 2004; Shaker et al., 2004). Therefore, we decided to remove this fourth item and come to the final version of the reduced 13-item IIFAS scale, as shown in Table 2.4.

The internal consistency of the 13-item IIFAS was found to be identical to that of the previous IIFAS Canadian validation study (Cronbach's $\alpha = 0.870$), supporting the high reliability of this measurement tool in the Canadian population (Twells et al., 2016). In addition, its consistency to predict outcomes was greater than that of all the other studies that have validated the tool's ability to assess maternal attitudes (Cox, Giglia, & Binns, 2015; Mora et al., 1999; Scott et al., 2004; Shaker et al., 2004).

It was not surprising that the predictive validity of the proposed 13-item IIFAS was higher than that of the original, given that the reliability of the reduced scale to predict breastfeeding intention was also higher and more precise than the original. None of the

previous studies that proposed a shorter version of IIFAS tool compared the predictive validity of the 17-item and proposed IIFAS (Nanishi & Jimba, 2014; Tomás-Almarcha et al., 2016).

As all participants volunteered to take part in a study about infant feeding, they may have had a more positive attitude towards breastfeeding in general and therefore a selection bias may have existed. The majority of participants were Caucasian and this homogeneity may limit the generalizability of the study findings to other, more culturally diverse, populations.

2.6 Conclusion

This study was conducted with the main aim to reduce the 17-item IIFAS to a shorter version using statistical analytics and theoretical considerations in order to empirically create the best set of most non-redundant items in the IIFAS questionnaire and examine maternal attitudes toward infant feeding. The resulting 13-item IIFAS, with a three-dimensional psychometric factor structure, was shown to have a robust internal consistency and capacity to predict maternal breastfeeding intention with similar validity as the original, more comprehensive scale. Ultimately, the adoption of the 13-item scale in clinical environments would facilitate the efficacious administration of the IIFAS measurement tool for prenatal women. Future research should determine a cut-off value for the 13-item IIFAS which will accurately predict a woman's infant feeding intentions as well as provide healthcare and breastfeeding support workers with score ranges to identify women with positive, neutral, and negative attitudes towards breastfeeding.

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Table 2.1 Baseline characteristics of prenatal women by intent to breastfeed

Variable	Overall Sample[a] (N = 1283) N (%)	Intent to breastfeed (n = 1061) n (%)	Non-intent to breastfeed (n = 222) n (%)	*P* value
Age (year)				<0.001
< 25	258 (20.1%)	181 (17.1%)	77 (34.7%)	
26-34	809 (63.1%)	698 (65.8%)	111 (50.0%)	
≥ 35	216 (16.8%)	182 (17.2%)	34 (15.3%)	
Ethnicity				0.044
Caucasian	1142 (89.0%)	953 (89.8%)	189 (85.1%)	
Aboriginal	55 (4.3%)	46 (4.3%)	4.1 (4.4%)	
Others	48 (3.8%)	43 (4.1%)	5 (2.3%)	
Marital status				<0.001
Single	160 (12.5%)	103 (9.7%)	57 (25.7%)	
Partnered	1111 (86.6%)	951 (89.6%)	160 (72.0%)	
Dwelling area[b]				<0.001
Urban	430 (33.5%)	394 (37.1%)	36 (16.2%)	
Rural	675 (52.6%)	549 (51.7%)	126 (56.8%)	
Educational level				<0.001
< Postsecondary	380 (29.6%)	272 (25.6%)	108 (48.6%)	
≥ Postsecondary	898 (70.0%)	786 (74.1%)	112 (50.5%)	
Yearly household income (CAD$)				<0.001
< 29,000	153 (11.9%)	108 (10.2%)	45 (20.3%)	
30,000 – 59,000	180 (14.0%)	137 (12.9%)	43 (19.4%)	
60,000 – 80,000	155 (12.1%)	124 (11.7%)	31 (14.0%)	
> 80,000	612 (47.7%)	559 (52.7%)	53 (23.9%)	
Smoking				<0.001
Current smoker	106 (8.3%)	62 (5.8%)	44 (19.8%)	
Previous smoker	272 (21.2%)	220 (20.7%)	52 (23.4%)	
Non-smoker	803 (62.6%)	695 (65.5%)	108 (48.6%)	
Previous children				0.003
Yes	599 (46.7%)	476 (44.9%)	123 (55.4%)	
No	684 (53.3%)	585 (55.1%)	99 (44.6%)	
Attended/plan to attend prenatal education				<0.001
Yes	723 (56.4%)	627 (59.1%)	96 (43.2%)	
No	560 (43.6%)	434 (40.9%)	126 (56.8%)	

Table 2.1. (continued)

Variable	Overall Sample[a] (N = 1283) N (%)	Intent to breastfeed (n = 1061) n (%)	Non-intent to breastfeed (n = 222) n (%)	*P* value
Breastfed as a baby				<0.001
Yes	430 (33.5%)	409 (38.5%)	21 (9.5%)	
No	853 (66.5%)	652 (61.5%)	201 (90.5%)	
Past breastfeeding experience				<0.001
Breastfed	482 (37.6%)	428 (40.3%)	54 (24.3%)	
Never breastfed	783 (62.0%)	617 (58.2%)	166 (74.8%)	
Family and/or friends encouraged breastfeeding				<0.001
Yes	712 (55.5%)	629 (59.3%)	83 (37.4%)	
No	244 (19.0%)	171 (16.1%)	73 (32.9%)	
Drink alcohol				0.251
Yes	33 (2.6%)	30 (2.8%)	3 (1.4%)	
No	1250 (97.4%)	1031 (97.2%)	219 (98.6%)	
Employment status				0.310
Employed	723 (56.4%)	602 (56.7%)	121 (54.5%)	
On leave	240 (18.7%)	190 (17.9%)	50 (22.5%)	
Unemployed	298 (23.2%)	251 (23.7%)	47 (21.2%)	

Abbreviation: CAD$, Canadian dollars

[a] Numbers may not add up to 1283 because of missing data.

[b] An urban area was defined as a population of 1,000 or more and a density of 400 or more per square kilometer, and any area outside of that was considered rural (Statistics Canada, 2011).

Table 2.2 Psychometric properties and descriptive statistics of the 17-item IIFAS

Attitude Item Variables	M (SD)	Loading	Corrected Item-Total Correlation	Cronbach's α if item deleted
1. The benefits of breastfeeding last only as long as the baby is breastfed.[a]	4.19 (0.96)	0.524	0.465	0.862
2. Formula feeding is more convenient than breastfeeding.[a]	3.65 (1.26)	0.702	0.636	0.854
3. Breastfeeding increases mother infant bonding.	4.46 (0.86)	0.602	0.511	0.860
4. Breastmilk is lacking in iron.[a]	3.74 (0.91)	0.402	0.343	0.866
5. Formula fed babies are more likely to be overfed than breastfed babies.	3.34 (1.02)	0.497	0.415	0.864
6. Formula feeding is the better choice if the mother plans to go back to work. [a]	3.52 (1.07)	0.630	0.578	0.857
7. Mothers who formula feed miss one of the great joys of motherhood.	3.22 (1.26)	0.619	0.521	0.860
8. Women should not breastfeed in public places such as restaurants. [a]	4.51 (0.85)	0.389	0.340	0.866
9. Breastfed babies are healthier than formula fed babies.	3.61 (1.14)	0.716	0.622	0.854
10. Breastfed babies are more likely to be overfed than formula fed babies. [a]	3.94 (0.86)	0.443	0.396	0.864
11. Fathers feel left out if a mother breastfeeds. [a]	3.53 (1.03)	0.362	0.313	0.868
12. Breastmilk is the ideal food for babies.	4.36 (0.85)	0.771	0.688	0.854
13. Breastmilk is more easily digested than formula.	4.19 (0.90)	0.748	0.658	0.854
14. Formula is as healthy for an infant as breastmilk. [a]	3.59 (1.06)	0.710	0.633	0.854
15. Breastfeeding is more convenient than formula.	3.84 (1.10)	0.681	0.597	0.856
16. Breastmilk is cheaper than formula.	4.66 (0.66)	0.417	0.335	0.866
17. A mother who occasionally drinks alcohol should not breastfeed her baby. [a]	3.15 (1.32)	0.406	0.352	0.869

Abbreviations: M, mean; SD, standard deviation
[a] Reverse-coded items

Table 2.3 Exploratory factor analysis of the 17-item IIFAS

Attitude Item Variables	Factor 1: Favourable to breastfeeding	Factor 2: Convenience	Factor 3: Favourable to formula feeding
9. Breastfed babies are healthier than formula fed babies.	0.828		
7. Mothers who formula feed miss one of the great joys of motherhood.	0.744		
13. Breastmilk is more easily digested than formula.	0.677		
12. Breastmilk is the ideal food for babies.	0.677		
14. Formula is as healthy for an infant as breastmilk. [a]	0.627		
5. Formula fed babies are more likely to be overfed than breastfed babies.	0.572		0.481
3. Breastfeeding increases mother infant bonding.	0.556		
15. Breastfeeding is more convenient than formula.	0.476	0.464	
2. Formula feeding is more convenient than breastfeeding.[a]		0.657	
11. Fathers feel left out if a mother breastfeeds. [a]		0.651	
6. Formula feeding is the better choice if the mother plans to go back to work. [a]		0.570	0.435
4. Breastmilk is lacking in iron.[a]		0.426	
17. A mother who occasionally drinks alcohol should not breastfeed her baby. [a]			0.669
10. Breastfed babies are more likely to be overfed than formula fed babies. [a]			0.658
1. The benefits of breastfeeding last only as long as the baby is breastfed.[a]			0.557
Initial eigenvalue	5.740	1.568	1.078
% of variance	33.764	9.221	6.340
Cronbach's α	0.856	0.712	0.654

Note: Extraction method used is principle component analysis. Item loadings of above 0.40 were considered as having the lowest acceptable criterion.

[a] Reverse-coded items

Table 2.4 Item-total correlations of the 13-item IIFAS and factors' reliability

Attitude Item Variables	Corrected Item-Total Correlation	Cronbach's α
Favourable to breastfeeding		0.823
9. Breastfed babies are healthier than formula fed babies.	0.708	
7. Mothers who formula feed miss one of the great joys of motherhood.	0.593	
13. Breastmilk is more easily digested than formula.	0.659	
12. Breastmilk is the ideal food for babies.	0.679	
5. Formula fed babies are more likely to be overfed than breastfed babies.	0.439	
3. Breastfeeding increases mother infant bonding.	0.526	
Convenience		0.674
2. Formula feeding is more convenient than breastfeeding.[a]	0.630	
15. Breastfeeding is more convenient than formula.	0.610	
8. Women should not breastfeed in public places such as restaurants.[a]	0.308	
Favourable to formula feeding		0.669
6. Formula feeding is the better choice if the mother plans to go back to work.[a]	0.525	
10. Breastfed babies are more likely to be overfed than formula fed babies.[a]	0.372	
1. The benefits of breastfeeding last only as long as the baby is breastfed.[a]	0.457	
14. Formula is as healthy for an infant as breastmilk.[a]	0.454	

Note: The Cronbach's α of the 13-item IIFAS is 0.870

[a] Reverse-coded items

Table 2.5 Predictive validity of intent to breastfeed for 17-item IIFAS and 13-item IIFAS

	17-item IIFAS		**13-item IIFAS**	
	Unadjusted (95% CI)	**Adjusted[a] (95% CI)**	**Unadjusted (95% CI)**	**Adjusted[a] (95% CI)**
Intention to breastfeed	1.259 (1.222 – 1.297)	1.211 (1.136 – 1.292)	1.306 (1.262 – 1.352)	1.248 (1.162 – 1.342)

[a] Adjusted for age, marital status, dwelling area, education level, annual household income, smoking status, previous children, attended/plan to attend prenatal education, breastfed as a baby, past breastfeeding experience, and family and/or friends encouraged breastfeeding

Figure 2.1 Distribution of the 17-item IIFAS among a sample of prenatal women (N= 1283)

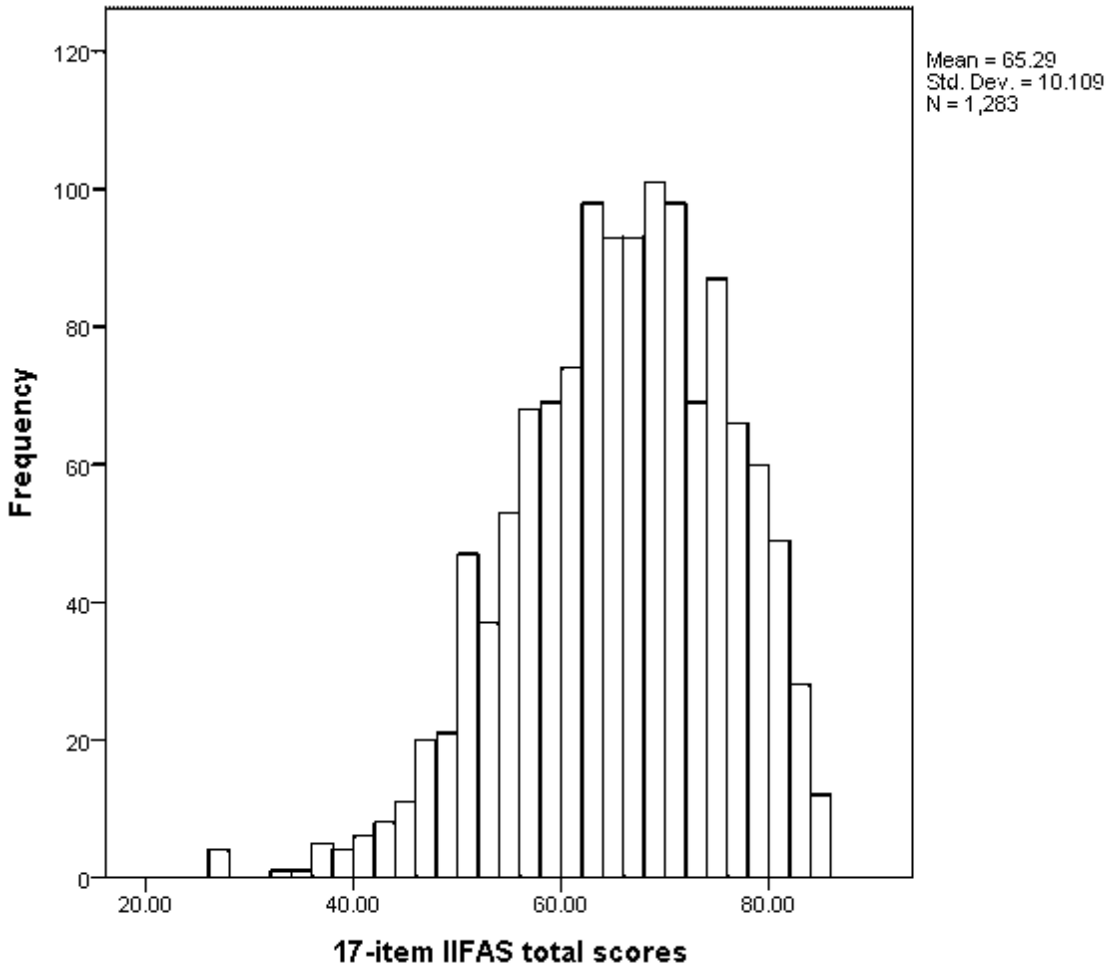


Figure 2.2 Distribution of the 17-item IIFAS among a sample of prenatal women (N= 1283)

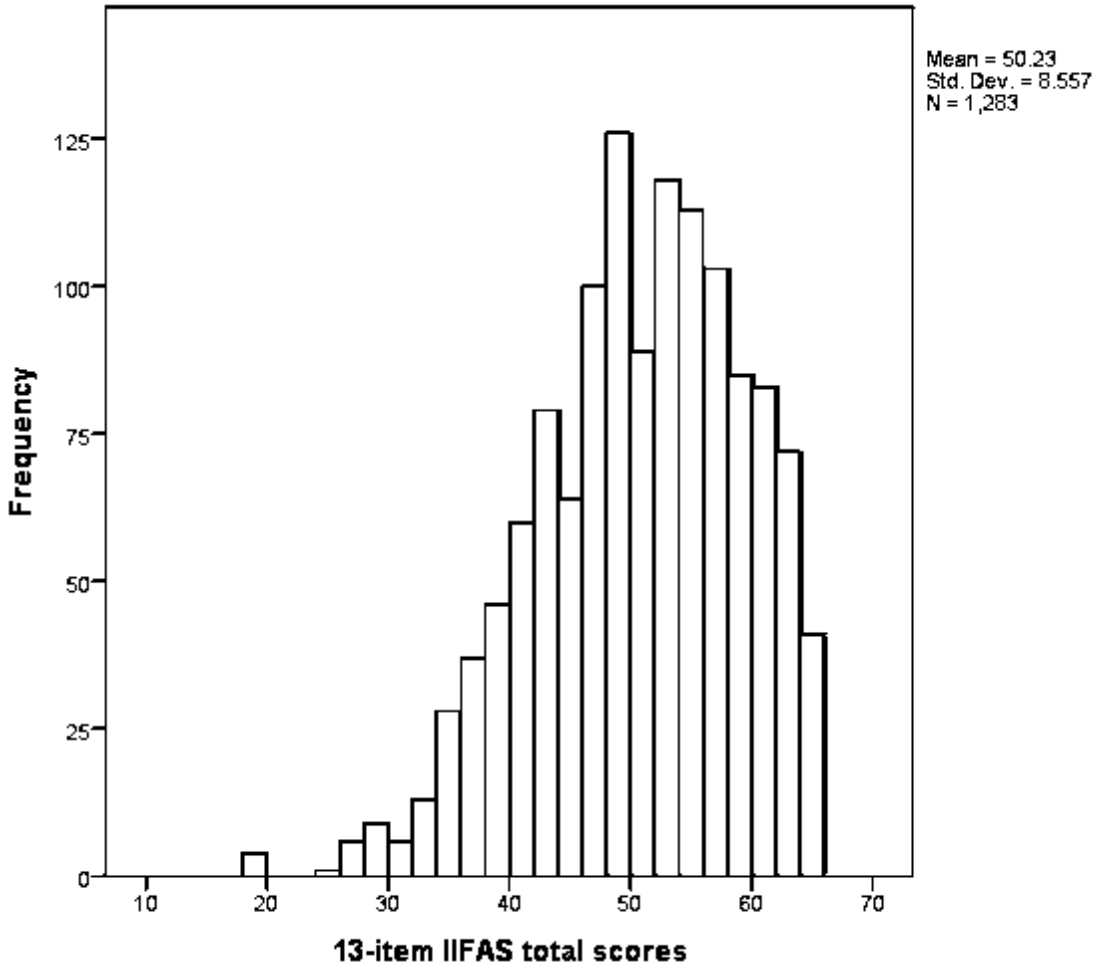
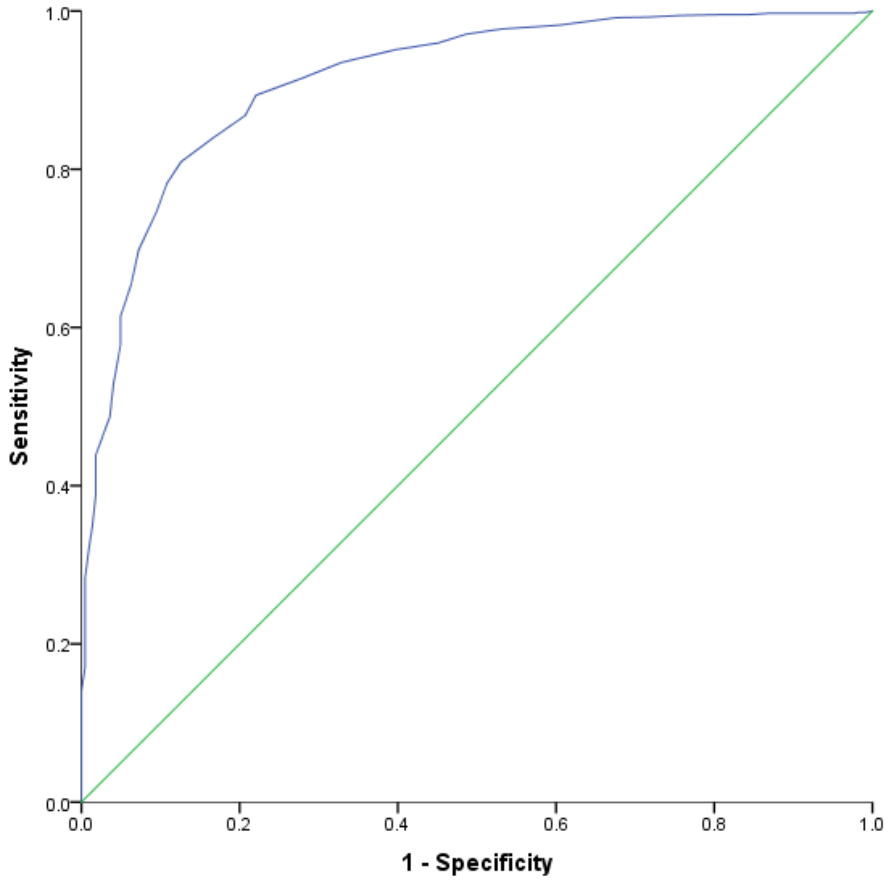
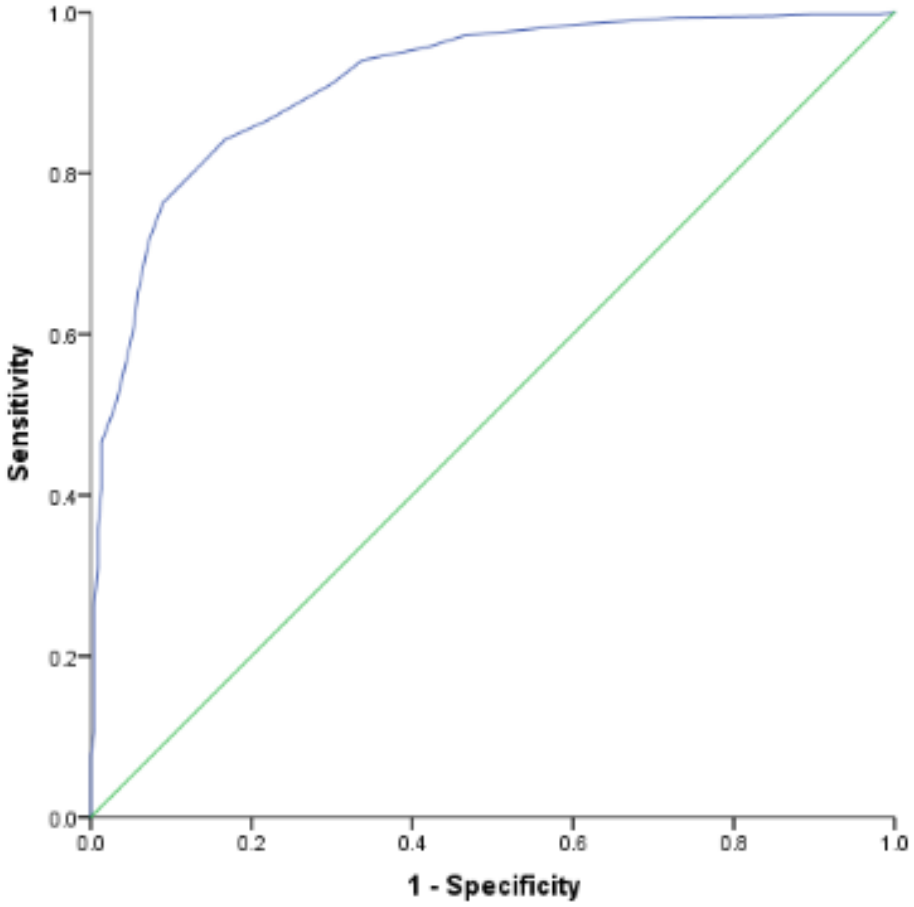


Figure 2.3 Receiver Operating Characteristic (ROC) Curve of 17-item IIFAS[a]



[a] Area Under the Curve (AUC) = 0.914

Figure 2.4 Receiver Operating Characteristic (ROC) Curve of 13-item IIFAS[a]



[a] Area Under the Curve (AUC) = 0.914

Chapter 3: Research Study #2

Determining Clinically Relevant Cut-Off Scores for the Iowa Infant Feeding Attitude Scales among Prenatal Women in Canada

Nouf M. AlKusayer, BSc, MSc (c)[1], William K. Midodzi, PhD[1], Leigh Anne Newhook, MD, MSc, FRCPC[2], Julia Temple Newhook, PhD[1], Janet Murphy-Goodridge, RN, MN, IBCLC[3], Lorraine Burrage, RN, MN[3], Nicole Gill, MSc[4], Halfyard B, MSc, PhD (c)[4], Laurie K. Twells, PhD[1,5]

[1] Faculty of Medicine, Memorial University, Health Sciences Centre [2] Janeway Pediatric Research Unit, Discipline of Pediatrics, Memorial University of Newfoundland [3] Perinatal Program NL, Janeway Children's Health & Rehabilitation Centre [4] Health Analytics and Evaluation Services, Newfoundland and Labrador Centre for Health Information [5] School of Pharmacy, Memorial University

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3.1 Abstract

Background: The original 17-item Iowa Infant Feeding Attitude Scale (IIFAS) has been validated and widely used to assess attitudes toward breastfeeding. A reduced 13-item version of the IIFAS was recently validated in a Canadian clinical setting. However, cut-off scores for categorization of infant feeding attitudes on both scales have not yet been established.

Objectives: This study aimed to determine optimal cut-off scores for the original and reduced IIFAS which predict breastfeeding attitudes and feeding outcomes.

Methods: The 17-item IIFAS was completed prenatally by 1283 women, 658 of whom were available for follow-up at one to three months postpartum. A receiver operating curve (ROC) and Youden index analysis were performed to identify sensitivity and specificity of cut-off scores. The magnitude of which these scores predicted postpartum feeding outcomes was then evaluated using linear regression analysis.

Results: A score ≤ 60 (sensitivity = 0.81, specificity = 0.87) and ≤ 45 (sensitivity = 0.84, specificity = 0.83) for both the 17-item and 13-item IIFAS, respectively, were found to be optimal cut-off scores for predicting negative breastfeeding attitudes. The cut-off score for the reduced IIFAS version demonstrated a greater ability to predict women who formula-fed at one month postpartum (adjusted OR = 6.32; 95% CI: 1.84, 11.61), compared to the original scale (adjusted OR = 4.62; 95% CI: 2.42, 16.52).

Conclusion: The proposed cut-off scores for both the original 17 item and the revised 13-item IIFAS have excellent predictive ability to determine infant feeding attitudes and to

predict infant feeding outcomes. The classification of scores enhances the utilization and applicability of the original and revised IIFAS.

Keywords

breastfeeding, breastfeeding attitudes, Iowa Infant Feeding Attitude Scale, sensitivity, specificity, predictive, cut-off score, Canada

3.2 Background

Despite the proven health benefits of breastfeeding and the clarity of current evidence-based breastfeeding recommendations, breastfeeding initiation rates and continuation of exclusive breastfeeding rates are generally low in many regions of the world. Among Canadian women, breastfeeding initiation rates have steadily increased since the early 2000's, although the rates of exclusive breastfeeding for up to six months postpartum have experienced little change in the past few decades (Gionet, 2013; Health Canada, 2012). In Newfoundland and Labrador (NL), a province located in the most eastern part of Canada, the rate of breastfeeding initiation is 72.0% while the rate of exclusive breastfeeding for up to six months is only 17.1%. Both of these rates are low compared to the national averages of 90.3% and 24.2%, respectively (Baby-Friendly Newfoundland and Labrador, 2016; Statistics Canada, 2016a). The sharp contrast between the NL and average Canadian rates demonstrates the need for the development of appropriate interventions and policies to improve breastfeeding rates. The Government of NL has recently launched a vision document, "The Way Forward," outlining policy decisions and goals focused on improving public health services and outcomes, including breastfeeding promotion (The Government of Newfoundland & Labrador, 2016). The policy outlines its mission to increase breastfeeding initiation by 7% by 2025.

There are a growing number of studies illustrating that maternal attitude towards breastfeeding is the most critical factor affecting breastfeeding intention, initiation, and duration, when compared to other non-modifiable socio-demographic factors (C. I. Dungy, Losch, & Russell, 1994; Mora, Russell, Dungy, Losch, & Dusdieker, 1999). The Iowa

Infant Feeding Attitude Scale (IIFAS) is commonly used to measure maternal attitudes toward infant feeding (Chambers, McInnes, Hoddinott, & Alder, 2007). The IIFAS, developed by De La Mora at al. in 1999, consists of 17 equally-weighted items on a Likert-type scale; approximately half of which are favourable to breastfeeding and half favourable to formula feeding (Mora et al., 1999). This self-administered measurement tool has been widely tested and validated in several populations and countries (Lau, Htun, Lim, Ho-Lim, & Klainin-Yobas, 2016; Shaker, Scott, & Reid, 2004; Sittlington, Stewart-Knox, Wright, Bradbury, & Scott, 2007). The 17-item IIFAS was validated in expectant mothers in NL in 2014 (Twells et al., 2016). A second study ensued with the aim of reducing the 17-item IIFAS to a more clinically manageable and time-efficient length while still maintaining the reliability and predictive validity of the original tool. A reduced 13-item version of the IIFAS which still possesses sound psychometric properties to reliably assess maternal attitudes towards infant feeding has been proposed (Cronbach's $\alpha = 0.870$) (AlKusayer et al., 2016).

While both the original 17-item and reduced 13-item IIFAS are validated tools, both are lacking clearly described, validated cut-off scores that would increase their ease and application to be utilized in appropriate clinical and educational settings. For example, understanding which mothers are more likely to breastfeed or formula feed using a simple range of scores would better inform mother's and health care workers which could facilitate the targeting and tailoring of interventions, prenatal education and support.

This is the first study that attempts to determine accurate and valid cut-off scores with optimal sensitivity and specificity for both the 17-item IIFAS as well as the reduced 13-item IIFAS in a Canadian population.

3.3 Methods

3.3.1 Study Design and Participants

This study is one part of the province-wide Feeding Infants in Newfoundland and Labrador (FiNaL) Study, a prospective study conducted between August 2011 to June 2016 (Twells et al., 2016). Two phases of the FiNaL Study, pre-natal (Phase 1) and postpartum (Phase 2), are explored in this study. Women were eligible to participate in the prenatal phase if they lived in NL, spoke English, and were 19 years or older. In the postpartum phase, women of infants with serious health issues or disorders were excluded from the study. In the prenatal phase, 1283 healthy, pregnant women were recruited in their third trimester and baseline demographic and health characteristics as well as attitudes toward infant feeding was examined using the 17-item IIFAS. Sample characteristics have been described elsewhere (AlKusayer et al., 2016). Actual infant feeding modes were followed from 1 to 3 months postpartum, and 658 completed supplementary breastfeeding questionnaires (response rate 51.3%) to report breastfeeding outcomes. This study was reviewed and approved by the Provincial Health Research Ethics Authority in Newfoundland and Labrador (HREA #20162701).

3.3.2 Measurements

3.3.2.1 *Survey variables*

A questionnaire about several factors known to be related to breastfeeding, including socio-demographics, lifestyle, attitudes towards infant feeding, and breastfeeding-related variables, was completed by eligible participants in the prenatal phase. Data about the ongoing feeding mode at one to three months postpartum was collected through self-administered questionnaires. The reported feeding modes were categorized as exclusively breastfed, mixed-fed, or exclusively formula-fed.

3.3.2.2 *Postpartum outcome variables*

Exclusive breastfeeding (EBF) was defined as having breastmilk only with no added solid food, formula, or water, mixed feeding (MF) was defined as offering both breast and commercial formula milk, and exclusive formula feeding (EFF) was defined as offering commercial infant formula only without any human breastmilk.

3.3.2.3 *The Iowa Infant Feeding Scale (IIFAS)*

The original 17-item IIFAS measurement tool was administered in the prenatal period. It consists of 17 items on a 5 point Likert type scale, ranging from strongly disagree (1) to strongly agree (5). Items favouring formula feeding (9 items) are reverse coded. The summative score of the 17 items, therefore, ranges from 17 to 85. While lower scores close to 17 reflect a positive attitude towards formula feeding, higher scores or those closer to 85 reflect a positive attitude towards breastfeeding. From the answers reported by each participant in the 17-item IIFAS, their total score on the reduced 13-item version was derived. Therefore, with fewer items, the total scores on the reduced version range from

13, reflective of positive formula feedings attitudes, to a maximum of 65, reflective of positive breastfeeding.

3.3.3 Data analysis

A descriptive analysis was performed on the baseline characteristics of participants who completed the postnatal questionnaires. Since all variables were categorical, Chi-square tests were performed to examine the association of maternal baseline prenatal variables with three feeding modes at one month postpartum: EBF, MF, and EFF. Two-sided p-values of <0.05 were considered statistically significant. The MedCalc Statistical Software version 16.8.4 (MedCalc) was used to compute receiver operating characteristic (ROC) curves. Other statistical analyses were completed using the Statistical Package for Social Sciences (SPSS) version 23 (IBM Corporation, New York, USA).

3.3.3.1 *Cut-off analysis*

An ROC curve analysis was performed to display the true positive ratio (sensitivity) and false positive ratio (1-specificity) for possible cut-off values for both the 13-item and 17-item IIFAS in order to define the appropriate cut-off scores which best predicted women's intent to breastfeed or formula feed. The false positive and false negative rates were deemed equally undesirable in our study context, therefore sensitivity and specificity were weighted equally using Youden's index (Youden, 1950). The Youden's index (J = sensitivity + specificity – 1) was employed across all potential cut points to determine the optimal cut-off values that yielded the maximum sensitivity and specificity in differentiating women who intended to breastfeed from those who did not intend to breastfeed. The Youden's Index measure has proven to be a robust method for its

discriminative ability (Fletcher, Fletcher, & Fletcher, 2014). The IIFAS score with highest Youden index, therefore, was considered the optimal cut-off score.

3.3.3.2 *Predictive validity*

The area under the receiver operating characteristic curve (AUC) was computed to examine the ability of the proposed cut-off scores for both the 17-item IIFAS and 13-item IIFAS to correctly classify women according to their intention to breastfeed. The values of AUC range from 0.50, indicating a predictive accuracy level that is no better than a random chance, to 1, representing a perfect predictive power. Values of AUC between 0.50 and 0.70 reflect low accuracy, between 0.70 and 0.90 reflect moderate accuracy, and greater than 0.90 reflect high accuracy (Fischer, Bachmann, & Jaeschke, 2003).

Linear regression analysis was conducted to assess the extent to which the cut-off scores would predict the actual reported feeding mode at one month postpartum. With the goal of identifying women who were not likely to EBF, women who reported EBF were selected as the reference group. Both the unadjusted and adjusted model were presented to illustrate the potential effect of confounding factors.

3.4 Results

3.4.1 Characteristics of participants

Baseline characteristics of the participants (n = 658) who completed both the prenatal and one month postpartum phase study visits are presented in Table 3.1. The majority of the participants were Caucasian (91.1%), partnered or married (92.8%), non-smokers (70.8%), and in the age group of 26-34 years (69.8%). Approximately, 92.0% of

expectant mothers reported their intention to breastfeed and over 80% had at least post-secondary level of education. Expectant mothers who reported intent to EBF had higher levels of education (88.1% vs. 59.8%; p= <0.001), were encouraged to breastfeed by their family and/or friends (66.5% vs. 44.4%; p= < 0.001), were breastfed as babies (47.0% vs. 20.5%; p= < 0.001), had breastfeeding experience (47.3% vs. 29.1%; p= < 0.001), and were mostly non-smokers (74.4% vs. 57.3%; p= < 0.001), compared to those who reported EFF. All women who EBF at one month had reported their intention to breastfeed in the prenatal phase. Among women who EFF, 53.0% had reported an intention to breastfeed in the prenatal phase.

3.4.2 Comparison of attitude scores

The mean score of the 17-item IIFAS for all mothers who completed the postnatal phase (n= 683) was 68.13 (SD = 9.26), while the mean score of the 13-item IIFAS was 52.52 (SD =7.83). The prenatal IIFAS score was significantly higher among mothers who EBF at one month postpartum (17-item IIFAS mean = 71.72; 13-item IIFAS mean = 55.47) than among mothers who MF (17-item IIFAS mean = 67.03; 13-item IIFAS mean = 51.68) or EFF (17-item IIFAS mean = 58.85, 13-item IIFAS mean = 44.56).

A detailed analysis of the scores revealed that mothers who were partially or exclusively breastfeeding at one month postpartum, compared to those who formula fed exclusively, were more likely to disagree with statements that formula feeding is more convenient, item 2 (mean = 4.12 vs. mean = 2.85; p = <0.001), is a better option for mothers who plan to return to work, item 6 (mean = 3.92 vs. mean = 3.03; p = <0.001), and is as healthy as the breastmilk item 14 (mean = 3.97 vs. mean = 2.91; p = <0.001) as well as that

breastfeeding should not be practiced in public item 8 (mean = 4.69 vs. mean = 4.44; p= 0.009).

3.4.3 Cut-off score for 17-item and 13-item IIFAS

A cut-off score of ≤60 yielded the maximum sensitivity and specificity (0.81 and 0.87, respectively) for the original 17-item IIFAS scale. For the reduced 13-item IIFAS scale, a cut-off score of ≤45 yielded the maximum sensitivity and specificity (0.84 and 0.83, respectively). Table 3.2 and Table 3.3 show the sensitivity, specificity, and the Youden's index for possible cut-off points of both the original 17-item IIFAS and 13-item IIFAS. Figure 3.1 and Figure 3.2 present the sensitivity and specificity with 95% CI for the optimal cut-off scores for the 17-item IIFAS and 13-item IIFAS, respectively.

3.4.4 Predictive validity of cut-off scores

The ROC curve analysis predicting mothers intention to breastfeed using the original 17-item scale yielded an AUC of 0.926 (95% CI: 0.889-0.962), suggesting high level of predictive accuracy of the 17-item IIFAS. Similarly, the reduced 13-item IIFAS scale yielded an AUC of 0.929 (95% CI 0.895-0.962), suggesting a slightly higher level of predictive accuracy in differentiating women with and without breastfeeding intention than the original scale.

The adjusted linear regression models illustrated that scores ≤ 60 on the original IIFAS were 4.62 times (95% CI: 1.84, 11.61) more likely to be associated with mothers who EFF, whereas scores equal to or less than 45 on the reduced 13-item IIFAS were 6.32 times (95% CI: 2.42, 16.52) more likely to be associated with mothers who EFF at one month postpartum (Table 3.4).

3.5 Discussion

To our knowledge, this is the first study to establish cut-off scores for both the original 17-item IIFAS and a reduced 13-item IIFAS, while also validating the performance of scores collected in the prenatal phase to predict actual postpartum infant feeding behaviour. Specifically, the scales appear to be highly predictive of mothers who exclusively formula feed at one month postpartum. Our key findings demonstrated that a score of 60 on the original scale and a score of 45 on the reduced version of the IIFAS were the optimal cut-off scores which differentiated between a high potential to breastfeed (score of > 60 or > 45, respectively) or formula feed (score of ≤60 or ≤45, respectively) with high specificity and sensitivity. The reduced version of the IIFAS had a stronger potential to predict those women who would formula-feed at one month postpartum compared to the original scale.

This study follows previous work conducted by our research group in which we derived a shorter version of the original 17-item IIFAS scale that would be manageable, time-efficient and convenient to administer in a clinical setting (AlKusayer et al., 2016). The elimination and reduction process of the scale down to 13 items marked the insignificant items to assess maternal attitudes toward infant feeding. In this study, we aimed to further enhance the feasibility, applicability, validity and accuracy of the administration of the IIFAS scale by identifying specific cut-off scores. The establishment of these scores will facilitate more efficient interpretation and prediction of breastfeeding attitudes and outcomes and provides insight into appropriate interventions.

Similar to previous studies' findings, a mother's decision to exclusively breastfeed was positively influenced by a higher level of education, residence in urban area, and household income over $30,000 per year (Al-Sahab, Lanes, Feldman, & Tamim, 2010; Jessri, Farmer, Maximova, Willows, & Bell, 2013). Having been breastfed as a baby was also associated with a mother's increased likelihood of breastfeeding her own children (Forster, McLachlan, & Lumley, 2006). Those who reported exclusive breastfeeding had significantly higher IIFAS scores in the prenatal phase, whereas women partially or exclusively formula feeding women had significantly lower IIFAS scores, a phenomenon which has been captured in previous studies (Dai, Guan, Li, You, & Lau, 2013; Vijayalakshmi, Susheela, & Mythili, 2015). Furthermore, we found that mothers who exclusively formula fed were more likely to report that breastfeeding is restrictive, embarrassing to be practiced in public, and that formula is a better choice for working mothers outside of the home. These associations and perceptions have also been observed previously (Cox, Giglia, & Binns, 2015; Dennis, 2002). All women who exclusively breastfed at one month postpartum had expressed their intention to breastfeed prenatally and had an IIFAS score greater than the proposed cut-off scores on the original scale (mean = 71.72) and reduced scale (mean= 55.47). This further supports the empirical evidence that attitudes and intention are strong indicators of infant feeding behaviours (Fishbein, 1980).

Even though previous studies have attempted to define IIFAS cut-off scores correlated with specific maternal breastfeeding behaviours, these proposed scores or ranges have not been congruent; an IIFAS score of 51 has been referred to as a "neutral" feeding

attitude (Ishak et al., 2014; Sittlington et al., 2007), while another study referred to the score of 55 to "undecided" women with neural attitude (Jefferson, 2012). On the other hand, Dungy et al. has reported that a score range of 70 to 85 refers to "positive to breastfeeding", a range of 49 to 69 indicates a "neutral" attitude, and a range of 17 to 48 refers to "positive to formula feeding" (C. Dungy, McInnes, Tappin, Wallis, & Oprescu, 2008). None of these studies justified or further described how those scores were derived and did not validate them.

While the most obvious attributes in identifying cut-off scores are sensitivity, which refers in this context to the IIFAS's correct identification of women who have intentions to breastfeed, and specificity, which refers to the scale's correct identification of women who have no intention to breastfeed, the process of identifying cut-off scores for any measurement tool requires decision-making in terms of the relative importance of true positive and true negatives as well as the expected cost of false positives and false negatives. In this study, it was not possible to precisely quantify these potential benefits or costs, however we employed qualitative indications in order to determine the critical implications for misclassification errors when using the IIFAS (Smits, 2010). Classification failure events, like misclassifying women who do not have the intention to breastfeed as having intention to breastfeed (false positive), may be associated with increased future economic costs resulting from lack of required educational interventions and potential health outcomes for the child. On the other hand, misclassifying women who have the intention to breastfeed as having no intention to breastfeed may trigger the unnecessary promotion of breastfeeding education and interventions which would increase resource

utilization. Therefore, it is reasonable to conclude that the potential economic impacts from the misclassification of both false positives and false negatives on the IIFAS have fairly equal weight and that the sensitivity and specificity of the tests were justifiably equally weighted in the Youden's index test.

The reliability and accuracy of the reduced 13-item IIFAS has also been validated in this study. It was not surprising to find that the proposed cut-off score of the reduced IIFAS demonstrated higher predictive ability of the breastfeeding mode at one month postpartum than that of the original 17-item IIFAS, especially due to the fact that our previous study demonstrated that the reduced scale showed higher internal consistency (13-item IIFAS: Cronbach's $\alpha = 0.870$ vs. 17-item IIFAS: Cronbach's $\alpha = 0.868$) (AlKusayer et al., 2016).

It should be acknowledged that women who volunteered to participate in the study may have had positive beliefs or personal interests in breastfeeding, thus introducing a potential source of selection bias. No data was available for women who did not participate in the postnatal phase therefore it is not possible to determine whether factors which may have impacted breastfeeding outcomes particularly in these participants were missing. Additionally, the generalizability of this study may be limited due to the fact that over 91% of the participants were Caucasian. Finally, the ROC analysis utilized may ignore the underlying continuous nature of the IIFAS scale scores, producing a simplistic graph and immediate conclusions. However, as aforementioned, the cut-off points can be used only as an indicator for classifying attitudes to infant feeding that will encourage conversations with mothers at higher risk of formula feeding than others.

3.6 Conclusion

This study has demonstrated that the IIFAS cut-off scores for both the original or reduced versions is valid for screening mothers breastfeeding attitudes prenatally and for predicting breastfeeding outcomes at one month postpartum in NL and Canada. Values equal to or less than the proposed cut-off scores should be viewed as indicators for potential interventions such as prenatal education regarding the benefits of breastfeeding and the risks of not breastfeeding and where to get education and support for whatever infant feeding decision the mother decides. Both the original or the reduced IIFAS can be used as a tool to initiate clinical conversations at prenatal appointments regarding infant feeding choices. The results and knowledge gained from this particular research will assist in measuring the general breastfeeding attitudes of mothers in this population, and provide informed guidance regarding the allocation of healthcare resources, and designing of provincial prenatal breastfeeding education and supports to eventually improve breastfeeding rates in NL.

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Table 3.1 Baseline characteristics of postnatal women by intent to infant feeding mode

Variable	Overall Sample[a] (N= 658) N (%)	EBB (n= 328) n (%)	MF (n=212) n (%)	EFF (n=117) n (%)	*p*-value
Age (year)					<0.001
< 25	85 (12.9%)	24 (7.3%)	30 (14.2%)	30 (25.6%)	
26-34	459 (69.8%)	251 (76.5%)	138 (65.1%)	70 (59.8%)	
≥ 35	114 (17.3%)	53 (16.2%)	44 (20.8%)	17 (14.5%)	
Ethnicity					0.559
Caucasian	605 (91.9%)	305 (93.0%)	196 (92.5%)	103 (88.0%)	
Aboriginal	24 (3.6%)	13 (4.0%)	5 (2.4%)	6 (5.1%)	
Others	20 (3.1%)	8 (2.4%)	7 (3.3%)	5 (4.3%)	
Marital status					<0.001
Single	44 (6.7%)	10 (3.0%)	13 (6.1%)	20 (17.1%)	
Married	611 (92.8%)	316 (96.3%)	198 (93.4%)	97 (82.9%)	
Dwelling area[b]					0.003
Urban	294 (44.7%)	157 (47.9%)	101 (47.6%)	36 (30.8%)	
Rural	359 (54.6%)	169 (51.5%)	108 (50.9%)	81 (69.2%)	
Educational level					<0.001
< Postsecondary	127 (19.3)	38 (11.6%)	41 (19.3%)	47 (40.2%)	
≥ Postsecondary	530 (80.5%)	289 (88.1%)	171 (80.7%)	70 (59.8%)	
Yearly household income ($CAD)					<0.001
< 29,000	44 (6.7%)	13 (4.0%)	17 (8.0%)	14 (12.0%)	
30,000 – 59,000	89 (13.5%)	37 (11.3%)	27 (12.7%)	24 (20.5%)	
60,000 – 80,000	89 (13.5%)	38 (11.6%)	32 (15.1%)	19 (16.2%)	
> 80,000	376 (57.1%)	218 (66.5%)	119 (56.1%)	39 (33.3%)	
Smoking					<0.001
Current smoker	22 (3.3%)	6 (1.8%)	4 (1.9%)	12 (10.3%)	
Previous smoker	130 (19.8%)	59 (18.0%)	39 (18.4%)	32 (27.4%)	
Non-smoker	466 (70.8%)	244 (74.4%)	154 (72.6%)	67 (57.3%)	
Previous children					<0.004
Yes	291 (44.2%)	159 (48.5%)	74 (34.9%)	58 (49.6%)	
No	367 (55.8%)	169 (51.5%)	138 (65.1%)	59 (50.4%)	
Attended/plan to attend prenatal education					0.006
Yes	376 (57.1%)	180 (54.9%)	139 (65.6%)	57 (48.7%)	
No	282 (42.9%)	148 (45.1%)	73 (34.4%)	60 (51.3%)	
Breastfed as a baby					<0.001
Yes	260 (39.5%)	154 (47.0%)	82 (38.7%)	24 (20.5%)	
No	398 (60.5%)	174 (53.0%)	130 (61.3%)	93 (79.5%)	

Table 3.1. (continued)

Variable	Overall Sample[a] (N= 658) N (%)	EBB (n= 328) n (%)	MF (n=212) n (%)	EFF (n=117) n (%)	*p*-value
Past breastfeeding experience					<0.001
Breastfed	254 (38.6%)	155 (47.3%)	65 (30.7%)	34 (29.1%)	
Never breastfed	399 (60.7%)	170 (51.8%)	145 (68.4%)	83 (71.0%)	
Intent to breastfeed					<0.001
Yes	600 (91.2%)	328 (100%)	210 (99.1%)	62 (53.0%)	
No	58 (8.8%)	0 (0.0%)	2 (0.9%)	55 (47.0%)	
Intent to breastfeed					<0.001
Others	20 (3.1%)	8 (2.4%)	7 (3.3%)	5 (4.3%)	
Marital status					<0.001
Single	44 (6.7%)	10 (3.0%)	13 (6.1%)	20 (17.1%)	
Married	611 (92.8%)	316 (96.3%)	198 (93.4%)	97 (82.9%)	

Abbreviations: CAD$, Canadian dollars; EBF, exclusive breastfeeding; MF, mixed feeding; EFF, exclusive formula feeding.

[a] Numbers may not add up to 658 because of missing data.

[b] An urban area was defined as a population of 1,000 or more and a density of 400 or more per square kilometer, and any area outside of that was considered rural (Statistics Canada, 2011).

Table 3.2 Specificity, sensitivity, and Youden's index of cut-off levels for 17-item IIFAS to predict breastfeeding intent

Cut-off scores	Sensitivity (%)	Specificity (%)	Youden's index J
> 45	99.53	15.77	0.153
> 50	98.21	39.64	0.379
> 55	93.50	67.12	0.606
> 60	80.96	87.39	0.684
> 65	61.45	95.05	0.565
> 70	38.93	98.20	0.371

Note: The total score of the 17-item IIFAS ranges from 17 to 85

Table 3.3 Specificity, sensitivity, and Youden's index of cut-off levels for 13-item IIFAS to predict breastfeeding intent

Cut-off scores	Sensitivity (%)	Specificity (%)	Youden's index J
> 30	99.72	8.65	0.084
> 35	99.34	27.03	0.264
> 40	95.66	58.11	0.538
> 45	84.17	83.33	0.675
> 50	61.17	94.59	0.558
> 55	36.00	99.10	0.351

Note: The total score of the 17-item IIFAS ranges from 13 to 65

Table 3.4 Predictive validity of the feeding mode at one-month postpartum of the optimal cut-off scores for the 13-item IIFAS and 17-item IIFAS

Feeding mode at one month postpartum	**17-item IIFAS ≤ 60 (95% CI)**		**13-item IIFAS ≤ 45 (95% CI)**	
	Unadjusted	**Adjusted[a]**	**Unadjusted**	**Adjusted[a]**
EFF	15.47 (8.85 – 27.04)	4.62 (1.84 – 11.61)	20.40 (11.16 – 37.27)	6.32 (2.42 – 16.52)
MF	2.36 (1.34 – 4.15)	2.08 (0.99 – 4.36)	2.12 (1.11 – 4.04)	1.53 (0.67 – 3.52)
EBF	*Reference*	*Reference*	*Reference*	*Reference*

Abbreviations: EBF, exclusive breastfeeding; MF, mixed feeding; EFF, exclusive formula feeding.

[a] Adjusted for age, marital status, dwelling area, education level, annual household income, smoking status, previous children, attended/plan to attend prenatal education, breastfed as a baby, past breastfeeding experience, intent to breastfeed, and family and/or friends encouraged breastfeeding.

Figure 3.1 Sensitivity and specificity curves with 95% CI for the optimal cut-off score of the 17-item IIFAS

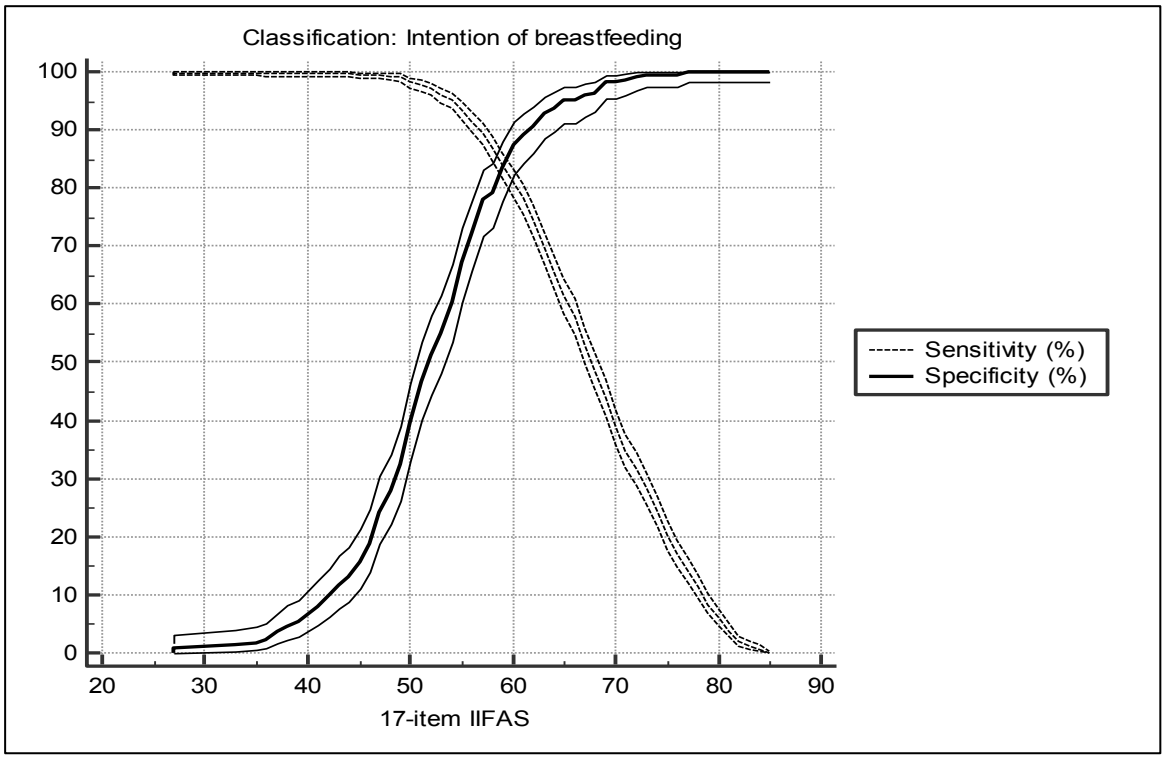
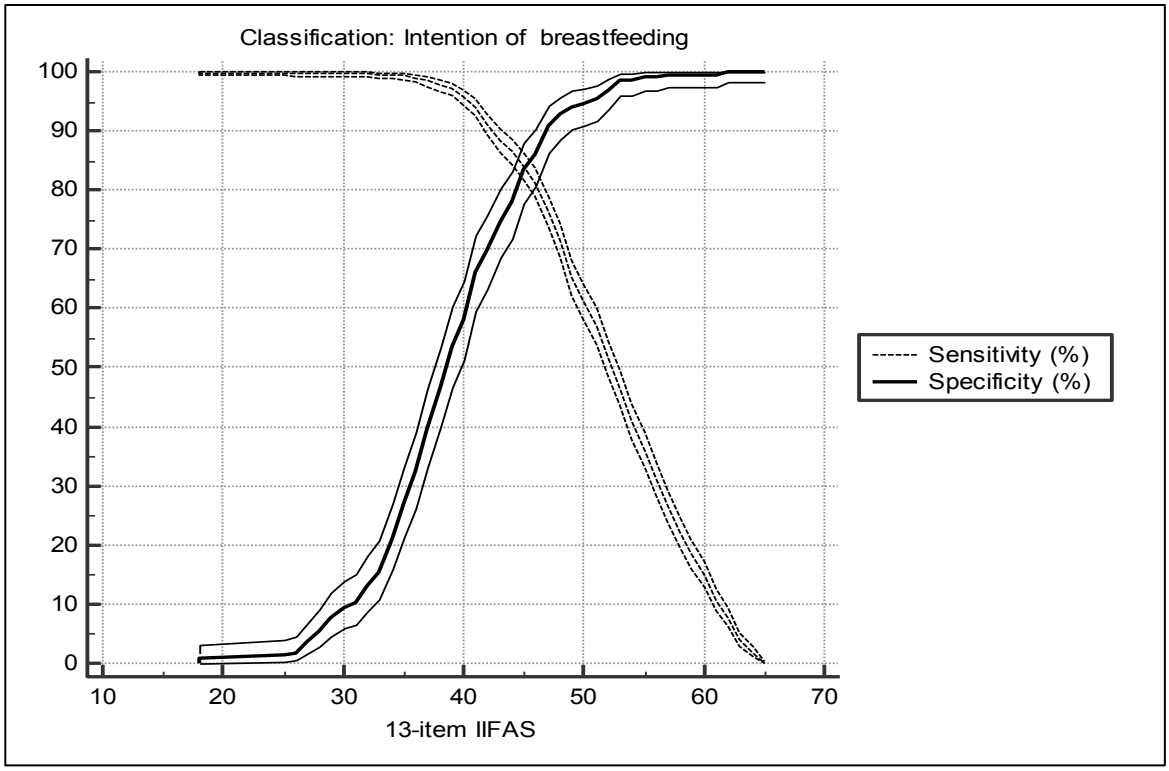


Figure 3.2 Sensitivity and specificity curves with 95% CI for the optimal cut-off score of the 13-item IIFAS



Chapter 4: Discussion

4.1 Summary of findings and discussion

This research study aimed to assess the psychometric properties of the IIFAS and to minimize the clinical version of the original IIFAS to a manageable length while maintaining its validity. It also set out to establish clearly defined cut-off scores for both the original 17-item IIFAS and the reduced scale to reliably indicate positive and negative attitudes toward breastfeeding and to predict breastfeeding postpartum practices in a Canadian population, located in NL. The findings revealed that the reduced 13-item IIFAS, derived from the original scale, is a psychometrically and conceptually sound tool to measure maternal infant feeding attitudes and to predict women's intention to breastfeed. This study also provides novel empirical evidence that a summative score of 60 on the original scale or a summative score of 45 on reduced IIFAS scales are the optimal cut-off scores to distinguish women with breastfeeding intentions from women with formula feeding intentions. The optimal cut-off score for the reduced scale demonstrated higher predictive ability for differentiating between women who chose to formula feed from those who chose to exclusively breastfeed at one month postpartum.

Breastfeeding is the most effective way to provide newborns with optimal nutritional requirements which are fundamental to their development and growth in the first six months to two years of life. In spite of being aware of some of the breastfeeding benefits, especially those related to higher developmental scores, fewer ear infections, decreased gastrointestinal problems and improved mother and infant bonding (Rivera, Dávila Torres, Parrilla Rodríguez, de Longo, & Gorrín Peralta, 2008), there are a many reasons why

women around the world either stop breastfeeding early or choose formula over breastfeeding, evidenced by the low breastfeeding rates worldwide. Only 39% of children who are less than six months of age worldwide are exclusively breastfed (United Nations International Children's Emergency Fund, 2015). Evidence suggests that maternal pre-determined attitudes and beliefs toward infant feeding play a key role in determining infant feeding practices and are more influential than other non-modifiable socio-economic, demographic, and biological factors (Kloeblen-Tarver, Thompson, & Miner, 2002; Shaker, Scott, & Reid, 2004). Maternal attitudes toward infant feeding have specifically been shown to be a strong predictor of breastfeeding intention, initiation, and duration (Chambers, McInnes, Hoddinott, & Alder, 2007; de la Mora, Russell, Dungy, Losch, & Dusdieker, 1999). Several measures have been developed to assess maternal attitudes toward infant feeding, but the self-reported IIFAS tool has several advantages over the other available tools including its ease of administration, applicability to wide range of populations, simplicity, and logical scoring system. The original IIFAS was developed by de la Mora in 1999 in an effort to understand factors associated with the low breastfeeding rates in the United States (Mora et al., 1999). Since its development, the IIFAS has been validated in many populations and translated to several languages (Charafeddine et al., 2016; Dai, Guan, Li, You, & Lau, 2013; Nanishi & Jimba, 2014; Wallis et al., 2008).

In this study, the mean score achieved by prenatal women completing the IIFAS during their third trimester was 65.29. Since the total possible scores of IIFAS range from 17 to 85, with a higher score being reflective of more positive attitude toward breastfeeding, the results demonstrates that expectant mothers in NL are more likely to have positive

attitudes toward breastfeeding, despite having the lowest breastfeeding rates in Canada. Women who had higher IIFAS scores in this population were more likely to have postsecondary education, higher annual household income, reported pre-determined intentions to breastfeed, and past breastfeeding experience. These findings were echoed in previous studies (Chen et al., 2013; Tomás-Almarcha, Oliver-Roig, & Richart-Martinez, 2016; Zhou, Younger, & Kearney, 2010). It is hypothesized that women with a higher level of education are more likely to make informed decisions with regards to choice of infant feeding methods and benefits and, thus, may be more likely to adhere to breastfeeding recommendations and to be receptive to maternal health promotional campaigns (Al-Sahab, Lanes, Feldman, & Tamim, 2010; Li et al., 2004). Furthermore, mothers who attended or planned to attend prenatal classes were more likely to have a positive attitude towards breastfeeding and were more likely to exclusively breastfeed at one month postpartum.

The IIFAS scale, based on its original structure, assessed ten different aspects relevant to attitudes toward infant feeding; five of which are related to the characteristics of breastmilk and formula feeding including cost, maternal physical shape, sexual pleasure, mental–physical comfort, and nutritional product, and the remaining five of which are related to the process of feeding including parental role, physical closeness, infant food intake, ease of feeding, and nighttime feeding (de la Mora et al., 1999). The original scale developed by de la Mora et al. contains 17 questions of which approximately 50% of the items are favourable to breastfeeding and the other half of the items are favourable to formula feeding (de la Mora et al., 1999). In this study, we uncovered the underlying structure and quantified the item-total correlation of the 17 IIFAS items to determine those

which best predict maternal intentions to breastfeed. The analysis provided new empirical and theoretical evidence of the IIFAS by classifying its items into three themes, 'favourable to breastfeeding,' 'favourable to formula feeding,' and 'convenience.' While the item categorization was not exactly the same, Lau et al. previously determined a similar three-factor structure within the IIFAS (Lau, Htun, Lim, Ho-Lim, & Klainin-Yobas, 2016). These thematic classifications differed from those found in other versions of the IIFAS, namely the Chinese version of the IIFAS which describes a four-factor structure including 'favourable to breastfeeding,' 'favourable to formula feeding,' 'sociological influences,' and 'convenience' (Dai et al., 2013). These discrepancies may be associated with the statistical procedures employed and may also be explained by the characteristics of participants in each study, such as the inclusion of prenatal women this study and the study by Lau et al., as opposed to the Chinese study which included postnatal participants only.

Once a comprehensive understanding of the original IIFAS scale and the value of each of its items was established, we aimed to reduce the scale to a more clinically manageable length while still maintaining its validity and accuracy in predicting maternal attitudes towards breastfeeding. Only one previous study has been conducted with a similar objective using the English IIFAS. Four hundred and seventeen prenatal participants from multi-ethnic backgrounds in Singapore were recruited for a study which attempted to reduce the number of items of the original English IIFAS (Lau et al., 2016). A reduced 15-item IIFAS (i.e. items 5 and 17 were omitted) was proposed, however the authors relied completely on statistical analysis, including factor analysis, to derive a shorter version of IIFAS without taking the contextual dimensions into account during the reduction process. Other foreign language-versions of the IIFAS have also been minimized. A proposed

Spanish version of IIFAS consisted of just nine items (i.e. items 1, 4, 5, 8, 10, 11, 16, and 17 were omitted), which illustrated higher level of reliability than the original IIFAS (Cronbach's alphas = 0.792 vs.0.726). The reduced version was developed on the basis of two criteria; by deleting items with adjusted item-total correlation less than 0.30, after running component factor analysis, and by the assessment of the predictive power of each item (Tomás-Almarcha et al., 2016). A reduced Japanese version of IIFAS was determined after conducting principal component analysis (Nanishi & Jimba, 2014). Only one item was removed (i.e. item 17), resulting in a 16-item IIFAS, because of its negative factor loading and low item-total correlation. The reduced Japanese scale was found to be reliable and valid for measuring prenatal maternal attitudes (Cronbach's alpha = 0.66). In order to continue to pursue a reduced English IIFAS, this project utilized statistical analysis, theoretical understanding of the scale's dimensions as well as thoughtful insights were employed to make informed judgements throughout the reduction process.

In the factor analysis explored in this thesis, it was discovered that two items were statistically insignificant; *item 8,* "women should not breastfeed in public places such as restaurants," and *item 16*, "breastmilk is cheaper than formula". Despite being removed from the scale by factors analysis, item 8 was kept in the model based on critically important theoretical and contextual explanations. A previous study that administered the IIFAS observed that women who agreed with this statement were less likely to breastfeed in public. Women who refrained from breastfeeding in public were in turn more likely to cease breastfeeding earlier, than those women who had breastfed in public places (Scott et al., 2015). Previous qualitative research in NL has shown that women's breastfeeding

practices in public were viewed to be “unacceptable” and “embarrassing” (Bonia et al., 2013). Embarrassment of public breastfeeding has been shown to be associated with decreased breastfeeding rates and has been cited as an important barrier to breastfeeding (Brand, Kothari, & Stark, 2011; McCann, Baydar, & Williams, 2007; Stewart-Knox, Gardiner, & Wright, 2003). Therefore, it was decided to keep this statement in the reduced IIFAS version. It was not surprising that almost all women in this study population agreed or strongly agreed (96%) with the statement that breastmilk is much cheaper than formula feeding (item 16). Due to the universal acceptance, it was decided that the item would not add any further benefit and it was omitted from the scale.

Three items were not flagged by factor analysis but were thoughtfully omitted from the scale by the authors. *Item 4*, “breastmilk is lacking in iron,” had a corrected item-total correlation that is less than the threshold of 0.40 (0.343). Approximately 32% of the participants reported a neutral response to this statement. In our evaluation, this statement does assess maternal breastfeeding knowledge but does not serve the purpose of the scale to assess attitudes toward infant feeding. For a participant to answer this question, knowledge of the chemical components of breastmilk as well as the significance and function of iron to the baby’s development would be required. With regards to *item 11*, “Fathers feel left out if a mother breastfeeds,” it was felt that this aspect of breastfeeding does not directly influence or determine maternal attitudes toward infant feeding as the IIFAS is meant to reflect the mother’s perceptions (Scott, Shaker, & Reid, 2004; Shaker et al., 2004). Furthermore, this item may not be relevant or meaningful to first-time mothers at the prenatal stage with no previous breastfeeding experience. Moreover, *item 17, “*A

mother who occasionally drinks alcohol should not breastfeed her baby," was also removed because it had weak predictive ability in relation to breastfeeding outcomes. It has repeatedly been shown to have a low item-total correlation, less than 0.30 (Charafeddine et al., 2016; Dai et al., 2013; Tomas-Almarcha et al., 2016; Nanishi & Jimba, 2014; Jessri, Farmer, Maximova, Willows, & Bell, 2013; Lau et al., 2016; Scott et al., 2004). Therefore, the final reduced version of the IIFAS proposed in this study consisted of a total of 13 items.

The reduced scale resulted in approximately half of the items worded as favourable to breastfeeding (7 items) and the remaining worded as favourable to formula feeding (6 items), similar to the original IIFAS scale reduction criteria proposed by de la Mora et al., in which they removed 9 items to finalize the original 17 item version (Mora et al., 1999). The original IIFAS was proven to be a valid and a reliable tool to measure attitudes toward infant feeding and feeding practices among prenatal women (Chambers et al., 2007). In this study, it was found that the level of internal reliability for the reduced 13 item IIFAS was higher than that of the original 17-IIFAS scale. Even though it consists of fewer statements, a high value of Cronbach's alpha of 0.870 was obtained, reflecting robust reliability. This value was also found to be higher than all the reported Cronbach's alphas in the previous literature validating the original IIFAS scale or translated versions of the scale (Charafeddine et al., 2016; Dai et al., 2013; Dungy, McInnes, Tappin, Wallis, & Oprescu, 2008; Ho & McGrath, 2011; Lau et al., 2016; Twells et al., 2016; Wallis et al., 2008).

The administration of the reduced 13-item IIFAS measurement tool in clinical settings will be more manageable and feasible compared to original IIFAS. In order to

further facilitate the applicability of the tool in a busy maternity, obstetrics, or family physician clinic, reliable cut-off scores to differentiate women with positive attitudes towards breastfeeding from those with positive attitudes toward formula feeding were desired. Some previous studies have associated specific scores or ranges of scores with certain infant feeding attitudes. Two studies referred to a score of 51 on the original 17-item IIFAS as "neutral" feeding attitudes (Ishak et al., 2014; Sittlington, Stewart-Knox, Wright, Bradbury, & Scott, 2007), while another study referred a score of 55 as "neutral" attitude (Jefferson, 2012). Another study referred to ranges of scores to define feeding attitudes; 17 to 48 as a "positive to formula feeding," 49 to 69 as a "neutral" attitude, and 70 to 85 as "positive to breastfeeding" (Dungy et al., 2008). However, none of these studies clearly described the process by which these scores were derived, nor did they attempt to validate the cut-off scores contributing to misleading results and interpretations. Therefore, to the best of my knowledge, this project was the first to determine a cut-off score for both the original and reduced IIFAS scales.

The cut-off scores for both the original and reduced 13-item IIFAS were determined based on the ability of the score to correctly and reliably differentiate between women with intention to breastfeed from those with no intention to breastfeeding. The findings demonstrated that a score of 60 on the original IIFAS yielded optimum sensitivity (0.81) and specificity values (0.87) and a score of 45 on the reduced scale yielded optimum sensitivity (0.84) and specificity (0.83), suggesting that achieved scores higher than these thresholds were highly likely to be predictive of breastfeeding intentions and behaviours one month postpartum.

Identification of cut-off scores ideally requires a critical quantitative analysis of the consequences that may result from the failure to classify women appropriately. This includes, accounting for qualitative costs associated with the misclassification of women with breastfeeding intention as having no intention to breastfeed (false negative results), which could lead to offering unnecessary clinical interventions and misdirecting valuable educational resources. Alternately, taking into account costs associated with cut-off scores' which would misclassify women with no breastfeeding intention as having intention to breastfeeding (false positive results), could result in losing the chance to provide necessary interventions and support to mothers who need it. Since it was impossible to assign numerical values to the possible consequences of false positive and false negative results, qualitative indications were employed to indicate relative importance of such misclassification events (Smits, 2010). It is reasonable to conclude that the economic burdens of both misclassifications errors are equally undesirable and are of equal importance. Therefore, sensitivity and specificity were equally weighted in the Youden's index test. The chances for misclassification errors in the proposed cut-off scores of the original and reduced IIFAS were very similar as a result.

The proposed cut-off score for the reduced IIFAS scale demonstrated a greater predictive ability of the infant feeding mode at one month postpartum than that of the original 17-item IIFAS. This is not surprising especially since the reduced scale has already shown a greater level of internal consistency (AlKusayer et al., 2016). Scores equal or less than the proposed cut-off scores should be considered as clinical signals for the potential

need for intervention to clarify misconceptions and to bridge knowledge gaps concerning breastfeeding and formula feeding.

4.2 Strengths and limitations

There are several strengths of this program of research. The data explored in this study are a component of a large province-wide, cohort study of mother-infant dyads. The large sample size, unlike previous studies using or assessing psychometric properties of IIFAS, provides accurate and reliable estimates that are more generalizable to the Canadian population compared to previous studies in this area. The longitudinal nature of the study has strengthened the evidence concerning the predictive validity of the reduced scale as well as the cut-off scores by assessing their ability to predict actual infant feeding practices at one month postpartum. The reliance on very short recall periods for the prenatal and postnatal questionnaires, in addition to the prospective design of the study, minimizes recall bias. This is the first study to reduce the original English IIFAS scale using North American sample data, and to determine highly reliable cut-off scores for differentiating women's infant feeding attitudes. This study adds valuable insight into the current knowledge gaps with regards to infant feeding attitudes and behaviors, especially in the Canadian context. The use of standard terms and definitions throughout the study's questionnaires to describe infant feeding practices (exclusive breastfeeding, mixed feeding, and exclusive formula feeding) is an important strength in this research, as it reduces the likelihood of participants misunderstanding the questionnaire items and falsely reporting.

Notwithstanding the numerous strengths of this study, there are some limitations. First, this study is prone to selection bias as all the participants were volunteers who may have had more positive perceptions and attitudes toward breastfeeding to begin with. Although the derived sample was representative of NL, given that the majority of participants were partnered and Caucasian, this may have limited generalizability in culturally diverse populations or in other settings. Furthermore, the study relied on self-reporting measures (questionnaires) that are susceptible to self-report and recall bias. The study would have benefited from including information on partner's support and attitudes toward infant feeding, and the level/type of support participants received from health care professionals; however, the collection of this information was outside of the scope of this project.

4.3 Implications

There are a number of important implications resulting from the findings of this thesis. The results and knowledge gained from the projects herein are a significant contribution to the literature related to understanding infant feeding attitudes and practices in the Canadian population, and in particular NL. This study may stimulate healthcare and lactation support professionals to administer the IIFAS measurement tool in clinical settings. The study findings also can affirm to researchers that the IIFAS can be used to assess mother's attitudes toward infant feeding but also to predict postpartum infant feeding practices. Furthermore, from a local perspective, the Government of NL has a set of missions and goals, outlined in "The Way Forward" a provincial vision statement, to

improve health services and outcomes in the province which includes increasing the breastfeeding initiation rate by 7% by 2025 (The Government of Newfoundland & Labrador, 2016). The findings of this research will serve to guide the design of provincial prenatal breastfeeding interventions utilizing the IIFAS. The clinically feasible 13-item IIFAS scale can be used as a screening measurement tool to help the professionals to explore and identify the prevailing misconceptions or knowledge gaps specific to local populations with regards to infant feeding attitudes and practices.

4.4. Conclusion

Breastfeeding provides the optimal nutritional requirements to infants, which cannot be replicated through commercial formulas. It has been shown that prenatal maternal attitude towards breastfeeding is the most influential factor in determining actual breastfeeding behaviours and outcomes. To measure maternal attitudes, the IIFAS has been shown to be the best tool to assess maternal breastfeeding attitudes in a clinical setting. However, efforts to reduce the scale even further, to optimize clinical effectiveness and time management for the English 17-item IIFAS has not been achieved previously in North America. Here, we reduced the IIFAS to a 13-item version that was shown to be a psychometrically sound tool with robust reliability and capacity to predict maternal intention to breastfeed. It maintained similar validity as the original 17-item IIFAS scale. The proposed novel cut-off scores for both the original and reduced scales herein also demonstrated an excellent validity and ability to correctly classify maternal infant feeding intention and outcomes. Values less than or equal to the proposed cut-off scores should be

viewed as indicators for potential intervention targeting knowledge gaps and misconceptions with regards to breastfeeding. The impacts of this thesis, including clinical administration of a shorter version of IIFAS as well as novel and validated cut-off scores, will enhance the feasibly and applicability of the IIFAS and allow for quicker prediction of feeding attitudes and breastfeeding outcomes in the busy clinical setting. The knowledge gained from this program of research may guide the design of provincial interventions and the allocation of resources, to ultimately improve upon the low breastfeeding rates in NL, and improve the health outcomes for children and their mothers.

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APPENDIX A: Iowa Infant Feeding Attitude Scale (IIFAS)

Iowa Infant Feeding Attitude Scale items
1. The benefits of breastfeeding last only as long as the baby is breastfed.
2. Formula feeding is more convenient than breastfeeding.*
3. Breastfeeding increases mother infant bonding.
4. Breastmilk is lacking in iron.*
5. Formula fed babies are more likely to be overfed than breastfed babies.
6. Formula feeding is the better choice if the mother plans to go back to work. *
7. Mothers who formula feed miss one of the great joys of motherhood.
8. Women should not breastfeed in public places such as restaurants. *
9. Breastfed babies are healthier than formula fed babies.
10. Breastfed babies are more likely to be overfed than formula fed babies. *
11. Fathers feel left out if a mother breastfeeds. *
12. Breastmilk is the ideal food for babies.
13. Breastmilk is more easily digested than formula.
14. Formula is as healthy for an infant as breastmilk. *
15. Breastfeeding is more convenient than formula.
16. Breastmilk is cheaper than formula.
17. A mother who occasionally drinks alcohol should not breastfeed her baby. *

* Reverse-scored items

The copy righted questionnaire may be found in:

de la Mora, A., Russell, D. W., Dungy, C. I., Losch, M., & Dusdieker, L. (1999). The Iowa Infant Feeding Attitude Scale: Analysis of reliability and validity. *Journal of Applied Social Psychology, 29*(11), 2362-2380. doi:10.1111/j.1559-1816.1999.tb00115.x

APPENDIX B: Ethics approval letter

Ethics Office
Suite 200, Eastern Trust Building
95 Bonaventure Avenue
St. John's, NL
A1B 2X5

March 21, 2016

Ms Alkusayer

Memorial University

Dear Ms. Alkusayer:

Researcher Portal File # 20162701
Reference # 2016.084

RE: "Poverty, Lactation, and Reproductive Health: Assessing Changes in Infant Feeding Attitudes from Pre-Natal through the first Post-Partum Year in a Vulnerable Population in NL"

Your application received an expedited review by a sub-committee of the Health Research Ethics Board (HREB). *Full approval* of this research study is granted for one year effective **March 18, 2016**.

This is your ethics approval only. Organizational approval may also be required. It is your responsibility to seek the necessary organizational approval from the Regional Health Authority (RHA) or other organization as appropriate. You can refer to the HREA website for further guidance on organizational approvals.

This is to confirm that the HREB reviewed and approved or acknowledged the following documents (as indicated):

- Application, approved
- Chart Audit Form, approved
- Budget, approved

MARK THE DATE

This approval will lapse on March 18, 2017. It is your responsibility to ensure that the Ethics Renewal form is submitted prior to the renewal date; you may not receive a reminder. The Ethics Renewal form can be found on the Researcher Portal as an Event form.

If you do not return the completed Ethics Renewal form prior to date of renewal:

APPENDIX B (continued)

- *You will no longer have ethics approval*
- *You will be required to stop research activity immediately*
- *You may not be permitted to restart the study until you reapply for and receive approval to undertake the study again*
- *Lapse in ethics approval may result in interruption or termination of funding*

You are solely responsible for providing a copy of this letter, along with your approved HREB application form; **to Research Grant and Contract Services** should your research depend on funding administered through that office.

Modifications of the protocol/consent are not permitted without prior approval from the HREB. **Implementing changes without HREB approval may result in your ethics approval being revoked, meaning your research must stop**. Request for modification to the protocol/consent must be outlined on an amendment form (available on the Researcher Portal website as an Event form) and submitted to the HREB for review.

The HREB operates according to the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2), the Health Research Ethics Authority Act (HREA Act) and applicable laws and regulations.

You are responsible for the ethical conduct of this research, notwithstanding the approval of the HREB.

We wish you every success with your study.

Sincerely,

Dr Fern Brunger (Chair, Non-Clinical Trials Health Research Ethics Board)
Ms. Patricia Grainger (Vice-Chair, Non-Clinical Trials Health Research Ethics Board)

CC: L. Twells