

Mount Saint Vincent University
Department of Applied Human Nutrition

**A cross-cultural assessment of the feeding environment and maternal-child interactions
during breastfeeding in the first 6 months**

By
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A thesis submitted in partial fulfilment of the requirements for the degree of
Master of Science in Applied Human Nutrition

June 02, 2022
Halifax, Nova Scotia

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Abstract

Background: Human milk is the sole recommended food for infants for the first 6 months of life. Despite this, little is known about whether breastfeeding practices, such as feeding responsiveness, differ across cultures. Responsive feeding practices are based on the cues and responses of a caregiver and infant and are associated with more intuitive eating patterns later in life. However, economic, cultural, and sociodemographic differences between high- and low- and middle-income countries may result in differing responsiveness of caregivers. However, there is a lack of cross-cultural research on responsiveness, particularly among infants under six months.

Objective: To complete a cross-cultural assessment of the level of responsiveness, and explore the infant feeding environment, during breastfeeding sessions among mothers and infants less than six months of age in Nova Scotia, Canada, and in Kampong Thom Province, Cambodia.

Methods: In this cross-sectional, observational study, the dyadic interaction was measured during a video-recorded breastfeeding session among 110 pairs, 55 at each site (infants were age- and sex-matched). Videos were collected in the participant's home using three small cameras and were subsequently analyzed using the Nursing Child Assessment Feeding Scale (NCAFS). Indicators of the feeding environment including length of feed, incidence of distractions, use of supports, and breastfeeding position were recorded. The primary outcome, NCAFS dyad, maternal, and infant scores were analyzed across settings, and within settings by sociodemographic factors, distractions, and use of breastfeeding support.

Results: In total, 110 dyads were included in analysis. Canadian mothers were significantly older (32.3 ± 4.1 vs 27.5 ± 5.3 years; $p < 0.001$), and 76% had household incomes above the third wealth quintile, as compared to 27% in Cambodia. Canadian mothers scored significantly higher overall, and on three of four NCAFS maternal subscales: I: Sensitivity to Cues (14.2 vs 12.2; $p < 0.001$); III: Social-Emotional Growth Fostering (12.1 vs 10.4; $p < 0.001$), IV: Cognitive Growth Fostering (7.1 vs 4.9; $p < 0.001$) but did not score differently on subscale II: Response to Distress (9.9 vs 9.7; $p = 0.7$). Infants in Canada scored significantly higher on subscale VI: Responsiveness to Caregiver (8.2 vs 6.6; $p < 0.001$) but scored similarly on subscale V: Clarity of Cues (13.2 vs 13.0; $p = 0.4$). Cambodian dyads experienced significantly more distractions (51 vs 16%; $p = 0.003$), most often other people ($n = 26$; 47%).

Conclusions: In this study, Cambodian dyads demonstrated significantly lower levels of responsiveness on the NCAFS, though infants provided similarly clear cues. Canadian dyads likely scored higher due to ample information and available supports, such as various resources on responsive feeding and recognizing infant cues; paid maternity leave, which allows for time dedicated to responsive feeding; and various breastfeeding supports which allow positioning that is optimal for interaction. These results provide novel information on how responsive breastfeeding differs cross-culturally and highlights areas which could benefit from intervention to improve responsive feeding practices in Cambodia.

Acknowledgements

The past three years working towards this thesis has been an extraordinary journey, and I would like to express my deepest appreciation to all of those who provided endless support for me throughout this program. I couldn't have made it to this point without the many cheerleaders I've encountered along the way.

Most importantly, I would like to thank the mothers and infants who participated in this study. They not only allowed us into their homes (for some, during a pandemic), but also allowed us to capture some of their most special moments, and some epic spit-ups. This research would not be possible without them.

Infinite thanks are owed to my supervisor, Dr. Kyly Whitfield, for the enormous role you played in this project, and my own growth as a student, a researcher, and a person. Looking back at the day I nervously met you at Acadia in 2019, I couldn't have imagined the opportunities you have given me. Thank you for your endless enthusiasm, optimism, and “c'est la vie” advice. Your patience with me, especially when it comes to the more nuanced aspects of academia, like emails, is admirable. I have thoroughly enjoyed learning from you and will always be grateful for your support.

Many thanks to my committee members, Dr. Misty Rossiter and Dr. Jeffrey Measelle for your helpful input and contributions, your stimulating questions, and flexibility. I appreciate your time and valuable expertise. To Mr. Hou Kroeun, thank you for offering your time and local Khmer knowledge.

A very special thank you to the team of incredibly intelligent and impressive women in the MAMA Lab who assisted with recruitment and data collection; especially Kathleen Chan, Jelisa Gallant, Jolene Bianco, Ksenia Kholina, Victoria Shupe, Jocelyne LaBonté, Haley Zora, and Andrea Field, who all helped collect videos. Organizing appointments, requiring an incredibly flexible schedule, and carrying around three cameras and tripods is not easy, especially in the heat of Cambodia, but you ladies did it with a smile. Thank you for always capturing babies' faces at just the right angle. To Olga Levin, thank you for your invaluable perspective as a mother, and your many hours spent downloading and double coding videos. Without this outstanding group effort, I'm sure recruitment would still be ongoing, and I would probably graduate in 2030.

I would like to acknowledge the support of my funders; the Canadian Institutes of Health Research (Frederick Banting and Charles Best Canada Graduate Scholarship-Master's and Michael Smith Foreign Study Supplement) and Research Nova Scotia (Scotia Scholar's Award- Master's Level).

Thank you to all who have been there through the ups and downs. To my sister, Kelsi, for just getting it, and to Caroline Anderson and Chanelle Zaphiropoulos for the commiseration, advice, reflections, and celebrations.

Finally, my sincerest gratitude to my husband, Mike, for reminding me to laugh through the trials and tribulations of this thesis, and who kept our dog (and myself) alive and fed while I was up to my eyeballs in reading material. I am so grateful for your unwavering support.

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List of abbreviations

ANOVA – Analysis of variance
BMI – Body mass index
CI – Confidence interval
FPSQ – Feeding Practices and Structure Questionnaire
GDP – Gross domestic product
GNI – Gross national income
HIC – High-income country
HRM – Halifax regional municipality
IgA – Immunoglobulin A
LMIC – Low- and middle-income country
MAMA – Milk and Micronutrient Assessment
MSVU – Mount Saint Vincent University
NCAFS - Nursing Child Assessment Feeding Scale
NCAST - Nursing Child Assessment Satellite Training
NECHR – National Ethics Committee for Health Research
OR – Odds ratio
REB – Research ethics board
RR – Relative risk
SD – Standard deviation
SE – Standard error
SIDS – Sudden Infant Death Syndrome
UNICEF – United Nations Children’s Fund
WHO – World Health Organization

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1.0 Introduction

Human milk is the optimal food for infants for the first six months of life, providing various short- and long-term psychosocial and health benefits for both infant (1,2) and mother (3,4). Despite recommendations from the World Health Organization (WHO) to initiate breastfeeding within the first hour of life, to exclusively feed human milk until six months of age, and to continue breastfeeding for 2 years or beyond (5), global rates of these breastfeeding indicators remain suboptimal (3). Rates differ between countries, but there is a global trend of higher rates of exclusive and continued breastfeeding in low- and middle-income countries (LMIC) as compared to high-income countries (HIC) (3). Various circumstances on an individual, community, and societal level could influence breastfeeding rates, such as the level of support available and cultural norms. For example, in Cambodia breastfeeding is the cultural norm, with 96% of children breastfed at some point and 65% of infants less than 6 months of age exclusively breastfed (6). Conversely, in Canada only 33% of infants are exclusively breastfed until 6 months; and only 22% in Nova Scotia, one of the lowest rates in the country (7).

Responsive feeding is rooted in responsive parenting and refers to the reciprocal interaction between a caregiver and child during a feeding session (8). When feeding an infant, a responsive caregiver creates a warm and safe environment while recognizing the infant's hunger and satiety cues, allowing the child to initiate, pace, and end the feed (9). Responsive feeding practices reinforce an infant's ability to recognize and respond to their innate hunger and satiety cues later in life (10). This has been shown to lower risk of energy overconsumption and accelerated infant growth, which both can increase risk of overweight and obesity and negatively impact vascular health (11).

Given the economic, cultural, and sociodemographic differences between LMIC and HIC and the resulting differences in breastfeeding rates, supports, and the breastfeeding environment, it is possible that levels of responsiveness while breastfeeding differ as well. However, there is a lack of research on responsive feeding in the first six months, and what is available is completed in HIC. Therefore, this research aims to carry out a cross-cultural assessment of the level of responsiveness during breastfeeding sessions in infants <6 months, in Nova Scotia, Canada, and Kampong Thom Province, Cambodia.

2.0 Literature Review

2.1 Human milk and breastfeeding

Human milk is the optimal food for infants, with the correct amounts and proportions of nutrients to foster appropriate growth and development, but also providing both short and long-term health protection through various bioactive compounds (1,12). Human milk is an excellent source of nutrients such as calcium, phosphorous, magnesium, vitamins, protein, water, and fat, and it is an adaptive food source, with macro- and micronutrient composition that varies over time to meet infants changing needs (2).

2.1.1 Short-term benefits

Human milk contains a complex set of bioactive compounds which have various roles and properties (2). Some bioactives aid in the development of the gastrointestinal mucosa, or in digestion, absorption, and utilization of milk-specific nutrients, such as bile salt-stimulated lipase, which hydrolyzes milk-specific lipids, cholesterol esters, and lyso-phospholipids (12). Others serve to protect the infant from pathogens, such as lactoferrin which inhibits bacterial growth by sequestering iron, or secretory immunoglobulin A (IgA), which prevents antigens from attaching and growing in the infant's small intestine (2). Working in tandem, these compounds play a vital role in the development of infant gastrointestinal and respiratory immune functioning, ultimately reducing the risk of infections in childhood. For instance, Victora *et al.* (3) conducted a meta-analysis of 66 different studies, mostly in low- and middle-income countries (LMIC), indicating that breastfeeding could prevent 72% of hospital admissions for diarrhea, and 57% of those for respiratory infections (1,3,12). The same authors used *The Lives Saved Tool* across 75 LMICs, and modelled 823 000 fewer deaths annually among children under five years if 95% of infants <1 month, and 90% of infants <6 months were exclusively breastfed, and 90% of infants partially breastfed from 6-23 months (3). Another meta-analysis also demonstrated a drastic difference in all-cause and infection-related mortality: as compared to exclusively breastfed infants, infants less than 6 months of age who had not been breastfed had a 14-fold (relative risk; RR: 14.4, 95% confidence interval; CI: 6.13-33.9) higher risk of all-cause mortality and an 8.7-fold (RR: 8.7, 95% CI: 3.19-23.5) higher risk of infection-related mortality (13). These differences may be at least partially explained by the aforementioned protection from respiratory and gastrointestinal infections, as well as the prevention of sudden infant death syndrome (SIDS) and necrotizing enterocolitis (1,3).

2.1.2 Long-term benefits

In addition to the clear short-term benefits of breastfeeding, there is also evidence of positive effects of breastfeeding on intelligence and lower risks for non-communicable diseases, long past infancy (14,15). A 2015 systematic review and meta-analysis reported that, compared to never breastfed, adults who had ever been breastfed had a lower risk of obesity (pooled odds ratio; OR: 0.74, 95% CI: 0.70-0.78), systolic blood pressure (-0.80 mmHg, 95% CI: -1.17-0.43), and risk of developing type 2 diabetes (pooled OR: 0.65, 95% CI: 0.49-0.86), which was even more pronounced in studies with adolescents (pooled OR: 0.46, 95% CI: 0.33-0.66) (14). Other systematic reviews have focussed on intelligence test scores; the four highest quality studies included in a 2015 meta-analysis indicated a mean difference of 1.76 IQ points (95% CI: 0.25-3.26), with breastfed children scoring higher than those not breastfed, even after controlling for maternal IQ (16). Not only does breastfeeding have numerous health benefits for infants, lactation can have positive maternal effects (3,4). This includes allowing for bonding, and prolonged lactational amenorrhea, while also reducing risk of type 2 diabetes and reproductive cancers (3,4). For instance, >12 months of breastfeeding is associated with a 26% and 37% decrease in risk of breast and ovarian cancers, respectively, as well as a 32% decrease in the risk of type 2 diabetes (17).

While evidence of breastfeeding to support longer term health outcomes will likely never truly establish causation without the ability to control all potential cofounders, and because it would be unethical to conduct a randomized controlled trial given strong evidence of breastfeeding benefits to date, there is strong observational evidence supporting the short- and long-term health benefits of human milk and breastfeeding (18).

2.2 *Breastfeeding rates around the globe*

Exclusive breastfeeding is defined by the WHO as the consumption of human milk alone, with no food or drink, even water, but can include expressed mother's own milk or milk from a wet nurse or donor (19). The WHO recommends that human milk feeding begin within the first hour after birth, and that milk should be fed exclusively for the first six months (1,5). Breastfeeding should then be continued up to two years of age and beyond, along with age-appropriate, safe, and adequate complementary foods (5). Though the benefits of breastfeeding are well established, rates of exclusive and continued breastfeeding worldwide remain low as a

result of many, often overlapping factors, including poor knowledge about breastfeeding, commercial or health system factors, or social and cultural factors (19–21). Though there have been modest improvements in global breastfeeding indicators, including an increase of seven percent in exclusive breastfeeding rates in the past 15 years, still only 44% of infants are put to the breast within the first hour of life, and only 42% of infants less than 6 months are exclusively breastfed as recommended (22). However, this is a global breastfeeding rate, and rates vary greatly by country for various reasons, from physiological complications, to cultural and societal constraints (20,23).

2.2.1 Differing breastfeeding rates by national wealth measures

Gross Domestic Product (GDP) is a common indicator of national wealth and is defined as the total value of all goods and services produced in a country, per year (24). Gross National Income (GNI) is a similar measure of national wealth, though also includes income earned by residents outside the country, making it a more accurate indicator (25). The GNI per capita is used by The World Bank to classify countries as low (<\$1,035), lower middle (\$1,036-\$4,045), upper middle (\$4,046-\$12,535), or high income ($\geq$ \$12,536) (26). A 2016 systematic review and meta-analysis (22 studies) reported that breastfeeding is one of the few beneficial health behaviours that is more prevalent in LMIC than in HIC (3), with the United Nations Children's Fund (UNICEF) recently reporting 96% versus 79% of infants ever receiving human milk (27). Not only do rates differ as a function of national wealth, but also by economic growth, as authors described a 10% decrease in breastfeeding prevalence at 12 months of age for each doubling of GDP per person. In a similar manner, the rates of adherence to all infant and young child feeding indicators, except for early initiation of breastfeeding, decrease as national wealth increases (3).

2.3 *Determinants of breastfeeding*

Decisions about infant feeding are made by caregivers under the influence of their social context at the family, community, and societal level, including social structure, socioeconomic status, public health messages, parenting philosophies, cultural expectations, and many other factors (28–30). Practical supports for breastfeeding are similarly impacted by hospital and government programs, policies, and resources. Differences in the barriers to, and supports for, optimal infant feeding in HIC and LMIC may contribute to vastly different breastfeeding rates.

Of most relevance to this thesis are maternal characteristics, cultural influences, and societal supports, which will be outlined in more detail below.

2.3.1 Maternal characteristics

Consistently, maternal factors such as higher age, married or common-law marital status, higher household income, higher education level, and parents' working status, are predictive of exclusive and continued breastfeeding (21,30,31). With regards to education, in HIC (Quebec), children of mothers who had completed a university program were nearly five times as likely (OR: 4.9, 95% CI: 2.473-9.881; n=2,223) to be breastfed from birth to 4 months than those of mothers with no high school diploma, agreeing with a second Canadian study in 2010 (30,32). Factors such as education level and maternal age are strong predictors of exclusive breastfeeding in LMIC as well (33). In contrast though, while younger mothers in HIC are less likely to breastfeed, older mothers in LMIC are less likely to exclusively breastfeed (33). This is likely due to higher rates of employment as well as greater maternal fatigue and the struggle to balance work outside the home, household responsibilities, and breastfeeding (33). Maternal employment is the most common reason for breastfeeding cessation in LMIC, and is similarly important in HIC, with only a small number of women continuing to breastfeed after returning to work (32–35).

Mother's self-efficacy and confidence in their ability to breastfeed, sometimes related to previous experience, are also important determinants of breastfeeding intention and exclusivity in HIC (21,36,37). Similarly, in Indonesia, higher levels of breastfeeding self-efficacy among mothers was related to higher perceived milk supply ($p<0.05$), which, in turn, was related to a higher likelihood of exclusive breastfeeding (OR: 3.2, 95% CI: 1.76-5.83) (38). The relationship between perceived milk supply and breastfeeding exclusivity and duration is well known. In Canada, perceived low milk supply is the most cited reason for breastfeeding cessation (39), and is commonly observed in both LMIC and HIC (40–42). However, these issues are often self-diagnosed, with mothers introducing human milk substitutes due to a self-perception of infant hunger or dissatisfaction without understanding the true signs of milk insufficiency, such as reduced infant urine output (43,44).

2.3.2 Societal supports

While maternal characteristics are important determinants, exclusive and continued breastfeeding must be supported at home, at work, and in the community (35,45). In HIC, the

support of peers can reduce stress and help build self-efficacy (46), and spouses can influence both breastfeeding intention and duration (47,48). Likewise, breastfeeding mother's own mothers are important players in breastfeeding decision making in both HIC (49) and LMIC (50). Beyond the home, support from health care practitioners is essential, even before hospital admission and after discharge. Attendance at prenatal classes has repeatedly been related to increased likelihood of breastfeeding in HIC, though rates of attendance are low in Canada (21,51). This relationship holds true in LMIC (33), such as in Cambodia where even a lack of paternal attendance at prenatal breastfeeding classes was a barrier to breastfeeding exclusivity in the first 6 months (OR: 1.93, 95% CI: 1.13-3.28; $p < 0.05$) (52). Similarly, having a health care practitioner such as a doctor, nurse, or midwife in attendance during birth, and giving birth in an institution, were all strong predictors of exclusive breastfeeding (33).

Support after hospital discharge at the community level is also critical, particularly in areas of LMICs where rates of home deliveries are high (6,19). Community health workers were reported to have influenced mother's decisions to exclusively breastfeed in Vietnam in 2002 (53), and as part of a randomized controlled trial in Syria in 2008, post-partum home visits from registered midwives significantly increased exclusive breastfeeding rates ($p = 0.023$) (54). Community health supports are important in HIC too, especially lactation consultants (55) and public health nurses, whose support has been credited with enabling mothers to continue to breastfeed (51). While these services are common in HIC, they are not regularly available or accessible to mothers in LMIC. For example, in Cambodia, access to services pertaining to reproductive health are dictated by place of residence, leaving 79% of rural women experiencing one or more serious issues in accessing health care, such as the distance to a health facility, getting money or permission to go, and not wanting to go alone (56).

2.3.3 Cultural influences on breastfeeding

Aspects of Western societies have created unsupportive environments for breastfeeding; as what is required to be 'good' parents is sometimes contradictory to breastfeeding. For example, the sexualization of breasts and societal pressure for maternal modesty can make breastfeeding in public taboo, prompting maternal discomfort around public feeding and the need to seek out private or designated breastfeeding spaces (28,57). This is not surprising, as a recent study in Nova Scotia examining attitudes towards photos of breastfeeding women reported that participants were more comfortable (on visual analog scale from 1 to 10) with photos taken in

private spaces such as a living room (7.9, 95% CI:7.7-8.1) as compared to public spaces such as a restaurant (7.3, 95% CI:7.0-7.5) (58). In LMIC, however, breastfeeding in public does not seem to be a barrier to breastfeeding, in fact, it is a common practice (59). Likewise, while breastfeeding is a cultural norm in LMIC, mothers in Sweden and Canada (HICs) have described a culture of pressure, competition, judgement, and surveillance (29). Differences in gender roles and cultural expectations were also cited as predictors of exclusive breastfeeding in both Tanzania, where women were found to be independently responsible for solving breastfeeding issues both in the home and workplace, and Lebanon, where familial support of a breastfeeding woman is an expectation (60,61).

2.4 Canadian context

Canada is a country in North America with a population of about 38 million, classified as high-income by the World Bank, with a per capita GNI of just over USD\$46,000 in 2020 (62). Despite national paid parental leave, allowing mothers who meet basic eligibility criteria to receive a benefit equivalent to 55% of their salary for 50 weeks (to a maximum of \$31,900), with many employers offering top-ups that provide nearly their full salary, breastfeeding rates remain suboptimal (29,63).

2.4.1 Breastfeeding rates in Canada

Though data from the 2009-10 Canadian Community Health Survey reported nearly all mothers (90%) expressed intentions to breastfeed during pregnancy, and 87% reported trying to breastfeed, 13% of mothers stopped exclusively breastfeeding within the first 5 weeks (64). While data from 2018 show that nationally, 91% of mother's initiate breastfeeding, still only 34% of mothers exclusively breastfeed to 6 months (64,65). Rates also vary greatly across the country; for example, the rate of breastfeeding exclusively for six months is highest in Saskatchewan at 50%, whereas the prevalence is 22% in Nova Scotia (7). Nova Scotia has also been reported to have an unsupportive breastfeeding culture among health care professionals (66), and with regards to breastfeeding in public (58), and nearby in Newfoundland and Labrador, formula-feeding has been considered the 'cultural norm' (49). Social, economic, and cultural factors may influence this trend in provincial breastfeeding culture, as Atlantic provinces also have larger proportions of adults over 65 years (67), lower educational attainment (68), are

less ethnically diverse (69), less urban (70), have less access to healthcare specialists (71), and lower median incomes (72).

2.4.2 Breastfeeding support in Canada

In an attempt to increase rates of breastfeeding, the Canadian government has implemented several programs, laws, and regulations to support new mothers. The Canadian Human Rights Commission requires employers to provide pregnant and lactating employees with accommodations to suit their needs, for example, a safe and clean place to breastfeed or express and store milk; longer or extra breaks to breastfeed or express milk; alternative work arrangements such as lighter work; or extended maternity leave (73). As part of the 2006-7 national Maternity Experiences Survey, interviews with new Canadian mothers (n=6,421) found that 20% of mothers introduced some other food or liquid in the first one or two weeks, and just over half of mothers reported still feeding some breastmilk at 6 months, despite 92% of mothers reporting that they had enough information about breastfeeding before birth (51). Many (81%) also reported that their health care providers offered to assist them in breastfeeding and gave them (86%) information on supports they could seek in the community. However, in Nova Scotia, focus groups with members of provincial and district level breastfeeding committees described a general unsupportive culture of breastfeeding, with others placing little value on breastfeeding promotion, and reporting issues with engaging physicians in dialogue around breastfeeding (66).

2.5 *Cambodian context*

Cambodia is a country with a total population of about 16.7 million, located in Southeast Asia, bordered by Thailand, Laos, and Vietnam (6,74). It is a largely agricultural country with over 80% of the population living in rural areas, and remains one of the least economically developed countries in Asia (6). With nearly 20% of people living below the poverty line in 2011, and despite an increase in GDP per capita in 2014, estimated to be USD\$1543 in 2020, Cambodia is classified as a LMIC by the World Bank (6,75,76).

2.5.1 Breastfeeding rates in Cambodia

On trend with global patterns, the 2014 Cambodian Demographic and Health Survey reports that 96% of the infants born in the two years prior had been breastfed at some point in time, with 63% being breastfed within one hour of birth, and 65% of infants exclusively

breastfed until 6 months of age (6,77). Similarly, with a mean breastfeeding duration of 19 months, Cambodia comes close to meeting WHO recommendations for continued breastfeeding (77). In rural Cambodia, rates are even more promising, with children not only more likely to ever be breastfed as compared to urban-dwelling children (97% versus 92%), they are also typically fed human milk for a longer duration (19 months versus 14 months) (6). Though these rates are high, there remain gaps in infant feeding practices, notably the exclusivity of breastfeeding, as 78% of infants less than 6 months of age are predominantly, rather than exclusively, breastfed, meaning that other liquids or foods are fed as well (6).

2.5.2 Breastfeeding support in Cambodia

Women who are employed in Cambodia are entitled to a parental benefit equivalent to 50% of their income for 90 days postpartum, with light work for two months following this leave (78). Employers are also required to supply nursing rooms and daycare centres and provide a one-hour breastfeeding break daily. However, it is not uncommon for employers not to pay maternity leave benefits, and the vast majority do not have functioning daycare centres (78).

As noted above, a supportive breastfeeding culture is essential to breastfeeding outcomes. Wren & Chambers conducted interviews with 141 mothers in Krong Kep province in 2011 to better understand knowledge, attitudes, and practices around breastfeeding (79). They found that while 94% of mothers knew to breastfeed for 6 months, only 71% actually followed this recommendation, most frequently because of maternal challenges including perceived low milk supply, sore nipples, or time constraints (79). Three quarters of participants (75%) reported not being shy to breastfeed in public, and 64% of women were confident in their breastfeeding skills and knowledge, despite 25% receiving no antenatal care (79). Similarly, in Takeo province, 27 caregivers and health providers reported knowing infant feeding recommendations, but lacking knowledge on topics like latch, positioning, frequency, duration of feeding, and how to tell if a baby is receiving enough milk (80). Among caregivers, positive behaviours emerged, despite a lack of support and advice regarding feeding, with one mother reporting that the number of times she breastfed depended on the baby, and other mothers recognizing signs that their baby was full, such as falling asleep or not crying (80).

2.5.3 Summary of breastfeeding and culture

Unquestionably, the individual characteristics of new mothers paired with supports available to her and the breastfeeding culture she is experiencing can impact her decision to

initiate breastfeeding, as well as breastfeeding exclusivity and duration both in LMIC and HIC. In LMIC such as Cambodia, women are less educated, have less workplace breastfeeding support, and their access to postnatal and lactation support could be minimal outside urban centers (6). Despite this, breastfeeding is a cultural norm, and women are confident in their breastfeeding skills and knowledge, potentially explaining the much higher rates of breastfeeding indicators, as compared to HIC, such as Canada. There, the breastfeeding culture differs immensely, and despite comparatively high levels of education, more accessible healthcare, and established breastfeeding policies and support programs, rates of breastfeeding indicators remain suboptimal.

2.6 Parenting style

The parenting style of a caregiver describes the general interactions that occur between a caregiver and child (81). The way a caregiver and child interact is crucial in forming behavioural patterns, influencing both cognitive and social development, and ultimately impacting health (82,83). Three parenting styles, authoritative, authoritarian, and permissive, were first described in 1966 by Baumrind (84). In 1983, Maccoby and Martin expanded upon this work, re-defining the ‘permissive’ style as ‘indulgent’ parenting, and adding a fourth parenting style called the ‘uninvolved’ or ‘neglectful’ parenting style (84,85). Each parenting style is associated with one of four different combinations of two dimensions, sometimes referred to as control and warmth, but also known as demandingness and responsiveness (84,85). This is illustrated in **Figure 2-1**.

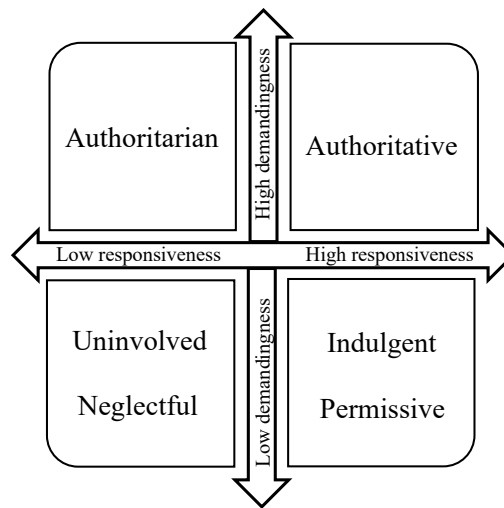


Figure 2-1: Parenting styles as described on dimensions of responsiveness and demandingness according to Baumrind (1966) and Maccoby & Martin (1983).

2.6.1 Characteristics of parenting styles

Demandingness is characterized by setting and enforcing boundaries and behavioural control, while responsiveness is demonstrated through nurturance and warmth (81). Indulgent caregivers do not exert control over their children or require responsibility, while authoritarian caregivers encourage responsibility and conformity, but lack in warmth (84). Uninvolved caregivers lack in both dimensions, in contrast to authoritative caregivers, who are both demanding and responsive, and encourage more resilient and self-controlled children. Authoritative parenting is the optimal approach; caregivers maintain firm control where themselves and their child are in disagreement, set standards for conduct, and appreciate disciplined conformity; but are responsive in that they also value the child's autonomy, recognize their child's own interests and affirm their qualities (84). This style of parenting has been shown to have positive impacts on a child's later social responsibility, adolescent psychosocial maturity, academic success (86), and other aspects of cognitive (87) and social development (88).

2.6.2 Cross-cultural research on parenting styles

Research on parenting styles may be inconsistent, however, due to lack of generalizability of styles across different populations. Even Baumrind, who first described the parenting styles in 1991, admitted that the parenting style framework is difficult to translate across cultures, even to different local cultural groups (88,89). In fact, in contrast to the

aforementioned benefits of authoritative parenting on academic success among middle-class Caucasian children, other studies have failed to find an impact on academic success in Asian-American and African-American youth (90–92). This has warranted recommendations from cross-cultural researchers to instead dismantle parenting styles into their component dimensions when studying parenting in different populations (93,94). The two dimensions, responsiveness and demandingness, have individually been shown to have similar outcomes across different cultures, demonstrating cross-cultural relevance and application (95,96). This allows for greater generalizability and provides more specificity in determining which component of parenting typologies are related to which child outcomes (93,97). In the case of developing favourable health behaviours, high responsiveness has also been shown to be an important quality of parenting for optimizing children's later health (82).

2.7 Responsive parenting

Responsiveness, one of the most important aspects of optimal parenting behaviour, is involved in many theories of parenting and research frameworks (98,99). It involves a reciprocal relationship between caregiver and child in which the caregiver offers nurturing acceptance of the child's individual needs and interests, fostering both healthy communication and attachment, and enabling the child to develop the skills needed to cope with new situations and stressors (83,98). The interactions that occur between a child and a responsive caregiver happen in three steps:

- 1) the child sends the caregiver a signal using movement or vocalizations and the caregiver observes the signal,
- 2) the caregiver accurately interprets the child's signal, for example realizing that an infant's cry communicates being tired, and
- 3) the caregiver quickly responds in a way that is contingent, and developmentally appropriate (83).

A responsive caregiver must not only recognize and respond to a child's signal quickly, but their responses should also show a change from previous behaviour to indicate that the response is contingent on the child's signal (83). Responses should also change as the child grows in order to remain suitable for the child's age and level of development (8,83).

When responded to in a responsive way, an infant will experience their needs being met in a predictable and consistent manner, encouraging the child to cooperate with caregiver's requests and continue signalling in a way that is more meaningful and recognizable (98). This is shown by infants who experience prompt caregiver responses that match their cues (e.g. responding with surprise when the child looks surprised), who become more attentive to their caregivers, and learn to maintain those cues (8). This reciprocity, directed and initiated by the child, provides a scaffold to guide a child's behaviours and social interactions until they are able to be more active in the exchange, building on their level of responsibility until they are able to regulate their own behaviours (98,99).

2.7.1 Impacts of responsive parenting

Responsiveness can have positive effects on a child's cognitive performance, months and even years later (83). In fact, in 1989 Bornstein and Tamis-LeMonda reported on three longitudinal studies (one they had completed in Japan and two others in the United States) of maternal responsiveness showing improved language comprehension at 13 months, and predicting faster problem solving and higher intelligence scores at four years old (83). This was true in both countries, demonstrating benefits of responsiveness that persist cross-culturally. In addition, responsiveness in early life has also predicted higher scores on cognitive competency tests at both 1.5 and 2.5 years old in Japan. Later, in 2006, a systematic review examined 50 studies on responsive parenting, finding that in HIC, parental responsiveness contributed to language acquisition (100), school performance (101), social competence (102), and IQ (103), as well as higher self-esteem and fewer behavioural problems (104), with some effects lasting until up to 12 years old (99).

2.7.2 Cultural influence on responsive parenting

Most research on caregiver responsiveness has been conducted in HIC, but there is some evidence of variability by culture, including cultural beliefs and perceptions about caregiving and about the child's needs and abilities at different stages (8,105). For example, in cultures where infant verbal cues are valued, caregiver responses are deemed more warranted than in other cultures where these vocalizations are less valued (105,106). Likewise, developmental expectations of children differ by culture; for example in Bangladesh, caregivers do not expect their children to eat independently until 2 years old, in contrast to the self-feeding that begins around 6 months of age in Western cultures, such as in Canada (107–109). Responsiveness

appears to cross cultural lines, however, representing an important facilitator of normal child development regardless of culture (8,99). Results from three studies in LMIC, Ethiopia, India, and Chile, reaffirm the role of responsive parenting on language acquisition and greater behavioural development (110–112). While each operationalized and defined ‘responsiveness’ in different ways (e.g. “maternal sensitivity”) the results support the cross-cultural reach of responsive parenting, warranting further exploration into cross-cultural similarities and differences in responsiveness (81).

2.7.3 Responsive parenting and health

Responsive parenting has been associated with better health-related behaviours, such as fruit and vegetable consumption, and has an established relationship with child overweight and obesity (82,113–115). Conversely, less responsive parenting styles (authoritarian or uninvolved parenting) have been associated with higher child body mass index (BMI), more sedentary leisure time activities, higher nicotine and/or alcohol consumption, and higher home availability of sweet drinks and candy (114). Interestingly, indulgent parenting, which also involves high levels of responsiveness, is associated with mixed health outcomes that differ from authoritative parenting likely due to the contrasting lower levels of caregiver demandingness (116). These behaviours include adverse behaviours such as self-serving larger portion sizes, excessive consumption of foods high in calories, and higher child BMI, but also positive behaviours including increased fruit and vegetable intake and increased physical activity (113,114).

The disagreement in health outcomes associated with parenting styles indicates the complexity of factors that influence child health, diet, and the feeding environment. This suggests that parenting style, and therefore responsive parenting, does not directly influence health behaviours. Rather, it has been suggested that parenting style mediates and influences the feeding style and feeding practices employed by caregivers, which then shape the later health of the child (82).

2.8 Feeding styles

Although caregiver feeding styles have historically been inferred from parenting styles, the terms are not synonymous (114). However, responsive caregivers are likely to also practice responsiveness while feeding their child, as levels of responsiveness are thought to be influenced by the amount of control caregivers want over their child, including their eating behaviours

(94,117). The interdisciplinary nature of infant feeding, from the food eaten to the practices used by caregivers to feed their children, have led to two different sets of feeding style paradigms. In 2005, Hughes *et al.* established four feeding styles based on parenting styles using similar dimensions of responsiveness and demandingness, as shown in **Figure 2-2** (117).

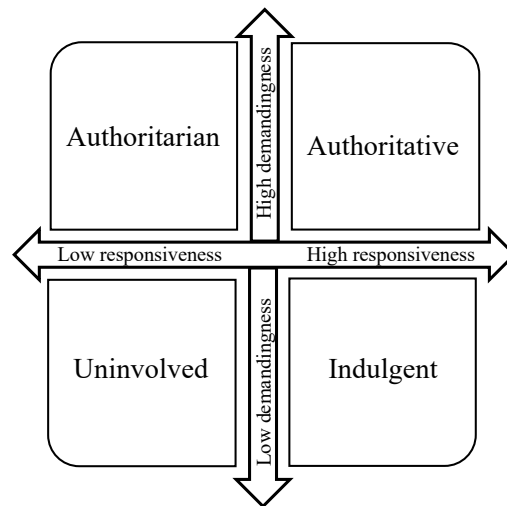


Figure 2-2: Feeding styles described on dimensions of responsiveness and demandingness, according to Hughes *et al* (120).

However, in the field of nutrition, feeding styles had been previously described by Birch & Fisher in 1995, and were further refined by Bentley *et al.* in 1999 (9,118). Through their work examining infant feeding behaviour and parental feeding practices, three feeding styles were established; 1) controlling, 2) laissez-faire, and 3) responsive. According to these definitions, caregivers with a controlling feeding style remain in control over the feed by restricting or pressuring a child to eat (similar to authoritarian caregivers), laissez-faire caregivers relinquish control of the feed entirely to the child, allowing them to eat unrestricted and offering little support (similar to indulgent and uninvolved caregivers) (80,82). While this disagreement in language and theoretical models across academic disciplines complicates the literature somewhat, the concepts of responsive feeding and responsive feeding practices remain constant. Just as responsive parenting involves an exchange between caregiver and child in both models, responsive feeding requires reciprocity and shared control; a caregiver must recognize cues from a child specifically in the context of eating, and respond to them appropriately, contingently, and in a timely manner (8,119).

2.9 Responsive feeding

Responsive feeding is based on a shared balance of control over a feeding session, and the ability of caregivers to modify their level of control and involvement in accordance with rising levels of self-control and self-feeding in the child with age (9). In order to explore responsive feeding during one of the most critical periods of development, this thesis particularly centers the feeding of infants less than 6 months old, who have not yet been introduced to solid food. In infancy, a child's responsibility during responsive feeding is to provide clear and recognizable cues, while the caregiver is to be attentive to their cues and respond to them accordingly, providing dyadic caregiver-infant interaction (8). The feeding session should occur in a predictable, stimulating, and safe environment. In contrast, non-responsive feeding involves paying more attention to other things in the environment while feeding, or relying on external cues (e.g. how much milk is left in a bottle, time of day) to dictate when the feed begins and ends. This also includes responding indiscriminately to children's cues (e.g. providing the breast every time an infant cries), or being uninvolved in the feeding by not paying attention to the child or their cues (8). These methods of feeding can increase the child's risk of higher BMI (120), or result in intense or inappropriate methods of gaining their caregiver's attention such as refusing to eat (121). Non-responsive feeding can later result in children who eat in the absence of hunger (122), or who similarly rely on external rather than internal cues to tell when to start and stop eating (123). Unsurprisingly, responsive feeding is associated with healthier growth trajectories (124,125) and better hunger and satiety responsiveness later in life (107).

2.9.1 Self-regulation

The ability to regulate behaviours and function independently is referred to as self-regulation (126). Infants are able to regulate their own energy intake by 6 weeks postnatal, and in fact, they will alter intake volume to suit their caloric needs (127,128). Even before the development of language, infants are able to signal to the caregiver that they are hungry, full, or have other needs, by using facial expressions, vocalizations, or motor actions (8). When their needs are met in response to these signals, such as being fed when they show hunger cues, the behaviour is reinforced by teaching the child that their signal is effective in accomplishing what they need (126). This was shown by Moore *et al.*, who observed feeding interactions in Bangladesh (108), and found that children (8-24 months) of responsive caregivers were able to

more clearly indicate when they were hungry and thirsty, likely because of reinforcement of these behaviours by caregivers (107,108). This can contribute to the development of self-feeding, and later, the ability to recognize and use their internal cues to dictate eating patterns (8). Early research on preschool children has shown that teaching children to rely on internal hunger and satiety cues results in greater ability to regulate energy density and meal size, in contrast to children who were taught to rely on external cues such as rewards for eating and encouragement to clean their plate (129). This was also true in infants; in 2014 Li *et al.* reported that infants who had been encouraged to finish their bottle for the first six months of life were more likely to clear their plates at six years of age (adjusted OR: 2.01, 95% CI: 1.05-3.83) (123). This demonstrates a learned inability to regulate intake as a result of non-responsive feeding practices, which could last into childhood or later.

2.9.2 Responsive infant feeding

One of the many benefits of breastfeeding is the inability of mothers to monitor their infant's intake, which may aid in learning to trust the infant's hunger and satiety cues (130). When feeding from the breast in comparison to feeding from a bottle, a caregiver is not only better able to respond to hunger cues quickly, but is also less able to monitor and manipulate the feed, as there are less available external cues to rely on (10). Due to the lack of external cues, breastfeeding caregivers are more likely to feed according to their child rather than to a schedule (131), and are more sensitive to the infant's cues, becoming more responsive the longer they breastfeed (130).

Infants who are fed responsively are less likely to consume milk in excess of their needs, resulting in a slower and/or more consistent rate of growth. This was demonstrated in a 2015 pilot study (n=25) which reported that infant's intake from opaque weighted bottles (105.5 ± 9.5 mL) was significantly less as compared to traditional bottles (131.8 ± 10.1 mL; $p < 0.01$) for caregivers who did not typically feed responsively (132). Similarly, when researchers ensured bottle-fed infants were fed according to their cues in a 2017 within-subject study, they consumed 42% less milk ($p = 0.03$) than when they were fed by their caregiver as normal (133). The impact this has on growth was reported by Worobey *et al.* in 2009, who found that lower levels of maternal sensitivity to infant satiety cues at 6 months predicted greater weight gain from 6 to 12 months ($\beta = -0.121$, SE (standard error) = 0.037; $p = 0.002$) among 96 low-income, formula-

feeding dyads. However, the same measures were examined at 3 months for growth from 3-6 months and no significant relationship was present (134).

2.9.3 Rapid growth

Rapid weight gain in infancy has been defined as a change in growth between birth and assessment that results in crossing centile lines on a growth chart (131). The relationship between responsive feeding and infant growth patterns is important because rapid or excess growth during infancy has been shown to predict risk of negative childhood health outcomes including overweight, obesity (135) and measures of body composition (136). Skilton *et al.* (2013) also reported negative cardiovascular outcomes including higher systolic blood pressure (1.24mmHg; 95% CI: 0.59-1.88), and greater arterial wall thickness (0.012mm; 95% CI: 0.004-0.019) per kilogram of excess weight gained at 8 years old, in a cohort of 395 children (11). Some risks have even been shown to last into adulthood, such as obesity (137) and non-alcoholic fatty liver disease (141). Conclusively, over-nutrition leading to rapid or excessive growth during infancy is associated with health risks that last into childhood and beyond and may be avoided by feeding responsively.

2.9.4 Responsive feeding and growth in LMIC

The vast majority of the literature on responsive feeding is based on research undertaken in HIC, with little taking place in LMIC where growth faltering or stunting is more common. Here, in contrast to HIC, maternal responsiveness has been linked to under- rather than over-nutrition (99). In comparison to well-nourished children, lower levels of maternal responsiveness were observed among undernourished children in Chile in 1982 (n=40, 5-11 months old) (139), and in West Bengal, India in 1976 (n=62 boys, 7-18 months old), where mothers of the most undernourished boys were the least responsive (140). Similarly, in Bangladesh, a responsive feeding intervention among 12- to 24-month-old children led to greater weight ($d=0.28$, $p=0.0021$), weight gain ($d=0.48$, $p=0.002$), and child self-feeding ($d=0.30$, $p=0.03$). Informal observations in Sri Lanka in 2014 revealed that this may be because caregivers commonly had issues making the child eat, leading to controlling and indulgent feeding patterns (141). However, further evidence in LMIC is needed, especially among infants less than six months old, before the complementary feeding period.

2.10 The feeding environment

An important aspect of any responsive feeding interaction involves setting a child up for success by proactively preparing the context in which the feeding takes place (8). The child should be supervised and safe, in a comfortable and developmentally appropriate seat or position, with few distractions, facing others, such as their caregiver, who should model ideal mealtime behaviour (106,119,142). The feeding environment should also be conducive to responsive feeding, where the caregiver is able to attend to the baby. Environmental factors that are of particular importance to this thesis include division of attention and maternal comfort.

2.10.1 Division of attention

Distractions, both technological and non-technological, while feeding can impede a caregiver's ability to recognize an infant's hunger and satiety cues, and therefore impair level of responsiveness. With regards to technological distractions, the use of cell phones, television, and other digital media is increasingly common amongst both caregivers and children in HIC during mealtimes (143). In a 2017 study of maternal self-reported distractions during breast- and bottle-feeding, technological distractions were reported during 26% of feeding sessions (n=2,982) and 83% of the 75 participating mothers reported a technological distraction during more than one feed (144). Non-technological distractions were reported during 17% of feeds, the most frequently reported being talking on the phone or to another adult, and sleeping.

Maternal distraction while feeding impacts the quality of the feeding interaction and has been associated with less sensitivity to their infant's cues (145) and less engagement in cognitive growth fostering (146). Though most studies in this area have small sample sizes, and all take place in HIC, they are indicative of a relationship between maternal distraction and negative infant outcomes (145,146).

2.11 Measuring responsive feeding

Measuring responsiveness while feeding requires analysis of caregiver feeding practices, which can be done either by the caregiver, through self-assessment tools, or by someone observing a feeding session using an observational tool. While self-assessment tools are open to caregiver subjectivity, linguistic skills, and social desirability bias, they are quick, simple, and inexpensive, making them useful in many circumstances (147).

2.11.1 Self-assessment tools

There are numerous self-assessment tools available to analyze caregiver feeding practices related to responsiveness, often including measures of pressure and control, how caregivers respond to cues, and the promotion of autonomy (148). Typical items include: “who decides how much food your child eats – you or your child?” and “when your child refuses food they usually eat, do you insist your child eats it?”(149). A recent systematic review of instruments assessing responsive feeding from birth to 5 years found 33 different instruments which had been recently developed or tested. Of particular importance for this thesis, only five instruments were designed for use in children less than one year old, and none encompassed responsive feeding as a whole, rather, they measured specific facets of responsive or non-responsive feeding, such as the Baby’s Basic Needs Questionnaire which only measures emotional feeding (150). Authors of the systematic review concluded that the Feeding Practices and Structure Questionnaire (FPSQ) (149) was the most rigorously tested instrument, but still lacked in criterion validity and internal reliability. Similarly, most tools had only been used in white, high-income populations, and lacked evidence of validity and reliability, resulting in recommendations for more comprehensive tools and further testing in diverse populations (148).

2.11.2 Observational tools

Observational tools, on the other hand, are less subjective to biases, and enable researchers to assess behaviours that occur without awareness (151). These can be used while observing a live or video-recorded feeding interaction, in a caregiver’s home or in a clinical setting, and may require training and/or a purchased or published manual for use (151). A 2015 systematic review of observation tools for measuring responsiveness identified eight tools that were designed to analyze infants from birth in a feeding context, however, only the Nursing Child Assessment Satellite Training (NCAST) Nursing Child Assessment Feeding Scale (NCAFS) was suitable for use in this thesis. The NCAFS was the only tool of eight, that 1) could be used for research purposes, 2) could be used to analyze video-recorded, in-home feeding sessions; and 3) was not restricted to practitioners only (151).

2.12 *The Nursing Child Assessment Feeding Scale*

The NCAFS includes several concepts related to responsiveness including contingency, positioning, verbalness, sensitivity, affect, and engagement/disengagement (152,153). With

regards to the feeding context, positioning is measured to ensure the caregiver provides safety, verbalness measures caregiver and infant verbalizations, both positive and negative, and affect is measured using both caregiver and child facial expressions. Infant engagement or disengagement items are specifically designed to identify when the infant wants to begin, end, or change the feeding situation. The caregiver's responses to these cues are recorded using contingency and sensitivity items, which measures whether they are timely (within 5 seconds) and appropriate, respectively. Some items on this scale include: "caregiver only offers food when the child is attending" and "caregiver terminates the feeding when the child shows satiation cues or after other methods have proven unsuccessful" (153).

2.12.1 NCAFS validity and reliability

The NCAFS is validated for use in the first year of life and has been used in ethnically diverse low- and high-risk populations and settings. In the United States, the scale has been used to measure responsiveness among Latina mothers (154), African American mothers (155), and a sample of low-income women, most of which had emigrated from South America (134). It has also been used in an Indigenous-Canadian population (156) and in mothers living in Prince Edward Island (157). The scale has also been used to assess the mother-infant interaction in LMIC through assessments in Bangladesh (152,158). The stability of NCAFS scores over time and across different ways of gathering data has been demonstrated through the establishment of internal consistency reliability (Cronbach's alpha overall: 0.86) (159), as well as test-retest reliability, both short-term (3 days, overall Pearson's $r=0.68$) (160), and long-term (6 months, Pearson's $r=0.23$ to 0.57 across subscales) (161). Likewise, the validity of the NCAFS has been demonstrated in several studies, proving its ability to measure what is intended by showing agreement or disagreement with other theoretically linked measures, such as the Bayley Mental Development Index (153,162). The NCAFS is also one of the few tools with proven content validity, as experts had reviewed the scale items during development (153). Based on its efficacy for capturing a naturalistic interaction, its use among varied populations and settings, and its well-established reliability and validity, the NCAFS has been referred to as the gold standard for quantifying the quality of caregiver-infant interactions (163).

2.13 Research gap and potential significance

Despite breastfeeding being the optimal source of nutrition for infants, rates of exclusive and continued breastfeeding differ greatly between LMIC and HIC. There are numerous determinants of breastfeeding, but culture is a key determinant due to its influence on societal supports, breastfeeding norms, and feeding practices. Responsiveness is key to setting infants up for optimal health outcomes, potentially fostering eating patterns that align with internal hunger and satiety. This could prevent rapid or excessive growth in infancy, as well as the associated negative health implications. While we have ample data describing differing breastfeeding rates between LMIC and HIC, there is little research on the responsiveness of breastfeeding practices cross-culturally, despite potentially being a similarly powerful influence on the growth and development of infants. As such, this exploratory research aims to assess the level of responsiveness while breastfeeding among dyads in Canada and Cambodia in order to address this gap. Data reporting levels of responsiveness among mother-infant dyads in both an LMIC and HIC will provide novel information on how breastfeeding practices differ and could inform intervention or educational programs to optimize responsiveness.

3.0 Methods

3.1 Research objective

The objective of this research was to explore feeding responsiveness, and describe the feeding environment, among predominantly breastfeeding mother-infant dyads <6 months in Kampong Thom, Cambodia and Halifax, Canada. Due to the exploratory nature of this study, there were no *a priori* assumptions or hypotheses. Instead, the results of this study provide novel contributions to this field for future hypothesis-driven research.

3.2 Study Setting

3.2.1 Halifax Regional Municipality

Nova Scotia is a Canadian province located on the east coast, nearest the Atlantic Ocean. The capital city of Nova Scotia, Halifax, along with the towns of Bedford, Dartmouth, and the former Halifax County are collectively referred to as the Halifax Regional Municipality (HRM) (164). The HRM is an urban center with a population of approximately 418,000, making it the 14th largest city in Canada (164,165). The province overall has one of the lowest breastfeeding rates in Canada, with only 22% of infants exclusively breastfed for 6 months in 2018, as compared to 33% nationally (7). Nova Scotia, and particularly the HRM, is the chosen setting for this study in part due to close proximity to an existing cohort of suitable participants (*see section 3.4.1*), but also because of the urban, large, and diverse population, within a province with very low breastfeeding rates.

3.2.2 Kampong Thom province

Kampong Thom is a centrally located rural province in Cambodia with a population of approximately 650,000 (6). In Kampong Thom, 74% of mothers deliver in a health facility, but 91% experience challenges accessing health care (6). While breastfeeding rates are already high across Cambodia, rural Cambodian infants are typically breastfed for longer (19 months versus 14 months in urban Phnom Penh), and Kampong Thom in particular has the highest rate of breastfeeding initiation within one hour of birth (85%). Kampong Thom province was also selected due to close proximity to an existing cohort of suitable participants (*see section 3.4.1*), as well because of the high breastfeeding rates. Also, Kampong Thom province provided a rural setting, in contrast to the urban center setting of HRM, Nova Scotia.

3.3 Study design

This study is a cross-sectional, observational, multi-country study, accompanying and capitalizing on two existing study cohorts of mother-infant dyads <6 months. Video-recorded breastfeeding sessions were analyzed using the *Nursing Child Assessment Satellite Training* (NCAST) *Nursing Child Assessment Feeding Scale* (NCAFS) (166) to assess feeding responsiveness. Data collection occurred in both the HRM in Nova Scotia, Canada, and in Kampong Thom province in Cambodia. Written, informed consent was gathered by a trained research assistant in participant's homes.

3.4 Participants

3.4.1 Sampling methods

In total, 110 mother-infant dyads ($n=55$ in Cambodia, $n=55$ in Canada) with infants aged <6 months were recruited for this study. Data from the Cambodian mother-infant dyads were collected between April and August of 2019, and in Canada data collection began in March of 2020 and ran until sample size was achieved in December of 2021. Upon recruitment, Canadian dyads were matched to Cambodian dyads based on infant age (± 14 days) and sex, because Cambodian data collection had already been completed. Recruitment for this study took advantage of two existing study cohorts:

- 1) In Cambodia: A double blind, four-parallel arm, placebo-controlled randomized trial of thiamine (vitamin B1) supplementation and salt disappearance, taking place in Kampong Thom Province. This cohort included $N=335$ infants between 2 and 24 weeks of age (167).
- 2) In Canada: In part, participants will be recruited from a longitudinal study designed to examine infant growth in relation to responsiveness while feeding human milk both directly from the breast, and from a bottle, taking place in the HRM, Nova Scotia. This cohort included $N=129$ infants between 2 and 6 months of age.

Additionally, in HRM, Canada, participants were recruited specifically for this cross-cultural study. Convenience sampling was employed via a study recruitment poster (Appendix A) posted on the Milk and Micronutrient Assessment (MAMA) lab website, and various social media platforms; specifically, on infant and infant feeding related pages (e.g. Breastfeeding Community of Practice, Halifax Mom Collective). The poster prompted interested mothers to contact researchers via email, text message, or phone. Mothers were screened for eligibility (*see section 3.4.2*), and those who were eligible were invited to partake in a video-recorded feeding session in their home.

3.4.2 Sample size

Due to the exploratory nature of this study, the minimal significant effect size of differences in NCAFS scores has not been established in this setting. Therefore, sample size was decided based on previous studies using the NCAFS. A similarly designed comparison pilot study using the NCAFS which was completed in the HRM included a within-subject sample of 10 (20 videos) and found significant differences in sub-scale scores (168). Likewise, other studies comparing responsiveness between groups of mother-infant dyads using the NCAFS have included: in Bangladesh, 55, 58, and 67 participants per group, comparing responsiveness across three micronutrient supplement groups (152), in the United States, 46 and 29 participants per group, comparing mother enrolled or not in a supplemental income program (169), and in Nova Scotia, 26 and 51 participants per group, comparing dyads who had experienced skin-to-skin contact or not (170). Based on these, and the typical sample size of similar studies, a sample size of 50 participants per group (N=100) was chosen. An additional five participants were included in each setting to offset unusable data, however, no participants in either group were excluded.

3.4.3 Eligibility criteria

Mother-infant dyads were eligible to participate if:

- mothers were 19-45 years old,
- dyads resided in an eligible data collection area (Kampong Thom, Cambodia, or HRM, Nova Scotia, Canada),
- mothers had a normal most recent pregnancy (i.e. no known chronic conditions, no preeclampsia, gestational diabetes, etc),
- the infant was a healthy, singleton baby who was born without complications (i.e. no tongue tie, cleft palate),

- at time of data collection, the infant was <6 months of age and was predominantly breastfed (i.e. a maximum of one feeding of human milk substitute per week),
- mothers provided informed consent for video-recording a breastfeeding session.

Mother-infant dyads were ineligible to participate if:

- the baby was born preterm (earlier than 37 weeks gestation),
- the baby was born outside the healthy weight range of 2,500 – 4,000 g (5lb 8oz – 8lb,13oz)

This study sample was not limited to exclusively breastfeeding mothers due to low rates of exclusive breastfeeding until 6 months in Nova Scotia (22%) (7) which could negatively impact recruitment. Though data does not exist on provincial rates of predominant breastfeeding, by including mothers who are not classified as exclusively breastfeeding (e.g. mothers who have given their child a taste of baby cereal or occasionally feed human milk substitute), the pool of eligible participants was expected to be considerably larger when targeting predominant breastfeeding.

3.5 Data collection

Data collection took place in participant's homes in a place where they typically breastfed ($\geq 50\%$ of the time). The appointment took place at a time when the mother expected the infant to be hungry, however, mothers were instructed not to interfere with the infant's signs of hunger to accommodate the appointment. The study procedures were explained to mothers, who then read (or were read) and signed the study consent form (Appendix B and C) to provide informed consent for both her and her baby. The questionnaire (Appendix D) was administered before or after video recording, depending on the infant's hunger. The researcher set up three video-cameras on tripods to record the feeding session. The participant was asked to feed as normal, and to verbally indicate when the feeding session is finished. The cameras were set to record, and the researcher left the area where feeding was taking place for the entirety of the recording to ensure that the naturalistic setting was not impacted by observation. A study visit was expected to take 30-60 minutes, depending on the length of the feeding session. Upon completion of the study visit, women were provided with a modest, study-appropriate remuneration of a gift valued at USD\$3 in Cambodia (sarong + laundry soap), or CAD\$15 remuneration in Canada, even if they did not complete the study visit (e.g. unable to feed, or withdraw consent).

3.6 Research tools

3.6.1 Questionnaire

The questionnaire (Appendix D), consisted of three modules and took approximately ten minutes to complete. The first section of the questionnaire collected sociodemographic data including caregiver date of birth, marital status, self-reported race or cultural group of both caregiver and infant, completed education level, and household income. This information was used to describe both the Cambodian and Canadian sample of participants and allowed analysis of levels of responsiveness by sociodemographic characteristics. The second section included questions about antenatal care and delivery to gather information on factors that could impact breastfeeding behaviours and outcomes, such as caregiver parity (171), infant's age (172), and sex (173). Section three identified the primary caregiver and asked questions about breastfeeding (174). Due to common confusion about the definition of 'exclusive' breastfeeding (175), two of these questions ("What food has your baby ever eaten?", and "Which foods did your infant consume in the last week?") were 'check all that apply' form questions with choices ranging from breastmilk to solid foods, and an open text box for 'other'.

3.6.2 The Perceived Stress Scale

Part of the Canadian data collection took place during the COVID-19 pandemic, and as such, a measure of maternal stress was collected from these participants (n=44 of 55 Canadian mothers). While maternal stress may impact the quality of the mother-infant interaction, the act of breastfeeding may also relieve stress (176,177). To measure maternal self-perceived life stress, the Perceived Stress Scale (PSS) was used. It is a short and widely used questionnaire developed in 1983 and measures the degree to which their life has felt unpredictable, uncontrollable, and overloaded in the past thirty days (178). The PSS-10, which contains ten questions, was chosen over two other versions containing 4 and 14 questions due to greater evidence of validity and reliability (179,180). Items on the scale are answered on 5-point Likert scales from 0 = never to 4 = very often. Four of the items in the PSS-10 are positively stated and were reverse coded (0=4, 1=3, 2=2, 3=1, 4=0). Scores were then be totalled and participants were categorized as low stress (0-13), moderate stress (14-26), high stress (27-40) (180). The PSS has been previously used in samples of Turkish breastfeeding mothers (181) and in the United States in both breast- and bottle-feeding mothers (182). Given that the PSS was included

to assess the level of perceived stress experienced by mothers during the COVID-19 pandemic, the PSS was only included in the Canadian questionnaire and no measure of self-perceived stress was measured among Cambodian participants.

3.6.3 Nursing Child Assessment Feeding Scale

The feeding scale created by NCAST, the NCAFS, is a validated assessment tool for feeding interactions during the first year of life (153). It is a 76-point dichotomous (yes/no) checklist including 6 subscales used to code behaviours, of both the caregiver and infant, that occur during a feeding session. Subscales include:

Caregiver:

- 1) Sensitivity to Cues (*maximum score: 16*),
- 2) Response to Child's Distress (*maximum score: 11*),
- 3) Social-Emotional Growth Fostering (*maximum score: 14*),
- 4) Cognitive Growth Fostering (*maximum score: 9*),

Infant:

- 5) Clarity of Cues (*maximum score: 15*), and
- 6) Responsiveness to Caregiver (*maximum score: 11*).

The checklist is used to calculate a score for each subscale, an overall score for the caregiver and infant individually, and an overall score for the dyad. The checklist also includes several “contingency items” which are important reciprocal behaviours (e.g. “child vocalizes or smiles within five seconds of caregiver’s verbalizations”; item 70), and a box to indicate which, if any, potent disengagement cues the child demonstrated during the feeding session (153). To use the NCAFS scale to analyze videos, the researcher underwent a three-day intensive NCAST Parent Child Interaction Feeding Scale training, and scored videos with a minimum reliability of 85% (Appendix E). Videos were viewed a minimum of three times for accurate analysis (153). Three videos of the feeding session from different angles were opened at once on a large computer screen using VLC Media player (v.3.0.11.1 for Mac OS X) and watched through entirely before scoring. Scoring was completed using the NCAFS scorecard (153).

3.6.4 Video collection

Three small, lightweight video cameras (GoPro Hero5, GoPro; California, USA) on tripods were set up to video-record the feeding session in the place where breastfeeding takes

place >50% of the time in the home (e.g. nursery, living space). As displayed pictorially from a bird's eye view in **Figure 3-1**, one camera was trained on the infant (yellow field of view), one was trained on the mother (red), and a third recorded both mother and infant directly in front and 10-12 feet away (blue) (183).

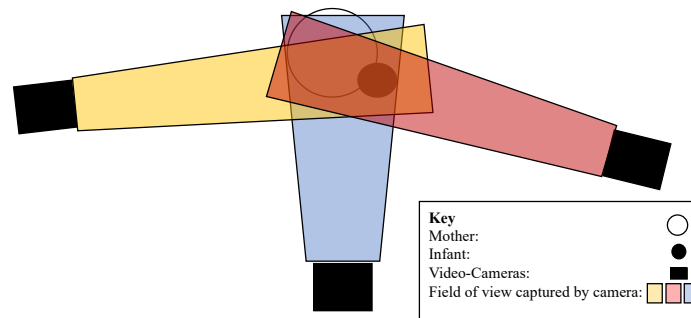


Figure 3-1: *GoPro camera setup for video-recording of mother-infant dyad during a breastfeeding session.*

Three video cameras were used, rather than the two suggested in the NCAST Caregiver/Parent-Child Interaction Feeding Manual (153) in order to capture minute details for the most accurate analysis, including eye contact between mother and infant, facial expressions, and noises. The mother was given a sign, or used a ‘thumbs up’ signal, (Appendix F) to indicate the beginning and end of the feeding session to the camera to ensure analysis only included the feeding session and not extraneous recording. From outside the feeding space, the researcher used a remote (GoPro Smart Remote, GoPro, California, USA) to begin recording simultaneously on all three cameras, in order to later sync videos for analysis. Mothers were instructed to feed as normal, and to verbally inform the researcher, who was outside the feeding space, when the feeding session was finished. This maintained a feeding environment as close to normal as possible, as past research indicates that breastfeeding behaviours change in an unfamiliar or uncomfortable environment (184). Videos were stored on a removable Secure Disk (SanDisk, California, United States) card and were transferred to both an online password-protected OneDrive belonging to the study, as well as an external hard drive (Seagate Technology, California, United States) kept in the locked filing cabinet of the locked laboratory office.

3.6.5 Feeding environment

Based on environmental factors that could impact the quality of the interaction while feeding, the environment captured on video was analyzed for length of feed, maternal distractions, the use of breastfeeding tools or supports (e.g. breastfeeding pillow), and breastfeeding position. The amount of time from beginning to end of the feed was used to determine the length of the feeding. Distraction was defined as looking away from the infant for >75% of the feeding session; using a mobile device at least once; conversing with other adults or children at least once; or sleeping (145). As breastfeeding supports may allow for a more comfortable feeding session (185), the use of any type of breastfeeding pillow or other supports at any point in the feeding session was recorded. These observations were recorded in a template created on Microsoft Excel for Mac (v.16.42).

3.7 *Potential sources of bias*

3.7.1 Inter-rater reliability

Inter-rater reliability is a measure of agreement between two coders who independently code the same participant using the same methods (186). This is especially important when analyzing observational data, to ensure one researcher's implicit biases do not impact scoring. The NCAST Feeding Manual suggests that 10-15% of the interactions be analyzed by a second reviewer, also trained to use the NCAFS, with 85-90% accuracy (153). Based on these recommendations, a randomly selected subset of 14 (13%; 7 Canadian and 7 Cambodian) video-recorded interactions will be scored by a second, certified, research assistant. Coder responses for each item were compared and an agreement level of 91% was achieved, higher than the 85-90% agreement that was deemed acceptable as suggested by NCAST (NCAST).

3.7.2 Cultural bias

Cultural bias is especially important to consider when conducting cross-cultural research. Several steps were taken to mitigate cultural bias in this study. During data collection in Cambodia, a Cambodian employee was present for translation, and explanation of Cambodian cultural context if necessary. After all Cambodian videos were collected, any speech was translated from Khmer to English by Khmer translators (Appendix G). While the researcher has not been to Cambodia and has not experienced Cambodian culture, the primary investigator, Dr. Whitfield, and other students on her research team have spent considerable time living in

Cambodia and were available for consult if questions, concerns, or misunderstandings arise. More importantly, study co-investigator Mr. Hou Kroeun (Deputy Country Director, Helen Keller International, Cambodia) was also available for consult. They have also provided important Cambodian context for interpretation and analysis (e.g. “mum mum mum” is a common comfort word used by Cambodian mothers while breastfeeding and means “milk milk milk”). Further, the NCAFS used for analysis has established cross-cultural validity and reliability, proving its use as an objective tool.

3.7.3 Social desirability bias

Due to the complex societal and cultural factors that influence breastfeeding, paired with the culture of judgement and surveillance among new mothers in Canada, social desirability bias was a possibility in this study. However, to limit behaviour change, the recorded breastfeeding session occurred in a safe and comfortable environment at the participant’s home, without observation by a researcher. In Cambodia, other friends or family members were sometimes present for the breastfeeding session. However, this is common and widely accepted, and it occurs at the discretion of the mother. Participants were assured that videos would not be seen by any person unnecessarily, unless consent was given for later educational use. Though there are cameras, the risk of a mother changing her behaviour to appear more socially acceptable was deemed less likely than the risk had direct observation of the feeding session been conducted.

3.8 *Ethical and copyright considerations*

This study underwent ethics review by the Mount Saint Vincent University Research Ethics Board (MSVU #2018-120) (Appendix H) and the Cambodian National Ethics Committee for Health Research (NECHR#45) (Appendix I).

NCAST is a copyrighted assessment tool owned by the University of Washington. The researcher completed the necessary certification to use the scale (Appendix E), and obtained scoring sheets for this study directly from the copyrighting company (166).

Members of the research team were able to see the faces and hear the voices of participants on the video during scoring. This was necessary for data analysis, and thus, the videos could not be de-identified. This was described clearly in the informed consent process. However, only the research team had access to the videos, and participants were assured that the

videos would only be used for scoring purposes. The exception here is if a mother would like access to her own video files, they will be made available to her in a password protected OneDrive folder. Such video were removed from the folder after 30 days in case of email breach.

3.9 Data analysis

Descriptive statistics are presented as mean $\pm$ standard deviation (SD) for continuous variables and n (%) for categorical variables. Caregiver age is reported as mean $\pm$ SD, but also categorized as above and below 31 years in Canada, the mean maternal age in Nova Scotia (187), and in Cambodia, as above and below 22 years, the median age at first birth (6) Parity is presented as a continuous variable (number of live births), and also categorized as primiparous or multiparous. Distracted feeding and the use of breastfeeding supports or tools were coded as dichotomous (yes/no) variables, based on the definitions outlined in *section 3.6.4*. Scores on the PSS were only analyzed within the Canadian sample who completed data collection during the COVID-19 pandemic, and were analyzed as both a continuous score and categorized into designated stress categories, low stress (score 0-13), moderate stress (score 14-26), high stress (score 27-40) (180). Analysis of outcomes by sociodemographic factors was only completed within each country, and were not compared across settings. The Shapiro-Wilks test was used to determine if continuous data were normally distributed ($p > 0.05$), in order to inform use of parametric or non-parametric tests. All data analyses were performed using IBM SPSS v. 26.0 for Mac OS (IBM Corp, 2018) with a significance level of $p < 0.05$.

Among Cambodian participants, National Wealth Equity Index score was calculated using EquityTool (188), with quintiles standardized to the 2014 Cambodian Demographic and Health Survey (CDHS). In Canada, national wealth deciles were available from the Government of Canada and were collapsed into quintiles. Quintiles in both settings were then categorized into $< 3^{\text{rd}}$ quintile, 3^{rd} quintile, and $> 3^{\text{rd}}$ quintile. For within country comparisons, Canadian participants' incomes were categorized as above and below \$CAD100,000, based on the median Nova Scotian income for couples with children of \$116,400 (189).

3.9.1 Statistical analysis for NCAFS scores

Descriptive statistics (mean $\pm$ SD) were computed for NCAFS total scores, both across all participants, and within each country. Scores on the NCAFS were not normally distributed

(Shapiro-Wilks $p < 0.05$), so non-parametric tests were performed. The Mann-Whitney U test was used to compare mean NCAFS scores between Canadian and Cambodian dyads, mean scores on each of the six individual NCAFS subscales by country, mean NCAFS total and subscale scores between distracted and non-distracted feeders and between those using a breastfeeding support/tool or not, and finally to compare scores by dichotomous sociodemographic factors (maternal age category, parity, and infant sex) within each country. The Kruskal-Wallis test was used to compare scores by perceived stress category and by sociodemographic factors with three or more categories (marital status, completed education level, wealth index or income, and racial or cultural group). Spearman's correlation coefficient was calculated between NCAFS scores and continuous sociodemographic factors (maternal and infant age), and continuous PSS scores.

3.9.2 Statistical analysis for indicators of the feeding environment

Descriptive statistics (mean $\pm$ SD) were computed for length of feed in minutes:seconds within each country. As length of feed was normally distributed, independent sample t-tests were used to compare mean length of feed by country, maternal age category, parity, and infant sex. A one-way ANOVA was completed to compare length of feed by perceived stress category, and by marital status, completed education level, and household income category.

The incidence of distracted feeding and the use of breastfeeding supports/tools are reported as n (%). Using chi-square tests, incidence was compared by country, perceived stress category, and all categorical sociodemographic factors (maternal age category, marital status, completed education level, household income category, parity, infant sex, and racial or cultural group). Where findings differed from expected values ($p < 0.05$), the Bonferroni post-hoc correction was used to determine where differences exist (190).

3.10 Dissemination of findings

The results from this research will be presented at an academic nutrition or infant feeding conference, such as the International Society of Research on Human Milk and Lactation biennial conference in Fall 2022, and will be published in a peer-reviewed, open-access journal (e.g. Maternal and Child Nutrition, or the International Breastfeeding Journal). Further, a lay summary of study results will be sent to participants who indicated interest in results on their consent form.

This summary will also be made available on the MAMA Lab website. In Cambodia, results will be shared with the National Nutrition Working Group.

The findings of this study could also have implications in public health among health care providers, and in antenatal policy and program development. As such, dissemination will also include a written research brief made available to public health nurses, lactation consultants, family resource centre staff, and other health care providers.

4.0 Results

4.1 Participant Characteristics

In total, 110 mother-infant dyads were included in data analyses; 55 dyads from Kampong Thom province, Cambodia, and 55 age- and sex-matched dyads from Nova Scotia, Canada. All videos collected were analyzed for the primary outcome, NCAFS score.

The maternal and infant participants' sociodemographic characteristics are presented in **Table**

4.1. Nearly all Canadian mothers (98%) had received education beyond high school (12 years); with nearly a third (31%) earning a graduate degree. The majority (76%) reported an annual household income in the two richest Canadian wealth quintiles (191). Participants had given

birth to between 1 and 4 children, but 38% were participating with their first child. The

Cambodian mothers (27.5 ± 5.3 years) were significantly younger than Canadian mothers (32.3 ± 4.1 ; $p < 0.001$), and had significantly greater parity (2.1 ± 1.0 vs 1.7 ± 0.7 ; $p = 0.024$). The majority (93%) of Cambodian mothers had received 12 years of education or fewer, and 44% had a household income below the third quintile of the Cambodian National Wealth Index.

Given that infants were sex- and age-matched, both groups were approximately half females, and they had similar ages of approximately 4.5 months old.

Table 4-1 Canadian and Cambodian maternal and infant sociodemographic characteristics¹

	Nova Scotia, Canada N=55	Kampong Thom, Cambodia N=55	p value ²
Mother			
Age, years	32.3 ± 4.1	27.5 ± 5.3	<0.001
Parity, number of live births	1.7 ± 0.7	2.1 ± 1.0	0.024
Range	1-4	1-6	
Primiparous	21 (38%)	17 (31%)	0.6
Ethnicity			
White	48 (87%)	-	
Khmer	-	55 (100%)	<0.001
Other ³	7 (13%)	-	
National Wealth Quintile ⁴			
< 3 rd Quintile	4 (7%)	24 (44%)	
Quintile 3	9 (16%)	16 (29%)	<0.001
> 3 rd Quintile	42 (76%)	15 (27%)	
Educational attainment			
Public school			
<7 years	0 (0%)	28 (51%)	
7-12 years	1 (2%)	23 (42%)	
≥ 13 years	54 (98%)	4 (7%)	<0.001
Undergraduate/college	37 (69%)	-	
Graduate	17 (31%)	-	
Marital status			
Married	41 (75%)	55 (100%)	<0.001
Common-Law	14 (26%)	-	
Infant			
Age, weeks	18.0 ± 3.9	18.6 ± 3.3	0.3
Range	11-27	13-25	
Sex			
Female	29 (53%)	27 (49%)	0.7
Ethnicity			
White	48 (87%)	-	
Khmer	-	55 (100%)	<0.001
Other ⁵	7 (13%)	-	

¹Data are shown as n (%) or mean ± SD, unless otherwise stated (i.e. range).

²Mann Whitney U test was used to compare infant age, and a t-test used to assess differences in maternal age, length of feed, and continuous parity by geographic location. Categorical comparisons were completed using chi square (parity, wealth quintile, education, marital status, and infant sex)

³In Canada, other maternal ethnicity included Chinese, Black, Latin American, West Asian, Korean, First Nations, and Métis.

⁴Cambodian Wealth equity index (WEI) quintiles calculated based on the Demographic Health Survey (6). Canadian Wealth Quintiles (2020) determined based on wealth deciles by Statistics Canada in the Canadian Income Survey 2012-2019 (191)

⁵In Canada, other infant ethnicities include Black, Filipino, Latin American, West Asian, First Nations, Métis, and one participant preferred not to answer.

4.2 Canadian and Cambodian NCAFS Scores

The NCAFS total and subscale scores are reported by country in **Figure 4-1**. The overall NCAFS scores (out of a possible 76) were significantly higher among the Canadian dyads (64.7 ± 5.5) than the Cambodian dyads (56.8 ± 6.2 ; $p < 0.001$). Caregivers in Canada scored significantly higher on three of four caregiver subscales, I: Sensitivity to Cues ($p < 0.001$); III: Social-Emotional Growth Fostering ($p < 0.001$) and IV: Cognitive Growth Fostering ($p < 0.001$). While Canadian and Cambodian infant scores did not differ on infant subscale V: Clarity of Cues, the higher scores among Canadian infants on subscale VI: Responsiveness to Caregiver (8.2 vs. 6.6; $p < 0.001$), contributed to significantly higher infant total score among Canadian infants (21.4 vs 19.6; $p = 0.002$). Based on NCAFS reference values, one Cambodian and two Canadian mothers scored below the tenth percentile based on education level, which NCAST calls a ‘worrisome’ score (153).

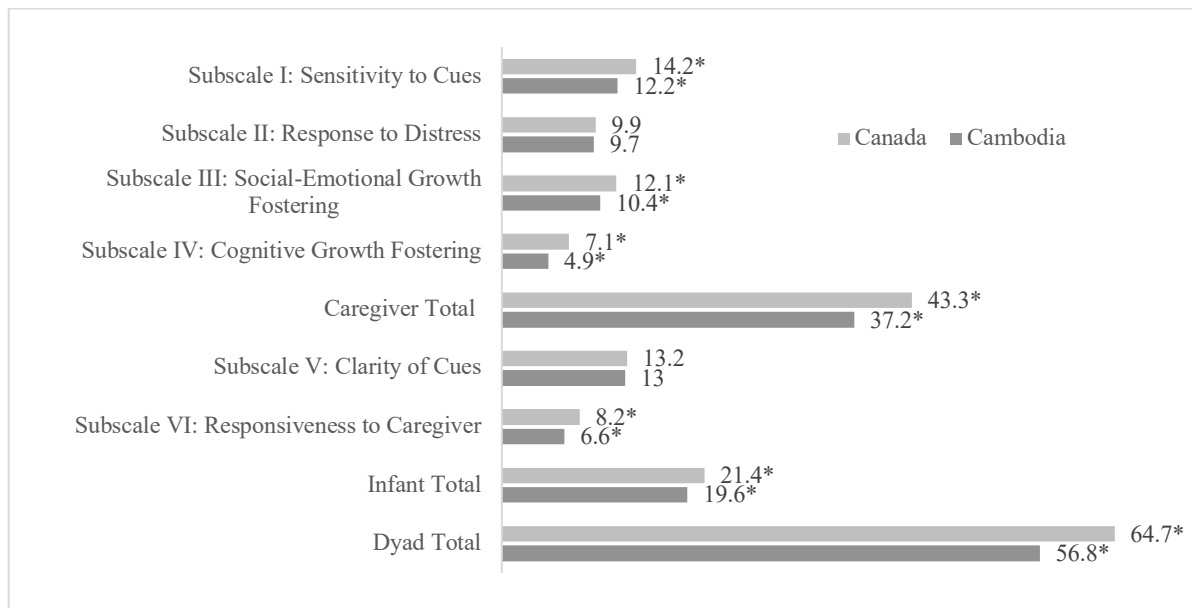


Figure 4-1 Canadian and Cambodian NCAFS total and subscale scores

* $p < 0.05$

Cambodian and Canadian NCAFS caregiver, infant, and dyad scores, assessed for differences by sociodemographic factors within each geographic setting, are reported in **Tables 4.2 and 4.3**. NCAFS caregiver, infant, and dyad scores differed in Cambodia by National Wealth Quintile, with significantly lower scores among those in the wealthiest quintile when compared to those in the third quintile. No other differences were found.

Table 4-2: NCAFS Scores by sociodemographic factors among Cambodian sample

	Cambodia (mean $\pm$ SD) ¹		
	Caregiver	Infant	Dyad
Maternal age, years			
< 22	37.0 $\pm$ 1.4	19.6 $\pm$ 1.0	56.6 $\pm$ 2.0
$\geq$ 22	37.2 $\pm$ 0.6	19.6 $\pm$ 0.5	56.9 $\pm$ 0.9
Parity			
Primiparous	36.9 $\pm$ 4.9	21.2 $\pm$ 3	57.1 $\pm$ 7.1
Multiparous	37.3 $\pm$ 3.4	19.4 $\pm$ 3.3	56.7 $\pm$ 5.9
National Wealth Quintile			
< 3 rd Quintile	36.7 $\pm$ 4 ^{ab}	19.7 $\pm$ 2.9 ^{ab}	56.3 $\pm$ 6.3 ^{ab}
Quintile 3	39.6 $\pm$ 2.8 ^a	20.9 $\pm$ 2.9 ^a	60.6 $\pm$ 4.9 ^a
> 3 rd Quintile	35.5 $\pm$ 3.5 ^b	18.1 $\pm$ 3.6 ^b	53.6 $\pm$ 5.5 ^b
Educational attainment			
< 7 years	36.9 $\pm$ 3.9	19.3 $\pm$ 3.4	56.2 $\pm$ 6.7
7-12 years	37.4 $\pm$ 4.0	20.0 $\pm$ 3.2	57.3 $\pm$ 6.0
13+ years	38.3 $\pm$ 3.3	20.0 $\pm$ 3.2	58.3 $\pm$ 5.6
Infant age, weeks			
Q1/Q2: 11-18 weeks	37.4 $\pm$ 3.7	20.2 $\pm$ 3.2	57.6 $\pm$ 6.0
Q3/Q4: 19-27 weeks	37.0 $\pm$ 4.1	19.0 $\pm$ 3.3	56.0 $\pm$ 6.5
Infant sex			
Male	37.1 $\pm$ 4.2	19.1 $\pm$ 2.7	56.3 $\pm$ 6.1
Female	37.3 $\pm$ 3.6	20.1 $\pm$ 3.7	57.4 $\pm$ 6.5

¹values in the same column with different letters are significantly different

Table 4-3: NCAFS Scores by sociodemographic factors among Canadian sample

	Canada (mean $\pm$ SD)		
	Caregiver	Infant	Dyad
Maternal age, years			
< 31	43.3 $\pm$ 4.4	21.3 $\pm$ 2.4	64.6 $\pm$ 6.1
$\geq$ 31	43.3 $\pm$ 3.6	21.5 $\pm$ 2.3	64.8 $\pm$ 5.2
Parity			
Primiparous	43.1 $\pm$ 4.4	21.3 $\pm$ 2.5	64.4 $\pm$ 5.9
Multiparous	43.4 $\pm$ 3.6	21.5 $\pm$ 2.3	64.9 $\pm$ 5.3
Income ¹			
< CAD\$100,000	43.9 $\pm$ 4.1	21.0 $\pm$ 2.6	64.8 $\pm$ 6.3
$\geq$ CAD\$100,000	42.9 $\pm$ 3.8	21.7 $\pm$ 2.2	64.6 $\pm$ 5.1
Educational achievement ²			
Undergraduate/college	43.3 $\pm$ 3.7	21.3 $\pm$ 2.3	64.6 $\pm$ 5.1
Graduate	42.9 $\pm$ 4.3	21.7 $\pm$ 2.6	64.6 $\pm$ 6.4
Marital status			
Married	43.0 $\pm$ 4.0	21.3 $\pm$ 2.5	64.3 $\pm$ 5.6
Common-Law	44.0 $\pm$ 3.7	21.7 $\pm$ 1.8	65.7 $\pm$ 5.2
Infant age, weeks			
Q1/Q2: 11-18 weeks	42.5 $\pm$ 4.1	21.4 $\pm$ 2.0	63.9 $\pm$ 5.5
Q3/Q4: 19-27 weeks	44.2 $\pm$ 3.4	21.5 $\pm$ 2.7	65.7 $\pm$ 5.4
Infant sex			
Male	44.4 $\pm$ 3.3	21.7 $\pm$ 1.5	66.1 $\pm$ 4.1
Female	42.3 $\pm$ 4.2	21.2 $\pm$ 2.9	63.5 $\pm$ 6.3

1 Median Nova Scotia Income for couples with children is \$116,400 CAD in 2020 (189).

2 One participant received High School education

4.3 The Feeding Environment

Relevant characteristics of the feeding environment including length of feed, breastfeeding position, and observed distractions, are described in **Table 4-4**. The length of feed in Cambodia (7:13 $\pm$ 4:02) was significantly shorter than in Canada (9:35 $\pm$ 5:34, $p=0.003$). In Cambodia, nearly all mothers were sitting straight at 90 degrees (93%) on the floor (75%) while breastfeeding, in contrast to mothers in Canada, 82% of whom breastfed in an armchair or couch, and more than half (66%) were leaned back to some degree.

Of the 55 videos recorded in Cambodia, 51 (93%) included another person, and in 35 (69%) of those videos, the mother spoke to another person. Almost half (47%) included non-domestic animals such as chickens. In Canadian videos, only 8 (15%) included another person, but four mothers were distracted by a technological device, while this never occurred in Cambodia.

Table 4-4 Characteristics of the feeding environment as captured in videos taken in Halifax, Canada and Kampong Thom, Cambodia¹.

	Halifax N=55	Cambodia N=55	p-value ²
Length of feed, <i>minutes:seconds</i>	9:35 ± 5:34	7:13 ± 4:02	0.012
<i>Range</i>	3:35-22:45	2:04-20:00	-
Used a breastfeeding support	35 (64%)	5 (9%)	
<i>Pillow</i>	25 (45%)	5 (9%)	0.002
<i>Armchair</i>	10 (18%)	-	
Distracted during feed ³	9 (16%)	28 (51%)	
<i>By other people</i>	4 (44%)	26 (93%)	
<i>By a device</i>	5 (66%)	-	0.003
<i>By the environment</i>	-	2 (7%)	
<i>By reading</i>	2 (22%)	-	
Other people present during feed	8 (15%)	51 (93%)	
<i>Grandparent</i>	-	11 (22%)	
<i>Other child</i>	3 (38%)	27 (53%)	<0.001
<i>Husband</i>	6 (63%)	1 (2%)	
<i>Other person</i>	-	34 (67%)	
<i>Multiple other people</i>	-	13 (26%)	
Mother talks to person present			
<i>Yes</i>	4 (50%)	35 (69%)	0.3
Animals present			
<i>Yes</i>	10 (18%)	26 (47%)	0.2
Mother's seat			
<i>Floor/ground</i>	-	41 (75%)	
<i>Hammock</i>	-	11 (20%)	
<i>Armchair/Couch</i>	45 (82%)	2 (4%)	<0.001
<i>Rocking Chair</i>	5 (9%)	1 (2%)	
<i>Other</i>	2 (4%)	-	
Mothers sitting angle			
<i>90 degrees</i>	15 (27%)	51 (93%)	
<i>Slightly leaned back</i>	23 (42%)	2 (4%)	<0.001
<i>Leaned back >30 degrees</i>	13 (24%)	-	
<i>Other</i>	4 (7%)	2 (4%)	
Infant distracted by cameras ⁴			
<i>Yes</i>	9 (16%)	-	0.002

¹ Data reported as n (%) or mean ± SD (minutes:seconds), unless otherwise specified

³ Differences in length of feed analyzed using t-test, all other comparisons completed using chi square

⁴ Maternal distraction was defined as looking away from the infant for >75% of the feeding session; using a mobile device or reading at least once for >30s; conversing with other adults or children at least once; or sleeping (145).

⁵ Infant distraction was defined as spending a greater amount of time looking at the cameras than looking at the caregiver.

4.4 NCAFS scores and the Perceived Stress Scale

Of the 55 Canadian participants, 44 (80%) completed the Perceived Stress Scale; caregiver, infant, and dyad NCAFS scores are reported by this stress in **Figure 4-2**. With this validated scale, approximately half of participants (n=23, 52%) were experiencing moderate perceived stress, with 36% and 11% experiencing high and low perceived stress, respectively. There were no significant differences in NCAFS scores by perceived stress levels, and no significant correlations between PSS scores and NCAFS caregiver ($\rho=0.003$; $p=0.983$), infant ($\rho=0.026$; $p=0.869$), or dyad ($\rho=0.012$; $p=0.941$) scores.

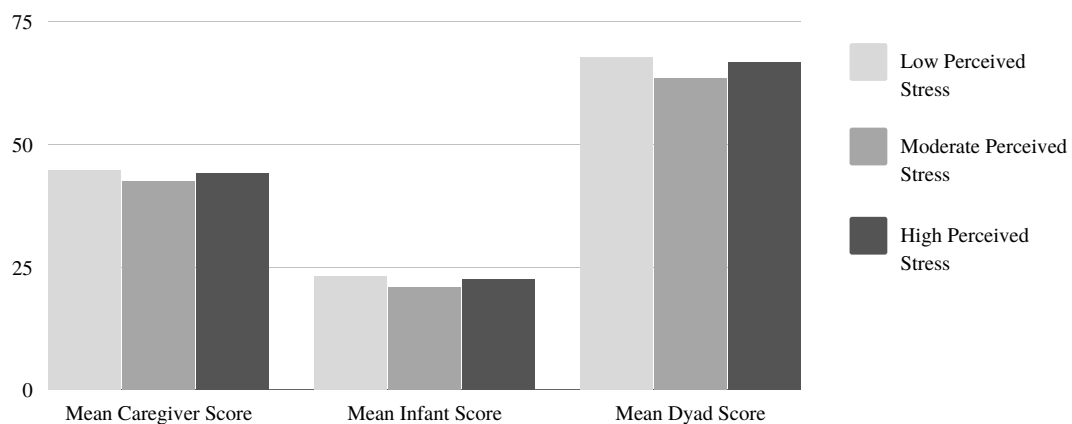


Figure 4-2 NCAFS scores and Perceived Stress category among Canadian participants

5.0 Discussion

The purpose of this study was to assess levels of responsiveness during breastfeeding interactions among Canadian and Cambodian maternal-infant dyads. The NCAFS tool was used to assess feeding responsiveness in 55 Canadian and 55 Cambodian video-recorded breastfeeding sessions (153). Canadian mother-infant dyads scored significantly higher overall, as well as on four of six subscales (*mother*: I. Sensitivity to cues; III. Social-emotional growth fostering; IV. Cognitive growth fostering, *infant*: VI. Responsiveness to caregiver). Mothers in both settings showed similar responses to their infants' distress (subscale II), and infants showed similar clarity of cues (subscale V). These similarities and differences may be owed in part to the observed feeding environment, cultural beliefs about child development, and various social and environmental enablers and barriers to responsive feeding in these two settings.

5.1 Participant characteristics

Infant characteristics across settings were largely similar by design, given the infant age- and sex-matching employed. Of note, Cambodian mothers were significantly younger than Canadian mothers (27.5 vs 32.3 years), had attained lower overall levels of education, and had a greater parity range (1-6 vs 1-4 children). These differences were expected, as sample characteristics are comparable to local demographics; for instance, Cambodian women typically have more children, as most achieve parity of 4.5 (3.9 surviving children) by the end of their reproductive years (6). Meanwhile, almost half (46%) of couples with children in Nova Scotia have only one child, and only 15% have three or more children (192). A notable difference in these two samples was wealth: the majority of our Cambodian participants had household incomes in the bottom two national wealth quintiles, while in Canada, almost half of our participants had household incomes in the upper two national wealth quintiles.

5.2 Overall NCAFS responsiveness scores

Mothers in Cambodia were less sensitive to their infant's cues and participated in less socio-emotional and cognitive growth fostering, and infants in Cambodia were also less responsive to their caregivers. The mean NCAFS total dyad score among Cambodian dyads was approximately 8 points lower than Canadian (56.8 vs 64.7). Overall, the Cambodian mean score was also 6 points lower than the NCAFS reference values (56.8 ± 6.2 vs 62.7 ± 8.5), which are

based on an American sample of 1,638 Caucasian, African American, and Hispanic/Latina mothers of infants aged 0-12 months (153). These results agree with previous reports of suboptimal levels of responsive feeding both in Cambodia (79,193) and in other LMIC, such as Sri Lanka (194). Canadian total scores (64.7 ± 5.5) were more comparable to NCAFS reference values, as expected, based on previous research showing that Canadian dyads score similarly to the NCAST PCI reference values (195), and that responsive feeding is valued by Canadian caregivers (196).

Based on these overall differences and given the vast differences in infant feeding across geographic settings, direct comparisons are inappropriate. As such, each NCAFS subscale will be discussed with reference to scores and related context within each country, rather than comparing results solely between the Canadian and Cambodian samples.

5.3 Subscale I: Maternal Sensitivity to Cues

Here we report lower levels of responsiveness on behalf of caregivers than infants, demonstrating that the lower levels of responsiveness in Cambodia cannot be owed to the clarity of infants' cues, but rather on how the caregivers interpreted and responded to them. A mother's ability to recognize and interpret infant cues is essential in ensuring appropriate responses, and is measured by the NCAFS Maternal Sensitivity to Cues subscale (subscale I) (153). In this study, Cambodian mothers achieved an average of 12.2 ± 1.5 out of 16 items on this subscale, slightly lower than the American NCAFS reference value of 13.6 ± 2.05 . Difficulty interpreting infant cues has been previously documented in Cambodia. In a 2011 study, mothers specifically noted that they needed more information on how to tell if their baby was getting enough milk (79). This seems to be a common concern, as three other studies completed in other LMIC, Malawi (197), Zambia (198), and Indonesia (199), similarly indicated that mothers did not know how to interpret infant cues. Further, using interviews (79), focus groups, and observations (80), authors of two studies in Cambodia reported some positive practices based on the recognition of cues to initiate feeds (e.g. the number of feeds in a day is dependent on the baby), but participants also seemed to have difficulty recognizing disengagement cues, reporting common problems such as "baby crying" and "baby won't breastfeed".

The inability to interpret infant cues is not solely a Cambodian, or LMIC, problem, though. For example, in Australia, commonly cited infant feeding 'problems' such as food

refusal or fussiness have been typically viewed negatively by caregivers, rather than as a means of infant communication (200). Further, Canadian participants in a 2015 study reported a need for more practical information regarding responsive feeding, such as learning to read their infant's cues, and knowing when they're getting enough, particularly during 'on demand' feeding (201). Despite this, Canadian dyads received scores even higher than NCAFS reference values on the Sensitivity to Cues subscale (14.2 ± 1.7). This may be a result of ample information provided in Canada on responsive feeding, specifically with information on recognizing early and late hunger and satiety cues, by the Canadian Government, Health Canada, and local health agencies such as the Nova Scotia Health Authority (43,109,202–204).

5.3.1 Distractions

Maternal sensitivity and responsiveness to infant cues can be negatively impacted by distractions during feeding, as caregivers who are splitting their attention may miss infant cues (106,145). In HIC, the most common distractions involve technology (e.g. phones, television), but also include reading, sleeping, and talking to others (144,205,206). In HIC, mothers self-reported media use ranged from 2-50% of feedings (144,169,207), with 97% of mothers in an American study self-reporting engagement with media at least sometimes while feeding their infant (207). Despite this, distractions - technological or otherwise - were not common among our Canadian participants. Here, feeds were commonly recorded inside a quiet modern home, with only five (9%) mothers using a device (e.g. phone or tablet) for >30 seconds during the breastfeeding session, and three (5%) others briefly checking a notification or silencing their phone after it rang/vibrated. Likewise, only 8 (15%) recorded breastfeeding sessions captured another person in the area. As previous reports of distractions among caregivers were self-reported, and this study included a single feed with potentially high incentive to 'perform', social desirability may have played an important role in the lack of distractions observed, and thus may not represent usual practice among Canadian participants. With such low incidence of distraction, it is not surprising that among Canadian participants, no differences were found in NCAFS maternal sensitivity to cues score (or other subscale scores) between those who were distracted and not distracted.

Distractions were much more commonly seen in our video-recorded breastfeeding sessions in Cambodia. Here, nearly all videos captured another person in the nearby area (93%), and in 69% of those, the mother spoke to another adult (67%), or another child (53%).

Comparable distractions were discussed in a report describing the feeding environment in rural Ethiopia, which included children playing in the background (21%), non-domestic animals (24%), and other adults (64%) (208). In Cambodia, this may be partially explained by the environment and housing. In this tropical climate, houses are built on stilts with cooler, shady areas underneath that make for a comfortable place to breastfeed. These are open areas, where passersby can be seen, vehicles or motos can be heard nearby, and where people gather to socialize. As a result, only 75% of mothers paid more attention to their infant than to other things in the environment (item #28) versus 96% in the Canadian sample.

Though potentially distracting, breastfeeding in these open areas and around other people is a great demonstration of the cultural acceptance and supportive breastfeeding environment in Cambodia, where women have reported being ‘not shy’ to breastfeed around other people (79). Likewise, Cambodian culture considers breastfeeding a family affair, with grandmothers and sisters commonly offering help (209). This supportive breastfeeding environment and the commonality of breastfeeding in public in Cambodia may mean that participants here, in contrast to Canadian participants, were less likely to feel the need to ‘perform’, so these results may be more reflective of usual practice. Additionally, the socialization that mothers are participating in while breastfeeding, while distracting, may have positive impacts on mothers’ mental health thereby increasing the quality of overall mother-infant interactions (207,209,210). Although distractions were more common in this sample, there were similarly no differences in NCAFS maternal sensitivity to cues or other subscale scores between distracted and non-distracted Cambodian mothers. This may be explained by the type of distractions, as it is possible that technological distractions are more engrossing and harder to quickly abandon, as compared to in-person distractions seen in Cambodia (211). As a result, they may not interfere with recognition of cues to the same extent.

5.4 Subscale II: Maternal Response to Distress

Infant distress, as indicated by potent disengagement cues, signal late hunger or a need to change the feeding situation (153). These include things like back arching, maximum lateral gaze (turning away), crying, and fussing. Maternal responses to these cues are measured on the NCAFS using subscale II: Response to Distress. In this study, response to infant distress was the one subscale that mothers in Canada and Cambodia did not score significantly differently on,

potentially because sensitivity to infant distress serves a different purpose than responses to non-distress cues measured on other subscales (212). These responses are thought to be based on different underlying beliefs and values: instead of fostering learning and reciprocity, these foster comfort and protection. This is corroborated by Leerkes et al., who reported that typical predictors of low maternal sensitivity, such as low income, are not predictors of sensitivity to distress (213). Together, this suggests that responses to distress may be more innate, and less impacted by external context or culture.

Just as an infants' tendency to seek comfort from a caregiver when distressed seems to be a universal adaptation (214), maternal comfort and nurturance are common responses across cultures (215). Authors of a 2017 study concluded that infant cries, a sign of distress, stimulate similar neurological and behavioural responses (e.g. holding the infant) among caregivers across 8 countries (216). Authors of this study go on to postulate that, from an evolutionary biology perspective, responding to infant distress may be a universal adaptive mechanism to ensure adequate reproduction and infant survival (215). With consideration of this research, and cross-cultural similarity in response to distress scores in the present study, it is possible that maternal responses to distress are universal.

5.5 Subscale III and IV: Social-Emotional and Cognitive Growth Fostering

Interactions that stimulate social-emotional and cognitive growth fostering are measured on the NCAFS subscales III and IV, measuring behaviours such as eye contact, touch, and verbalizations which serve as proxies for contingent social interaction and the ability of a caregiver to provide scaffolding for infant growth and development (153). Cambodian mothers in this study participated in lower levels of social-emotional and cognitive growth fostering (10.4 ± 1.6 and 4.9 ± 1.9 , respectively) than Canadian mothers (12.1 ± 1.3 and 7.1 ± 1.6 , respectively) and NCAFS American reference values (11.9 ± 2.1 and 6.6 ± 2.1 , respectively) (153). These interactions may have been driven by differences in positioning and maternal verbalness, which will be explored as case examples below.

5.5.1 Positioning

Positioning while breastfeeding is not only important for reducing pain and discomfort (217) but also influences important social interaction by enabling or preventing face-to-face and eye-to-eye contact (153). Among Cambodian participants, 75% were seated on the floor or raised

bamboo pallet, and 93% were sitting straight at a 90-degree angle. This position has been shown to cause musculoskeletal pain, restrict infant movement, and hinder face-to-face contact, interfering with natural cues (217). Common use of this position among Cambodian mothers may be related to a lack of access to the types of supports that assist in other breastfeeding positions such as armchairs, couches, and breastfeeding support pillows, all of which were commonly used among Canadian mothers (82%). Even the weather could be impacting mothers' choice of breastfeeding position: tropical temperatures in Kampong Thom may encourage minimal close contact between the trunks of mother and baby, made easier in a 90 degree position (217,218). With common concerns of overheating among mothers of infants in Cambodia, this position may be an effort to prevent maternal body heat transfer (219,220). In support of this, 8 (15%) Cambodian mothers did not achieve trunk-to-trunk contact during 50% of the feed (item #3), another important enabler of responsive behaviours (153). Unfortunately, this lack of physical contact paired with a position that may limit eye contact and does not encourage interaction could be contributing to lower levels of responsiveness (153,217).

In contrast, breastfeeding while laid back, also coined biological nursing, is a position in which a mother's back is supported and the baby's weight is rested on a mother's trunk (221). This allows for greater comfort, and with the help of gravity, encourages hands-free and face-to-face interaction (221,222). Laid back breastfeeding was most common among Canadian mothers, with 23 (42%) slightly leaning against the back of a couch or chair, and 13 (24%) reclined 30 degrees or more. This position did seem to allow for greater interaction, as nearly all Canadian mothers achieved social interaction (item #32; 80% vs 51%), and 69% offered fingerplay (item #42), as compared to 38% in Cambodia (153). Canadian participants also created comfortable positions with breastfeeding pillows (46%) and the arm of an armchair or couch (18%), which have been shown to decrease caregiver discomfort (185). Further, positioning has been described as one of the key skills for successful breastfeeding, with the Public Health Agency of Canada, the Canadian Pediatric Society, and Nova Scotian Department of Health and Wellness all suggesting the use of breastfeeding pillows if needed to allow for comfort (43,203,223). As such, results may be an indication of the information Canadian mothers receive.

While there is a lack of consensus on 'correct' breastfeeding postures, the one which imposes the least burden on the mother and allows the greatest opportunity for interaction likely will lead to more responsiveness (224,225). A 90-degree position, commonly observed in

Cambodian mothers in this study, may interfere with face-to-face and trunk-to-trunk contact, which makes interaction more difficult (221,222). In Canada, however, mothers have many supports available to create a position that works for them and their infant. In this way, positioning is likely to have played some role in the reported differences in social-emotional and cognitive growth fostering.

5.5.2 Verbalness

Verbalness has been described as one of the five main aspects of positive parenting, as exposure to language and vocalizations in everyday interactions supports infants' developing language and other developmental outcomes such as social skills (98,100,226). Compared to Cambodian mothers, Canadian mothers in this study achieved three items related to maternal verbalizations significantly more often: item #7: "caregiver comments verbally on hunger cues prior to or up to the first minute of the feeding"; #44: "caregiver talks to the child using two words at least three separate times during the feeding", and #48: "caregiver verbally responds to child's sounds within five seconds after child has vocalized" (153). This may be explained by active encouragement of verbalization in Canada, where it is accepted that children require verbal stimulation even in the womb, and resources commonly recommend smiling, laughing, and talking to your baby while feeding (203).

In Cambodia, cultural norms surrounding language differ greatly. Here, talking to babies *in utero* is not widely recognized as an important part of stimulating child development (209). In fact, over half of Cambodian women who participated in a 2006 study believed that infants did not hear at birth, instead 24% believed they would begin to hear around 1-2 months of age, and 33% believed that a baby would begin to hear at 3 months of age or older (209). This could explain why Cambodian mothers in our study participated in less verbal interaction; it could be that responding to infant vocalizations is not valued. However, the relationship between verbalness and nutrition is complicated. Though these types of interaction are important in social and cognitive development (227), they may not actually impact eating behaviours (228) or other markers of nutrition status, such as infant weight gain (229). Further, positive caregiver verbalizations while feeding, studied in Vietnam, actually increased infant susceptibility to pressured feeding, increasing intake even past the point of satiation (230), demonstrating the delicate balance between positive, responsive verbalizations and adverse pressuring verbalizations.

These results demonstrate the importance of cultural context in measuring, and designing interventions to facilitate, maternal-infant interactions. While improving verbal interactions while breastfeeding may be beneficial to the child (229), interventions must consider cultural beliefs about language to ensure programs target the root issue, and do not cause harm.

5.6 Subscale V: Infant Clarity of Cues

Research in HIC has shown that infants have the innate ability to communicate hunger and satiety through cues such as rooting or turning away (231). During responsive feeding, caregivers should be able to recognize those cues, and for that to happen cues must be clear and consistent (8). Infant's clarity of cues, measured on the NCAFS subscale V, were similar among Cambodian (13.0 ± 1.6) and Canadian (13.2 ± 1.5) infants in this study. Scores in both countries also aligned with American NCAFS reference values (12.77 ± 1.95). Similar results were found in a study examining mother-child responsiveness among dyads in rural Ethiopia, where infants were found to be more behaviourally responsive than their caregivers (208). Further, just as there are universally recognizable facial expressions among adults in different cultures, vocal infant cues, regardless of culture, seem to have universal properties (232). Cross-culturally, infant cues are distinguishable when communicating negative emotions, positive emotions (233) and even subtle interactions such as giving, showing, and requesting food (234). These findings corroborate the innate ability of infants, regardless of location and culture, to communicate hunger and satiation.

5.7 Subscale VI: Infant Responsiveness to Caregiver

While innate cues seem to be present cross-culturally, infant responsiveness to their caregivers is a learned response owed to the bidirectionality of responsive feeding (8). Black & Aboud postulate that when caregivers respond responsively to an infant's cues, infants realize that their cues are effective and continue to produce more distinct and meaningful signals. In support of this, the author of a study involving mothers from 8 countries reported that across cultures, mothers who engaged their infants in turn had infants who were more attentive to them, and those mothers who encouraged learning had infants who explored their environments more (215). In further agreement, a 2012 study compared interactions between German infants, who experience many face-to-face interactions, and infants from rural Cameroon, in a community

with little such interaction (235). At six weeks old, infants and mothers from both groups exchanged smiles a similar amount, but by 12 weeks German infants had learned to participate in the interaction and smiled in response to their mothers smile more frequently. This learned responsiveness through interaction could explain why infants in Cambodia, who were experiencing lower levels of responsiveness than Canadians, were also less responsive to their mothers (6.6 ± 1.9 vs 8.2 ± 1.3 , respectively; $p < 0.001$), despite scoring similarly on the clarity of cues subscale.

5.8 Length of feed

Time spent breastfeeding is highly variable among women, with NCAFS suggesting a 10–15-minute range, while acknowledging that mothers should simply follow the infants lead (153). The average length of feed in Cambodia was significantly shorter than in Canada by over two minutes ($7:13 \pm 4:02$ vs $9:35 \pm 5:34$, $p = 0.012$). ‘Time poverty’ likely has impacts on the length of feed in Cambodia, as one of the most common maternal breastfeeding difficulties is “time constraints” (79,80). Cambodian women typically continue to work shortly after birth, have large, often multi-generational households with multiple children and elders requiring care, and experience inequitable sharing of home-minding responsibilities, all of which could adversely impact the time dedicated for breastfeeding (193,209,236). Short feeds may also be a result of feeding more frequently. Without methods of soothing such as pacifiers that are common in HIC, it is possible that Cambodian mothers offer the breast to soothe, resulting in more frequent feeds. This is in agreement with information from UNICEF, who suggests feeding not just for food, but also for comfort, in response to distress, or “whenever it might help” (237).

Longer feeds, such as those seen among Canadian participants, which leave a baby satiated for longer likely also better allow for maternal control over ‘mealtimes’, scheduled naps, and extracurricular activities. In support of this, in a 2009 qualitative study, 50% of Canadian women reporting following a feeding schedule either alone or in combination with on-demand feeding (238). Longer feeds have also been associated with higher levels of maternal controlling feeding behaviours in American women (239). Despite this, lengthier feeds may also provide more opportunities for dyads to pause, burp, and interact, which may contribute to higher responsiveness scores. Further, mothers in Canada have smaller households and most women are afforded paid maternity leave for 12-18 months (240), which likely creates more time to dedicate

to breastfeeding. This dedicated time may also allow Canadian mothers to learn and master skills in responsive feeding, which take practice.

5.9 NCAFS scores and sociodemographic factors

Various sociodemographic factors have been shown to impact NCAFS responsiveness scores. The NCAST reference values themselves highlight significant differences by maternal age/education, parity, and ethnic group (153), that are also reported elsewhere (241,242). However, in the current study, there were no differences in NCAFS scores by sociodemographic characteristics among Canadian participants. While this may be attributable to the homogenous composition of the Canadian sample, authors of a Canadian study completed in 2009 also found no associations between sociodemographic factors and NCAFS scores other than maternal level of education among maternal-newborn dyads (157). As all but one Canadian participant in the present study had received an undergraduate or graduate degree, it is not surprising that no differences were found.

In a similar way, NCAFS scores among Cambodian dyads did not differ by maternal age, education level, parity, or infant age, but did differ by wealth index. Cambodian participants in the richest two quintiles scored lower than those in the middle wealth quintile. While this may be unexpected based on research in HIC where those with higher incomes are typically more likely to breastfeed, in LMIC, breastfeeding rates are lower among wealthier and older parents (15,33). This may be because maternal income-generating activities outside the home are the main predictor of early breastfeeding cessation, and could be impacting responsiveness as well (33). However, there was no significant difference between NCAFS scores of those in the poorest and middle wealth quintile.

5.10 NCAFS in Cambodia

A 2019 systematic review revealed limited validity and reliability of tools available to assess responsive feeding, particularly in infants less than 2 years old (148). Although the NCAFS tool has been used in other LMICs (153,243), the tool is not necessarily appropriate for use globally as infant feeding beliefs and practices differ greatly cross-culturally. For example, in Cambodia, it is believed that gently tapping the child's chest or covering their mouth will serve to calm the child which, without cultural context would likely be considered a 'negative' behaviour on the NCAFS (209). Further, 'sweet words', and particularly praise for good

behaviour, are seen as something for the rich and elite in Cambodia, and as a result, are less common among the less educated or poor (244). Likewise, with cultural beliefs that infants are unable to hear and the demonstrated lack of caregiver verbalizations, it is unlikely that item #50, pertaining to the use of baby talk, is relevant in Cambodia. Encouragingly though, some NCAFS items did allow for consideration of cultural context. In our study, Cambodian culture was specifically taken into consideration when scoring “gentle touch” and “abrupt handling”, which is to be scored based on the infant’s reaction. Cambodian mothers tended to enthusiastically pat their baby’s bums while feeding, and though it may be considered ‘rough’ by Canadian standards, here, the infant was not startled or upset by it, and Cambodian collaborators confirmed that this is a normal Cambodian parenting behaviour. This allowed the behaviour to be scored as the comforting behaviour it seemed to be, comparable to rocking or bouncing commonly seen in Canada.

Given the examples above, cultural adaptation may be required to accurately measure certain facets of the NCAFS in Cambodia, such as verbal responsiveness. Verbal responsiveness is measured in a potentially more appropriate way in a recently developed tool for measuring feeding responsiveness, which only distinguishes between positive and negative verbalizations (245). In contrast, the NCAFS scale specifies that verbalizations from a caregiver must only be used to score if the caregiver is talking *to* or *about* their infant (153). In nine video-recorded breastfeeding sessions in Cambodia, mothers were observed talking to another adult in the area while maintaining their gaze on the infant. By remaining in a position where they are still able to openly interact with their babies, these verbalizations may similarly contribute to cognitive development, whether speech is directed to them or not. If these verbalizations were able to be included in the NCAFS score, four Cambodian mothers would have received one additional points, and five participants would have received two additional points.

5.10.1 Responsiveness in Cambodia not measured by NCAFS

Despite low levels of responsiveness as scored by the NCAFS in this study, upon informal observation, it seems that Cambodian mothers are actually very good at recognizing and responding to their child’s hunger and fullness cues. In videos recorded for this study, many times a mother is already breastfeeding when the video begins, or the mother reports that their infant is refusing the breast because they have already been fed. It seems this is because Cambodian mothers pay little attention to external cues, such as the time of day or when the

research assistant is scheduled to arrive, when deciding when to feed. In fact, many simply do not have any external cues to rely on, with only 15% of Cambodian participants in this study owning a watch or clock. A similar phenomenon was observed by Sall et al (2020), who reported that 80% of Cambodian dyads excluded from their study on responsive feeding were excluded because the meal had already been fed to the child, despite scheduling a visit time (245). Despite higher responsiveness scores, several videos in Canada show mothers consoling their baby in response to late-stage hunger cues because they relied more on the timing of the research assistant than infant hunger cues. This further calls into question the validity of the NCAFS, particularly when used to analyze an isolated feeding session.

5.10.2 Responsiveness interventions

Many intervention studies in LMICs aim to increase responsiveness by providing education on responsive feeding and parenting. Interventions focussing only on responsive feeding have improved self-feeding and responsive verbalizations among infants 8-20 months old in Bangladesh (229), and improved dietary intake and mental development among 200 mother-infant (<2 yrs) dyads in India (246). However, interventions in Cambodia typically take place during the complementary feeding stage (>6 months), and include various other confounding interventions, making it difficult to isolate the impact of responsive feeding education (219).

Despite a lack of responsive feeding-focussed interventions in Cambodia, specifically among dyads including infants <6 months old, mothers included in Wren & Chambers 2011 study were eager to learn and improve their practices. As Cambodian mothers were significantly less responsive than their Canadian counterparts and are facing critical barriers with regards to knowledge of responsive feeding, widespread and consistently delivered interventions particularly focussing on preventing distractions, increasing verbal interactions, and emphasizing the importance of breastfeeding position in encouraging interactions, could improve responsive feeding, and potentially the nutritional status, of Cambodian children.

5.11 Recommendations for further research

Considering this, further efforts to improve responsive feeding in Cambodia should employ a tool that has been validated for use in Cambodia, such as the recently created tool by Sall et al. (2020) which was developed in consultation with local Cambodian enumerators and

includes items pertaining to common distractions such as “taking care of other family members” (245). Unfortunately this tool is limited to use among children aged 6-23 months, which further supports the need for tools that measure responsiveness in infants less than six months old, before the complementary feeding period (243).

There is also a strong need for longitudinal research, particularly in LMICs, to investigate whether levels of responsiveness in early childhood impacts growth, dietary intake, and eating habits later in life. While positive effects of responsive parenting and feeding on cognitive outcomes are well established, even in HIC, research is still inconclusive regarding the long-term impacts of responsive and non-responsive infant feeding behaviours on levels of under- or overnutrition and later ability to eat in accordance with hunger and satiety cues (8,247). This is especially apparent in the case of responsiveness and undernutrition in LMIC, versus overnutrition commonly studied in HIC (126,247,248). Importantly, further research should also investigate responsive feeding in Cambodia qualitatively to better understand why Cambodian mothers feed in the way that they do. This may provide better context regarding cultural differences in feeding behaviours and would likely provide better guidance regarding interventions.

With this, future intervention studies in should: include infants <6 months old; allow for the analysis of the relationship between responsiveness and related outcomes (dietary intake, growth, later cognitive or social development) without confounding interventions, such as nutrient supplementation; and be provided for no charge, as cost is typically a determining factor for Cambodian women receiving care. The provision of support through cell phones (249), home visits, and educational sessions with community-based volunteers (250) has been shown to be effective in facilitating intervention uptake in the past. Similarly, community or family-based meetings would likely be effective, given the supportive breastfeeding culture in Cambodia, and research demonstrating positive effects of including grandmothers and husbands in behaviour change interventions in LMIC (251).

Further research on responsive infant feeding in Canada should focus on measuring responsiveness in more diverse, normative, populations to establish more representative yardstick measures. Much of the research using NCAFS in HIC involves high-risk maternal-infant dyads, and as the NCAFS normative values may not be accurate in Canada, comparisons are difficult. A recent study compared the responsiveness of Canadian high-risk and community

samples to American NCAST normative data to determine its applicability, but focussed on the NCAST teaching scales, rather than the feeding scales (252). A study similarly examining levels of feeding responsiveness among healthy and diverse participants would fill a gap in Canadian research. In addition, with growing use of breastfeeding supports, pacifiers, and bottle-feeding in HIC, it would be beneficial to examine the impacts these may have on maternal-infant interactions in Canadian dyads.

5.12 Strengths and limitations

5.12.1 Strengths

Major strengths of this study were that feeding sessions were recorded in participants homes, rather than in a laboratory, as well as the employment of local research assistants in both settings to allow for instructions and data collection in local language. Another of the strengths of this study was the use of video-recorded breastfeeding sessions, which decreases the likelihood of missing more subtle NCAFS items, such as an infant's smile, compared to live assessments. The use of video-recorded sessions also allowed for the later translation of videos from Khmer to English, versus in-person translation which may be less accurate and more distracting for mothers. Another strength of the recorded feedings was that it allowed for highly accurate inter-rater coding, as each rater used the same videos in contrast to in-person observation where each rater may be seeing a different angle. The level of inter-rater reliability was a further strength of this study, with 91% agreement based on 14 videos coded by two NCAFS trained coders (85-90% agreement is deemed appropriate by NCAFS). Double-coding to ensure consistency over time was also performed, with 5 videos double-coded halfway through analysis, and 5 when all had been analyzed, with 97% intra-rater agreement. Use of the NCAFS among Canadian mothers is also a strength of this study, as its validity and reliability is well-documented (*see section 3.6.3*).

5.12.2 Limitations

The COVID-19 pandemic, which took place throughout data collection in Canada, may have introduced greater levels of stress and anxiety among dyads participating during this time. To assess and potentially control for related impacts, the Perceived Stress Scale was employed. Of the Canadian participants in this study, 44 participated during the COVID-19 pandemic, and of those, 16 (29%) were experiencing high levels of stress. Despite research showing negative

impacts of stress on caregiver responsiveness (253), there were no significant differences between the total or subscale NCAFS scores of those experiencing low (n=5), moderate (n=23), or high (n=16) stress. However, the impact of this stress on responsive feeding cannot be excluded. Another limitation of this study was the inclusion of only one feeding session. While potentially appropriate for an exploratory study such as this, Bentley et al. 2011 discuss the importance of measuring more than one feeding session due to such a high degree of variability between feeding sessions and across meals (254). Many factors can impact a parents' ability to perform optimal responsive feeding practices during a single feeding session including time allocation, their infants' temperament, and level of stress (231,254). These variations likely would have been more controlled or avoided by being able to record two feeding sessions at different times of the day. Finally, there is also potential for both social desirability and response bias in this study.

Though video-recording breastfeeding sessions for analyses brought greater flexibility and less potential for human error in scoring, the observational nature of the study lends itself well to the Hawthorne effect, which is a phenomenon whereby people act differently while being observed (255). This effect was partially controlled by recording feeding sessions in participants' homes, versus in a laboratory. However, as the successfulness of breastfeeding is inherently tied to 'good mothering', as judged by infant behaviours or concepts like 'neatness' in public, the social desirability effect is likely to have still impacted behaviour (29,209,256). Despite these being observed in both settings, it is also possible that it may have had greater impacts on scores in Canada, as mothers were likely more aware of the recommendations to feed responsively and so may have had a better understanding of what the study was measuring, i.e. what the researchers were 'looking for'.

Response bias likely also impacted results of this study, as evidenced by the wealth distribution in both Canadian and Cambodian samples. In Canada, participants were mostly White, highly educated, and had high incomes. This suggests that perhaps a certain type of mother was interested in participating in the study, despite varied recruitment (*see section 3.4*). In Cambodia, the opposite trend was in effect, with most participants having incomes below the middle quintile, suggesting the same. Based on results of this study and previous research (*see section 5.9*), these populations both may have scored higher on the NCAFS than more

representative samples. This may explain why Canadian dyads in this study scored slightly higher than NCAFS reference values.

5.13 Conclusions

In this study, we assessed levels of responsiveness during breastfeeding sessions of 110 mothers and infants < 6 months old in both Nova Scotia, Canada, and Kampong Thom Province, Cambodia using the NCAFS. Levels of responsiveness differed by country, with Cambodian dyads scoring significantly lower overall (56.8 vs 64.7; $p < 0.001$), and on four of six NCAFS subscales. Differences in responsiveness were owed less in part to the clarity of the infant's cues, which may be innate across cultures, and more to how mothers responded to them, indicating that results are likely attributable to differences in the observed feeding environment and the availability of information and support to encourage responsive feeding across countries. In contrast, maternal responses to distress cues did not differ between Canadian and Cambodian mothers (13.2 vs 13; $p = 0.7$), agreeing with past research suggesting a universal maternal impulse to soothe an infant in similar ways.

The feeding environment in Cambodia offered significantly more distractions, particularly other people, and lasted a shorter length of time. Despite research suggesting high use of technology among mothers while breastfeeding, the feeding environment afforded to Canadian dyads was typically quiet, and mothers used various breastfeeding supports to optimize positioning, seemingly allowing for more mother-infant interaction.

Results of this study may have been impacted by social desirability bias, due to its observational nature, and in Canada, a taboo regarding breastfeeding in public. These results may also be an indication of need for cultural adaptation of the NCAFS for use in Cambodia, however, particularly with regards to maternal verbalness.

Results of this study highlight specific facets of responsiveness that are lacking in Cambodia and provides novel insights into how responsive breastfeeding practices differ cross-culturally among mothers and infants less than six months old. Despite previous evidence to support positive impacts of responsive feeding on cognitive and social development, and growth

and eating patterns, the clinical significance of differences in NCAFS scores across countries in this study is not clear. As such the long-term impacts of lower levels of responsiveness seen in Cambodia, particularly on eating behaviour and long-term outcomes such as childhood growth patterns, should be further investigated. To investigate these outcomes, further research should be particularly focussed on using interventions on highlighted areas, such as verbalness. In Canada, research should continue to explore responsiveness using the NCAFS in more diverse Canadian dyads such as minority ethnicities and those with lower socioeconomic status.

6.0 References

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7.0 Appendices

Appendix A: Recruitment poster (Nova Scotia, Canada)

Are you a breastfeeding
mom interested in research?

*We're exploring how mothers and babies interact
while breastfeeding, and are looking for participants!*

You may be
eligible to
participate if:

- you are 19-45 years old,
- you live in the Halifax area,
- your infant is aged ≤ 6 months, and
- your infant is exclusively/predominately breastfed

Contact the MAMA Lab to learn more:



(902) 943-5652



breastfeeding.videos@msvu.ca



Researchers will video-
record you breastfeeding
your baby at home, and
you'll fill out a short
questionnaire about your
family and eating.



**You'll receive \$15
for participating**



www.mamalab.ca



Study approved by the Mount Saint Vincent University
Research Ethics Board (#2018-120)

Appendix B: English study consent form



A cross-cultural assessment of the feeding environment and maternal-child interactions during breastfeeding in the first 6 months

CONSENT FORM

Study Investigators

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Introduction

You are invited to take part in the research study entitled *A cross-cultural assessment of the feeding environment and maternal-child interactions during breastfeeding in the first 6 months*. This form provides information about the study. Before you decide if you want to participate, it is important that you understand the purpose of the study, the risks and benefits, and what you will be asked to do. We will provide you with all of this information before asking for your authorization to participate. A member of the research team will be available to answer any questions you have. You may decide not to participate, or you may withdraw from the study at any time. Participation is entirely voluntary.

Potential Conflict of Interest

This study is to be completed by Dr. Kyly Whitfield and Mr. Hou Kroeun, researchers who study nutrition and infant feeding, who have no conflicts of interest to report.

Who is conducting the study?

Researchers in the Department of Applied Human Nutrition at Mount Saint Vincent University and Helen Keller International are conducting this study. A grant from Mount Saint Vincent University is funding this study.

Purpose of the research

Human milk is the optimal food for infants, and the only food recommended for the first 6 months. Despite this, breastfeeding is not the cultural norm in many high-income countries like Canada, where infant formula is more commonly fed to infants. An unsupportive culture around breastfeeding has been identified as a key barrier to improving breastfeeding outcomes in Nova Scotia. On the flip side, breastfeeding is normal, and expected, in low-income countries such as Cambodia. While there has been a lot of research exploring breastfeeding rates around the world, to date there have been no cultural comparisons of breastfeeding practices. Given the cultural, economic, and social differences between Canada and Cambodia, a cross-cultural comparison of breastfeeding practices may provide an opportunity to share ‘lessons learned’ between both countries that could fill a gap in our knowledge of breastfeeding globally.

We will ask to visit your home to video-record you breastfeeding your baby as you normally would. We have already video-recorded breastfeeding moms in Kampong Thom province, Cambodia. We will invite 50 Canadian and 50 Cambodian women to participate. Participation in this study is entirely voluntary and will not cost you anything. As a thank you for your time and participation, you will receive \$15 at the end of the visit.

Study Procedure

Who can participate?

You will chat with a member of the research team to determine if you can participate in this study.

You may be eligible to participate if:

- you are 19-45 years old,
- you currently live in the Halifax Regional Municipality in Nova Scotia,
- you had a normal most recent pregnancy (i.e. no known chronic conditions, no preeclampsia, gestational diabetes, etc),

- you delivered a singleton infant who was born without complications (e.g. low birth weight (<2.5 kg), tongue tie, cleft palate),
- your infant is between 11-25 weeks of age and is exclusively breastfed,
- you are willing for you and your baby to be video-recorded during a breastfeeding session.

What will participation in this study look like?

If you wish to participate in this study, we will ask to visit your home to video-record you breastfeeding your baby, as you normally would. The researcher will set up 3 video cameras in the space of your choosing: one camera will be focussed on your baby's face, one on your face, and one will be placed approximately 10-12 feet from you and your baby to capture the entire feed. The researchers will step away during the feeding session so that you and your baby can stick to your usual feeding practices. The researchers will give you a sign and ask you to hold it up at the beginning, and again at the end of the feed to signal the start and end of the video. Any video footage not within this feeding window will not be analysed and will be permanently deleted.

Either before or after the breastfeed, we will ask you to fill out a short questionnaire to collect information about you and your baby, including your age and how many children you have, and your baby's age and sex.

Taking part in this study is voluntary. You do not need to answer any questions that you don't feel comfortable answering. You may choose not to take part or may leave the study at any time and do not have to give a reason for your decision.

Confidentiality

Your confidentiality will be respected; your records will be kept in a locked cabinet in the Department of Applied Human Nutrition at Mount Saint Vincent University. The video recordings will be stored on a university-based, password-protected server. You will be assigned a unique study number as a participant in this study. Only this number will be used on any research-related information collected about you during the course of this study, so that your identity [i.e. your name or any other information that could identify you] as a participant in this study will be kept confidential. Information that contains your personal information (such as this consent form) will

remain only with the Principal Investigator. The list that matches your name to the unique study number that is used on your research-related information will not be removed or released.

Only the research team will view and analyze the videos recorded as part of this study. The results of the study may be presented at scientific meetings and/or published in a scientific journal. If the results are published, only group values will be reported. All data will be kept for a minimum of five years and then securely destroyed.

Option to use your videos for educational purposes

For the purposes of this research project, all videos will be viewed by the research team only.

However, some women may choose to provide permission for these videos to be used for educational purposes, such as showing clips of the videos in relevant university classes to teach students about infant feeding, or for the production of a future educational movie clip. For example, nutrition students may need to explain good feeding behaviours in their future careers; if we capture you interacting with your baby in a positive way, it could be a terrific, and highly memorable, teaching tool to help these students remember this positive behaviour. **Note that this is a possible secondary use of the video recordings and is in no way required for your participation in this study.** If you would like to provide this permission to use these videos, please indicate this on the last page of this consent form.

Risks

We do not believe there are any risks involved with participation in this study.

Benefits

You will not receive direct benefits from participating in this study. You will have the benefit on contributing to research; in this study we hope this information can be used to inform future research, or potentially even future education programs about the feeding of young children. If you would like, we will provide you with a copy of the feeding session videos through a password-protected online file-sharing system run through Mount Saint Vincent University.

Questions and further information

Participation is completely voluntary. Also, you have the option to stop participating and withdraw from the study at any time without any penalty or concern. If you have any questions or would like further information concerning this research, please do not hesitate to contact Dr. Kyly Whitfield, the Principal Investigator, at kyly.whitfield@msvu.ca, or by phone at (902) 457-5978. If you have questions about how this study is being conducted and wish to speak with someone who is not directly involved in the study, you may contact the MSVU Research Office at (902) 457-6350 or via e-mail at research@msvu.ca.

Participants Rights

By accepting the terms and conditions, you indicate that you have understood the information regarding participation in the research study and agree that you will participate. Again, you are free to withdraw from the study at any time. By accepting the terms and conditions, you indicate that you understand that for purposes of the research, if you choose to withdraw from the study at any time, you may do so without any problems. You also indicate that you are aware that the researchers may publish the study results in scientific journals, keeping your identity confidential. This study has been explained to you and you have been given the chance to ask questions about taking part in this study. If you have questions you can ask Dr. Kyly Whitfield at (902) 457-5978.

Research Results

If you wish, a summary of the study results can be provided. They will be available around one year after the end of the study. The ethical components of this research study have been reviewed by the University Research Ethics Board and found to be in compliance with Mount Saint Vincent University's Research Ethics Policy.

Consent Form for Research Participation

PARTICIPANT AUTHORIZATION:

I have read or had read to me this information and authorization form and have had the chance to ask questions which have been answered to my satisfaction before moving forward. I understand the nature of the study and I understand the potential risks. I understand that I have the right to withdraw from the study at any time without any problems. I have received a copy of the Consent Form for future reference. I freely agree to participate in this research study.

Name of Participant: _____ Date: _____

Signature: _____

Would you like to receive a summary of the study results when they are available?

____ Yes ____ No

Would you like to receive a copy of your feeding session video?

____ Yes ____ No

If yes to either, please include your email address below. Files will be shared through a secure, password-protected file sharing system called *OneDrive* housed at Mount Saint Vincent University:

Do you provide permission for the video-recordings of you and your baby to be repurposed for educational purposes (e.g. viewing in university classes, for the production of an educational video, etc) after the research study is complete?

____ Yes ____ No

Name of Participant: _____ Date: _____

Signature: _____

STATEMENT BY PERSON PROVIDING INFORMATION ON STUDY AND OBTAINING CONSENT

I have explained the nature and demands of the research study and judge that the participant named above understands the nature and demands of the study. I have explained the nature of the consent process to the participant and judge that they understand that participation is voluntary and that they may withdraw at any time from participating.

Name of Person Explaining Consent: _____

Date: _____ Signature: _____

Appendix C: English Cambodian study consent form

CONSENT FORM: A cross-cultural assessment of the feeding environment and maternal-child interactions during breastfeeding in the first 6 months



This form provides information about the study entitled *A cross-cultural assessment of the feeding environment and maternal-child interactions during breastfeeding in the first 6 months*. Before you decide if you want to participate, it is important that you understand the purpose of the study, the risks and benefits, and what you will be asked to do.

Who is conducting the study? Researchers in the Department of Applied Human Nutrition at Mount Saint Vincent University and Helen Keller International are conducting this study. A grant from Mount Saint Vincent University is funding this study. This study is to be completed by Dr. Kyly Whitfield and Mr. Hou Kroeun, researchers who study nutrition and infant feeding, who have no conflicts of interest to report.

Purpose of the research: Human milk is the optimal food for babies, but infant formula is a more common food in many high-income countries like Canada. An unsupportive culture around breastfeeding is a key barrier to improving breastfeeding rates in high-income countries like Canada. On the flip side, breastfeeding seems to be normal, and expected, in low-income countries like Cambodia. To date there have been no cultural comparisons of actual breastfeeding practices between high- and low- or middle-income countries. Given the cultural, economic, and social differences between Canada and Cambodia, a cross-cultural comparison of breastfeeding practices may provide an opportunity to share ‘lessons learned’ between both countries

We will ask to visit your home to video-record you breastfeeding your baby as you normally would. We will invite 50 Canadian and 50 Cambodian women to participate. Participation in this study is entirely voluntary and will not cost you anything. As a thank you for your time and participation, you will receive a gift of a sarong and laundry soap at the end of the visit.

Study Procedure

Who can participate?

To participate in this study you must simply already be a participant in the ongoing study entitled *Trial of thiamine supplementation in Cambodia*.

What will participation in this study look like?

If you wish to participate in this study, we will ask to visit your home to video-record you feeding your baby, as you normally would. The researcher will set up 3 video cameras in the space of your choosing: one camera will be focussed on your baby’s face, one on your face, and one will be placed approximately 10-12 feet from you and your baby to capture the entire feed. The researchers will step away during the feeding session so that you and your baby can stick to

your usual feeding practices. The researchers will give you a sign and ask you to hold it up at the beginning, and again at the end of the feed to signal the start and end of the video. Any video footage not within this feeding window will not be analysed and will be permanently deleted. We will access some information about you and your baby that we already collected at the very beginning of the study, including your age and how many children you have, and your babies age and sex. Taking part in this study is voluntary. You may choose not to take part or may leave the study at any time and do not have to give a reason for your decision.

Confidentiality

Your confidentiality will be respected; your records will be saved on a secure digital platform, a university-based, password-protected server. You have been assigned a unique study number as a participant in this study. Only this number will be used on any research-related information collected about you during the course of this study, so that your identity [i.e. your name or any other information that could identify you] as a participant in this study will be kept confidential. Information that contains your personal information (such as this consent form) will remain only with the Principal Investigator. The list that matches your name to the unique study number that is used on your research-related information will not be removed or released. Only the research team will view and analyze the videos recorded as part of this study. The results of the study may be presented at scientific meetings and/or published in a scientific journal. If the results are published, only group values will be reported. All data will be kept for a minimum of five years and then securely destroyed.

Option to use your videos for educational purposes

For the purposes of this research project, all videos will be viewed by the research team only. However, some women may choose to provide permission for these videos to be used for educational purposes, such as showing clips of the videos in relevant university classes to teach students about infant feeding, or for the production of a future educational movie clip. Note that this is a possible secondary use of the video recordings, and is in no way required for your participation in this study. If you would like to provide this permission to use these videos, please indicate this on the last page of this consent form.

Risks and Benefits

We do not believe there are any risks involved with participation in this study. You will not receive direct benefits from participating in this study. You will have the benefit of contributing to research; in this study we hope this information can be used to inform future research, or potentially to improve breastfeeding practices in high-income countries like Canada.

What happens after the study finishes?

We will return to your village after the study is complete to share the results of the study.

Questions and further information

Participation is completely voluntary. Also, you have the option to stop participating and withdraw from the study at any time without any penalty or concern.

If you have any questions or would like further information concerning this research, please do not hesitate to contact study co-investigator Mr. Hou Kroeun at XXX XXX XXX.

If you have questions about how this study is being conducted and wish to speak with someone who is not directly involved in the study, you may contact the MSVU Research Office at +1 902 457-6350 or via e-mail at research@msvu.ca

BILL & MELINDA
GATES foundation

The Sackler Institute
for Nutrition Science
The New York Academy of Sciences

MOUNT
SAINT VINCENT
UNIVERSITY

Helen Keller
INTERNATIONAL



UNIVERSITY
OF OREGON



SAHMRI

The Sackler Institute
for Nutrition Science
The New York Academy of Sciences

Consent Form for Research Participation

I have listened to, or read, and understood the information provided on this consent form.

I have had sufficient time to consider the information provided and to ask for advice (if needed).

I have had the opportunity to ask questions and have received a satisfactory response to my questions.

I understand that all of the information collected will be kept confidential and that the results of this study will only be used for scientific objectives.

I understand that participation in this study is voluntary and that I am completely free to refuse to participate or to withdraw from this study at any time.

I understand that I am not waiving any of my legal rights as a result of signing this consent form.

I have listened to, or read, the information on this form and I freely consent to participate in this study.

I have been told that I will receive a dated and signed copy of this form.

I consent to myself and my infant participating in this study.

Participant's name

Child's name

Signature

Date

Do you provide permission for the video-recording of you and your baby to be repurposed for educational purposes (e.g. viewing in university classes, for the production of an educational video, etc) after the research study is complete?

☐ Yes

☐ No

_____ Signature	_____ Date
--------------------	---------------

Name of person obtaining consent
consent

Signature of person obtaining

Appendix D: Study questionnaire

Staff Use Only

Subject ID: _____

Date: (DD/MM/YYYY) ____ / ____ / ____

Time: ____ : ____ AM / PM

SECTION 1: SOCIODEMOGRAPHIC INFORMATION

1. What is your date of birth? (DD/MM/YYYY)
____ / ____ / ____
2. What is your marital status?
 - a. Married
 - b. Common-law
 - c. Divorced/Separated
 - d. Single
 - e. Other: _____
 - f. Prefer not to answer
3. **You** may belong to one or more racial or cultural groups on the following list. Are you:
(Please check all that apply.)

☐ White	☐ West Asian (e.g. Afghan, Iranian)
☐ Chinese	☐ Japanese
☐ South Asian (e.g. East Indian, Pakistani, Sri Lankan)	☐ Korean
☐ Black	☐ First Nations (North American Indian)
☐ Filipino	☐ Métis
☐ Latin American	☐ Inuk (Inuit)
☐ Southeast Asian (e.g. Cambodian, Indonesian, Laotian, Vietnamese)	☐ Other: _____
☐ Arab	☐ Don't know
	☐ Prefer not to answer
4. **Your baby** may belong to one or more racial or cultural groups on the following list. Is he or she: (Please check all that apply.)

☐ White	☐ West Asian (e.g. Afghan, Iranian)
☐ Chinese	☐ Japanese
☐ South Asian (e.g. East Indian, Pakistani, Sri Lankan)	☐ Korean
☐ Black	☐ First Nations (North American Indian)
☐ Filipino	☐ Métis
☐ Latin American	☐ Inuk (Inuit)
☐ Southeast Asian (e.g. Cambodian, Indonesian, Laotian, Vietnamese)	☐ Other: _____
☐ Arab	☐ Don't know
	☐ Prefer not to answer

5. What is the highest level of education you have completed?
 - a. Some high school education
 - b. High school diploma
 - c. College degree
 - d. Undergraduate degree
 - e. Graduate degree
 - f. Other: _____
 - g. Prefer not to answer

6. What is your household's total annual income?
 - a. Less than \$10,000
 - b. 10,000 to \$19,999
 - c. \$20,000 to \$29,999
 - d. \$30,000 to \$39,999
 - e. \$40,000 to \$49,999
 - f. \$50,000 to \$59,999
 - g. \$60,000 to \$69,999
 - h. \$70,000 to \$79,999
 - i. \$80,000 to \$89,999
 - j. \$90,000 to \$99,999
 - k. \$100,000 to \$149,999
 - l. \$150,000 or more
 - m. Prefer not to answer

SECTION 2: ANTENATAL CARE AND DELIVERY

7. How many pregnancies have you had? _____ pregnancies

8. How many live births have you had? _____ births

9. Infants date of birth (DD/MM/YYYY): _____ / _____ / _____

10. Infant sex:
 - a. Male
 - b. Female

11. Infant birth weight: _____ kg OR _____ lb and _____ oz

12. Infant birth length: _____ cm / inches (*circle one*)

13. Infant head circumference at birth: _____ cm / inches (*circle one*)

SECTION 3: INFANT AND YOUNG CHILD FEEDING PRACTICES

14. Who is your infant's primary caregiver?
 - a. Yourself (mother)
 - b. Other: _____

15. What foods has your baby ever eaten? *(Please check all that apply.)*

- | | |
|--|---|
| ☐ breast milk | ☐ almond milk |
| ☐ breast milk substitute (infant formula) | ☐ medicine, such as oral rehydration salts |
| ☐ water | ☐ baby food |
| ☐ cow's milk | ☐ other solid food |
| ☐ goat's milk | ☐ other: _____ |
| ☐ soy milk | |

16. Which foods did your infant consume in the last week? *(Please check all that apply.)*

- | | |
|--|---|
| ☐ breast milk | ☐ almond milk |
| ☐ breast milk substitute (infant formula) | ☐ medicine, such as oral rehydration salts |
| ☐ water | ☐ baby food |
| ☐ cow's milk | ☐ other solid food |
| ☐ goat's milk | ☐ other: _____ |
| ☐ soy milk | |

17. How often in the last week did your infant consume food or drink **other than** breastmilk?

Answer '0' if baby is exclusively breastfed _____ instances

Thank you for your participation!

Appendix E: NCAST Caregiver/Parent-Child Feeding Scale letter of reliability



December 11, 2019

Hillary Fry,

Congratulations upon successfully completing your reliability in the NCAST Feeding scale and for your pursuit of excellence in your practice.

Please keep this with your records, as this will be your only official verification of your NCAST Feeding scale certification at the practice level.

Good luck with your work.

Sincerely,

Denise Findlay
Director of Education



University of Washington • School of Nursing • Center on Human Development and Disability • Box 357920
Seattle, WA 98195-7920 • 206-543-8528 • FAX 206-685-3284 • e-mail: pcrp@uw.edu •
www.pcrprograms.org

**START VIEWING
VIDEO**



**STOP VIEWING
VIDEO**



Appendix G: Breastfeeding Video Translation Form

Participant ID:

Date of Translation:

Name of Translator:

Time	Khmer to English translation	Mom's tone was:
		☐ Happy ☐ Angry ☐ Neutral
		☐ Happy ☐ Angry ☐ Neutral
		☐ Happy ☐ Angry ☐ Neutral
		☐ Happy ☐ Angry ☐ Neutral
		☐ Happy ☐ Angry ☐ Neutral
		☐ Happy ☐ Angry ☐ Neutral
		☐ Happy ☐ Angry ☐ Neutral

1. a) Did Mom sing?	☐ Yes ☐ No	
b) What did she sing about?		
2. Mom praises the child or the child's behaviour	☐ Yes ☐ No	Ex. <i>"You have such a nice smile"</i> <i>"You're such a good girl today"</i>
3. Caregiver avoids consistent use of baby talk during the feeding.	☐ Yes ☐ No	Consistently and intentionally mispronounces words or uses improper grammar. Ex. <i>"do you want your milky-wilky?"</i>

Appendix H: MSVU REB Certificate of Ethics Clearance



University Research Ethics
Board (UREB)

Certificate of Research Ethics Clearance

☒ Clearance	☐ Secondary Data Clearance	☐ Renewal	☐ Modification	☐ Change to Study Personnel
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Effective Date	January 21, 2018	Expiry Date	January 20, 2020
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File #:	2018-120
Title of project:	A cross-cultural assessment of the feeding environment and maternal-child interactions during breastfeeding in the first 6 months
Researcher(s):	Kyly Whitfield
Supervisor (if applicable):	n/a
Co-Investigators:	Hou Kroeun
Version :	1

The University Research Ethics Board (UREB) has reviewed the above named research proposal and confirms that it respects the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* and Mount Saint Vincent University's policies, procedures and guidelines regarding the ethics of research involving human participants. This certificate of research ethics clearance is valid for a period of **one year** from the date of issue.

Researchers are reminded of the following requirements:	
Changes to Protocol	Any changes to approved protocol must be reviewed <u>and</u> approved by the UREB prior to their implementation. Form: REB.FORM.002 Info: REB.SOP.113 Policy: REB.POL.003
Changes to Research Personnel	Any changes to approved persons with access to research data must be reported to the UREB immediately. Form: REB.FORM.002 Info: REB.SOP.113 Policy: REB.POL.003
Annual Renewal	Annual renewals are contingent upon an annual report submitted to the UREB prior to the expiry date as listed above. You may renew up to four times, at which point the file must be closed and a new application submitted for review. Form: REB.FORM.003 Info: REB.SOP.116 Policy: REB.POL.003
Final Report	A final report is due on or before the expiry date. Form: REB.FORM.004 Info: REB.SOP.116 Policy: REB.POL.003
Privacy Breach	Researchers must inform the UREB immediately and submit the Privacy Breach form. The breach will be investigated by the REB and the FOIPOP Officer. Form: REB.FORM.015
Unanticipated Research Event	Researchers must inform the UREB immediately and submit a report to the UREB within seven (7) working days of the event. Form: REB.FORM.008 Info: REB.SOP.115 Policy: REB.POL.003
Adverse Research Event	Researchers must inform the UREB immediately and submit a report to the UREB within two (2) working days of the event. Form: REB.FORM.007 Info: REB.SOP.114 Policy: REB.POL.003

*For more information: <http://www.msvu.ca/ethics>

Daniel Seguin, Chair
University Research Ethics Board

Halifax Nova Scotia B3M 2J6 Canada
Tel 902 457 6350 • msvu.ca/ethics

Appendix I: NECHR Ethics Clearance Certificate

9



ព្រះរាជាណាចក្រកម្ពុជា
KINGDOM OF CAMBODIA
ជាតិ សាសនា ព្រះមហាក្សត្រ
NATION RELIGION KING

ធ្វើនៅ ភ្នំពេញ ថ្ងៃ ទី ២២ ខែ កុម្ភៈ ឆ្នាំ ២០១៩
Phnom Penh, February 22, 2019

Dr. Kyly Whitfield

Project: Request for amendment of the study protocol entitled: "Trial of thiamine supplementation in Cambodia. Version N° 2.1, dated 24th July 2018" to "Trial of thiamine supplementation in Cambodia. Version N°3.1, dated 15th January 2019"

Reference: 22nd February 2019 NECHR meeting minute

Dear Dr. Kyly Whitfield,

I am pleased to notify you that your request for amendment of the study protocol entitled: "Trial of thiamine supplementation in Cambodia. Version N° 2.1, dated 24th July 2018" to "Trial of thiamine supplementation in Cambodia. Version N°3.1, dated 15th January 2019" has been approved by National Ethics Committee for Health Research (NECHR) in the meeting on 22nd February 2019. This approval is valid for twelve months after the approval date.

The Principal Investigator of the project shall submit following document to the committee's secretariat at the National Institute of Public Health at #80 Samdach Penn Nouth Blvd, Sangkat Boeungkok2, Khan Tuol Kok, Phnom Penh. (Tel: 012-842-442, 012-528-789, 012-203-382. Email: sarayvannat@gmail.com, nouthsarida@gmail.com):

- Annual progress report
- Final scientific report
- Patient/participant feedback (if any)
- Analyzing serious adverse events report (if applicable)

The Principal Investigator should be aware that there might be site monitoring visits at any time from NECHR team during the project implementation and should provide full cooperation to the team.

Regards,

Chairman

Prof. ENG HUOT