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Knowledge and Attitudes Towards Breastfeeding Among Medical Students at Memorial University

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Abstract

Breastfeeding has many short term and long term health benefits to mothers and children, yet not all mothers in Canada initiate breastfeeding. Physicians' support has been shown to improve breastfeeding rates, yet many physicians have poor knowledge and skills about breastfeeding. Improving breastfeeding education at an undergraduate level in medical school may lead to improved breastfeeding knowledge amongst physicians.

This thesis explores medical students' knowledge and attitudes towards breastfeeding at Memorial University. A previously validated questionnaire was administered to first and second year medical students at Memorial University to examine their knowledge and attitudes towards breastfeeding. A descriptive qualitative study was conducted with breastfeeding educators at Memorial University to examine knowledge gaps within the breastfeeding curriculum.

Medical students were found to have positive attitudes towards breastfeeding, yet limited knowledge. Students from rural areas had the highest attitude scores, whereas second year students had the highest knowledge scores. Breastfeeding educators noted many curriculum gaps in breastfeeding education, and provided suggestions to improve the curriculum. This study was the first to examine medical students' knowledge and attitudes towards breastfeeding in Canada. The study was conducted in the Province of Newfoundland and Labrador, which has the lowest breastfeeding initiation rate in Canada. During the time of this study, undergraduate curriculum refinement was occurring at the medical school of Memorial University. Thus the findings of this study may lead to potential curricular improvements at Memorial University.

Keywords

Breastfeeding, medical students, medical education, descriptive qualitative

Summary for Lay Audience

Breastfeeding has many short term and long term health benefits to mothers and children, yet not all mothers in Canada initiate breastfeeding. Physicians' support has been shown to improve breastfeeding rates, yet many physicians have poor knowledge and skills about breastfeeding. Improving breastfeeding education in medical school may lead to improved breastfeeding knowledge amongst physicians.

This thesis explores medical students' knowledge and attitudes towards breastfeeding at Memorial University. A questionnaire was administered to first and second year medical students at Memorial University to examine their knowledge and attitudes towards breastfeeding. Interviews were then conducted with breastfeeding educators at Memorial University to examine knowledge gaps within the breastfeeding curriculum.

Medical students were found to have positive attitudes towards breastfeeding, yet limited knowledge. Students from rural areas had the highest attitude scores, whereas second year students had the highest knowledge scores. Breastfeeding educators noted many curriculum gaps in breastfeeding education, and provided suggestions to improve the curriculum. This study was the first to examine medical students' knowledge and attitudes towards breastfeeding in Canada. The study was conducted in the Province of Newfoundland and Labrador, which has the lowest breastfeeding initiation rate in Canada. During the time of this study, undergraduate curriculum refinement was occurring at the medical school of Memorial University. Thus the findings of this study may lead to potential curricular improvements at Memorial University.

Co-Authorship Statement

This thesis and both studies were developed, planned, conducted, and written by the author.

The following contributions were made:

Dr. Amanda Terry, Dr. Sudha Koppula and Dr. Merrick Zwarenstein supervised the thesis project. Drs. Terry and Koppula were involved in the analysis of qualitative interviews. Drs. Terry, Koppula and Zwarenstein provided guidance and advice throughout the planning, execution and analysis, of the studies along with editorial advice.

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Chapter 1

1 Thesis introduction

Breastfeeding is associated with a reduction in acute and chronic illnesses such as communicable diseases, respiratory infections, obesity, hypertension and diabetes (American Association of Pediatrics, 2012; Horta & Victoria, 2013a; Horta & Victoria, 2013b). Newfoundland and Labrador is a unique province as it has the highest rates of diabetes, hypertension and obesity in Canada, and the lowest rates of breastfeeding initiation.

Traditional prevention measures to reduce chronic diseases have recommended lifestyle changes, such as healthy eating and exercise (Diabetes Canada Clinical Practice Guidelines Expert Committee, 2018; Leung, et al., 2016), yet these strategies have not curbed the rates of these diseases in Newfoundland and Labrador. Promoting breastfeeding initiation and duration could be another way to improve the health of the population in the province by reducing rates of obesity, hypertension and diabetes.

Improving breastfeeding rates in Newfoundland and Labrador requires a multipronged approach, which includes improved communication, public awareness and implementation of the World Health Organization breastfeeding initiatives (Provincial Perinatal Program of Newfoundland and Labrador, 2014). Enhancing the knowledge and support of physicians who assist breastfeeding mothers and babies has also been shown to improve breastfeeding rates (Bentley et al., 1999; Brodribb, Fallon, Hegney, & O'Brien, 2007; Brodribb, Fallon, Jackson, & Hegney, 2008, 2009; 2010; Brodribb, 2012; Li, Zhang, Scott, & Binns, 2004; Taveras, Capra, Braveman, Jensvold, & Lieu, 2003) This education can begin in medical school by advancing undergraduate medical education and ensuring all medical students receive adequate educational opportunities.

Attitudes in medical students are acquired through personal experiences in their social and physical worlds (Breckler & Wiggins, 1989). Attitudes help shape how knowledge is retained and applied (Bandura, 1977, 1986; Baron & Byrne, 1991). Medical students are now graduating in their mid to late twenties (The Association of Faculties of Medicine of

Canada, 2015), meaning they have already amassed many life experience which have molded their attitudes. Understanding medical students' attitudes towards breastfeeding is equally important for both guiding the medical school curriculum, and in shaping future Newfoundland and Labrador physicians into supportive breastfeeding advocates.

There is a paucity of literature in North America pertaining to medical students' knowledge and attitudes towards breastfeeding. Breastfeeding knowledge and attitudes among medical students have never been studied in Canada. This gap in the literature, coupled with low breastfeeding rates in this province, point to the need to explore the knowledge and attitudes of medical students in Newfoundland and Labrador.

1.1 Purpose of the thesis

This thesis explored medical students' knowledge and attitudes towards breastfeeding and determined whether there were differences in knowledge and attitudes of subgroups of students, such as those from rural and urban areas in Newfoundland and Labrador. Educational gaps within Memorial University's medical school breastfeeding curriculum were identified by interviewing local breastfeeding educators who are actively involved with teaching medical students.

Questionnaires were administered to first and second-year medical students at Memorial University to determine their knowledge and attitudes towards breastfeeding. Instructors involved in delivering Memorial University's medical school curriculum were interviewed to identify corresponding gaps within breastfeeding education at Memorial University.

The research questions for this thesis were: What are the knowledge and attitudes towards breastfeeding among first and second year Memorial University medical students? What are the gaps in breastfeeding knowledge in undergraduate medical education at Memorial University?

1.2 Terms and definitions

Terms that are used to describe breastfeeding in this thesis are consistent with those used by the World Health Organization. Breastfeeding initiation is defined as at least one attempt to breastfeeding following delivery (World Health Organization, Unicef, 2018). Some mothers choose to feed their newborn non-breastmilk supplements (usually infant formula) following this initial feed, such that they would no longer be exclusively breastfeeding. They would, however, fall in the definition of having initiated breastfeeding.

Breastfeeding duration is typically described as the number of mothers who exclusively breastfeed their infant at six months (World Health Organization, Unicef, 2018).

Medical students have varying lengths of undergraduate medical education. In Canada, medical school programs vary between three to four years, while in other countries, the curriculum may span six years. For this study, students who learn primarily in non-clinical settings (lectures, small groups, workshops) are defined as junior medical students. Students who learn mostly in clinical settings (clerkship) are defined as senior medical students.

1.3 Thesis study design

In this thesis, two separate studies were conducted: one quantitative and one qualitative. A quantitative approach was employed to examine undergraduate medical students' attitudes and knowledge towards breastfeeding at Memorial University, and determine if there were differences in subgroups of medical students, such as students from rural and urban areas. A qualitative approach was used to examine knowledge gaps in breastfeeding education within the undergraduate medical curriculum at Memorial University by interviewing key educators.

For the quantitative study, a cross-sectional questionnaire of first and second year medical students at Memorial University was conducted to explore their attitudes and knowledge towards breastfeeding. A scale previously validated with family physicians and family medicine residents was employed. Descriptive analyses were conducted to

describe the sample. Bi-variate analyses were conducted to explore if subgroups of medical students had different attitudes or knowledge scores. Finally, multiple linear regression was employed to explain the variance in knowledge and attitude scores.

For the descriptive qualitative study, breastfeeding educators at Memorial University involved with teaching or curriculum development were identified and interviewed. A semi-structured interview guide was utilized. Knowledge gaps within the undergraduate curriculum were examined, as well as potential solutions to improve breastfeeding education at Memorial University. Following verbatim transcription, transcripts and field notes were reviewed and independently coded by the research team. Initial codes were used to develop a coding template which was applied to the rest of the interviews and iteratively refined. Emerging key themes and subthemes were discussed with the research team. Sufficient data for analysis and saturation of the main themes were obtained by the tenth interview.

1.4 Thesis structure

The goal of this study was to understand the attitudes of knowledge of medical students towards breastfeeding; to understand curricular gaps in breastfeeding education; to ultimately make recommendations to improve the breastfeeding curriculum at Memorial University.

The current chapter introduces the overall topic, study design and structure of the thesis.

Chapter two reviews the literature on breastfeeding benefits and discusses the importance of knowledge and attitudes amongst medical students and future physicians. Learning theories in adult education are outlined, along with recommendations from the literature regarding the improvement of knowledge and attitudes of medical students towards breastfeeding.

Chapter three details the quantitative study, including methodology, findings and discussion. The purpose of this study was to determine the knowledge and attitudes towards breastfeeding in first and second year medical students at Memorial University. Differences in knowledge and attitudes between subgroups of medical students are also

described and analyzed. Findings of this study are compared and contrasted with similar studies in the literature.

Chapter four details the qualitative study, including methodology, findings and discussion. The purpose of this study was to determine the gaps in medical education as noted by local breastfeeding educators. Breastfeeding educators at the medical school were interviewed to determine educational gaps related to breastfeeding at Memorial University and to offer suggestions for future curriculum development. Findings of this study are compared and contrasted with similar studies in the literature.

Chapter five integrates the findings of both studies and compared and contrasted the key findings. Recommendations for curricular refinement from the perspectives of medical students and educators are discussed.

Chapter 2

2 Literature review

The World Health Organization recommends exclusive breastfeeding for the first six months of an infant's life, with continuation up to two years of age and beyond (World Health Organization, Unicef, 2018).

Breastfeeding has many benefits for the mother and the baby and is associated with a reduction of acute and chronic illnesses (American Association of Pediatrics, 2012; Horta & Victoria, 2013a; Horta & Victoria, 2013b). In the short term, mothers have reduced risk of postpartum bleeding and an earlier return to pre-pregnancy weight (American Association of Pediatrics, 2012). The long term benefits for mothers include reduced risk of ovarian and breast cancers (American Association of Pediatrics, 2012; World Health Organization, 2017). In the short term, the infant receives protection from gastrointestinal infections, respiratory infections, necrotizing enterocolitis, otitis media, and urinary infections (American Association of Pediatrics, 2012; Horta & Victoria, 2013a; World Health Organization, 2017). There is also a reduction in hospital admissions and morbidity and mortality from respiratory infections and diarrhea across all income settings (Horta & Victoria, 2013a). A large meta-analysis on the long term effects of breastfeeding showed substantial protection from diabetes and obesity in breastfed children and adults (Horta & Victoria, 2013b). There was also a small protective effect in terms of blood pressure reduction (Horta & Victoria, 2013b). Children who are breastfed are less likely to develop lymphoma, leukemia and Hodgkins disease (American Association of Pediatrics 2012). Breastfeeding also causes a modest increase in intelligence testing scores (Horta & Victoria, Long-term effects of breastfeeding: a systematic review, 2013b).

Despite all the benefits provided by breastfeeding, not all women in choose to breastfeed. Breastfeeding initiation, defined as at least one attempt to breastfeed varies between countries. In Canada, the breastfeeding initiation rate is 89%, while initiation rates are

74% in the United States, 81% in the United Kingdom, 92% in Australia, 93% in Jordan, 94% in Pakistan, 96% in India, and 96% in Egypt (Unicef, 2018).

Although 89% of women attempt to initiate breastfeeding with their newborn, breastfeeding rates decline after the first weeks of life, with only 26% of mother breastfeeding exclusively at six months (Statistics Canada, 2012). Newfoundland and Labrador has the lowest breastfeeding initiation rate in Canada. In 2015, breastfeeding initiation was 69.6% in this province, with rates ranging from 45-80%. Urban areas tended to have higher initiation rates than rural (Provincial Perinatal Program of Newfoundland and Labrador, 2014). The breastfeeding duration rate at six months in Newfoundland and Labrador was 16% (Provincial Perinatal Program of Newfoundland and Labrador, 2014).

The medical school at Memorial University has a mandate to accept at least 75% of students born in Newfoundland and Labrador (Associate Dean of Admissions, 2017). Between 2011 and 2016, up to 49% of the medical students were from rural communities (Associate Dean of Admissions, 2017). Almost half of the physicians in Newfoundland and Labrador graduated from medical school at Memorial University (Newfoundland and Labrador Medical Association, 2010). Breastfeeding initiation and duration are both improved by the knowledge and support of physicians who assist mothers in postpartum care (Bentley et al., 1999; Brodribb et al, 2009; Li et al, 2004; Taveras et al, 2003). Understanding the knowledge and attitudes that accompany these students in their medical training might be a significant contributor to explain why breastfeeding initiation rates are lower in this province than in all others. In turn, this may help shape the education of these future physicians.

2.1 Importance of breastfeeding knowledge

The knowledge, skill and support provided by physicians leads to increased breastfeeding initiation and duration rates (Bentley, et al., 1999; Brodribb et al., 2009; Li et al. 2004; Taveras et al., 2003). In order for medical professionals to provide adequate breastfeeding support, there is an expectation to attain competency in breastfeeding medicine. The World Health Organization states that all levels of health care

professionals require adequate knowledge and skills of breastfeeding to help promote and support breastfeeding (World Health Organization, Unicef, 2018). When the World Health Organization asked countries about breastfeeding education in medical and nursing schools, however, incorporating breastfeeding education was found to be insufficient and the World Health Organization has identified breastfeeding education as a gap in the research:

> the available evidence about breastfeeding education and training of health workers in the knowledge, attitudes, skills and competence needed to work effectively with breastfeeding parents is limited and of poor quality. Further research is required to compare different durations, content (including clinical and practical skills) and modes of training delivery, in order to meet minimum competency to address common breastfeeding challenges. (World Health Organization, Unicef, 2018)

The College of Family Physicians of Canada advises physicians to promote and support breastfeeding, and note that breastfeeding is "an endangered natural resource" (The College of Family Physicians of Canada, 2011).

The Canadian Pediatric Society issued a joint statement with Dieticians of Canada, Breastfeeding Committee for Canada and Government of Canada in 2015. Several recommendations were given to connect with expectant and new mothers to educate them about breastfeeding (Health Canada, 2015) and textbook information was provided for medical schools.

The Academy of Breastfeeding Medicine in the United States recommends that "all physicians, regardless of discipline, should have basic knowledge and skills in breastfeeding" and that breastfeeding education should be incorporated into medical school curricula (Liebert, 2011). Recommendations were made to incorporate breastfeeding into undergraduate medical education, including biological and cultural aspects of breastfeeding (Liebert, 2011).

Finally, the Medical Council of Canada, which provides licensing exams for the practice of medicine in Canada, assesses breastfeeding knowledge during these exams (Examination Objectives Overview. Medical Council of Canada, 2019).

Medical students study breastfeeding at Memorial University in their first year in large and small group formats in a two hour session. During clinical experience (clerkship, electives), they may also be exposed to breastfeeding dyads. The breastfeeding education may be different for each student, depending on the clinical experience.

2.2 Importance of breastfeeding attitudes

Attitudes are described as "enduring mental representations of various features of the social or physical world. They are acquired through life experiences, and they exert a direct influence upon behavior" (Breckler & Wiggins, 1989). Attitudes may stem from personal experiences, observation of others, and communication with others. Depending on the situation or experience, the resulting positive or negative appraisal influences attitudes.

There are many health benefits of breastfeeding, and it is how our society survived infanthood before the introduction of commercial formula. Breastfeeding should be perceived as normal, even though resistance towards breastfeeding is common in our society (Pound, Moreau, Hart, Ward, & Plint, 2015). When considering breastfeeding, the appraisal of the experience occurs at a cognitive and emotional level. A person may certainly be aware of the health benefits of breastfeeding, but have a negative emotional response due to aversive experiences associated with it, which in turn shapes attitude (Bandura, 1977, 1986; Baron & Byrne, 1991).

Physician attitudes towards breastfeeding "drastically impact the frequency and duration of their patients' breastfeeding experience" (Gary, Birmingham, & Jones, 2017). Health professionals, including medical students, have an important role in the mother's breastfeeding decision (Smith, 2009). Health care workers involved in the care of infants and their parents must recognize the importance of breastfeeding and translate their knowledge to their patients (Pound & Unger, 2015). Women are less likely to breastfeed if their physician does not support breastfeeding, whether this is due to encouraging formula feeding or not expressing an opinion about breastfeeding (Bentley et al., 1999; DiGirolamo, Grummer-Strawn, & Fein, 2013).

University aged students, including medical students, recognize the importance of breastfeeding their future children, but still experience resistance (Fairbrother & Stranger-Ross, 2019; Pound et al., 2015) to breastfeeding themselves. Medical students have a variety of educational backgrounds and experiences prior to studying medicine. Understanding these backgrounds and experiences may help us comprehend how they are shaped into physicians. Attitudes towards breastfeeding could better guide our medical school curriculum to shape future Newfoundland and Labrador physicians into supportive breastfeeding advocates. Strong health care advocates will help normalize breastfeeding in the province.

2.3 Knowledge and attitudes of breastfeeding in medical students

There is a paucity of literature in Canada pertaining to medical students' knowledge and attitudes towards breastfeeding. International research, however, has explored the knowledge and attitudes of medical students towards breastfeeding. Studies have been conducted in Pakistan (Anjum, Ashfaq, & Siddiqui, 2007), Australia (Brodribb et al., 2010), Egypt (Abdel-Hady, Eladawi, & El-Gilany, 2013), Jordan (Khriesat, et al., 2014), Saudi Arabia (Amin, Abdulrahman, Al Muhaidib, & Al Hamda, 2014), India (Kakrani, Rathod Waghlea, Mammulwar, & Bhawalkar, 2015), the United Kingdom (Bali, Jacob, & Fertleman, 2015), the United States (Gary et al., 2017), and Lebanon (Moukarzel, et al., 2018).

A cross sectional survey on medical students in all years of training in Pakistan also showed a low level of breastfeeding knowledge, although senior medical students had more knowledge than junior (Anjum et al., 2007). There was no information on the validation of the scale, and attitudes were not assessed. Most students did know that breastfeeding should begin immediately after birth (61% in junior) and breastfeeding prevents gastrointestinal and upper respiratory illnesses (70% in junior).

Senior Australian medical students were found to have positive attitudes towards breastfeeding, but a lack of knowledge and a reluctance to encourage breastfeeding (Brodribb et al., 2010). Medical students felt mothers should breastfeed, but if the

decision was made not to breastfeed, the physician should support this decision. The medical students were aware of the unique composition of breastmilk, but not aware of reduction of morbidity and mortality amongst breastfed infants. Some medical students believed physicians should support and encourage breastfeeding, others felt that it was an individual decision.

Female junior and senior medical students were surveyed in Egypt on their knowledge of breastfeeding. The self-administered questionnaire was tested for temporal stability and readability. The students' knowledge about the benefits of breastfeeding was quite high, for example, 98% knew breastmilk is easier to digest than formula. The knowledge of breastfeeding in special situations (for example after a twin delivery) and initiation of breastfeeding (when to wean) were lower. Junior and senior medical students were compared, senior medical students had significantly higher knowledge of initiation of breastfeeding and benefits of breastfeeding, and some examples of breastfeeding in special situations (Abdel-Hady et al., 2013).

Senior medical students in Jordan were randomly surveyed after pediatrics lectures to study their knowledge and attitudes towards breastfeeding. The survey was based on a tool previously validated on midwives in Scotland, which was previously shown to be reliable and valid (Ingram, 2006). The results were compared by sex and if the subject had children. Khriesat (2014) found that medical students in their final year of study were not equipped to counsel breastfeeding patients. Knowledge was significantly better for female students with children in some instances, such as growth patterns and jaundice. Attitude scores were generally positive, with significantly more male medical students feeling the father would be left out by breastfeeding, and significantly more female medical students feeling breastfeeding provides additional benefits over formula (Khriesat, et al., 2014)

Amin studied knowledge and attitudes of senior and junior medical students (excluding first year students) using the validated Iowa Infant Feeding Attitude Scale (IIFAS), which was translated into Arabic and a knowledge scale previously validated in Saudi Arabia (Amin et al., 2014). Both scales were piloted with good internal consistency and validity.

Medical students had positive attitudes towards breastfeeding. With the exception of duration of breastfeeding, knowledge scores were low and demonstrated misconceptions of breastfeeding (Amin et al., 2014).

Breastfeeding knowledge was studied in senior medical students in India by assessing their knowledge of the ten Baby-Friendly Hospital Initiative (BFHI) steps (Kakrani, et al., 2015). The survey questions were validated. The BFHI was introduced in 1991 as a manner of encouraging breastfeeding within hospitals. The majority of the senior medical students were aware of the ten steps, but did not understand the policy or community supports. In terms of breastfeeding knowledge, there was an acceptable level of knowledge of skin to skin, counselling and no supplementation; knowledge was much lower in rooming in, cues to breastfeed and pre and post-natal information (Kakrani et al., 2015).

Senior medical students in England were surveyed during their pediatric rotation in a teaching hospital. Medical students showed a lack of confidence and competence in their breastfeeding knowledge (Bali et al., 2015). No information was given on validation of Bali's scale. The students did indicate they would benefit from further breastfeeding instruction in medical school.

The only North American study was conducted in the United States. Medical students felt they did not have adequate exposure to breastfeeding medicine and lacked confidence in their knowledge and counselling abilities about breastfeeding (Gary et al., 2017). Most felt they had not received any formal education (Gary et al., 2017).

The most recent study was conducted in Lebanon. Senior medical students in a public medical school had lower than expected knowledge levels, and there was no difference between third and fourth year students (Moukarzel, et al., 2018). Moukarzel (2018) also found that students considering a specialization in obstetrics or pediatrics did not have a higher knowledge score as compared to other senior medical students.

2.4 Learning theories

Andragogy is a theory of adult learning that details how adults learn differently from children (Kaufman, 2003). Educators may use these concepts to improve the effectiveness of educating adult learners, such as medical students.

Andragogy is rooted in humanism (Kaufman, 2003). The humanist approach to learning theories emphasize how attitudes and perceptions are an integral part of the learning experience (Merriman & Cafarella, 2006). The educator acts as a facilitator and establishes a comfortable learning environment (Dunn, 2002). Facilitators accept feedback and listen to learners' needs, while learners provide input for the learning (Dunn, 2002).

Knowles described andragogy as "the art and science of helping adults learn" (Kaufman, 2003). Being a theory of adult learning, andrology has five basic assumptions: adults are independent and self-directed, they have accumulated great experience; they value learning; they have internal motivation and they are interested in problem solving (Kaufman, 2003).

To convert andragogy theories into practice, Kaufman developed seven principles to guide teaching. Included in these are ensuring the learner is an active contributor to the educational process and understanding learners' current knowledge and attitudes to learning situations (Kaufman, 2003).

Health professionals develop knowledge and attitudes towards breastfeeding by personal experience, general cultural influences, role models and didactic information. Attitudes are primarily formed by personal experience and general cultural influences, while knowledge is obtained through all four methods. Personal experience of breastfeeding has the most powerful influence on attitudes, behavior and confidence. Negative attitudes towards breastfeeding may override positive knowledge obtained through didactic information, and may now stimulate health care professionals to support breastfeeding (Dykes, 2006). This supports the theory of andragogy as it illustrates the importance of learners' attitudes on knowledge acquisition.

2.5 Recommendations to improve breastfeeding curricula

Several educators have recommended that breastfeeding attitudes be considered when developing an educational program. Medical students "come to formal education with a range of prior knowledge, skills, beliefs, and concepts that significantly influence what they notice about the environment and how they organize and interpret it. This, in turn, affects their abilities to remember, reason, solve problems, and acquire new knowledge." (Bransford, Brown, & Cocking, 2000).

Dykes has recommended educational strategies for health care providers, including physicians, nurses and midwives (2006). She also recommended considering knowledge and attitudes when developing a breastfeeding educational program. She believed that knowledge deficit must be addressed, as well as the underlying attitudes, within the specific population.

> Any interaction between a practitioner and a childbearing or breastfeeding woman will be influenced by the practitioner's attitudes, knowledge and skills. As these are key areas to consider in any educational programme, it is useful to briefly refer to the ways in which these are generated. It must, however, be stated that knowledge, attitudes and skills are very closely interconnected (Dykes, 2006).

Upon reviewing the literature for curricular improvements in undergraduate breastfeeding medicine, there have been some recommendations made. Some programs have been initiated and evaluated in North American and international universities.

A multidisciplinary team was established at the University of New Mexico to review the breastfeeding curriculum within undergraduate and postgraduate medicine (Ogburn, Espey, & Leeman, 2005). Comprising pediatricians, obstetricians, family physicians and a midwife, resources were identified and a new curriculum was established. This new curriculum comprised didactic sessions, daily rounds in the newborn nursery, self-study modules and hands on session with a lactation consultant. Only residents participated in the evaluation of the program, and the residents felt it enhanced their knowledge (Ogburn et al., 2005).

Anjum (2007), Brodribb (2012), and Khriesat (2014) made recommendations to improve breastfeeding education in medical school, however, no evaluations have been completed. Anjum (2007) supported the idea that breastfeeding education should occur at all levels of the medical school curriculum. Brodribb (2012) felt breastfeeding medicine should be regarded as a public health strategy, have inter-professional learning opportunities with a breastfeeding friendly work environment. She also felt that breastfeeding should be taught in all years of the curriculum, be case-based, and target the influence that attitudes have on breastfeeding knowledge, and to address these poorer attitudes. Khriesat (2014) recommended spending more time with breastfeeding consultants, lectures and workshops instead of the traditional pediatrics rotation in hospital.

In Canada, Pound (2015) is working towards developing, implementing and evaluating a national breastfeeding educational intervention for medical residents. Pound has completed a needs assessment, written learning objectives and organized team planning meetings. The next steps will be implementing and evaluating the program.

Medical students, along with residents and practicing physicians, attended breastfeeding seminars and completed post-session surveys on knowledge and attitudes of breastfeeding (Sigman-Grant & Kim, 2016). The seminars were delivered between 2004 and 2011. The knowledge and attitude scores were consistent among the medical students during this time, despite the increase in breastfeeding initiation within Nevada women (Sigman-Grant & Kim, 2016). Mean scores for medical students were less than physicians and nurses for both knowledge and attitudes. There was no comparison group during the study, and no change in the breastfeeding seminar.

A new pediatric nutrition educational module was developed in Indonesia and tested on senior medical students (Sjarif, et al., 2016). Pre and post surveys were conducted, and the experimental group was compared to a control group using the existing pediatric feeding module. Besides typical feeding practices, students received audiovisual teaching, and learned about behavioral approaches and oral-motor development, which was instructed by psychiatrists and physiatrists. Three months following the study

period, the experimental group retained significantly more material and six months following the study, they performed significantly better on OSCE examination (Sjarif, et al., 2016). The authors theorized the study group was exposed to active learning, and had the benefit of integrating pediatrics with other specialties, which improved their knowledge and skills retention (Sjarif, et al., 2016).

Dykes (2006) stated that a breastfeeding curriculum should integrate formal and practice based knowledge, which may be "best achieved through programmes of education that incorporate opportunities for deep reflexive learning, personal debriefing, high levels of interaction and teaching of basic person-centred counselling skills." She also suggested peer support, mentors and a multi-disciplinary approach. The knowledge obtained in formal settings should be integrated with hands on practice, and personal experiences. The organizational constraints in the hospital should be considered, with more time devoted to understanding breastfeeding issues (not just in the small window of morning rounds) and to understand the cultural context of the hospital (such as private rooms versus wards).

2.6 Application of this research to Newfoundland and Labrador

In Canada, chronic illnesses have increased in prevalence (Public Health Agency of Canada, 2017). Many chronic diseases and risk factors for chronic diseases are increasing in Newfoundland and Labrador (Public Health Agency of Canada, 2017); in particular, rates of diabetes, hypertension, and obesity are increasing. In Canada, the age standardized prevalence of diabetes was 4.8% in 2000, rising to 7.6% in 2012 (Public Health Agency of Canada, 2017). The age standardized prevalence of diabetes was 6.5% in Newfoundland and Labrador in 2009, the highest in Canada (Public Health Agency of Canada, 2011). The age standardized prevalence of self-reported obesity in Canada was 26.5% in 2013 (Public Health Agency of Canada, 2017). The age standardized prevalence of self-reported overweight and obesity in Newfoundland and Labrador was 62.3% in 2010 (Public Health Agency of Canada, 2011), which is the highest prevalence in Canadian provinces. Newfoundland and Labrador also had the highest prevalence of

hypertension, at 31.1%, while the Canadian prevalence was 24.9% in 2014 (Public Health Agency of Canada, 2017).

There is also a trend toward more chronic illnesses in children and youth (Public Health Agency of Canada, 2017). In Canada, the self-reported prevalence of obesity in youth (ages 12-17) was 16.5% and children (ages 5-11) was 8.8% (Public Health Agency of Canada, 2017). Among youth in Newfoundland and Labrador, the self-reported prevalence of overweight and obesity was 39.0% in youth (ages 12-17) in 2016; while it was 26.8% for Canada (Public Health Agency of Canada, 2017).

Traditionally, prevention of these chronic illnesses has involved the promotion of healthy eating and exercise (Leung, et al., 2016). These strategies, although essential for population health, have not curbed the rates of these diseases in Newfoundland and Labrador. Breastfeeding can protect both mother and child from diabetes, hypertension and obesity (Horta & Victoria, 2013b). Promoting breastfeeding initiation and duration could be another way to improve the health of the population in the province by reducing rates of obesity, hypertension and diabetes.

Newfoundland and Labrador has the lowest breastfeeding initiation rate in Canada (Provincial Perinatal Program of Newfoundland and Labrador, 2017). When considering why breastfeeding rates are lower in Newfoundland and Labrador compared to the rest of the country, one can consider proximal factors, such as parental knowledge and attitudes, and distal factors, such as society, demographics and health professionals' knowledge and attitudes. Twells (2014) validated the Iowa Infant Feeding Attitude Scale (IIFAS) amongst Newfoundland and Labrador mothers. She found that there was a significant difference in positive breastfeeding attitudes between mothers who intended to breastfeed, and those who did not. Considering the Newfoundland and Labrador society, Bonia (2013) cited a lack of support within the community for breastfeeding mothers, and a maternal sense of embarrassment of breastfeeding in public as hindrances to breastfeeding. Finally, Newfoundland and Labrador's health care providers may be impeding provincial breastfeeding rates. We know that breastfeeding rates are lower in rural areas (Provincial Perinatal Program of Newfoundland and Labrador, 2017), and

health care providers in rural areas in Newfoundland and Labrador are also less likely to discuss breastfeeding with their patients than those in urban areas (Bonia, Twells, Halfyard, Ludlow, & Newhook, 2013).

One way to improve breastfeeding rates is to improve by the knowledge and support of physicians who assist breastfeeding mothers and babies (Bentley et al., 1999; Brodribb et al., 2007, 2008, 2009, 2010; Li et al., 2004; Taveras et al., 2003). This can begin in medical school by improving undergraduate medical education and ensuring all undergraduate medical students receive adequate educational opportunities. Improving the undergraduate medical curriculum must also consider the attitudes of medical students. These attitudes are important in shaping the students' approach to patients with breastfeeding questions and concerns.

Currently, breastfeeding education is introduced in the first year curriculum at Memorial University. There is a one hour lecture on breastfeeding, and a one hour tutorial on breastfeeding physiology. During these two hours, the following topics are covered: physiology of breastfeeding, breast anatomy, benefits of breastfeeding, breastfeeding initiation, medication safety, contraindications to breastfeeding, community-based resources, socio-cultural influences of breastfeeding. During clerkship, breastfeeding is taught during rural family medicine and obstetrics and gynecology. During the rural family medicine rotation, medical students are expected to provide basic education and counselling regarding breastfeeding. During the obstetrics and gynecology rotation, medical students are expected to counsel a patient on the benefits of breastfeeding.

Improving breastfeeding rates in Newfoundland and Labrador requires a multipronged approach, comprising of improved communication, public awareness and implementation of WHO breastfeeding initiatives (Provincial Perinatal Program of Newfoundland and Labrador, 2014). The World Health Organization recommends adequate parent leave, the right to breastfeeding the work place, restrictions on marketing breastmilk substitute, provision of breastfeeding materials to mothers and positive social norms to encourage breastfeeding (Unicef, 2018). To accomplish this goal, several stakeholders are essential, including health professionals, community partners, media, researchers, regional health

authorities, provincial government and school (Provincial Perinatal Program of Newfoundland and Labrador, 2014). The Baby Friendly Council of Newfoundland and Labrador is an interdisciplinary committee formed in 1982 to help promote and improve breastfeeding initiation and duration within the province. Their strategic plan involves improving public education and awareness and implementing the World Health Organization breastfeeding recommendations (Provincial Perinatal Program of Newfoundland and Labrador, 2014). As part of implementing the WHO recommendations, the Baby Friendly Council plans to continue encouraging and supporting professional development of front line care providers, through breastfeeding symposiums and The Newfoundland and Labrador Physicians' Breastfeeding Toolkit.

2.7 Importance of the research

Breastfeeding has been shown to reduce many acute and chronic illnesses (American Association of Pediatrics, 2012; Horta et al., 2013a; Horta et al., 2013b). Many of these chronic diseases, such as diabetes, hypertension and obesity are prevalent in Newfoundland and Labrador (Public Health Agency of Canada, 2011, and 2017). Breastfeeding initiation in Newfoundland and Labrador is the lowest in Canada (Statistics Canada, 2012). One key initiative to improve breastfeeding initiation rates in Newfoundland and Labrador is to implement the World Health Organization breastfeeding recommendations in front line health care providers (Provincial Perinatal Program of Newfoundland and Labrador, 2014).

There is a paucity of literature in North America pertaining to medical students' knowledge and attitudes towards breastfeeding. Breastfeeding knowledge and attitudes among medical students have never been studied in Canada.

This gap in the literature, coupled with low breastfeeding rates, point to the need to explore the knowledge and attitudes of medical students in Newfoundland and Labrador. The reasons for low breastfeeding initiation in Newfoundland and Labrador are multifactorial, therefore, the knowledge and attitudes of health care professionals are important to understand. Examining student's pre-existing attitudes and knowledge towards breastfeeding could better guide our medical school curriculum to shape future

Newfoundland and Labrador physicians into supportive breastfeeding advocates. Strong health care advocates will help normalize breastfeeding in the province.

In this thesis, a quantitative survey was utilized to examine undergraduate medical students' attitudes and knowledge towards breastfeeding at Memorial University, and determine if there were differences in subgroups of medical students, such as students from rural and urban areas. Knowledge gaps in breastfeeding education within the undergraduate medical curriculum at Memorial University were identified by interviewing key educators within the curriculum. The goal of this study was to understand the attitudes of knowledge of medical students towards breastfeeding; to understand curricular gaps in breastfeeding education; and to ultimately make recommendations to improve the breastfeeding curriculum at Memorial University.

2.8 Conclusions

Breastfeeding has many benefits for the immediate and long term health of mothers and babies. Breastfeeding initiation rates in Newfoundland and Labrador are the lowest in Canada. In particular, breastfeeding rates in rural areas are the lowest in the province, and health care providers in these areas are less likely to discuss breastfeeding with their patients.

The knowledge and support provided by physicians have been shown to enhance breastfeeding rates. Positive attitudes towards breastfeeding can enhance knowledge acquisition. Negative attitudes, however, may negate the positive knowledge obtained through educational sessions.

Knowledge and attitudes of medical students towards breastfeeding has been studied in many countries, but not in Canada. Surveying junior medical students at Memorial University will allow an understanding of what medical students know and how they feel about breastfeeding. Interviewing breastfeeding educators at Memorial will allow exploration of breastfeeding education across all four years of study, to determine gaps in medical education. Combing these studies will help identify the gaps and barriers in breastfeeding education at Memorial University, and recommend curricular changes.

Chapter 3

3 Study 1: What are the knowledge and attitudes towards breastfeeding in medical students at Memorial University?

This study explored knowledge and attitudes towards breastfeeding among first and second year medical students at Memorial University. Objectives of the study were to assess knowledge and attitudes among these students, to describe and analyze any differences in knowledge and attitudes among sub-groups, such as students from urban and rural areas, students in first and second year, those who were parents and non-parents, those who had previous breastfeeding experience as a parent, and those who were previously breastfed by their mother.

Approval for this study was received from Western University Health Science Research Ethics Board Delegated Approval (109741) on December 21, 2017; and with secondary approval by the Interdisciplinary Committee on Ethics in Human Research at Memorial University (20181572-EX) on February 7, 2018 (Appendices 1 and 2).

3.1 Methods

3.1.1 Design

A cross sectional study was conducted to explore first and second year medical students' attitudes and knowledge towards breastfeeding.

3.1.1.1 Questionnaire

A survey of first and second year medical students at Memorial University was conducted to assess their attitudes toward, and knowledge of, breastfeeding.

To survey the medical students, the 90-item Australian Breastfeeding Knowledge and Attitude Questionnaire developed and validated by Brodribb (2008, 2009, 2010), was adapted and administered to first and second year medical students at Memorial University (Appendix 3). This questionnaire had 90 items that include demographic items, preferred learning format, perceived effectiveness in counselling breastfeeding

women, confidence in ability manage breastfeeding challenges, as well as items on breastfeeding attitudes, and breastfeeding knowledge. The questionnaire used a 5-point Likert scale for responses to the questions. The questionnaire had been previously used to survey practicing physicians, but had not been used with medical students. Therefore, to adapt the questionnaire to junior medical students, several questions were deleted or modified as the difficulty level was deemed too advanced or the questions did not apply to the intended population (see assessment of validity and reliability). The modified questionnaire is included in Appendix 4.

The attitude items in this questionnaire were previously validated in Scottish midwives by Scott (Scott et al., 2003). As part of Brodribb's study, the attitude items were validated in family physicians and family medicine residents (Brodribb et al., 2008).

The knowledge items were identified by reviewing the literature and conducting focus groups; these items were subsequently revised by breastfeeding experts, and tested with Australian family physicians (Brodribb et al., 2008, 2009, 2010). Content validity was determined by reviewing items used in previous validated scales, and by conducting focus groups of medical students and interviews of family physicians in Australia (Brodribb et al., 2008). Face validity was determined by three physicians who were not part of the study sample and a researcher, all with breastfeeding counselling experience, prior to questionnaire administration (Brodribb et al., 2008).

The modified questionnaire had several questions were deleted or altered as the difficulty level was deemed too advanced or the questions did not apply to the intended population. The complete modified questionnaire is included in Appendix 4.

In the demographic section, Q2-"Where did you learn about breastfeeding? (please mark all that apply)", "general practice", "within a hospital, post-graduation" and "Australian Breastfeeding Association" were removed as they were not applicable. Junior medical students have less medical knowledge than practicing physicians. For the 40 knowledge items, several questions were removed as the level of difficulty was deemed too high for junior medical students (questions 36-40; 42-44; 46-48; 50-60; 62; 65; 68-75). For question 78, "In what country were you born" was changed to "Did you spend most of

your childhood years living in an area with a population <10,000" (Rourke, 2017). Rural Newfoundland and Labrador has a much lower rate of breastfeeding initiation than urban areas (Provincial Perinatal Program of Newfoundland and Labrador, 2014), which makes the knowledge and attitude levels of rural medical students important. Questions 79-81 were removed as they are not applicable to medical students. Question 82 was changed from "At what stage are you in your GP training?" to "In which year of medical school are you?" Finally, question 83 was removed "Where would you like to practice after completing your GP training", as it is not applicable to junior medical students.

A summary of modifications to the 90-item Australian Breastfeeding Knowledge and Attitude Questionnaire can be found in Appendix 4.

In keeping with Brodribb's study (2008), the response categories for the attitude questions used a Likert scale of 1 to 5 (strongly disagree, disagree, neither agree nor disagree, agree, strongly agree), and were scored accordingly. Negatively worded questions were reverse scored, such that higher scores always indicated more positive attitudes. The attitude score for each individual question was calculated. The mean attitude score was calculated by summing the score of each question and dividing by the number of items in the scale, such that 1.0 represented the poorest score, and 5.0 represented the highest attitude score.

Similarly, the response categories for the knowledge items used a Likert scale of 1 to 5 (strongly disagree, disagree, neither agree nor disagree, agree, strongly agree), and were scored accordingly. Negatively worded questions were reverse scored, such that a score of 5 represented the correct response. The knowledge questions had an additional category of 'don't know'. For statistical purposes, this was coded as neither agree or disagree, as answers suggested participants did not have enough knowledge to answer the question or they were unwilling to answer the question. This follows Brodribb's methodology (2008).

To calculate the percentage of participants answering the question correctly for the knowledge questions, correct answers were defined as responses of 4 or 5, as per Brodribb' methodology (2008). The total number of participants who responded

correctly was divided by the total number of participants who answered the question to determine the percentage who responded correctly.

The knowledge score for each individual question was calculated. A score of 5 represented a perfect knowledge score, and 1 indicated the lowest score. The mean knowledge score was calculated by summing the score of each question and dividing by the number of items in the scale, such that 1.0 represented the poorest score, and 5.0 represented the highest knowledge score.

Information about previous breastfeeding education and preferred educational formats for learning breastfeeding medicine were also collected in the questionnaire.

3.1.1.2 Assessment of validity and reliability

Validity refers to "the accuracy of empirical measures in reflecting a concept" (Aday & Cornelius, 2006). Validity is important to determine if conclusions may be drawn from the scale (Streiner & Norman, 2003). Reliability reflects the stability of the questionnaire responses over time (Aday & Cornelius, 2006) and how the same results are reproduced under different conditions (Streiner & Norman, 2003).

Validity may be measured by: content validity, face validity, construct validity and criterion validity (Streiner & Norman, 2003).

Content validity relies on how well the questions in the questionnaire represent all the relevant concepts to be studied (Aday & Cornelius, 2006; Streiner & Norman, 2003). Experts in the field may be asked to determine content validity (Aday & Cornelius, 2006; Streiner & Norman, 2003). Brodribb's scale was validated for content using questions from previously validated scales, conducting focus groups with medical students and interviewing family physicians to assess attitudes towards breastfeeding and knowledge needs (Brodribb et al., 2010).

Face validity describes whether the measurement scale used appears reasonable (Hulley, Cummings, & Browner, 2013) and appears to be assessing the appropriate qualities (Streiner & Norman, 2003). Brodribb asked three independent physicians and a

breastfeeding researcher to review her 90 item scale (Brodribb et al., 2009). For this research study, four senior medical students at Memorial University reviewed the 90-item Australian Breastfeeding Knowledge and Attitude Questionnaire after it was modified to ensure the knowledge level was appropriate for junior medical students, the clarity of instructions and the time for completion.

Construct validity examines "whether and how many of the relationships predicted by these theories or hypotheses are empirically borne out when the data are analyzed (Aday & Cornelius, 2006). Construct validity is appropriate when the measured concept is abstract, such as attitudes. To assess construct validity in this study, the relationship between mean attitude scores and mean knowledge scores was investigated by calculating a Pearson correlation coefficient. Specifically, it was hypothesized that respondents demonstrating higher attitude scores would have higher knowledge scores, and the magnitude of the association would be large (r=0.5 or greater).

Criterion validity refers to the correlation of the scale with an accepted measure of the characteristic studied, namely the gold standard which has been universally accepted (Streiner & Norman, 2003). In the case of breastfeeding attitudes and knowledge, there is no such gold standard.

Reliability may be measured by internal consistency, test-retest reliability and intra-observer reliability (Streiner & Norman, 2003). Internal consistency was used in this study.

Internal consistency measures the correlation of each item in a scale "with the scores of all other items", thus reflecting the fact that items are tapping into "the same underlying dimension " of what is being measured (Streiner & Norman, 2003). Internal consistency can be used to evaluate summary scores (Aday & Cornelius, 2006) such as mean breastfeeding knowledge and mean breastfeeding attitude scores. There are several ways to calculate internal consistency, Cronbach's alpha is one such way (Streiner, 2003). Cronbach's alpha ranges from 0-1, with higher scores being more desirable (Streiner, 2003). Generally, the lowest acceptable internal consistency is 0.7; a higher Cronbach's alpha reflects a higher level of internal consistency. Values lower than 0.7 can indicate

some of the individual questions in the summary scale do not reflect the summary scale as well as others. In Brodribb's 90-item Australian Breastfeeding Knowledge and Attitude Questionnaire, Cronbach's alpha was 0.84 for the attitude scale and 0.83 for the knowledge score, indicating good internal consistency (Brodribb et al., 2009). In the present study, Cronbach's alpha was calculated for each of the knowledge and attitude scores.

3.1.2 Sampling and recruitment

The medical school at Memorial University accepts 80 students each year, with 75% being from Newfoundland and Labrador (Associate Dean of Admissions, 2017). Breastfeeding is taught during the four year curriculum. Inclusion criteria: first or second year medical students. Exclusion criteria: students who were repeating the first year classes and students who planned on leaving the program. All students in first and second year were asked to participate, comprising a census of the students.

The curriculum in the first year of medical school at Memorial University includes two hours of breastfeeding lectures, but not until six months into the program. Medical students were surveyed following these sessions.

The self-administered questionnaire was administered electronically using Survey Monkey, following the guidelines of Web Questionnaires and Implementation (Dillman, Smyth, & Christian, 2014). To maximize response rates, the established method of The Tailored Design Method (Dillman et al., 2014) was followed, using tools such as weekly reminders, specifying how the questionnaire results were to be used, asking for help and conveying that others had responded.

3.1.3 Variables

The two dependent variables were breastfeeding attitude score and breastfeeding knowledge score. These scores represent the mean knowledge or attitude score calculated using Brodribb's modified the 90-item Australian Breastfeeding Knowledge and Attitude Questionnaire (Appendix 4). Table 1 outlines the dependent and independent variables used in this study.

Independent variables included: sex, population of students' hometown, year of medical school, whether or not the medical student was breastfed, if the medical student was a parent, personal breastfeeding experience (if the medical student was a parent). Variables were defined in the following ways: in terms of hometown, rurality was defined as students previously living in a community with less than 10 000 persons (Rourke, 2017). Previous breastfeeding experience refers to experience breastfeeding a child, or having a partner breastfeed a child. Length of time breastfeeding refers to length of time a student breastfed a child (in months), or the partner of the medical student breastfed their child.

Table 1 Independent and dependent variables studied regarding breastfeeding attitudes and knowledge amongst Memorial University medical students

Independent Variables
Sex M F
Year of medical school First Second
Population of students' hometown <10 000 (rural) 10 000+ (urban)
Parent Yes No
Breastfed as a child Yes No Unsure
Previous breastfeeding experience Yes No
Length of breastfeeding experience Months
Dependent Variables

Mean attitude score
Mean knowledge score

3.1.4 Data collection

To maximize response rates, the established method of The Tailored Design Method (Dillman et al., 2014) was followed. This method is used to improve response rates.

Researcher AP had a leadership position within undergraduate medicine at Memorial University and taught several lectures throughout medical school. The questionnaire was distributed after all researcher AP's assessments of the medical students were complete.

An online questionnaire was chosen, because of low cost, speed, and ease of distribution. The capacity of the respondents to answer an online questionnaire was known since medical school evaluations and assessment occur online. Survey Monkey was used to program the survey, as this is the platform used by Memorial University. Questions appeared similar on different browsers, and the questionnaire could be completed on a smartphone. It was possible to skip questions if a participant did not wish to respond. As recommended by Dillman (2014), interesting visuals and consistent layouts were used. Reminder emails were sent. Participants were also informed how the questionnaire results were to be used and it was conveyed that others had responded.

The Office of Student Affairs at Memorial University assisted with the administration of the questionnaires by sending the questionnaires and four reminder emails to all first and second year medical students.

3.1.5 Analysis

The data were analyzed using SPSS version 25.0 (Pallant, 2013). Univariate analyses were conducted to describe the characteristics of the sample, to examine frequencies of dichotomous variables and to calculate the mean and standard deviation of continuous variables. The dependent variables were mean attitude score and mean knowledge score. Independent variables were medical students from rural or urban areas; sex; year of training, whether or not the student was parent, previous breastfeeding experience, length

of time breastfeeding, and personal history of breastfeeding. These variables are listed in Table 1.

After reverse scoring (if required), two steps were taken to calculate scores for the attitude scale. First, responses to the individual items in the survey were summed and divided by the number of participants to create scores for the individual breastfeeding attitude questions. Second, participants' responses to all the items in the attitude scale were summed and divided by the number of individual items in scale to calculate mean attitude scores. A score of five represented a perfect attitude score.

To calculate knowledge scores, two methods were used: percentage of questions answered correctly and mean knowledge score.

Two steps were taken to calculate the percentage of knowledge items answered correctly, Participants answering correctly were identified by a response of 4 (agree) or 5 (strongly agree). Participants answering incorrectly were identified by a response of 0, 1, 2, 3 (don't know, strongly disagree, disagree or neutral), as Brodribb (2008) employed in her scale. First, the percentage of individual knowledge items answered correctly was determined for each individual item. Then, the overall percentage of all knowledge items answered correctly was calculated.

Two steps were taken to calculate the mean knowledge scores, individual scores for each item were added and then divided by the number of participants. Zero scores (don't know) were combined with neutral scores (3), as Brodribb did in her scale (2008). First, responses to the individual items in the survey were summed and divided by the number of participants to create scores for the individual breastfeeding knowledge questions. Second, participants' responses to all the items in the knowledge scale were summed and divided by the number of individual items in scale to calculate mean attitude scores. A score of five represented a perfect knowledge score.

Bivariate analyses were employed to examine the relationships between the independent variables and the dependent variables of mean knowledge and attitude scores. Table 2 outlined the statistical tests that were employed. In the end, only four students were

parents, out of these, three students breastfed their children. These variables (parent yes/no; length of time breastfeeding (months)[2]) were removed from the analysis as the number of respondents were too small to calculate differences.

Table 2 Independent and dependent variables studied along with statistical test employed

Independent variable	Dependent variable	Statistical test
Population of students' hometown (Population <10,000/10,000+)	Mean breastfeeding attitude score[3]	t-test
Female/Male		t-test
Year of medical school (Year 1 or 2)		t-test
Breastfed as a child (Yes/No/Unsure)		t-test
Parent (Yes/No)		t-test
Previous breastfeeding experience (Yes/No)[1]		t-test
Length of time breastfeeding (months)[2]		Correlation coefficient
Population of students' hometown (Population <10,000/10,000+)	Mean breastfeeding knowledge score[4]	t-test
Female/Male		t-test
Year of medical school (Year 1 or 2)		t-test
Breastfed as a child (Yes/No/Unsure)		t-test
Parent (Yes/No)		t-test
Previous breastfeeding experience (Yes/No)[1]		t-test
Length of time breastfeeding (months)[2]		Correlation coefficient

[1] Previous breastfeeding experience refers to any breastfeeding by a student or their partner.
[2] Length of time breastfeeding refers to breastfeeding by a student or their partner in months.
[3] Mean breastfeeding attitude score was calculated by taking the mean of individual attitude items. The maximum attitude score would be 5, with 5 being the most positive attitude.
[4] Mean breastfeeding knowledge score was calculated by taking the mean of individual knowledge items. The maximum knowledge score would be 5, with 5 being the most knowledgeable.

As a final step in the analyses, standard multiple regression was used. The goal of this analysis was to explain the maximum variation in mean attitude and knowledge scores. Variables were entered in the model by forced entry. First, correlation between independent and dependent variables was analyzed separately to ensure the independent variables had a relationship with the dependent variable. If the correlation coefficient was less than 0.3, the independent variable was removed from the standard multiple regression analysis, as this may indicate the independent variable may have little relation with the dependent variable (Pallant, 2013).

Collinearity diagnostics were next used to determine if multicollinearity was present in the sample. Multicollinearity indicates that independent variables are strongly correlated to each other, which could skew their correlation to the dependent variable (Tabachnick & Fidell, 2013). Multicollinearity was determined by calculating tolerance and variance inflation factor. If tolerance was less than 0.1 (or the variance inflation factor greater than ten), this indicated high multiple correlation, suggesting multicollinearity. If multicollinearity was detected, the independent variable was removed from the model for the standard multiple regression calculation.

Outliers are cases which have too much impact on the regression analysis, in that the scores are either very high or very low (Tabachnick & Fidell, 2013). Outliers were detected using a residual plot, where residual is defined as the difference between the actual and the predicted dependent variable score. Residual plots allows the identification of cases having a poor fit between actual and predicted dependent variable scores. As per Tabachnick and Fidell (2013), outliers with standardized residual values above or below 3.3 were removed from the standard multiple regression calculation.

The residual plot was also used to identify other aspects of the relationship between variables, such as normality and linearity (Tabachnick & Fidell, 2013). Multivariable regression analysis assumes that residuals, or differences between obtained and predicted dependent variable scores, are distributed normally about the predicted dependent variable score and the residuals have a straight line relationship with the predicted dependent variable scores (Tabachnick & Fidell, 2013). In this study, the residuals were

analyzed to determine if there was a normal distribution and a linear relationship between residuals and predicted dependent variable score (Pallant, 2013).

3.1.6 Sample size

The variable of primary interest was attitude towards breastfeeding. This was chosen as Brodribb's study (2008) found a significant geographical variation in breastfeeding attitudes amongst family physicians. This dependent variable was used to calculate sample size, according to Hulley's (2013) method. The null hypothesis was that there is no difference in breastfeeding attitudes between medical students who previously lived in rural areas, and those living in urban areas. The alternative hypothesis was that there is a difference in breastfeeding attitudes between medical students previously living in rural versus urban areas.

Results from previous administrations of the Australian Breastfeeding Knowledge and Attitude Questionnaire were used in calculating sample size (Brodribb et al., 2008). The mean attitudinal score for physicians in Australia was 4.07 +/- 0.43, while the score for non-Australian trained physicians was 3.86 +/- 0.41, producing an effect size of 0.21 and a standardized effect size of 0.49. Using Hulley's (2013) method to calculate the sample size using the t-test, using the standardized effect size of 0.49 and setting a two sided alpha of 0.05 and power of 0.8, the sample size required was 78 per group (156 in total).

3.1.7 Approach to missing data

Major variables missing less than 10% of responses were included in the analysis (Aday & Cornelius, 2006). Major variables missing more than 25% of responses were excluded from the analysis (Aday et al., 2006). Variables missing between 10 and 25% of responses were imputed.

In this study, the demographic variables had responses over 90%, so imputation was not needed.

For major questions included in the attitude and knowledge scores missing between 10-25% of responses, there were several types of imputation that could be employed. First, the data could be omitted. Second, cold-deck imputation could be employed. Cold-deck

imputation involved replacing missing data with the overall mean knowledge or attitude score. Third, hot-deck imputation could be employed, meaning a random respondent was selected from the sample, and his/her responses could be used to replace missing data (Aday et al., 2006).

For this study, mean attitude and knowledge scores were calculated using no imputation, cold-deck imputation and hot-deck imputation for missing variables that ranged between 10-25% using SPSS 25.0 (Pallant, 2013) (Appendix 5). For many health questionnaires, hot-deck imputation, regression and multiple imputation have been used; hot-deck and regression tend to generate similar distributions and results (Aday et al., 2006). In this study, hot-deck imputation was used to estimate variables that had missingness between 10-25% using SPS 25.0 (Pallant, 2013).

3.2 Findings

3.2.1 Response rates

The questionnaire was emailed to 160 first and second year medical students between February and April of 2018. Thirty-seven questionnaires were completed, yielding a response rate of 23.2%.

The individual response rates for questionnaire questions are found in Tables 4 and 5. Questions with response rates less than 25% were excluded from the analysis. These questions were:

- Doctors should discuss breastfeeding with mothers early in their pregnancy. (18.9% response rate)

- How effective do you think you are in meeting the needs of the breastfeeding women you see? (16.2%)

- How confident would you say you are with your ability to assist women who present with breastfeeding problems? (18.9%)

Questions with response rates between 75-90% were analyzed using hot-deck imputation to estimate missing variables. Questions having response rates between 75-90% included:

- Female doctors are better able to assist breastfeeding women, regardless of their experience or training, than male doctors. (89.2% response rate)
- Infant formula is more easily digested than breast milk. (86.5%)
- Breast milk is the ideal food for babies. (86.5%)
- Mothers who smoke should formula feed their babies. (86.5%)
- Breastfeeding is incompatible with working outside the home. (86.5%)
- Fathers feel left out if a mother breastfeeds. (86.5%)
- Breastfed babies need to be fed too often. (86.5%)
- Current infant formulas are nutritionally equivalent to breast milk. (86.5%)
- Women who have breastfed have a lower incidence of premenopausal breast cancer. (86.5%)
- Breastfed infants are less likely to become obese children (86.5%)

3.2.2 Reliability measurements

Reliability was tested using Cronbach's alpha coefficient for both mean attitude score and mean knowledge score. In the current study, Cronbach alpha coefficient for mean attitude score was 0.81. In Brodribb's (2008) study, Cronbach alpha was 0.84. In this study, for mean knowledge score, Cronbach alpha coefficient was 0.48. Brodribb's (2008) study had a Cronbach's alpha coefficient of 0.83.

3.2.3 Validity measurements

For this research study, face validity was measured by four senior medical students at Memorial University. Brodribb's 90-item Australian Breastfeeding Knowledge and Attitude Questionnaire was modified in that several knowledge questions were removed as the level of difficulty was deemed too difficult for junior medical students. The four senior medical students at Memorial University reviewed the modified Australian Breastfeeding Knowledge and Attitude Questionnaire to ensure the knowledge level was appropriate for junior medical students, the clarity of instructions and the time for completion.

Construct validity was also calculated. The correlation between mean attitude score and mean knowledge supported the hypothesis ($r=0.49$, $P=0.003$), confirming that respondents who had higher attitude scores also had higher knowledge scores.

3.2.4 Sample characteristics and previous breastfeeding instruction

The demographics and characteristics of the sample can be found in Table 3. There were more females that participated in the study, and more urban students. Over 80% of students had been breastfed as a child.

Table 3 Sample characteristics of responders in the study population.

Variable	Participants (%)
Sex (n=37) Male Female	 11 (29.7) 26 (70.3)
Population of students' hometown (n=37) Rural (<10 000) Urban (10 000+)	 14 (37.8) 23 (62.2)
Year of medical school (n=36) First year Second year	 16 (44.4) 20(55.6)

Breastfed as a child (n=36) Yes No Unsure	 30 (83.3) 0 6 (16.7)
Do you have children? (n=37) Yes No	 4 (10.8) 33(89.2)
Did you breastfeed your children? (n=4) Yes No	 3 (75%) 1 (25%)

Medical students received previous training about breastfeeding medicine from a variety of sources, the majority being medical courses (91.9%) and family and friends (64.9%), as noted in Figure 1. In this study of junior medical students at Memorial University, preferred learning methods included: discussion with other physicians (64.9%), small group sessions (62.2%) and case studies (51.4%). The least preferred learning method was reading medical journals (2.7%), see Figure 2. Their most useful source of breastfeeding information so far has been medical courses (Figure 4). Medical students felt their knowledge about breastfeeding medicine for their level of training was adequate in 40.5% of students, and inadequate in 24.3%. The remainder felt their knowledge was adequate, but the required further training (Figure 3).

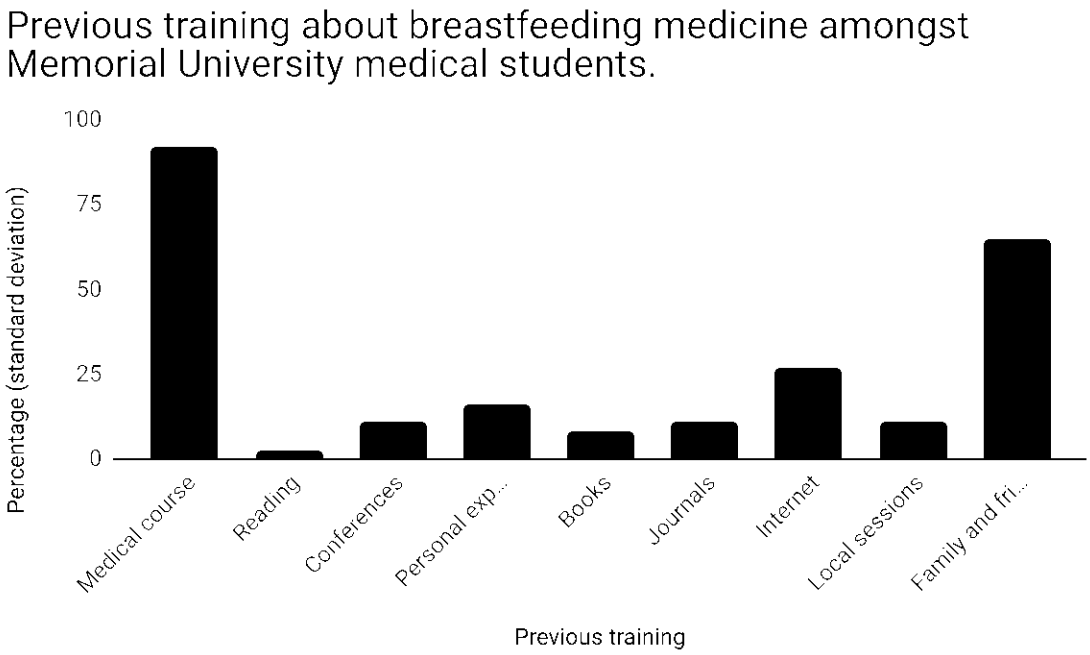

Figure 1 Previous training about breastfeeding medicine in first and second year medical students at Memorial University

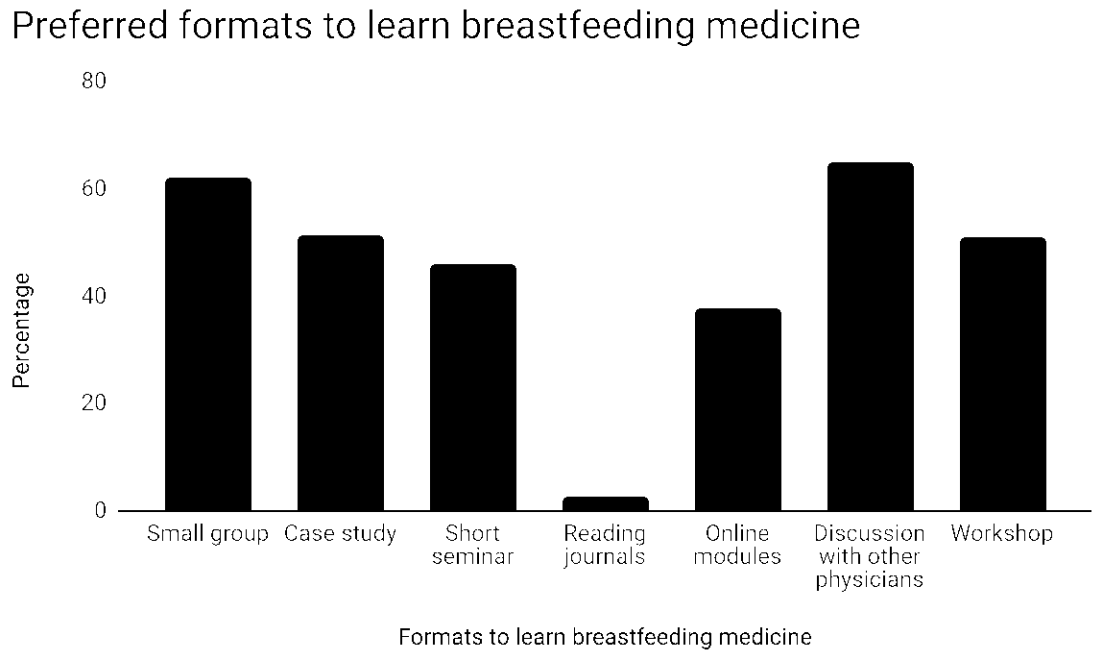

Figure 2 Preferred format to learn about breastfeeding medicine in first and second year medical students at Memorial University

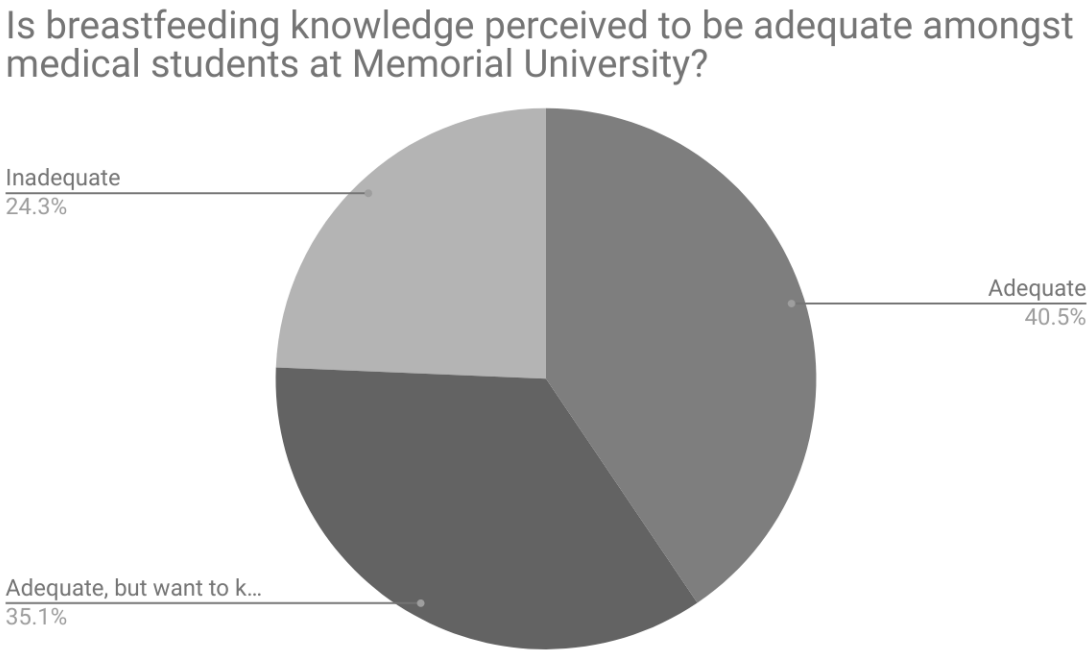

Figure 3 Perception of adequacy in breastfeeding knowledge and need for further learning amongst first and second year medical students at Memorial University

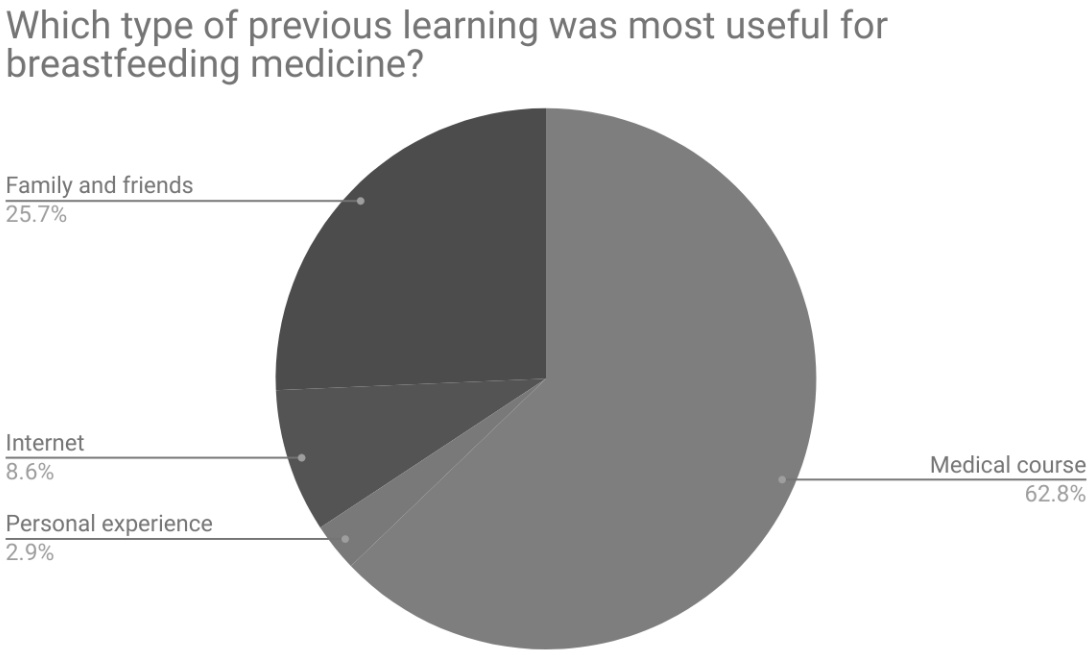

Figure 4 Most useful modality to learn about breastfeeding medicine in first and second year medical students at Memorial University

3.2.5 Research question: What are the knowledge and attitudes towards breastfeeding in medical students at Memorial University?

The questionnaire contained 27 attitude questions and 8 knowledge questions. Individual responses and response rates for each breastfeeding attitude question can be found in Table 4. Individual responses and response rates for each knowledge question can be found in Table 5.

One attitude question, "Doctors should discuss breastfeeding with mothers early in their pregnancy" had higher than 25% missingness, and was therefore excluded from the analysis. The attitude scale ultimately contained 26 questions.

Six of the questions had missing data that ranged from 10-25%: Infant formula is more easily digested than breast milk (reverse scored), breastmilk is the ideal food for babies, mothers who smoke should formula feed their babies (reverse scored), breastfeeding is incompatible with working outside the home (reverse scored), fathers feel left out if a

mother breastfeeds (reverse scored), breastfed babies need to be fed too often (reverse scored).

3.2.5.1 Descriptive analysis: breastfeeding attitude and knowledge scores

The mean breastfeeding attitude score was 4.14 +/- 0.53. Attitude scores for individual questions is found in Table 4. The highest individual item attitude scores were "Women should not breastfeed in public places such as restaurants" and "Breastfeeding provides health benefits for infants that cannot be provided by infant formula" The lowest individual item attitude score was "Mothers who formula feed miss one of the great joys of motherhood."

Table 4 Individual responses to individual breastfeeding attitude questions[1] and response rates in medical students at Memorial University

Attitude item	Mean	Standard deviation	Response rate (%)
Doctors have an important role in encouraging and supporting breastfeeding women.	4.70	0.46	94.6
Female doctors are better able to assist breastfeeding women, regardless of their experience or training, than male doctors.*	3.29	1.00	89.2
Doctors have little influence on a mother's decision to breastfeed.*	4.14	0.59	94.6
It is not appropriate for doctors to advise mothers to breastfeed. *	4.35	0.89	91.2

Only doctors with personal experience of breastfeeding (self or partner) are able to assist breastfeeding women.*	4.21	0.71	100
It is appropriate to refer breastfeeding mothers to others with more expertise.	3.89	0.94	97.3
Infant formula is more easily digested than breast milk.*	4.21	0.71	86.5
Breast milk is the ideal food for babies.	4.38	1.26	86.5
Formula feeding is a good way of letting fathers care for the baby.*	3.91	0.83	89.2
Breastfeeding & formula feeding are both equally acceptable methods of feeding infants.*	3.49	1.10	91.2
Breastfeeding increases mother-infant bonding.	4.76	0.50	97.3
A mother knows instinctively how to breastfeed.*	3.59	0.86	91.2
Breastfeeding provides health benefits for infants that cannot be provided by infant formula.	4.89	0.32	91.2
Mothers who smoke should formula feed their babies. *	3.70	0.91	86.5
Breastfeeding is incompatible with working outside the home. *	4.35	0.59	86.5

Fathers feel left out if a mother breastfeeds. *	3.81	0.88	86.5
Breastfed babies need to be fed too often.*	4.08	0.64	86.5
Infant formula is as healthy for an infant as breast milk.*	4.57	0.69	89.2
Breastfeeding is more convenient than formula feeding.	3.27	1.05	89.2
Formula feeding is the better choice if the mother plans to go out to work.*	4.02	0.55	86.5
The benefits of breast milk last only as long as the baby is breastfed.*	4.51	0.65	86.5
Mothers who formula feed miss one of the great joys of motherhood.	2.84	0.80	89.2
A mother who occasionally drinks alcohol should not breastfeed her baby. *	4.29	0.62	89.2
Formula feeding is more reliable because you can calculate the exact quantity of milk the baby is getting.*	4.32	0.58	91.2
Current infant formulas are nutritionally equivalent to breast milk.*	4.59	0.64	86.5
Women should not breastfeed in public places such as restaurants.*	4.89	0.31	94.6

Mean attitude score	**4.14**	**0.53**	

[1]Higher score indicates a more positive attitude.

Maximum score is 5, minimum score is 0.

*Questions with an asterix were reverse scored.

The response rates and responses to the individual knowledge questions included in the knowledge score can be found in Table 5. One question had missing data that ranged from 10-25%: "Breastfed infants are more likely to become obese children", so imputation was required.

The mean knowledge score was 3.93 +/- 0.39.

In terms of knowledge, over 90% of the medical students answered three questions correctly: "Exclusive breastfeeding (no other fluids or solids) is the most beneficial form of infant feeding for the first six months of life."; "Women who have breastfed have a lower incidence of premenopausal breast cancer."; "Breastfed infants are less likely to become obese children." Each of these questions had a knowledge score of greater than 4. Two questions shared the lowest mean knowledge scores: "A change to infant formula will improve the symptoms of a breastfed baby with 'colic'" and "Growth of breastfed infants differs from that of formula fed infants". Both these questions had knowledge scores of 3.32. More students answered the growth question correctly (43.2%) than the colic question (29.7%).

Table 5 Individual responses to breastfeeding knowledge questions[1] and response rates in medical students at Memorial University

Knowledge item	% answering correctly[2]	Mean Knowledge Score	Standard deviation	Response Rate (%)

Exclusive breastfeeding (no other fluids or solids) is the most beneficial form of infant feeding for the first six months of life.	97.3	4.49	0.65	89.2
Women who have breastfed have a lower incidence of premenopausal breast cancer.	94.6	4.41	0.60	86.5
Breastfed infants are less likely to become obese children.	94.6	4.32	0.78	86.5
The nutritional content of breast milk changes throughout a breastfeed.	62.2	3.97	0.93	89.2
Formula fed infants have more ear infections than breastfed infants.	62.2	3.92	0.68	89.2
A change to infant formula will improve the symptoms of a breastfed baby with 'colic'. *	29.7	3.32	0.97	91.2
In most cases a breastfeeding mother must temporarily wean her baby while she is taking prescription medications. *	46.9	3.73	1.24	91.2
Growth of breastfed infants differs from that of formula fed infants.	43.2	3.32	0.89	94.6
Mean Knowledge Score	**66.3**	**3.93**	**0.39**	

[1]Higher score indicates a higher knowledge level. Maximum score is 5.

[2]Percentage answered correctly was the percentage who answered 4 or 5 (agree or strongly agree).

*Questions with an asterisk were reverse scored.

3.2.5.2 Bivariate analysis

Mean attitude and mean knowledge scores were analyzed by participant characteristics. The variables of primary interest were attitude toward breastfeeding and knowledge about breastfeeding, specifically whether or not there was a difference between different subgroups of medical students. Independent sample t-tests were employed. For attitude scores, Levene's test for equality of variances was >0.05 for each independent variable except breastfed as a child. This meant that the variation of scores between the two groups of each independent variable (e.g. male and female) studied was the same. When the independent variable 'breastfed as a child' was tested, equal variance was not assumed. For knowledge scores, Levene's test of equality of variance was >0.05 for each independent variable.

As seen in Table 6, there was no significant difference in mean attitude score between sex and whether or not the student was a parent. As only four participants were parents, the number was too small to calculate significance if a previous history of breastfeeding led to a difference in attitude score. The students who were parents were also asked if they or their partner breastfed their child. Again, the number of respondents was too small to calculate differences.

There was a significant difference between first and second year medical students' attitude towards breastfeeding, whereas second year students had a more positive attitude (4.23 versus 4.02, p=0.014). In addition, significantly more students from rural areas had more positive attitude scores compared to urban students (4.29 versus 4.04, p=0.003). And, students whose mother breastfed them also had significantly higher attitude scores (4.17 versus 3.97, p=0.005). The attitude score of each independent variables is listed in Table 6.

The knowledge scores were also analyzed by participant characteristic. There was no significant association among mean knowledge scores and sex, size of childhood home, being breastfed as a child or being a parent. There was, however, a significantly higher knowledge score in second year medical students versus first year students (4.04 versus 3.78, p=0.044). The knowledge score for all independent variables is listed in Table 6.

Table 6 Results of Bivariate Analysis - Breastfeeding Attitude and Knowledge Scores by Independent Variables in medical students at Memorial University.

Participant characteristic	Mean Attitude Score[1] (SD)	95% Confidence Intervals	P value	Mean Knowledge Score[2](SD)	95% Confidence Intervals	P value
Sex Female Male	 4.11 (0.24) 4.20 (0.31)	 -0.096, 0.29	 p=0.32	 3.93 (0.35) 3.91 (0.48)	 -0.31. 0.27	 p=0.87
Year of medical school First Second	 4.02 (0.21) 4.23 (0.27)	 -0.38, -0.045	 p=0.014	 3.78 (0.35) 4.04 (0.39)	 -0.52, -0.01	 p=0.044
Population of students' hometown <10,000 population 10,000+ population	 4.29 (0.26) 4.04 (0.22)	 0.094, 0.42	 p=0.003	 4.05 (0.45) 3.85 (0.33)	 -0.05, 0.47	 p=0.12
Parent Yes No	 4.15 (0.24) 4.13 (0.27)	 -0.27, 031	 p=0.88	 4.09 (0.21) 3.91 (0.40)	 -0.23, 0.61	 p=0.37
Did you or your partner breastfeed? Yes No	 4.17 (0.29) 4.12	 -1.40, 1.50	 No data[3]	 4.13 (0.25) 4.00	 -1.12, 1.67	 No data[3]
Breastfed as a child Yes	 4.17 (0.27)	 0.066, 0.33	 p=0.005	 3.93 (0.41)	 -0.32, 0.39	 p=0.84

No Unsure	3.97 (0.10)			3.90 (0.23)		

[1]For attitude scores: equal variances assumed (significance of Levene's test > 0.05) except for breastfed as a child (unequal variances)

[2]For knowledge scores: equal variances assumed

[3]Insufficient data to calculate p values

3.2.5.3 Multivariate analysis

Before beginning standard multiple regression, correlation between the independent and dependent variables was assessed. When analyzing mean attitude scores, two variables had Pearson correlations less than 0.3: sex (0.17) and do you have children (-0.025). When analyzing mean knowledge scores, there were three variables that had Pearson correlations less than 0.3: sex (0.028), were you breastfed (0.034), do you have children (-0.15). Each of these independent variables was eliminated from the standard multiple regression analysis as it was likely there was little relationship with the dependent variables (Pallant, 2013).

Collinearity diagnostics next determined that each remaining independent variable had a tolerance greater than 0.1 (or variance inflation factor less than ten) thus no further independent variables were removed from multiple regression analysis.

Next, residual plots were examined to detect outliers. None of the cases had a residual value above 3.3 or below -3.3; as a result, there were no outliers to be removed. The residual plots were examined and determined that there was a normal distribution and a linear relationship between residuals and predicted dependent variable score.

In this study, there were 37 respondents and three independent variables for the mean attitude score, which is a case to independent variable ratio of 37:3, well above the minimum requirement of 5:1 as recommended by Tabachnick and Fidell (2013). In

addition, there were 37 respondents and two independent variables for the mean knowledge score, giving a ratio of 37:2.

In analyzing the mean attitude score (see Table 7), the total variance in mean breastfeeding attitude explained by this model was 27.5% (adjusted R^2=0.275, p=0.004). The independent variables used in this model were: size of childhood home, sex, year of training and whether they were breastfed as a child. Size of childhood home was a significant contributor to mean attitude score in this model (p=0.017).

In analyzing the mean knowledge score (Table 8), the total variance in mean breastfeeding knowledge score explained by this model was 3.1% (adjusted R^2=0.031, p=0.091). The independent variables used for this model were: year of training and size of childhood home.

Table 7 Multiple linear regression analysis of mean attitude score in medical students at Memorial University. (N=37)

Independent variables	β^1	Standard Error	t	p-value	95% confidence intervals
Population of students' hometown	0.39	0.084	2.51	0.017	0.039, 0.377
Year of medical school	-0.22	0.084	-1.14	0.18	-0.281, 0.055
Breastfed as a child	0.22	0.11	1.15	0.137	-0.053, 0.369

Notes:
Adjusted R^2 = 0.275, p = 0.004
[1]Reference category for beta

- Childhood home: population <10,000
- Level of training: First year
- Breastfed as a child: yes

Table 8 Multiple linear regression analysis of mean knowledge score in medical students at Memorial University. (N=37)

Independent variables	β^1	1 Error	t	p-value	95% confidence intervals

Population of students' hometown	0.16	0.14	0.91	0.37	-0.15, 0.40
Year of medical school	-0.28	0.14	-1.60	0.12	-0.49, 0.06

Notes
Adjusted R^2 = 0.031, p = 0.091
[1]Reference category for beta
- Childhood home: population < 10 000
- Level of training: First year

3.3 Discussion

3.3.1 General

The purpose of this study was to answer the research question: what are the knowledge and attitudes towards breastfeeding among first and second year Memorial University medical students? A cross sectional survey of first and second year medical students was conducted in 2018. Descriptive statistics were calculated; bivariate and multivariate analyses were completed.

In this study of first and second year medical students at Memorial University, the mean breastfeeding attitude score was high and the mean knowledge score was lower. Students from rural areas, students who were breastfed as a child and second year students had significantly higher mean breastfeeding attitude scores. Second year students had significantly higher mean breastfeeding knowledge scores.

Breastfeeding should be perceived as normal (Pound et al., 2015) even though resistance towards breastfeeding is common in our society. University aged students recognize the importance of breastfeeding their future children, but still experience resistance towards breastfeeding, especially with breastfeeding in public (Fairbrother & Stranger-Ross, 2019; Pound et al., 2015). Medical students have a variety of educational backgrounds and experiences prior to studying medicine. Understanding these experiences may help us understand how they are shaped into physicians. Examining student's pre-existing attitudes and knowledge towards breastfeeding, could better guide our medical school curriculum to shape future Newfoundland and Labrador physicians into supportive

breastfeeding advocates. Strong health care advocates will help normalize breastfeeding in the province.

3.3.2 Breastfeeding attitudes in medical students

3.3.2.1 Individual attitude items

Brodribb's study has been validated with family physicians. This was the first time the questionnaire was used with medical students, who may be less educated in breastfeeding and have differing attitudes than practicing physicians. This was also the first time that knowledge and attitudes towards breastfeeding have been explored in Canada.

This study found that medical students at Memorial University have better attitudes towards breastfeeding than Australian family physicians. The mean attitude score in this study was 4.14 +/- 0.53. In Brodribb's study of family physicians in Australia, the mean attitude score was 3.99 +/- 0.43. Having a perfect breastfeeding attitude score would be 5.

Many mean attitude scores in this study were greater than four, indicating a very positive attitude. The highest score of 4.89 was "women should breastfeed in public places such as restaurants", and "breastfeeding provides health benefits for infants that cannot be provided by infant formula." In Brodribb's study the mean attitude score for these items were 4.33 and 4.43. This result may indicate changing views in breastfeeding in Newfoundland and Labrador. Newfoundland and Labrador is a modest and traditional society. In 2013, Bonia cited a maternal sense of embarrassment of breastfeeding in public as a hindrance to breastfeeding. One participant stated: "…taking out the bottle and mixing the formula together is much more acceptable than me sitting out somewhere [breastfeeding the baby]" (Bonia et al., 2013). This study indicated that medical students have positive attitudes towards breastfeeding in public, and given their likely future influence on culture norms, this might result in a shift to allow more women to feel comfortable publically breastfeeding in this province.

In Brodribb's study, the highest ranked mean attitude score was "breastmilk is the ideal food for babies" at 4.67. Interestingly, in this study, it was lower at 4.38. This is a well-

known fact (World Health Organization, 2017) and should be stressed in the undergraduate medical school curriculum. Understanding the World Health Organization guidelines on breastfeeding and its numerous benefits should be added to the undergraduate medical curriculum.

The lowest ranked mean attitude score in Brodribb's study was "breastfeeding and formula feeding are both equally acceptable methods of infant feeding" (reverse scored) at 2.85; while the mean attitude score of this item was 3.49 for this study. This could reflect the formula feeding culture in Newfoundland and Labrador. As the breastfeeding initiation rate is lower than other provinces, there is still a strong culture of formula feeding. This could explain the higher attitude score, and the higher acceptance for formula feeding. The score for this attitude item is also consistent with the students lower attitude than expected for "breastmilk is the ideal food for babies", noted in the previous paragraph.

In this study, the lowest attitude score was 2.84 "women who do not breastfeed miss out on one of the great joys of motherhood"; this was also ranked low in Brodribb's study at 3.11. Both attitude scores may reflect an ambivalence towards breastfeeding. Breastfeeding is well known to benefit mothers and babies (World Health Organization, 2017), however, some women struggle with the ability to breastfeed. Some women may experience guilt with an inability to breastfeed. Leurer (2015) studied the emotional experience of breastfeeding in mothers in Canada, and found some women felt regret and guilt towards breastfeeding. One mother stated her feelings: "Feel very let down, feel guilty I could not feed my baby". Interestingly, however, in a study carried out in pregnant Newfoundland women (some who intended to breastfeed, others who intended to formula feed), the attitude score of "women who do not breastfeed miss out on one of the great joys of motherhood" was 3.16, which was much higher than this study (Twells, et al., 2014). Perhaps there is a disconnection between the mother's feelings and the medical student's feelings on this topic.

One attitude item was deleted from the mean attitude score in this study. The question "Doctors should discuss breastfeeding with mothers early in their pregnancy." received

only seven responses (18.9% response rate). As the medical students overall had a positive attitude towards breastfeeding, it is uncertain why this question was poorly answered. Perhaps the medical students felt women should be empowered to make a decision and they did not want to pressure the patient one way or another, or elicit feelings of guilt. Perhaps other issues, such as concerns over miscarriage, were more pressing areas for discussion. Maybe if the question was reworded, and "early" was deleted, the response rate would have been improved. In mothers who decided to formula feed their babies in Newfoundland and Labrador, Bonia (2013) discovered that the majority of infant feeding decisions were made before visiting physicians. Most mothers, however, had discussed breastfeeding with their physicians.

3.3.2.2 Comparing attitudes between groups

In comparing mean attitude scores between independent variables, it was found in bi-variate analyses that students from rural areas had higher attitude scores compared to urban students (4.29 versus 4.04, p=0.003) and second year medical students had higher attitude scores as compared to first years (4.23 versus 4.02, p=0.014); the latter variable was not significant after adjusting for other variables in the multiple regression model. These results should be interpreted with caution due to the small sample size. Nevertheless, it is interesting that students from rural areas showed a more positive attitude towards breastfeeding, especially as breastfeeding initiation rates in rural Newfoundland and Labrador are much lower than urban initiation rates (45% rural and 80% urban) (Provincial Perinatal Program of Newfoundland and Labrador, 2014). Brodribb found a higher attitude score in physicians born in Australia (4.04) versus other areas (3.85, p=0.26). She also found significantly higher mean attitude scores in parents with a positive breastfeeding experience and parents who breastfed longer than 26 weeks. In this study, there were only four parents (three who breastfed), so the numbers did not allow analysis.

One could hypothesize why second year medical students had higher attitude scores as compared to first year students. Second year medical students had completed a community placement with family physicians. Perhaps they were more comfortable observing breastfeeding dyads due to this experience. Many second year medical

students also avail themselves of a shadowing program, which includes pediatrics and obstetrics. They could have become more habituated to breastfeeding dyads there as well.

Multiple regression analysis was conducted to explain the maximum amount of variance in attitude scores. Students from rural areas, second year students and students who were breastfed were used in this model. With this regression model, we could explain 27.5% of the variation in attitude scores (p=0.091). Students from a rural home were a significant contributor to this model (p=0.017).

3.3.3 Breastfeeding knowledge in medical students

3.3.3.1 Individual knowledge items

Brodribb's study has been validated with family physicians. This was the first time the questionnaire was used with medical students, who are less educated in breastfeeding than practicing physicians. The mean knowledge score in this study was 3.93 +/- 0.39. In Brodribb's study of family physicians in Australia, the mean knowledge score was 3.40 +/- 0.39.

In this study, medical students at Memorial University had good knowledge about breastfeeding preventing obesity and premenopausal breast cancer, and felt that breastmilk was the best food for infants less than six months of age. Over 95% of medical students answered these questions correctly, and the mean knowledge scores were greater than 4 for each of these items. In Brodribb's (2008) study, almost 80% of Australian family physicians and residents responded that exclusive breastfeeding was the most beneficial form of infant feeding.

However, some of the knowledge items in this study indicate a need for further education. For example, medical students did not know that most medications are compatible with breastfeeding (46.9% answered correctly, giving a knowledge score 3.73) or changing formula will not improve colic (29.7% answered correctly, giving a knowledge score 3.32). Similarly to Brodribb (2008), the mean knowledge score of knowing breastfed infants have fewer ear infections was lower than expected. This study

showed that 62.2% of medical students were aware breastfeeding was protective against otitis media, while Brodribb (2008) showed that only 43.5% of Australian family physicians and residents were aware of this fact. Interestingly, medical students at Memorial University receive instruction on infant growth and development early in the first year of medical school. However, only 43.2% of medical students knew that breastfed infants grow at different rates than formula fed infants. Similarly, 43.5% of Australian family physicians and family medicine residents were aware of the fact.

The medical students receive breastfeeding education at the midpoint in year one. This questionnaire was sent to first and second year medical students after the breastfeeding curriculum was completed. Despite having several hours of breastfeeding education, there were gaps in the knowledge areas of nutritional content of breastmilk, benefits of breastfeeding, growth of infants and safety of medications while breastfeeding. This points to a need to enhance the medical school curriculum at Memorial University on growth of breastfed infants, as well as medication safety and colic.

3.3.3.2 Comparing knowledge between groups

The mean knowledge score was analyzed in relation to all the independent variables (sex, year of medical school, population of students' hometown, and whether or not the student was a parent). The only independent variable that was statistically significant in the bivariate analysis was year of medical school. Second year students had higher breastfeeding knowledge scores than first year students ($p=0.044$); this variable was not significant after adjusting for other variables in the multiple regression model. This bi-variate result is perhaps not surprising. Even though the traditional didactic breastfeeding curriculum was completed for both groups, second year medical students have had more clinical experiences, where they may have been exposed to breastfeeding dyads.

There were no differences in knowledge levels between students from rural and urban areas. Again, this is in contrast to Twells (2014) findings, that rural physicians are less likely to discuss breastfeeding with their patients. Perhaps these physicians may be knowledgeable in breastfeeding, but dealing with demands of a strained healthcare system and lack of resources in rural settings. This result was also unexpected as the

breastfeeding initiation rate is lower in rural areas, implying that breastfeeding knowledge is lower there. There must be other factors at play to explain this discrepancy that were not studied.

Multiple regression analysis was conducted to explain the maximum amount of variance in knowledge scores. Students from rural areas and second year students were used in this model. With this regression model, we could explain 3.1% of the variation in mean knowledge scores, although this model did not reach statistical significance.

3.4 Strengths, implications, limitations

3.4.1 Strengths

To help promote breastfeeding rates in Newfoundland, as well as in Canada, it is important to have health care providers with positive breastfeeding attitudes and adequate knowledge. This is the first study to examine breastfeeding attitudes and knowledge in medical students in Canada. Junior medical students were selected as they had limited exposure to clinical medicine. If positive attitudes and basic knowledge are encouraged early in their medical career, it will then be possible to build on their skills in clerkship and residency. Overall, medical students at Memorial University had high attitude scores, indicating positive attitudes towards breastfeeding. This was especially evident in a positive attitude towards breastfeeding in public, which has been a barrier for breastfeeding mothers, especially in rural Newfoundland (Twells, et al., 2014).

There are some knowledge gaps, which are also seen in Australian family physicians and family medicine residents (Brodribb et al., 2008). In this study, there were knowledge gaps in areas such as understanding growth of breastfed infants, medication safety and treatment of colic. One could consider adding to the undergraduate medical school curriculum at Memorial University to address these knowledge gaps. At present, there are two hours of breastfeeding education in the first two years of medical school at Memorial University. The results from this study can be used to improve the curriculum, or perhaps to increase curricular hours spent on breastfeeding medicine.

One interesting finding in this study was a more positive attitude towards breastfeeding in students from rural areas. This is in direct contrast to the lower breastfeeding initiation rates in rural Newfoundland. Students from rural areas was the only significant variable in the breastfeeding attitude model. Further studies could be undertaken in this area to explore the reasoning for this unexpected result.

3.4.2 Implications

One way to promote breastfeeding is to improve by the knowledge and support of physicians who assist breastfeeding mothers and babies (Bentley et al., 1999; Brodribb et al. 2007, 2008, 2009, 2010; Li et al., 2004; Taveras et al, 2003). Newfoundland and Labrador has the lowest breastfeeding rate in Canada. Almost 50% of medical school graduates from Memorial University pursue a residency in family medicine (Phase 4 Lead, 2019) and over half of practicing physicians in this province are graduates of Memorial University (Newfoundland and Labrador Medical Association, 2010). As a result, it is vital to understand knowledge and attitudes towards breastfeeding in these medical students.

At present, Memorial University is undergoing a curriculum review. Studying knowledge deficits and attitudes will help guide the breastfeeding curriculum review process. The information gained from this study will be presented to the curriculum reviewers to improve the breastfeeding curriculum at Memorial University. Future studies will involve repeating the questionnaire following the curriculum implementations.

3.4.3 Limitations

The main limitations of this study were: sample size, possible selection bias and low internal consistency of the knowledge score.

The questionnaire was distributed to 160 first and second year medical students at Memorial University in 2018 over five weeks. To maximize response rates, the established method of The Tailored Design Method (Dillman et al., 2014) was followed, using tools such as weekly reminders, specifying how the questionnaire results were to be

used, asking for help and conveying that others had responded. There was an initial email with a link to the questionnaire, and four follow up emails.

Sample size calculations indicated a sample of 156 was needed for this study. To obtain this number of participants, the questionnaire would need to be given to a larger population. This study could be repeated by studying all years of medical students at Memorial University, or studying first and second year medical students in a variety of medical schools in Canada.

Despite following The Tailored Design Method (Dillman et al., 2014) only 37 students out of 160 (23.1%) completed the questionnaire. This response rate is similar, however, to other published studies requiring physicians and medical students to complete questionnaires (Aitken, Power, & Dwyer, 2008; Bonevski, Magin, Horton, Foster, & Girgis, 2011; Brodribb et al., 2008; Cunningham, et al., 2015; Scott, Jeon, & Joyce, 2011).

Brodribb's study (2008) had a response rate of 33%. Bonevski (2011) surveyed over 1600 family physicians in Australia, and had a 30% response rate. This survey was distributed by mail and online. Only 0.6% completed the online survey. Physicians stated that barriers to completing the survey were time constraints, workload pressures, survey fatigue and lack of interest in the topic. Another Australian survey that included medical students had a 12.95% response rate, after being sent to over 2700 physicians and medical students (Scott et al., 2011). An online survey, also conducted in Australia and sent to physicians, had a response rate of 8.7% (Aitken et al., 2008). The authors postulated that the topic may not have been interesting to the participants.

A Canadian survey was sent to physicians, and the response rate was 35.0% for an online survey. Amongst pediatricians, the rate was 29.2%. Non responders noted a lack of time as the primary reason for not responding, however, they also described survey burnout, lack of interest and a feeling they were not eligible (Cunningham, et al., 2015).

The survey in the present study was sent to all junior medical students. Even though the students were early in their training, they had a variety of educational backgrounds and

experiences prior to studying medicine. Perhaps some had interest in breastfeeding, and others did not. A lack of interest may have been a reason that the response rate was low.

Medical students also describe an email fatigue. They receive multiple emails each day from the university. As an invitation to a survey is not an urgent issue to address, perhaps it was not dealt with immediately, and ended up hidden in their inbox.

Finally, medical students, just as practicing physicians, have workload pressures. During the five weeks the survey was available, the medical students had exams, assignments and clinical placements.

From reviewing the literature, paper surveys did have slightly higher response rates. Researcher AP had a leadership position within undergraduate medicine at Memorial University. As a result, the ethics board decided a paper survey distributed by AP might represent a conflict of interest. It is possible that the response rate may have been higher had the survey also been available in paper. If this study is to be repeated, it might be worthwhile to consider using paper copies and speaking with the medical students directly.

Over 80% of the medical students who responded to the survey stated they were breastfed as a child; the remainder stated they were unsure. It should be noted that individuals who were breastfed may have stronger attitudes towards breastfeeding, and therefore could have been more likely to respond to the survey.

Finally, reliability tests revealed a Cronbach alpha coefficient of 0.81 for the attitude scale, which is above the acceptable norm for internal consistency of 0.7. For the knowledge scale, the internal consistency was 0.48. As previously mentioned, several of Brodribb's knowledge items were omitted from this study, as senior medical students felt junior medical students lacked the knowledge base when face validity was assessed. Achieving an acceptable internal consistency is more difficult with scales containing less than ten items (Pallant, 2013). In retrospect, the scale might have had improved internal consistency if it contained more items, and more information may have been gained to improve the curriculum.

3.5 Conclusions

This was the first time that breastfeeding knowledge and attitude in medical students was studied in Canada. Medical students in first and second year at Memorial University had positive attitudes towards breastfeeding. The highest positive attitude scores were observed in students from rural areas, those who were breastfed as children and second year students. Students from rural area was the only significant variable in the breastfeeding attitude model.

Medical students at Memorial University had inadequate knowledge levels. The highest knowledge scores were observed in students from rural areas and second year students.

Based on these results, curricular review might include focusing more on basic knowledge of breastfeeding in first and second year medical students at Memorial University. Further studies are required to explore why rural medical students have stronger attitudes towards breastfeeding and more knowledge towards breastfeeding.

Chapter 4

4 Study 2: Are there educational gaps in breastfeeding education within the undergraduate medical program at Memorial University?

4.1 Purpose

This qualitative study explored educational gaps within Memorial University's medical school breastfeeding curriculum by interviewing local breastfeeding educators involved with instruction and curriculum development.

4.1.1 Study objectives

The purpose of this study was to explore potential gaps in medical education at Memorial University as noted by local breastfeeding educators. Key informants (such as breastfeeding lecturers at the medical school, breastfeeding leaders in society) were interviewed for this study.

4.1.2 Research question

The research question was: What are the gaps in breastfeeding undergraduate education Memorial University?

4.2 Methods

4.2.1 Study design

A descriptive qualitative study using semi structured interviews was carried out to explore potential gaps in breastfeeding education at the medical school at Memorial University. Descriptive qualitative studies provide a comprehensive summary of everyday events (Sandelowski, 2000) and allow the researcher to describe a situation vividly and in detail (Richards & Morse, 2013). Sandelowski (2000) stated "qualitative description is especially amenable to obtaining straight and largely unadorned (i.e., minimally theorized or otherwise transformed or spun) answers to questions of special relevance to practitioners". This aligned with the purpose of this study, which was to

explore educators' concerns about breastfeeding educational gaps within the medical school curriculum at Memorial University.

4.2.2 Participant recruitment and sampling

Breastfeeding experts have training in breastfeeding medicine and work directly in patient care, either in the wards or in breastfeeding postpartum clinics at the teaching hospital associated with Memorial University. These experts recruited for this study included pediatricians, family physicians, nurses and lactation consultants.

These experts, who were also involved with medical education at Memorial University, were identified by reviewing the medical school teaching schedule to identify named teachers of the breastfeeding sessions, by attendance at breastfeeding committees in Eastern Health (regional health district for Eastern Newfoundland) to meet breastfeeding experts who attend, and by speaking with the nurse managers working in the newborn nursery and obstetrical units at the Health Sciences Hospital (affiliated with Memorial University) to obtain names of breastfeeding experts. The pool of breastfeeding experts eligible to participate in the study was in excess of 40.

Invitations to participate, which included a letter of information, were extended by email. There was no financial or token incentive to participate. The semi-structured interview guide may be found in Appendix 6. To achieve maximum variation in study participants, breastfeeding educators of differing backgrounds were selected to be interviewed. For example, educators that worked on the wards and clinics; educators who were early career and mid-career; educators who were physicians and educators who were nurses.

4.2.3 Data collection

Out of the pool of breastfeeding educators, twelve participants were selected who had the most contact with medical students. These twelve participants were contacted by email. Ten accepted the invitation to be interviewed. These ten participants were interviewed between October 2018 and January 2019.

Prior to interviews, consent form were signed and confidentiality was discussed (Appendix 7). Researcher AP conducted the interviews using open ended questions. Interviews were conducted at AP's office at Memorial University medical school. Participants' questions were answered, and informed consent was obtained before commencing the interview. The interviews were digitally audio recorded. The interviewer also took field notes during the interview.

The interviews questions covered educational gaps that informants had detected among medical students with whom they had contact on the topic of breastfeeding, as well as perceived attitudes amongst medical students and areas which the informants believe could be potential curricular improvement.

Interviews were transcribed verbatim. Information was collected on participants' teaching role (clinical or large group) and occupation (pediatrician, nurse, lactation consultant, family physician).

4.2.4 Data analysis

In keeping with descriptive qualitative analysis (Sandelowski, 2000), following verbatim transcription of the audio recordings by researcher AP, the transcripts and field notes were reviewed by AP and a member of the thesis committee (ALT). Transcripts were coded independently by AP and ALT. After independently reviewing each transcripts, AP and ALT met to discuss their individual findings. Initial codes were used to develop a coding template which was applied to the rest of the interviews and iteratively refined. Emerging key themes and subthemes were discussed at each meeting. Subsequently, the larger research team met (AP, ALT, SK) to discuss emerging themes. Regular meetings of the research team and the iterative review of the data facilitated immersion and crystallization (Crabtree & Millers, 1999). Interviews continued until sufficient data for analysis and saturation of the main themes were achieved.

4.2.5 Trustworthiness and credibility

Trustworthiness and credibility were ensured by following several steps. First, interviews were audiotaped to ensure accuracy and field notes were taken by AP in order

to capture salient issues. The interviews were transcribed verbatim and reviewed for accuracy. Each investigator reviewed the transcripts independently. Discussions among the research team facilitated reflection on the coding process and the emerging ideas and themes. Reflection of this sort is important for a qualitative study's trustworthiness and credibility (Barry, Britten, Barber, Bracley, & Stevenson, 1999).

4.2.6 Ethics approval

Approval for this study was received from Western University's Health Science Research Ethics Board (109741) on December 21, 2017; and was accepted by the Interdisciplinary Committee on Ethics in Human Research at Memorial University (20181572-EX) which provided secondary approval on February 7, 2018 (Appendices 1 and 2).

4.3 Findings

4.3.1 Study participants

Twelve participants were invited to be involved in the study. Out of these twelve, ten agreed to be interviewed. Length of experience in educating medical students ranged from one year to twenty five and interviews ranged from 10-47 minutes.

Six were physicians, four of whom were family physicians who practiced family medicine obstetrics, and two were pediatricians. Four were nurses, who worked on the newborn unit or were lactation consultants. All participants had experience with breastfeeding medicine and clinical, small group and large group teaching of medical students.

Sufficient data for analysis and saturation of the main themes were obtained by interview ten. Participants were de-identified and instead sequentially referred to by letter and number, starting at P1, and based on order of their interview.

4.3.2 Themes identified

Memorial University is located in Newfoundland and Labrador. Formal teaching in the first two years of the curriculum is completed in the capital city. Clerkship may be in the

city, or in smaller rural areas. Many clinical rotations are completed in rural Newfoundland and Labrador, where the culture may differ from the capital city.

Several themes emerged from the analysis of the interviews. These themes were: attitudes of learners, deficiencies in knowledge amongst learners, attitudes of educators, learning environment at Memorial University, impediments to learning and breastfeeding culture in Newfoundland and Labrador.

4.3.2.1 Attitudes of learners

The breastfeeding educators were asked to identify attitudes of learners in undergraduate medical education at Memorial University towards breastfeeding. Generally, they felt the learners had positive attitudes, however the attitudes could sometimes be naive. Participants stated that medical students seemed uncomfortable observing breastfeeding patients in clinical settings.

4.3.2.1.1 Positive attitude of learners

The breastfeeding educators felt that learners had positive attitudes. Participants felt that breastfeeding was accepted, and was a normal part of development by medical students:

> P5: ...respectful, they were interested, they asked questions, and there was a complete, for me, there was a complete normalization of this is part of growth, development, infant feeding, bonding, you know the life journey of parents and babies. It was just completely normal, you know, kind of part of life. And I just thought it was pretty inspirational. I was pretty struck by that.

4.3.2.1.2 Naivety towards breastfeeding issues

Educators, however, noted that some learners could be naive towards breastfeeding issues. Overall, the learners felt breastfeeding was positive and acceptable, but the learners often did not understand the nuances and the difficulties that could accompany the breastfeeding dyad:

> P9: So there is definitely, you know, a sort of open-minded attitude, but the naivety about, you know, the reasons things can go off the rails or that a woman might not want to breastfeed.

These learners were early in their career, and did not have as much experience with finding common ground with patients. The naivety towards breastfeeding was also demonstrated through difficulty finding common ground with prenatal patients and new mothers in some instances. Medical students understood that breastfeeding was most beneficial for a mother and her baby, but did not always have the understanding that the role of a physician is to provide the best evidence available, and allow the patient to make their own decision, even if it differs from your own:

> P8: I think it's important for them not to be judgmental. We always tell them "Make sure you breastfeed, make sure you breastfeed, make sure you breastfeed". And it's hard to pull back when patients come in and they have their mind made up that is what they're doing. Yes, explore around it and that kind of thing, but at the end of the day, when mom makes the decision, then that should be supported. And, you don't want to lose patients over that. Sometimes they can be very rigid and "OK, these are the guidelines. If you don't follow the guidelines, then why are you here?" type of thing.

4.3.2.1.3 Discomfort around breastfeeding patients

Participants suggested some learners seemed to feel uncomfortable in the presence of a breastfeeding woman. This may stem from being early in their clinical experience, not having much experience being in the room with a breastfeeding mother and not fully understanding how to assess a breastfeeding patient:

> P3: Sometimes they will leave the room if the mom is breastfeeding. And that's actually a prime opportunity to check latch and see how things are going. It's like they're "Oh, I'll give you a bit of privacy", but really you want to be involved, as long as mom is ok with it.

At Memorial University, local breastfeeding educators felt that medical students had mostly positive attitudes towards breastfeeding. There were instances, however, when these attitudes were found to be naive, especially when attempting to find common ground with patients. Educators also found medical students sometimes showed discomfort being in the presence of an actively breastfeeding woman.

4.3.2.2 Deficiencies in knowledge amongst learners

Breastfeeding educators felt that medical students had low levels of breastfeeding knowledge, especially in assessing clinical problems. The knowledge was mostly at a surface level, and medical students did not understand the nuances, nor did they have the hands on skills to assist with breastfeeding. This lack of knowledge and hands on skills were associated with a lack of confidence. Educators noted that medical students with experiential knowledge, from being parents, had a higher knowledge level.

4.3.2.2.1 Low levels of breastfeeding knowledge and skills in medical students

All breastfeeding educators interviewed felt there were low levels of breastfeeding knowledge amongst medical students. They felt the knowledge level was similar to the general public:

> P8: If it's going well, and mom says "yeah, I'm breastfeeding and it's fine", then they usually leave it at that. They don't generally probe any more deeply, you know, to say "how are the nipples, how often are you feeding, what do the poops look like"; those kinds of things.

One participant working on the newborn ward with third year students, indicated the students did not seem to know how to take a breastfeeding history or assess breastfeeding:

> P7: This week I had two med students on the floor...And then I ask them how is the feeding going? And they'd be like "oh...good I guess" Ok, and how do you know it's going good? And they'd say "Well, the mom said". And you look through the chart and the feedings is actually not going great. And then, I would always have to go and double check.

According to the educators, the medical students knew more about general breastfeeding information than practical skills, such as helping a baby latch:

> P1: They seem to kind of take a step back and let the nurses do a lot of the work, rather than kind of get their hands on the patient themselves and be interacting with the patients and the moms that are breastfeeding and stuff like that.

4.3.2.2.2 Personal experience enhances breastfeeding knowledge

Medical students who were parents however, had more robust knowledge levels according to the breastfeeding educators. This also extended to well-baby care:

> P8: A lot of their knowledge seems to come from personal experience. So if they've had kids, it's a little easier for them to talk about breastfeeding with patients...And I don't only find that with breastfeeding. Also when they see well babies.

A demographic shift was also noted, since families are smaller than previous generations and the birth rate is declining. Participants indicated that medical students started their training later, therefore they may not have the same social exposure to babies and pregnancy as previous generations:

> P10: Because a lot of them have moved away from home...And the first baby they're exposed to is maybe when they do that rotation <in the hospital>...if you're studying for seven years, you're not so much going around so much socially looking at babies.

4.3.2.2.3 Lack of confidence in medical students

This lack of knowledge in medical students in breastfeeding medicine was also associated with a lack of confidence. Several breastfeeding educators noted that students appeared to lack confidence in approaching a breastfeeding mother:

> P2: They seem to be a little intimidated about giving advice and being the one that's supposed to be the expert if they are faced with a situation or questions around breastfeeding.

This issue also occurred especially if there was no personal experience with breastfeeding, where there was an imbalance between the patient's knowledge level and the medical student's:

> P8: I've had residents and medical students say, "You know I feel a bit like a fraud trying to counsel someone on breastfeeding when I haven't, you know, been through it or have my partner go through it, or whatever".

Some educators wondered if this lack of confidence appeared to be disinterest in others:

> P2: I think they feel, when it's outside that realm, they feel a little out of their comfort zone...That may get miscommunicated or misunderstood as lack of interest.

Medical students at Memorial University had an understanding of the basics of breastfeeding, but struggled with more complex issues, such as assessing clinical problems and practical skills. This lack of knowledge was also demonstrated with a lack of confidence in assessing breastfeeding patients. Students with personal experience in breastfeeding, had more robust knowledge levels.

4.3.2.3 Attitudes of educators

All breastfeeding educators had positive attitudes towards breastfeeding. They reflected on their personal experience that shaped their teaching styles and how to improve their teaching. They realized that their attitudes might not mirror all of their students, and attempt to create an open environment for learners who may have disagreed with them.

4.3.2.3.1 Reflection on personal breastfeeding experience

While discussing breastfeeding education at Memorial University, and the experiences educators had with learners, many educators reflected on their own personal experiences. One participant had brought her own children, who are now adults, to demonstrate breastfeeding at the medical school. She found this to be an incredibly rich experience:

> P5: So, I felt that experience, actually, being a breastfeeding mother. And they (medical students) were looking at me and a little bit nervous...but they were so interested...they would come over, and they would ask questions and I just thought it was amazing. It was magic. And I loved doing it.

One participant in the study had just returned from maternity leave, and continued to breastfeed her child. She noted that even amongst learners in medical school, there was discomfort with breastfeeding or pumping in public:

> P8: Speaking as someone who breastfeeds and pumps in the workplace, even for me, it's sometimes uncomfortable trying to find a place. Like, I'm not going to

> go to the bathroom to pump. Right? So I tend to do it a little in front of medical students and residents. I haven't had anybody say anything to me, but I have had people get up and leave the room. Yeah, so, there is a little bit of uncomfortableness with that still.

4.3.2.3.2 Reflection on teaching styles

Many of the educators reflected on their teaching styles. Some participants reflected during the interview how they could improve teaching practical breastfeeding techniques to third year medical students. This was expressed by both recent graduates, and more experienced educators:

> P7: I don't take them in with me as much when I do hands on with the mom. But, reflecting back, I should start bringing them in... But it's hard, because when the mom is struggling, you don't want to bring in an inexperienced med student who does not know what they're doing. Usually they're at their wits end about to give up breastfeeding. So it's hard. But I'm sure for myself there are ways to bring them in. Instead of me saying 'you wait here, I'll go deal with it"

> P10: And I've been asking it <do physicians examine your breasts?>...we could improve there, I'm sure. What an opportunity we're missing out on, just to have that discussion very early in the pregnancy.

4.3.2.3.3 Introducing breastfeeding into teaching

All breastfeeding educators had positive attitudes towards breastfeeding. Some of these educators had been challenged on these attitudes, and attempted to create an open environment for learners who may had disagreed with them:

> P6: I have to be very transparent in the beginning, that I am biased towards breastfeeding. And then I explain the baby friendly <Baby Friendly Initiative> is for all babies. And women choose their infant feeding method for a variety of reasons. They're all doing what they think is the best for their babies. But the science shows that breastmilk is better.

One educator found that a gentle approach to bringing breastfeeding into the conversation may be the best:

> P5: You might come to a conversation or come to a practice with your own past experience. But if you can, I think as educators if we can recognize that and find

> ways of kind of softening those boundaries and allowing the information to be received without too much resistance. I find that kind of interesting.

All breastfeeding educators had positive attitudes towards breastfeeding. Their attitudes were shaped by their personal experience, which they often brought into their teaching. Many educators also reflected on their teaching styles, and how they could improve their teaching methods.

4.3.2.4 Learning environment at Memorial University

There are many types of learning environments at Memorial University. There are lectures, small groups, online asynchronous learning modules and clinical teaching. In clerkship, many rotations are based in rural settings. Academic half days are often conducted online, where engagement can be challenging. One participant, however, remembered excitement in a medical student who had an encounter with a breastfeeding mother:

> P2: ...just the enthusiasm that one of the students had…the patient was comfortable enough to let them observe and just let them see the actual part of breastfeeding. Yes, and I will admit she was pretty excited to come share that.

4.3.2.4.1 Integration of medical students into the clinical team

Clinical teaching occurred on wards, in clinics, and in labor and delivery. The clerkship students are integrated into layered learning teams, which often comprise residents and faculty, along with nurses, lactation consultants and allied health professionals. Due to the activity at these locations, full participation in the team can be difficult, and sometimes the experience is likened to a shadowing experience, as one participant noted:

> P10: They are watching me, I have to be honest. They are sent into see what I'm doing. And I don't really get a chance to reciprocate that back to see what they've picked out of it.

One clinician thought that successful integration into the team required an improved skill set for the medical students, especially hands on learning. The clinician remembers the feeling of inadequacy she had before she learned these skills:

> P7: ...like the other day, I went in and put a mom on and started a SNS <supplemental nursing system>. Before that, I would have just ignored her, and kind of let other people deal with it. Whereas now that I have those skills, I feel that I can add something instead of just being another person to go in the room and bother them. So I wonder if we equip them with more hands on skills, they'll feel more empowered too and they'll be more interested in it, because they'll feel like they're adding to the dyad.

4.3.2.4.2 Gender differences

A few breastfeeding educators noted a difference in male and female medical students. It was felt that males were more eager to ask questions of the instructors, yet felt more uncomfortable in the clinical setting:

> P4: They're interested in learning...surprisingly enough, I find the guys more interested than the girls.

> P7: I think the newborn ward is very female oriented, and I think it could be very daunting to men. I had a male student, and he was the one who was a bit more hesitant about going into the feeding. So I wonder if they find it hard to relate and they feel uncomfortable with the breastfeeding and being there.

4.3.2.4.3 Motivation to learn

As with many medical schools, assessment will motivate learning. Educators found that medical students were focused on their upcoming Licentiate of the Medical Council of Canada (LMCC) exam and learning the topics that may appear on the exam. Pediatricians that worked with medical students in their third year rotation, often found that the students were motivated to learn through assessment. Their LMCC exam was approaching, and they were focused on learning the material:

> P6: Because that's sometimes what drives the students, right? If it's going to be on the exams.

> P7: The medical students focus on whatever people teach them, whatever they think is going to be on the exam.

The learning environment at Memorial University comprises large group sessions, small group sessions and clinical teaching. There is layered learning in the clinical setting, with medical students working with residents, senior medical students, nursing students and

pharmacy students. This can sometimes create situations where some students receive more teaching than others, along with a struggle for educators to meet the needs of the student and the needs of the patients. Although enthusiastic, medical students at Memorial University are often motivated to learn for upcoming assessments, instead of what might be commonly seen in clinical settings.

4.3.2.5 Impediments to learning

The breastfeeding educators interviewed demonstrated a high level of interest in teaching. There were, however, impediments to teaching medical students. Structural impediments existed as there were many topics to cover and little time to achieve these goals. The undergraduate medical school curriculum was renewed in 2013, and many educators were still not familiar with the new curriculum and where breastfeeding fit.

4.3.2.5.1 Structural impediments to learning

In teaching medical students about breastfeeding, educators noticed several impediments to learning. There were structural impediments directly related to turnover of students, differing schedules for medical, nursing and pharmacy students, and difficulty finding a time to teach breastfeeding along with other curricular requirements:

> P10: And they change every few weeks so they are constantly on the move.

> P7: So you prep them before they get on the ward. Because when they get on the ward, it's crazy. There are nursing students, there are a million people, there are four people in a room, it's not the best.

Some thought that the basic education should be completed earlier in their training, in classroom settings, before the medical students were introduced to the wards:

> P3: Once we get people into the clinical setting, it's very difficult to get them back out into the classroom.

Many educators also teach other health care professionals, such as pharmacists and nurses, as well as medical students. There was a tension that all of these teaching responsibilities were not completed together, as students' schedules differed. The

educators felt this should be achieved, especially at early stages when knowledge transfer was similar:

> P3: We are a team. And, it's difficult to sometimes feel like a team when there's doctors teaching med students on one side and nurses teaching nursing students on the other side, and we meet when we have to meet.

As bedside teaching is dependent on clinical exposure, learners need to be exposed to a variety of patients. There are times, however, when the learners are needed to help out in other parts of the hospital:

> P6: One of the problems is, when the residents do their neonatal rotation, they used to do a fair bit of time with the normal newborns on the maternity ward. Because there's been a shortage with people that work in the NICU, my understanding is the residents have been seconded to the NICU. And, they would have less exposure, to like normal breastfeeding anyway.

4.3.2.5.2 Lack of knowledge of medical school curriculum

A recurring comment from educators was a lack of understanding about the content and sequence of breastfeeding medicine within the medical school curriculum at Memorial University. Educators were not always aware of the medical students' baseline knowledge about breastfeeding, what was previously taught in the curriculum, and what was expected to be taught during their session. This was especially pervasive amongst educators who were newer in their positions:

> P4: I do the clerk teaching during their obstetrical rotation. Yeah, I've been doing that from when I started...Nobody told me exactly what I was supposed to do.

> P7: I guess they have certain cases they need to do, do they have that still? Like where they should see a baby with this, or a kid with these problems?

Educators were often responsible for teaching nurses, medical students and residents. Some educators were not sure if medical student teaching should differ from other teaching:

> P4: So, I sort of do the same sort of teaching that I do with the nursing students...it's not the benefits and all those kinds of things with breastfeeding, because I assume, which you never should assume, but I assume that it's taught.

Changing curriculum in the medical school also made it difficult to remember the teaching that preceded their ward rotations:

> P9: I'm not sure where it's <breastfeeding> taught in the curriculum, I'm not sure how, and whether they get that balanced teaching.

> P10: I know they used to bring in mothers and babies to the med school, I don't know if they still do that.

Educators also felt that they were familiar with areas in the curriculum where they taught, but were not familiar with the breastfeeding curriculum as a whole:

> P6: I don't know if in their academic half days, if the clerks get any teaching on breastfeeding. I'm not doing it.

At Memorial University, several impediments to learning were identified. Structural impediments included lack of space for teaching, high turnover of students and different schedules for different types of learners. There was also a lack of knowledge of the medical school curriculum amongst the breastfeeding educators. May were not sure what teaching was required, and what teaching the medical students had prior to their clinical experiences.

4.3.2.6 Breastfeeding culture in Newfoundland and Labrador

According to participants interviewed for this study, there is more interest about breastfeeding from parents in Newfoundland and Labrador. The breastfeeding educators noted some physicians do not spend enough time discussing breastfeeding with their patients, but there is an overall hope that future physicians graduating from medical school at Memorial University will have improved breastfeeding knowledge and better communication with their patients about breastfeeding.

4.3.2.6.1 More interest from society

The breastfeeding educators noted that the breastfeeding culture in Newfoundland and Labrador was shifting to include more interest from medical students and patients. Lactation consultants described an increase in frequency of prenatal breastfeeding clinics and an increase in attendance. Medical students are more open to discussing breastfeeding as noted by experienced educators:

> P5: I think there is much more openness to breastfeeding in that age cohort, from my experience than maybe there might have been, even you know, 10 or 15 years ago. So maybe that's society changing as well.

> P3: So I think the culture that the medical students are being brought in to, is a culture of breastfeeding.

4.3.2.6.2 Physicians' role in breastfeeding discussions

Despite the renewed interest from families and learners, physicians in the community often do not discuss breastfeeding with their patients. One participant noted a low rate of completion of the intent to breastfeed section in the provincial prenatal record by physicians:

> P3: In St. John's, 85% of the intention to breastfeed box on the prenatal record is not checked. So right off the bat we either know that that conversation is not happening, or/and the box is not getting checked.

Participants noted that physicians have a very important role to support breastfeeding in the community. However, sometimes these discussions do not happen until after the baby was delivered:

> P10: What an opportunity we're missing out on, just to have that discussion very early in the pregnancy.

> P5: So, we've done so much work in so many different areas, but we all know it's the physician oftentimes who can make or break that continuation of breastfeeding, or the promotion of breastfeeding, or just the initiation of that discussion.

4.3.2.6.3 Hope for future physicians

There was an overall hope for the new generation of physicians. The participants felt that it was important to introduce breastfeeding early in the curriculum to minimize bias that learners may develop as they pursue their education:

> P5: I think they're a group that are eager to learn and I think it is a great opportunity. A far better to start and then build on it. To normalize it all the curriculum, rather than to introduce it later in the curriculum.

The overall feeling was physicians should be more educated about breastfeeding so they could better support their patients when they practice:

> P4: I think it's important that our new, young physicians are more educated. So that when they go out into the field, it's getting passed on.

Many of these medical students are older, and have been in the education system for many years. Breastfeeding rates in Newfoundland and Labrador were quite low when they were born. Educators felt that these students were at a disadvantage as breastfeeding may not have been discussed or observed in the home:

> P5: This discussion, ideally, would have happened when they're little, when they're two and three years old, right? And somehow we're trying to catch up when they already, perhaps, have some biases.

Educators at Memorial University felt that Newfoundland and Labrador was developing a culture with more acceptance to breastfeeding. They felt family physicians were integral with the promotion and discussion of breastfeeding, but felt this conversation was sometimes lacking. Overall, there was a hope for the future physicians to better support their breastfeeding patients.

4.3.3 Interplay between themes

These themes: attitudes of learners, deficiencies in knowledge amongst learners, attitudes of educators, learning environment at Memorial University, impediments to learning and breastfeeding culture in Newfoundland and Labrador did not occur in isolation. There was significant overlap with how the breastfeeding educators viewed the

knowledge and attitudes of the medical students with the teaching restraints and their own attitudes.

Tension was noted as educators attempted to balance their teaching responsibilities with clinical duties, a changing medical curriculum, and lack of familiarity with their learning objectives. The educators often wanted to provide the best learning experience for the medical students, yet, protect their patients and manage the physical restraints of the ward. This especially occurred with new mothers, who might be recovering from a difficult delivery and struggling to breastfeeding. In these cases, educators did not always involve medical students:

> P7: So you prep them before they get on the ward. Because when they get on the ward, it's crazy. There are nursing students, there are a million people, there are four people in a room, it's not the best...I don't take them in with me as much when I do hands on with the mom. But, reflecting back, I should start bringing them in. Obviously just asking the mom if it's ok. But it's hard, because when the mom is struggling, you don't want to bring in an inexperienced med student who does not know what they're doing. Usually they're at their wits end about to give up breastfeeding. So it's hard. But I'm sure for myself there are ways to bring them in. Instead of me saying 'you wait here, I'll go deal with it"

Educators struggled when clinical duty trumped teaching duty. One participant described a situation where there was an inability to fully staff the NICU. The learning plan for residents was altered, such that residents no longer had exposure to healthy newborns on the floor, but were required to report for duty in the NICU. The educator understood this need, but also felt that the residents were missing a valuable opportunity to learn about breastfeeding and healthy newborns:

> P6: there's been a shortage with people that work in the NICU...the residents have been seconded to the NICU. And, they would have less exposure, to like normal breastfeeding anyway.

This tension between duty of education and duty of patient care was also seen off the ward, in outpatient clinics. Educators felt a responsibility to protect their patients who were unable to breastfeed, or chose not to breastfeed. They noted that medical students,

early in their training, sometimes saw the decision to breastfeed as a dichotomy, instead of a decision made after careful reflection:

> P9: I think the attitude is very positive, in that they are very pro breastfeeding. I'm not sure that they would acknowledge that it's not for everyone. So I think they might have a bit of a naive approach, that everyone can and should breastfeed...which I can't really fault them for, because I think that was my naive attitude when I started practice. When you start helping women breastfeed, or when you start breastfeeding yourself, you realize there are a lot of challenges, you know, social challenges, physical challenges. So I think they might have a little more of "an every woman should breastfeed" approach and not recognizing when women could have barriers to that.

Tension was also seen when educators were challenged about breastfeeding. Students would sometimes challenge the information presented in lectures or challenge the research. This often prompted educators to alter their teaching styles, to be more open to the realization that their bias is to promote breastfeeding:

> P6: When I do the first year lecture, I noticed in the beginning, sometimes I would get in the evaluations, I'd get maybe one comment from a student, about my lecture being too biased towards breastfeeding. It is a topic, when you're teaching it, for some people it's very sensitive. So that's something I realized, that I have to be very transparent in the beginning, that I am biased towards breastfeeding. And then I explain the baby friendly is for all babies. And women choose their infant feeding method for a variety of reasons. They're all doing what they all think is the best for their babies. But the science shows that breastmilk is better. And I found out that since then, I don't get those types of comments on my evaluations.

As noted by a participant with many years of experience, medical students are different that they were a generation ago. They are older, often with more education prior to starting medical school. Some have made a career change. Some are parents. By the time they are in clerkship, some have decided their future career paths. Some educators have noted that they are more interested in their teaching, than the students are in the subject. Educators struggle with this lack of engagement:

> P10: Some of them to come clinic and act as if it's a chore they have to do and they don't want to be there and they make it obvious.

When asked if this was similar to when she started her career:

> P10: No, it's more prevalent now. And some of them are more in to it, they're focused in it, they're excellent, but others are not interested...I don't think it's just with breastfeeding. It's a different era. It's a different age group. It's a different dynamic.

Tension was noted between educators' roles of patient care and teaching. Clinics and wards can be busy, and it is sometimes difficult to manage the care of all the patients. Patients may have experienced a difficult delivery or may have challenges breastfeeding, and educators sometimes felt they should be protected from the medical students, instead of using this as a teaching opportunity. Medical students sometimes challenged the information provided by the educators. Educators sometimes struggled with engagement if the medical students were not interested in the topic of breastfeeding.

4.3.4 Curricular recommendation

The interview participants expressed multiple ideas for curricular improvement. Recommendations focused on curriculum timing, curriculum content and novel applications of curriculum, including multidisciplinary teaching and experiential learning.

Participants felt that basic breastfeeding information was lacking. There were strong feelings that having the entire medical school class together to relay the same information was important. This was best achieved in the first or second year of the curriculum. This would allow the learners to be more prepared as they entered their clinical rotations, especially obstetrics, pediatrics and family medicine. One pediatrician even felt that residency did not equip her to assess breastfeeding in patients:

> P2: I think for me even, as a resident I knew nothing. And it's hard, because the parents will ask you, and they think you know, and when you don't, it's embarrassing. Because as a pediatrician, you should know! And I had no idea what breastfeeding looked like.

Recommendations for pre-clerkship lectures from the breastfeeding experts included: development of breastmilk, anatomy of breastfeeding, benefits of breastfeeding, maternal medical conditions and breastfeeding, complications of breastfeeding, taking a

breastfeeding history, neonatal feeding history, normal neonatal feeding patterns, difficulties with latch, and ankyloglossia. Several breastfeeding educators encouraged multidisciplinary teaching, such that pharmacy students, nursing students and allied health students were included in the breastfeeding basics teaching.

Most participants felt that a large group format would work best for the basics. However, there was much discussion about experiential, hands-on learning. Assessing breastfeeding requires specific procedural skills, including assessment of latch and examination of breasts. It was felt that medical students needed to be introduced to the mother and baby breastfeeding dyad early, such that they could build on these skills in clerkship. Ideally, this would be accomplished in small groups, where mothers and babies were brought to the medical school. Alternately, this could be incorporated into a clinical experience during the pre-clerkship years, where medical students could attend breastfeeding clinics. At present, there are breastfeeding simulators available, which might aid with hands-on learning.

Another recommendation made by breastfeeding educators was to include other important physician-patient roles, in addition to the medical expert roles. Educators noted the importance of incorporating health advocate, communicator, collaborator, professional, scholar and leader as well (Royal College of Physicians and Surgeons of Canada, 2019).

There was much discussion about incorporating the communicator, professional, collaborator and advocator roles in breastfeeding education by the participants. Communication skills acquired in learning the patient-centred clinical method in Phases 1 and 2, would allow learners to understand the importance of a patients' proximal and distal contexts to understand the whole person, and the importance of achieving common ground in physician-patient encounters. Breastfeeding is an example that may be used to illustrate these important learning objectives. Educators felt that students must understand the stigma that sometimes accompanying breastfeeding, especially the comfort with discussing breastfeeding, and the importance of not being judgmental if a woman decides not to breastfeed. It is important for learners to recognize the social and

economic barriers that may impede breastfeeding, especially in the underserviced population. Another solution discussed was to have multidisciplinary teaching, involving medical students, nursing students, pharmacy students and social work students as the basics of breastfeeding information would be similar for all groups. This could also promote a greater understanding of each other's roles in women and children's health.

Another facet of breastfeeding that educators felt to be important was how to be respectful of the breastfeeding mother. Understanding how to approach a patient who may be recovering from a difficult delivery, dealing with the challenges of a new baby, suffering from baby blues and sleep deprivation is much more challenging that discussing breastfeeding during a routine prenatal visit. Medical students must acquire the knowledge required to assess for breastfeeding difficulties, while learning how to approach these patients in a respectful and non-intimidating way.

Examining a breastfeeding mother is another important learned skills. Many learners have a tendency to leave a breastfeeding mother to give her privacy. While important to be respectful, it is also important to use these learning opportunities to become comfortable with latching a baby and instructing a mother how to hold a baby.

Finally, many educators felt it was important to incorporate the breastfeeding continuum into the curriculum, instead of restricting breastfeeding education to purely breastfeeding sessions. Breastfeeding offers short term and long term protection from diseases to mothers and children. Many communicable diseases are reduced amongst breastfed babies, this can be also be instructed in epidemiology and community health lectures. As breastfeeding reduces chronic diseases, such as maternal and childhood diabetes, it may be discussed in sessions on disease prevention, as well as endocrinology and cardiology. Breastfeeding can also be used to illustrate several concepts of population health, such as food security and emergency preparedness. Recommendations made by the breastfeeding educators are found in Table 9.

Table 9 Recommendations for curriculum improvement in breastfeeding education at Memorial University, as noted by breastfeeding educators.

Curriculum Content	Timing	Format	CanMEDS role
Breastfeeding basics (anatomy, physiology, benefits, anatomy of breastmilk)	Pre-clerkship	Lecture	Medical expert
Breastfeeding advanced (maternal illness and breastfeeding, breastfeeding history, neonatal feeding history, normal feeding patterns)	Pre-clerkship	Lecture	Medical expert
Hands on sessions (assessing latch, basic holds, examining breasts)	Pre-clerkship	Clinical experience Small groups with mothers-babies Small groups with simulators	Medical expert
Patient centered clinical method	Pre-clerkship	Clinical experience Small groups with mothers-babies	Communicator, professional
Social barriers to breastfeeding	Pre-clerkship	Panel discussion Round table Small groups Multidisciplinary	Advocate, professional, leader, collaborator
Entire perspective breastfeeding	Pre-clerkship	Panel discussion Round table Small groups Multidisciplinary	Professional, advocate, leader, collaborator
Refresher to breastfeeding	Clerkship	Online modules	Medical expert
Breastfeeding clinical skills	Clerkship	Bedside teaching	Medical expert

In summary, breastfeeding educators had a wealth of recommendations to improve breastfeeding medicine at Memorial University. The breastfeeding educators suggested that breastfeeding information should be taught in pre-clerkship. After that topic was mastered, hands on learning should be introduced. Breastfeeding educators also noted that breastfeeding should be included in teaching for non-medical expert CanMEDS roles, including communication with breastfeeding women about barriers to breastfeeding and finding common ground. Finally, breastfeeding educators felt it would be helpful to have multidisciplinary breastfeeding teaching, including nursing, pharmacy and allied health students.

4.4 Discussion

Several themes emerged from the analysis of the interviews. These themes included: attitudes of learners, deficiencies in knowledge amongst learners, attitudes of educators, learning environment at Memorial University, impediments to learning and breastfeeding culture in Newfoundland and Labrador. There were also tensions noted between breastfeeding educators, medical students and patients. Each theme will be discussed sequentially.

4.4.1 Learner attitudes

In this study, medical students had generally positive attitudes towards breastfeeding. These findings parallel other studies outside North America. Senior Australian medical students were found to have positive attitudes towards breastfeeding (Brodribb et al., 2010). Khriesat (2014) found that medical students in their final year of study in Jordan had generally positive attitudes towards breastfeeding. Similar results, with medical students demonstrating positive attitudes towards breastfeeding, were also found by studying medical students in Saudi Arabia (Amin, 2014).

It is interesting that the educators in the present study noted a naivety in the learner's attitudes and a discomfort being around actively breastfeeding patients. This suggests a lack of normalization of breastfeeding, and perhaps a resistance towards complete acceptance of breastfeeding, which might be explained by the differing backgrounds of medical students. Similar attitudes have been recognized in other studies: Fairbrother

(2010) and Pound (2015) both found that university aged students recognized the importance of breastfeeding their future children, but had suboptimal attitudes, including breastfeeding in public. The naivety and discomfort in the learner's attitudes in the present study could also be due to lack of experience, as medical students might have difficulty understanding the ideas and feelings towards breastfeeding in patients if they are not explored properly. This underscores the importance of understanding breastfeeding medicine, but also understanding how to communicate effectively with patients.

4.4.2 Deficiencies in knowledge amongst learners

This study found that medical students only had a basic understanding of breastfeeding medicine in Newfoundland and Labrador. There were exceptions, such as those who challenged educators' views about breastfeeding, and parents who had higher levels of knowledge in breastfeeding medicine. These findings are similar to those found in other studies. Senior Australian medical students were found to have a lack of knowledge and a reluctance to encourage breastfeeding (Brodribb et al., 2010). Khriesat (2014) found that medical students in their final year of study in Jordan were not equipped to counsel breastfeeding patients. Knowledge was significantly better for female students with children. Gary (2017) noted that knowledge levels of breastfeeding medicine were low, and many felt they had not received adequate training. Similar results, with medical students demonstrating deficiencies in knowledge of breastfeeding medicine were also found by studying medical students in Pakistan (Anjum et al., 2007), Egypt (Abdel-Hady et al., 2013), Saudi Arabia (Amin et al., 2014), and India (Kakrani et al., 2015). Abdel-Hady (2013) compared knowledge levels of junior and senior medical students, and found senior medical students had higher levels of knowledge.

In this study, breastfeeding educators noted a lack of confidence in medical students. Confidence of breastfeeding knowledge was studied in England (Bali et al., 2015) and the United States (Gary et al., 2017). Medical students were found to lack confidence in this area, similar to what the breastfeeding educators in the present study noted amongst Memorial University medical students.

There could be several reasons why these knowledge deficits existed. Firstly, the medical school curriculum at Memorial University has two hours of lectures on breastfeeding medicine. This is likely not enough to cover all the areas of importance. Medical students are now older, and have more education before beginning medical school. About 50% of medical students at Memorial University grew up in rural areas, indicating they moved away from home to study. This would have removed them from their families, and likely limited exposure to babies at a time when they could develop an experiential understanding of breastfeeding and maternal feelings.

4.4.3 Educator attitudes

This study found that breastfeeding educators at Memorial University had positive attitudes towards breastfeeding. They wanted to create an open environment for learners, while appreciating that some learners may have had their own views on breastfeeding. They reflected on their personal experience and teaching styles to continually improve their teaching methods.

Reflection on teaching is "so essential to educating physicians, is even more crucial for clinical teachers" (Ramani & Leinster, 2008). In fact, they stated that clinicians become educators not through medical expertise, but through reflecting on their teaching experiences. In this study, there were several examples of teaching reflections. Furthermore, Ramani and Leinster (2008) stated that reflecting on the clinical encounter along with learner feedback can help plan the next teaching encounter.

Breastfeeding educators in the present study were engaged and passionate. They were respectful of their patients and learners. Irby (2001) found that excellent clinical teachers are passionate, supportive, exhibit respect and clinical competence and engage in self-reflection. All these traits were observed in the breastfeeding educators at Memorial University indicating excellence in many of the breastfeeding educators.

The Fundamental Teaching Activities in Family Medicine was designed for family physicians working as educators within postgraduate programs and medical schools (Walsh, et al., 2015). The participants in this study (family physicians, pediatricians and

nurses) have shown capacity in all three domains of this framework: clinical preceptor, teacher outside the clinical setting and educational leader. There was much supervision of clinical activities, there were large group lectures and small group sessions, and much advice provided on curriculum improvements to help with educational programming and administration (Walsh et al., 2015). According to The Fundamental Teaching Activities in Family Medicine, these educators demonstrated leadership and scholarship in several of these teaching activities.

4.4.4 Learning environment at Memorial University

Breastfeeding education begins in first year at Memorial University. Medical students are generally engaged at this time and receptive to learning. Breastfeeding educators felt more could be done at this stage to normalize breastfeeding. This has also been emphasized in previous studies (Brodribb et al., 2012; Anjum et al., 2007). Breastfeeding should be considered a normal part of infant development (Pound et al., 2015, Amin et al., 2014).

Breastfeeding educators also felt that teaching opportunities were limited in clinical settings during clerkship. At that time, teaching had to be balanced with timing, space and needs of the patients. They felt that more education should occur in pre-clerkship years to prepare the medical students for the wards and clinics. Several studies have noted that breastfeeding education should begin early and span the curriculum. Anjum (2007) stated education should occur at all levels, and Dyke (2006) felt it should be integrated, and not only present in the small window of morning rounds. This is an important consideration for improving the breastfeeding curriculum at Memorial University. Breastfeeding should be introduced early in the curriculum, normalized and then refined as the students progress through medical school.

As part of the understanding of the learning environment, it is important to note that the medical school at Memorial University has transitioned to a competency based curriculum (UGME Memorial University, 2019) which “tracks the longitudinal progression of each learner toward competence prior to residency” by meeting entrustable professional activities (EPA). Amongst these competencies include obtaining

a history (EPA1), formulating a differential diagnosis (EPA2) and formulating a management plan (EPA5). Each of these competencies can apply to breastfeeding medicine. These EPAs will be met in core rotations of rural family medicine, obstetrics and pediatrics. The majority of residency programs at Memorial University are moving towards competency based assessment, including family medicine (The Discipline of Family Medicine, 2019). The College of Family Physicians of Canada recognize a competency-based curriculum for family medicine residents, including comprehensive education and patient care, continuity of education and patient care, centred in family medicine (The College of Family Physicians of Canada, 2019). In 2019, 48% of medical students at Memorial University chose Family Medicine as a residency program (Phase 4 Lead, 2019). Introducing a progressive breastfeeding education curriculum at Memorial University, where medical students begin by learning the basics about breastfeeding, and then progress to complications and hands on experience, follows the medical school's assessment plans involving competency based activities, and also follows studies that noted breastfeeding education should begin early and span the curriculum (Amin et al., 2014; Anjum et al., 2007; Dyke, 2006; Pound et al., 2015). As many of the medical students at Memorial University are accepted to Family Medicine residency programs, this competency assessment methods continues, and ideally breastfeeding competencies can increase at the postgraduate levels.

4.4.5 Impediments to learning

There were impediments to learning noted by the breastfeeding educators. There were structural impediments, such as a busy ward or clinic and a lack of space for clerkship teaching. There was also a lack of knowledge in the medical school curriculum. The curriculum at Memorial University was revised in 2013. There have been issues with educators fully grasping the changes in the curriculum, especially as many are not members of undergraduate medical committees. This lack of knowledge in the curriculum is not limited to breastfeeding medicine.

Previous research has found challenges in clinical teaching. Spencer (2003) found that time constraints, work demands, and engaging multiple levels of learners to be

particularly challenging to clinical educators, which is similar to the findings of the present study.

4.4.6 Breastfeeding culture in Newfoundland and Labrador

The breastfeeding culture in Newfoundland and Labrador is evolving. The educators noted patients were more inquisitive and interested in breastfeeding. There was sometimes a lack of interest from physicians in the community, as breastfeeding was not discussed in pregnancy. There was an overall hope for the new generation of physicians, in that medical students were more interested in breastfeeding than previous medical students.

These findings are similar to those found in previous studies conducted in Newfoundland. Bonia (2013) found that health care providers, especially in rural areas in Newfoundland and Labrador are less likely to discuss breastfeeding with their patients. Bonia also cited a lack of support within the community for breastfeeding mothers. This study indicated there may be an improvement in these areas, as medical students are more engaged, and families in Newfoundland are more interested in learning about breastfeeding.

4.4.7 Tension between educators, learners and patients

This study found a tension between educators, learners and patients as educators attempted to balance their clinical duties with teaching responsibilities. This was an unexpected finding from this study. This highlights the strain of multiple demands faced by medical educators, and how non-educational roles may take precedence. Researchers and curriculum developers should consider the expectations of educators and the constraints of clinical medicine when developing curriculum content.

This is not the first time, however, that tension has been described between clinical and teaching responsibilities. Spencer (2003) noted several challenges in clinical teaching, including: time pressures, competing demands between the needs of patients and the needs of students, increasing numbers of students, and fewer patients (shorter hospital stays). This was similar to the views expressed by the educators interviewed in this study. Breastfeeding educators also noted a constant influx of other students seeking

clinical experience on top of the continual rotation of medical students. There was also the time pressure to see patients and discharge them as new patients needed to be admitted. Turnover in the newborn ward is high, with some patients being discharged within 24 hours. Breastfeeding educators described a time pressure to see patients and discharge them, as new patients had often delivered and were waiting to be admitted. In addition, the wards are crowded, with many rooms containing four mothers and four babies. The outpatient clinics are also busy, with learners at different levels. Breastfeeding educators also noted a constant influx of other students seeking clinical experience on top of the constant rotation of medical students.

When a patient had difficulty with breastfeeding, this was a prime opportunity to have a medical student assess the latch and assess the feeding. This had to be balanced, however, with the needs of the patient, which might include having an experienced clinician handle the problem, not an inexperienced medical student.

Despite the challenges, many patients enjoy clinical teaching, and learners feel it is an effective method of teaching (Nair, Coughlan, & Hensley, 1997). Spencer (2003) also emphasized the patient's role in teaching. It is important for the medical students and the educators not only to focus on the current problem (such as poor latch) but to remember the patient can enrich the teaching experience. The patient can give "deeper and broader insights into their problems...and can give feedback to both learners and teacher" (Spencer, 2003). This can be especially important if an educator is reluctant to involve their patient. In fact, this might be a missed opportunity to allow the new mother to share her struggles with a medical student who will have the responsibility to help similar patients upon graduation.

4.5 Implications

This study was the first to assess knowledge levels in breastfeeding medicine in undergraduate medical students in Canada. Similar to other countries, undergraduate medical students have deficiencies in their knowledge of breastfeeding medicine. Their knowledge levels are described as superficial, without understanding the complexities or the practical aspects of breastfeeding.

There were multiple suggestions to improve the curriculum at Memorial University (Table 9). These suggestions may be grouped as followed:

- Introduction of breastfeeding early in the curriculum
- Didactic sessions on basic breastfeeding and advanced breastfeeding
- Hands on experience
- Small group discussion of social barriers
- Communication skills
- Exposure to mothers and babies

All these suggestions should occur in pre-clerkship, and skills may be refined in clerkship. Multi-disciplinary education was strongly encouraged.

These suggestions are similar to recommendations in other countries. In the United Kingdom, Dykes (2006) agreed with Nair, Coughlan and Hensley (1997) that most patients enjoy clinical teaching, and learners feel it is an effective method of teaching. She felt breastfeeding medicine should be instructed in formal settings, with integration of hands on practice. This integration should be accompanied by reflection, debriefing and high levels of interaction (Dykes, 2006). And, as in the present study, peer support, mentors and a multi-disciplinary approach should be employed.

There have been some studies to evaluate curricular changes in breastfeeding medicine. Sjarif (2016) developed an education module on pediatric nutrition in Indonesia. This module was tested on senior medical students. Students learned about oral-motor development, infant feeding and behavioral modification by psychiatrists, physiatrists and pediatricians. Audiovisual instruction, was also used. Six months following the study, this group performed significantly better on OSCE examination than the control group. The authors theorized the study group was exposed to active learning, and had the benefit of integrating pediatrics with other specialties, which improved their knowledge and skills retention.

An older study conducted in New Mexico established a multidisciplinary team to review breastfeeding education within undergraduate and postgraduate medicine (Ogburn et al., 2005). This team consisted of pediatrician, obstetricians, family physicians and midwives. The new curriculum comprised daily rounds in the newborn nursery, didactic sessions, self-study modules and hands on sessions with a lactation consultant. Medical students were not part of the evaluation, however, residents felt their knowledge was enhanced (Ogburn et al., 2005).

Curricular improvements in breastfeeding in the undergraduate curriculum have not been evaluated in Canada. There are many passionate breastfeeding educators at Memorial, who have already begun curricular implementations since being interviewed for this study. In addition, the undergraduate curriculum at Memorial University is in its fifth year since a complete reform. There is a curriculum review committee reviewing the first two years of curriculum, including breastfeeding. Short term goals can be to clarify breastfeeding objectives, improve breastfeeding lectures in first and second year by including mothers and babies, other disciplines, and discussions around social determinants of health. This could easily be achieved for the 2019-2020 academic year.

4.6 Strengths, limitations

The strengths of this study included a sample that included representatives from many academic disciplines. Participants were involved in didactic teaching, clinical teaching, and online teaching. Many participants also instructed breastfeeding to other professionals, such as pharmacists and nurses and were involved in research. The response to the request to participate in the study was quite high, with only two individuals declining an interview. Interviews were conducted in a private setting, and ample time was made available; participants were very engaged in the interviews. Many curricular recommendations were made. Future studies can involve implementing and evaluating these changes.

Limitations of this study included the sample profile. All breastfeeding educators were located in St. John's, NL at the Memorial University campus. All pre-clerkship breastfeeding education occurs in St. John's. Pediatric and obstetric clerkship rotations

also occur in St. John's. Rural family medicine, however, occurs in other parts of the province. St. John's has the highest breastfeeding rates in the province. It is unclear if knowledge deficiencies noted by educators in St. John's differ from other parts of the province. Future studies could be conducted on this group, which would compromise rural family physicians with breastfeeding experience who work with medical students.

4.7 Conclusions

This study examined educational gaps in breastfeeding medicine in medical school, as identified by breastfeeding educators. Medical students had deficiencies in many areas of breastfeeding medicine, including practical, hands-on aspects. Many recommendations were provided to enhance the undergraduate medical school curriculum at Memorial University. This was the first study to explore possible content and approaches to improve undergraduate breastfeeding curriculum in Canada.

Chapter 5

5 Synthesis: Knowledge and attitudes surrounding breastfeeding in medical students and educational gaps in the undergraduate medicine curriculum at Memorial University.

5.1 Aim of research

This thesis measured medical students' knowledge and attitudes towards breastfeeding, and determined whether there were differences in knowledge and attitudes among students from rural and urban areas. Educational gaps within the curriculum were then analyzed.

Questionnaires were administered to first and second year medical students at Memorial University of Newfoundland. Then, key educators involved in the medical school curriculum were interviewed to determine corresponding gaps within breastfeeding education at Memorial University.

This was the first study to examine knowledge and attitudes towards breastfeeding in medical students and to make recommendations for improvements in undergraduate breastfeeding curriculum in Canada.

5.2 Review of main findings

5.2.1 Quantitative study: What are the knowledge and attitudes towards breastfeeding among first and second year Memorial University medical students?

To help promote breastfeeding rates in Newfoundland, as well as in Canada, it is important to have health care providers with positive breastfeeding attitudes and adequate knowledge. This was the first study to examine breastfeeding attitudes and knowledge in medical students in Canada. Junior medical students were selected as they had limited exposure to clinical medicine. If positive attitudes and basic knowledge are encouraged

early in their medical career, it will then be possible to build on their skills in clerkship and residency.

Medical students in first and second year at Memorial University had positive attitudes towards breastfeeding. The highest attitude scores were observed in students from rural areas, those who were breastfed as a child and second year student. Medical students at Memorial University had inadequate knowledge levels and there was room for improvement. The highest knowledge scores were observed in students from rural areas and second year students.

One interesting finding in this study was a more positive attitude towards breastfeeding in students from rural areas. This is in direct contrast to the lower breastfeeding initiation rates in rural Newfoundland. The identified knowledge gaps in breastfeeding education included: understanding growth of breastfed infants, medication safety and treatment of colic. At present, there are two hours of breastfeeding education in the first two years of medical school at Memorial University. The results from this study can be used to improve the curriculum, or perhaps to increase curricular hours spent on breastfeeding medicine.

5.2.2 Qualitative study: Are there educational gaps in breastfeeding education within the undergraduate medical program at Memorial University?

This study examined educational gaps in breastfeeding medicine in medical school, as identified by breastfeeding educators. Several themes emerged from this study including positive, yet naive, attitudes from medical students towards breastfeeding. Medical students had deficiencies in many areas of breastfeeding medicine, including practical, hands-on aspects.

Educators had positive attitudes towards breastfeeding. Their attitudes were shaped by their personal experience, which they often brought into their teaching. Many educators also reflected on their teaching styles, and how they could improve their teaching methods.

The learning environment at Memorial University can sometimes create a struggle for educators to meet the needs of the student and the needs of the patients. Although enthusiastic, educators found medical students at Memorial University to be more motivated to learn through assessment, instead of what might be more commonly seen in clinical practice. Impediments to learning, as described by educators, included: lack of space for teaching, high turnover of students rotating through their clinical rotations and different schedules for different types of learners. There was also a lack of knowledge of the medical school curriculum amongst the breastfeeding educators. May were not sure what teaching was required, and what teaching the medical students had prior to their clinical experiences.

Tension was noted between educators' roles of patient care and teaching. Clinics and wards can be busy, and it is sometimes difficult to manage the care of all the patients. Patients may have experienced a difficult delivery or may have challenges breastfeeding, and educators sometimes felt they should be protected from the medical students, instead of using this as a teaching opportunity. Medical students sometimes challenged the information provided by the educators. Educators sometimes struggled with engagement if the medical students were not interested in the topic of breastfeeding.

Despite the challenges, educators at Memorial University felt that Newfoundland and Labrador was developing a culture with more acceptance to breastfeeding. They felt family physicians were integral to the promotion and discussion of breastfeeding, but felt this conversation was sometimes lacking. Overall, there was a hope for the future physicians to better support their breastfeeding patients.

Many recommendations were provided to enhance the undergraduate medical school curriculum at Memorial University.

5.3 Synthesis of the two studies

5.3.1 Attitudes of medical students

Both studies demonstrated that medical students at Memorial University have positive attitudes towards breastfeeding. On the modified 90-item Australian Breastfeeding

Knowledge and Attitude Questionnaire developed by Brodribb (2008, 2009, 2010), the mean breastfeeding attitude in medical students was quite high. Medical students felt that breastfeeding provided many health benefits for babies, and women should breastfeed in public places.

Also interesting was that none of the medical students stated they were not breastfed as a child. Most stated they were breastfed, and the remainder were not sure. If the medical students knew this, breastfeeding was likely discussed in their family environment, contributing to their positive attitudes.

The breastfeeding educators also felt that learners had positive attitudes. They felt that breastfeeding was accepted, and felt to be a normal part of development. The educators, however, sometimes noticed a naivety in this attitude in that learners did not understand the nuances and the difficulties that could accompany the breastfeeding dyad. Being early in their career, there was sometimes difficulty finding common ground with prenatal patients and new mothers. Medical students understood that breastfeeding was most beneficial for a mother and her baby, but did not always have the understanding that the role of a physician is to provide the best evidence available, and allow the patient to make their own decision, even if it differs from their own.

5.3.2 Knowledge and confidence of medical students

Both studies demonstrated that medical students at Memorial University have knowledge deficiencies in breastfeeding. When the modified 90-item Australian Breastfeeding Knowledge and Attitude Questionnaire developed by Brodribb (2008, 2009, 2010) was distributed to medical students at Memorial University, the mean breastfeeding knowledge in medical students was low.

Medical students were also asked about their confidence in addressing breastfeeding concerns: the majority stated they were not confident addressing the needs of breastfeeding patients. This is similar to the findings of interviews with breastfeeding educators in this study. The educators also noted a lack of confidence in the medical

students, as they appeared intimidated and preferred to let other health care professionals address patients' concerns, just as the medical students noted in their questionnaire.

An interesting contrast, however, is how the medical students rated their knowledge about breastfeeding. Most felt their knowledge level was adequate for their level of training, which contrasts to the perceptions of breastfeeding educators, who felt the medical students' knowledge levels were inadequate. Breastfeeding educators at Memorial University felt the medical students had a surface understanding of breastfeeding medicine, but did not comprehend the intricacies of problems that may arise. Medical students also lacked practical skills, such as helping a baby latch. This may indicate a lack of insight from the medical students, on the expected level of breastfeeding knowledge at this stage of their training.

5.3.3 Tension between learner and educator

The qualitative study found a tension between educators, learners and patients as educators attempted to balance their clinical duties with teaching responsibilities. This tension was most pronounced in clinical teaching. Clinics and wards can be busy, and it is sometimes difficult to manage the care of all the patients. Educators felt a responsibility to protect their patients who were unable to breastfeed, or chose not to breastfeed. There was a feeling that these patients should be insulated from the medical students, instead of using this as a teaching opportunity. There was also tension noted in the clinical teaching schedules; many educators also teach other health care professionals, such as pharmacists and nurses, as well as medical students, yet the clinical teaching was separated due to differing schedules, even though the content was similar.

The quantitative study did not explicitly study tensions between educators, medical students and patients, however, inferences can be made. One of the most positively answered attitude questions was about breastfeeding in public. Almost all medical students felt this was acceptable. However, when breastfeeding educators were interviewed, several observed a discordance with public breastfeeding. Some educators still noted a modesty in medical students observing breastfeeding. There was a sense the medical students were not always comfortable being in a room with a breastfeeding

mother, and they were not comfortable seeing an educator breastfeed or pump. The educators noted that medical students felt that patients should have their privacy, when in reality, this was a prime opportunity to learn about breastfeeding.

5.3.4 Curriculum refinement

Multiple areas for curriculum improvement were noted in both studies. In the survey of medical students, they indicated a preference for interactive style teaching (small groups, speaking with physicians, case studies, workshops). There was also preference for online modules. Interestingly, the students had two hours of breastfeeding lectures prior to the timing of the questionnaire, and when asked about the best source of previous breastfeeding education, two thirds of students stated this was the most useful way they had learned about breastfeeding.

Interviewing breastfeeding educators provided a wealth of curriculum improvements. Content was discussed (starting with breastfeeding basics in a lecture and building from there), timing (incorporating breastfeeding into pre-clerkship and clerkship) and also pedagogy (hands on sessions, small groups, clinical experiences). Furthermore, medical educators at Memorial University were found to be enthusiastic, passionate and self-reflective, which are all observed traits in excellent instructors.

Together, the two studies in this thesis comprise steps one through four of curriculum development according to Kern (2009): problem identification; targeted needs assessment; goals; educational strategies. Future studies would involve implementing changes in the curriculum and evaluating these changes.

The questionnaire revealed an inadequate knowledge level in junior medical students at Memorial University. Coupled with the breastfeeding educators' sense of breastfeeding knowledge deficits in medical students, this identifies an important deficit in the undergraduate curriculum at Memorial University. This lack of knowledge may have downstream effects on the quality of life, utilization of healthcare resources and clinical outcomes in Newfoundland and Labrador. These findings point towards an identified

problem within the medical school curriculum, and form the basis of a general needs assessment (Kern, Thomas, & Hughes, 2009).

The results of the questionnaire and the interviews provided information that is important in establishing a targeted needs assessment, which is the next step in curriculum design (Kern et al., 2009). The questionnaire revealed which areas of breastfeeding education were lacking in medical students at Memorial University. This was further explored while interviewing breastfeeding educators. The questionnaire revealed inadequacies in knowledge of topics, such as medication safety in breastfeeding, while the interviews demonstrated a lack of hands on experience in breastfeeding medicine among medical students. The results from these two studies allowed the lack of breastfeeding knowledge to be further understood and properly framed. It also allowed those most invested in the breastfeeding curriculum at Memorial University to offer solutions.

Goals and objectives (Kern et al., 2009) have already been incorporated into the medical school curriculum at Memorial University, however, this study shows these objectives have not been properly shared with educators, and have not been met. The undergraduate medical curriculum at Memorial University is presently undergoing a review. This provides a well-timed opportunity to rewrite these learning objectives.

Educational strategies (Kern et al., 2009) were also explored in both studies. In the questionnaire, medical students relayed their preferred learning formats. In the interviews, breastfeeding educators made many recommendations, including large group, small group and hands on sessions to teach the medical expert CanMEDS role. There were guidance provided to incorporate non-medical expert CanMEDS roles, which are essential to produce skills of communication and patient advocacy.

Future work in this area could involve steps five and six of curriculum development: implementation and evaluation (Kern et al., 2009).

5.3.5 Evolving breastfeeding culture in Newfoundland and Labrador

Newfoundland and Labrador has the lowest rate of breastfeeding initiation in Canada. These studies, however, provided hope that interest in breastfeeding is on the rise, which may translate into improved breastfeeding rates in this province.

It was encouraging to see positive attitudes amongst medical students at a time when the last published breastfeeding initiation rates were 69.6% in Newfoundland (Provincial Perinatal Program of Newfoundland and Labrador, 2014). Historically, in Newfoundland and Labrador, one of the main reasons patients cite a reluctance to breastfeeding is modesty (Bonia et al., 2013; Twells, 2014). Medical students in this survey, however, indicated positive attitudes towards breastfeeding in public. This might result in a paradigm shift to allow more women to feel comfortable publically breastfeeding in this province.

A trend towards more interest in breastfeeding was also seen in the interviews with breastfeeding educators. More breastfeeding clinics for pregnant patients are now available and attendance has increased at these clinics. Medical students were noted to be more open to breastfeeding discussions than medical students in the past. The educators felt that family physicians are integral to the promotion and discussion of breastfeeding, but felt this conversation was sometimes lacking. Overall, there was a hope for the future physicians to better support their breastfeeding patients.

5.4 Recommendations for future research

This study has shown that medical students at Memorial University have positive attitudes towards breastfeeding, and breastfeeding educators are passionate about teaching. This study has occurred at an important time. The undergraduate medical curriculum at Memorial University is undergoing a curricular review and researcher AP has leadership roles in curriculum programming and administration. Educators have already indicated their desire and willingness for a change. Medical students are ready to learn more about breastfeeding, and educators state the public is showing more interest.

More interested patients will also allow more opportunities for medical student clinical learning.

Multiple suggestions for curricular review and refinement were elicited in this study. In fact, four of the six steps of curriculum development (Kern et al., 2009) were explored and developed in this study. Next steps would be to begin implementing changes to the pedagogy and content of the medical school curriculum regarding breastfeeding (step 5) and evaluating these changes (step 6) (Kern et al., 2009).

Further studies may evaluate outcomes to these curriculum changes at Memorial University. Short term outcomes may involve administering the 90-item Australian Breastfeeding Knowledge and Attitude Questionnaire to medical students following curricular reviews to evaluate knowledge improvements. In the future, this questionnaire can be administered before and after breastfeeding teaching. Competencies in clerkship at Memorial University, especially hands on skills and confidence in managing breastfeeding difficulties, can be assessed before and after curricular chang.es.

Medium term outcomes could involve assessing medical students' confidence upon graduation and long term goals could be to reassess provincial breastfeeding initiation rates.

5.5 Conclusions

This study examined medical students' attitudes and knowledge towards breastfeeding at Memorial University and breastfeeding educators' identification of educational gaps in the undergraduate medical curriculum.

The breastfeeding culture in Newfoundland and Labrador appears to be changing, with more emphasis on acceptance. Both studies showed positive attitudes towards breastfeeding in medical students and both studies also showed knowledge deficiencies and lack of confidence in medical students. There was tensions noted between the educators, medical students and patients, particularly in the interviews with medical educators. To address the knowledge deficits, the medical educators gave much

information about curriculum review, and the next steps would be implementation of change and evaluation of outcomes.

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Appendices

Appendix 1 Western University Health Science Research Ethics Board HSREB Delegated Approval (109741) on December 21, 2017

Western Research

Research Ethics

Western University Health Science Research Ethics Board
HSREB Delegated Initial Approval Notice

Principal Investigator: Amanda Terry
Department & Institution: Schulich School of Medicine and Dentistry\Family Medicine,Western University

Review Type: Delegated
HSREB File Number: 109741
Study Title: Knowledge and Attitudes Towards Breastfeeding among Memorial University Medical Students

HSREB Initial Approval Date: December 21, 2017
HSREB Expiry Date: December 21, 2018

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Revised Western University Protocol	Clean Copy	2017/12/08
Revised Letter of Information & Consent	Interview-Clean Copy	2017/12/08
Revised Letter of Information & Consent	Survey-Clean Copy	2017/12/08
Instruments	Clean Copy	2017/12/05
Instruments	Interview questions for faculty and staff	
Recruitment Items	Script for recruitment of undergraduate students	
Recruitment Items	Script for recruitment of staff and faculty	
Recruitment Items	Reminder Email 1	2017/12/08
Recruitment Items	Reminder Email 2	2017/12/08
Recruitment Items	Reminder Email 3	2017/12/08
Recruitment Items	Reminder Email 4	2017/12/08
Other	Reference list for studies	
Other	TCPS certificate	

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

HSREB approval for this study remains valid until the HSREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review.

The Western University HSREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use Guideline for Good Clinical Practice Practices (ICH E6 R1), the Ontario Personal Health Information Protection Act (PHIPA, 2004), Part 4 of the Natural Health Product Regulations, Health Canada Medical Device Regulations and Part C, Division 5, of the Food and Drug Regulations of Health Canada.

Members of the HSREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Appendix 2 Secondary approval by the Interdisciplinary Committee on Ethics in Human Research at Memorial University (20181572-EX) on February 7, 2018.

MEMORIAL UNIVERSITY

Interdisciplinary Committee on
Ethics in Human Research (ICEHR)

St. John's, NL Canada A1C 5S7
Tel: 709 864-2561 icehr@mun.ca
www.mun.ca/research/ethics/humans/icehr

ICEHR Number:	**20181572-EX**
Approval Period:	February 7, 2018 – February 28 , 2019
Funding Source:	Not Funded
Responsible Faculty:	N/A
Title of Project:	*Knowledge and Attitudes Towards Breastfeeding among Memorial University Medical Students*

February 7, 2018

Dr. Amanda Pendergast
Schulich School of Medicine and Dentistry
Western University

Dear Dr. Pendergast:

Thank you for your submission to the Interdisciplinary Committee on Ethics in Human Research (ICEHR) with Wester University Health Science Research Ethics Board file #109741, and their approval for your project with entitled *"Knowledge and Attitudes Towards Breastfeeding among Memorial University Medical Students."*

The Committee has reviewed the documents and agrees that the proposed project is consistent with the guidelines of the *Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans (TCPS2)*. Full ethics clearance is granted to *recruit students from Memorial's Faculty of Medicine* provided all approved protocols are followed. Please be advised that ICEHR approval applies to the ethical acceptability of the research, as per Article 6.3 of the *TCPS2*, and does not constitute agreement on behalf of any department(s) and/or unit(s) to facilitate your research here at Memorial.

If you need to make changes during the project, which may raise ethical concerns, please submit an amendment request with a description of these changes for the Committee's consideration. In addition, the *TCPS2* requires that you submit an annual update to ICEHR before February 28, 2019. If you plan to continue the project, you need to request renewal of your ethics clearance, and include a brief summary on the progress of your research. When the project no longer involves contact with human participants, is completed and/or terminated, you are required to provide the annual update with a final brief summary, and your file will be closed.

Annual updates and amendment requests must be submitted from your Memorial University Researcher Portal account from the *Applications: Post-Review* link on your Portal homepage.

We wish you success with your research.

Yours sincerely,

Appendix 3 Brodribb's 90 item Australian breastfeeding knowledge and attitude questionnaire

☐☐☐

Australian breastfeeding knowledge and attitude questionnaire

Thank you for completing this questionnaire. The information obtained from your responses will be used to develop an educational resource about breastfeeding targeted specifically at GP registrars.

Unless otherwise indicated please give only one response for each question.

To complete the questionnaire please cross the appropriate box, circle the appropriate number or complete the question in the space provided. The questionnaire will take approximately 10 to 15 minutes to complete. Please return the questionnaire to in the reply paid envelope, or post to

Dr Wendy Brodribb
Centre for Rural and Remote Area Health
University of Southern Queensland
Toowoomba 4350

Or fax it to (07) 46315452

Each questionnaire will be coded for follow-up purposes only and will be kept separate from any identifying information.

If you would have any questions or concerns please contact me at brodribb@usq.edu.au or on (07)46311993.

First, I would like to ask you about previous breastfeeding training and how you like to learn.

1. **How would you rate your previous training about breastfeeding? (please mark only one response)**

   1 ☐ Adequate for what I need now
   2 ☐ Adequate but I would like to know more
   3 ☐ Inadequate for what I need now

2. **Where did you learn about breastfeeding? (please mark all that apply)**

   1 ☐ Medical course
   2 ☐ Within a hospital, post-graduation
   3 ☐ General practice
   4 ☐ Journals
   5 ☐ Other independent reading
   6 ☐ Internet sites
   7 ☐ Conferences
   8 ☐ Local education sessions
   9 ☐ Personal experience
   10 ☐ Experience with family and friends
   11 ☐ Books intended for lay audiences
   12 ☐ Australian Breastfeeding Association/NMAA
   13 Other

4. **In what format do you like learning new information? (please mark all that apply)**

1 ☐ Small group discussion sessions
2 ☐ Case studies
3 ☐ Short seminars or conferences
4 ☐ Journals
5 ☐ On-line learning resources
6 ☐ Discussions with other doctors in the practice
7 ☐ Workshops
8 ☐ Other

The next group of questions relate to how you see your role and your confidence with assisting breastfeeding women, as well as your attitude to breastfeeding.

The following statements are about a doctor's role with breastfeeding. Please indicate how much you agree or disagree with the statement by marking the appropriate response.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
5. Doctors have an important role in encouraging and supporting breastfeeding women.	☐	☐	☐	☐	☐
6. Female doctors are better able to assist breastfeeding women, regardless of their experience or training, than male doctors.	☐	☐	☐	☐	☐
7. Doctors have little influence on a mother's decision to breastfeed.	☐	☐	☐	☐	☐
8. Doctors should discuss breastfeeding with mothers early in their pregnancy.	☐	☐	☐	☐	☐
9. It is not appropriate for doctors to advise mothers to breastfeed.	☐	☐	☐	☐	☐
10. Only doctors with personal experience of breastfeeding (self or partner) are able to assist breastfeeding women.	☐	☐	☐	☐	☐
11. It is appropriate to refer breastfeeding mothers to others with more expertise.	☐	☐	☐	☐	☐

12. **How effective do you think you are in meeting the needs of the breastfeeding women you see? (please mark one response)**

3. **Of the responses in question 2, which one was the most useful?**

Not very effective				Very effective
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

13. How confident would you say you are with your ability to assist women who present with breastfeeding problems? (please mark one response)

Not very confident				Very confident
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

To what extent do you agree or disagree with the following statements about breast milk and breastfeeding? Please mark the appropriate response.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
14. Infant formula is more easily digested than breast milk.*	☐	☐	☐	☐	☐
15. Breast milk is the ideal food for babies.	☐	☐	☐	☐	☐
16. Formula feeding is a good way of letting fathers care for the baby.*	☐	☐	☐	☐	☐
17. Breastfeeding & formula feeding are both equally acceptable methods of feeding infants.*	☐	☐	☐	☐	☐
18. Breastfeeding increases mother-infant bonding.	☐	☐	☐	☐	☐
19. A mother knows instinctively how to breastfeed.*	☐	☐	☐	☐	☐
20. Breastfeeding provides health benefits for infants that cannot be provided by infant formula.	☐	☐	☐	☐	☐
21. Mothers who smoke should formula feed their babies. *	☐	☐	☐	☐	☐
22. Breastfeeding is incompatible with working outside the home. *	☐	☐	☐	☐	☐
23. Fathers feel left out if a mother breastfeeds. *	☐	☐	☐	☐	☐
24. Breastfed babies need to be fed too often.*	☐	☐	☐	☐	☐
25. Infant formula is as healthy for an infant as breast milk.*	☐	☐	☐	☐	☐
26. Breastfeeding is more convenient than formula feeding.	☐	☐	☐	☐	☐
27. Formula feeding is the better choice if the mother plans to go out to work.*	☐	☐	☐	☐	☐
28. The benefits of breast milk last only as long as the baby is breastfed.*	☐	☐	☐	☐	☐
29. Mothers who formula feed miss one of the great joys of motherhood.	☐	☐	☐	☐	☐
30. A mother who occasionally drinks alcohol should not breastfeed her baby. *	☐	☐	☐	☐	☐
31. Formula feeding is more reliable because you can calculate the exact quantity of milk the baby is getting.*	☐	☐	☐	☐	☐
32. Current infant formulas are nutritionally equivalent to breast milk.*	☐	☐	☐	☐	☐

The next group of questions relate to your knowledge of breastfeeding and breast milk.

34. Around what age do you recommend solids be introduced to a breastfed infant?

1 ☐ 4 months 2 ☐ 6 months 3 ☐ 9 months 4 ☐ 12 months

5 Other

35. For how long do you recommend to a mother that she continue to breastfeed her infant?

1 ☐ No longer than 6 months 2 ☐ Until teeth erupt 3 ☐ Around 9 months

4 ☐ No longer than 12 months 5 ☐ Between 12 and 24 months 6 ☐ 2 years and beyond

7 ☐ For as long as the mother and baby wish 8 ☐ Other

To what extent do you agree or disagree with the following statements? Please mark the appropriate response. If you are unable to give a response to a statement, mark the first response column headed "don't know".

	Don't know	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
36. A woman with mastitis should express and discard her milk from that breast until treatment is complete.*	☐	☐	☐	☐	☐	☐
37. A nulliparous woman is able to lactate to breastfeed an adopted baby.	☐	☐	☐	☐	☐	☐
38. A correctly positioned baby will suck at the breast with a different action to that used by a baby feeding from a bottle.	☐	☐	☐	☐	☐	☐
39. Breastfed infants require extra water in hot weather.*	☐	☐	☐	☐	☐	☐
40. It is expected that breastfed infants will regain their birth-weight by two weeks of age.	☐	☐	☐	☐	☐	☐
41. Exclusive breastfeeding (no other fluids or solids) is the most beneficial form of infant feeding for the first six months of life.	☐	☐	☐	☐	☐	☐
42. In the first few weeks after birth a normal breastfed infant will usually feed 8-12 times in 24 hours.	☐	☐	☐	☐	☐	☐
43. A breastfeeding woman should be advised to wean if she becomes pregnant.*	☐	☐	☐	☐	☐	☐

44. It is normal for an adequately breastfed 2 -week old infant to only pass a bowel motion every 3 days or so.*	☐	☐	☐	☐	☐	☐
45. Women who have breastfed have a lower incidence of premenopausal breast cancer.	☐	☐	☐	☐	☐	☐
46. A mother who weaned her baby because of a low milk supply will be unlikely to produce enough milk for any subsequent babies.*	☐	☐	☐	☐	☐	☐
47. A woman who has had a previous benign breast biopsy is usually unable to breastfeed.*	☐	☐	☐	☐	☐	☐
	Don't know	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
48. Amoxycillin is the drug of choice to treat mastitis in a woman 3 months postpartum.*	☐	☐	☐	☐	☐	☐
49. Breastfed infants are less likely to become obese children.	☐	☐	☐	☐	☐	☐
50. All women with cracked nipples should express their milk and rest the nipples for 24 hrs.*	☐	☐	☐	☐	☐	☐
51. Increasing her fluid intake will increase a mother's milk supply.*	☐	☐	☐	☐	☐	☐
52. The nutritional properties of breast milk are only effective for 9 months postpartum.*	☐	☐	☐	☐	☐	☐
53. Breastfeeding protects against rubella. *	☐	☐	☐	☐	☐	☐
54. High maternal prolactin levels are essential for the initiation of lactation.	☐	☐	☐	☐	☐	☐
55. Introducing complementary feeds (water or formula) interferes with the establishment of breastfeeding.	☐	☐	☐	☐	☐	☐
56. Antenatal nipple preparation prevents nipple soreness in the first week postpartum.*	☐	☐	☐	☐	☐	☐
57. A nipple shield should be used if there are any problems with the infant attaching to the breast.*	☐	☐	☐	☐	☐	☐
58. Removal of breast milk (either by breastfeeding or expressing) is essential to maintain milk production.	☐	☐	☐	☐	☐	☐
59. Premature infants who are fed breast milk are less likely to develop necrotising enterocolitis.	☐	☐	☐	☐	☐	☐
60. Breastfeeding is contraindicated for women with Hepatitis C.*	☐	☐	☐	☐	☐	☐
61. The nutritional content of breast milk changes throughout a breastfeed.	☐	☐	☐	☐	☐	☐
62. A woman with nipple and breast pain during and following a breastfeed may have a thrush infection of the nipple.	☐	☐	☐	☐	☐	☐
63. Formula fed infants have more ear infections than breastfed infants.	☐	☐	☐	☐	☐	☐

64. A change to infant formula will improve the symptoms of a breastfed baby with 'colic' *	☐	☐	☐	☐	☐	☐
65. The most common cause of cracked nipples is poor positioning and attachment of the infant at the breast.	☐	☐	☐	☐	☐	☐
66. In most cases a breastfeeding mother must temporarily wean her baby while she is taking prescription medications. *	☐	☐	☐	☐	☐	☐
67. Growth of breastfed infants differs from that of formula fed infants.	☐	☐	☐	☐	☐	☐
68. In general, the most appropriate advice to give a woman with a low milk supply is to increase the frequency of breastfeeds.	☐	☐	☐	☐	☐	☐
69. Regular dummy use in the first month postpartum has been associated with a reduction in breastfeeding duration.	☐	☐	☐	☐	☐	☐
70. Formula feeding has been associated with improved neurodevelopment.*	☐	☐	☐	☐	☐	☐
	Don't know	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
71. A 'top-up' bottle after each breastfeed is the best way to manage an infant who is not gaining weight adequately.*	☐	☐	☐	☐	☐	☐
72. A woman with a breast abscess can continue to breastfeed on both breasts.	☐	☐	☐	☐	☐	☐
73. A woman being treated for postpartum depression can continue to breastfeed.	☐	☐	☐	☐	☐	☐
74. Breastfeeding reduces the incidence of gastroenteritis in the infant.	☐	☐	☐	☐	☐	☐
75. Only feeding from one breast at each feed is a management option for a woman with an oversupply of breast milk.	☐	☐	☐	☐	☐	☐

Finally, I would like to ask some questions about yourself.

76. What is your gender? 1 ☐ Male 2 ☐ Female

77. In what year were you born?

78. In what country were you born?

79. In what year did you complete your medical degree?

a. **In what country did you complete your medical degree?**

80. What Regional Training Provider are you enrolled with now?

81. At what stage are you in your GP training?

1 ☐ Subsequent term GP training 2 ☐ Advanced GP training 3 ☐ Basic GP training

82. Where would you like to practice after completing your GP training?

1 ☐ Large metropolitan area (RMMA 1) 2 ☐ Other metropolitan area (RRMA 2)

3 ☐ Large rural centre (RMMA 3) 4 ☐ Small rural centre (RRMA 4)

5 ☐ Other rural area (RRMA 5) 6 ☐ Remote centre (RRMA 6)

7 ☐ Other remote centre (RRMA 7) 8 ☐ Uncertain

83. Did your mother breastfeed you?

1 ☐ Yes 2 ☐ No 3 ☐ Don't know

84. Do you have children of your own?

1 ☐ Yes 2 ☐ No (go to question 89)

85. Were any of your children breastfed?

1 ☐ Yes 2 ☐ No, not at all (go to question 89) 3 ☐ Don't know (go to question 89)

86. What is the TOTAL length of the personal breastfeeding experience of you or your partner?

1 ☐ Less than 2 weeks 2 ☐ 2 – 12 weeks 3 ☐ 13 - 26 weeks

4 ☐ 27 – 52 weeks 5 ☐ more than 52 weeks

87. Overall, how was the personal breastfeeding experience of you or your partner?

1 ☐ Positive 2 ☐ Negative 3 ☐Neutral

88. In the past 3 months, how many patients have you seen in TOTAL who were pregnant, were mothers of infants under 12 months of age or were infants under 12 months of age? (please mark the most appropriate response)

0 ☐No patients 1 ☐1-5 2 ☐6-10 3 ☐11-15 4 ☐16-20 5 ☐>20

89. In the past 3 months how many patients have you seen with a problem related to breastfeeding? (please mark the most appropriate response)

0 ☐No patients 1 ☐1-5 2 ☐6-10 3 ☐11-15 4 ☐16-20 5 ☐>20

Thank you very much for taking the time to complete the questionnaire.

Please check that you have answered all the questions.

Please return the questionnaire to:

Dr Wendy Brodribb

Appendix 4 Modified Brodribb's 90 item Australian breastfeeding knowledge and attitude questionnaire.

Questions with an asterisk (*) were reverse scored.

Original Question	Modified	Reason
How would you rate your previous training about breastfeeding?	Not modified	
• Where did you learn about breastfeeding? (please mark all that apply) • Medical course • Within a hospital, post-graduation • General practice • Journals • Other independent reading • Internet sites • Conferences • Local education sessions • Personal experience • Experience with family and friends • Books intended for lay audiences • Australian Breastfeeding Association/NMAA	Deleted "Within a hospital, post-graduation" Deleted "General Practice: Deleted "Australian Breastfeeding Association/NMAA"	Not applicable
1. Of the responses in question 2, which one was the most useful?	Not modified	
In what format do you like learning new information? (please mark all that apply)	Not modified	
Doctors have an important role in encouraging and supporting breastfeeding women.	Not modified	
Female doctors are better able to assist breastfeeding women, regardless of their experience or training, than male doctors.	Not modified	
Doctors have little influence on a mother's decision to breastfeed.	Not modified	
Doctors should discuss breastfeeding with mothers early in their pregnancy.	Not modified	
It is not appropriate for doctors to advise mothers to breastfeed.	Not modified	

Only doctors with personal experience of breastfeeding (self or partner) are able to assist breastfeeding women.	Not modified	
It is appropriate to refer breastfeeding mothers to others with more expertise.	Not modified	
How effective do you think you are in meeting the needs of the breastfeeding women you see?	Not modified	
How confident would you say you are with your ability to assist women who present with breastfeeding problems?	Not modified	
Infant formula is more easily digested than breast milk.*	Not modified	
Breast milk is the ideal food for babies.	Not modified	
Formula feeding is a good way of letting fathers care for the baby.*	Not modified	
Breastfeeding & formula feeding are both equally acceptable methods of feeding infants.*	Not modified	
Breastfeeding increases mother-infant bonding.	Not modified	
A mother knows instinctively how to breastfeed.*	Not modified	
Breastfeeding provides health benefits for infants that cannot be provided by infant formula.	Not modified	
Mothers who smoke should formula feed their babies. *	Not modified	
Breastfeeding is incompatible with working outside the home. *	Not modified	
Fathers feel left out if a mother breastfeeds. *	Not modified	

Breastfed babies need to be fed too often.*	Not modified	
Infant formula is as healthy for an infant as breast milk.*	Not modified	
Breastfeeding is more convenient than formula feeding.	Not modified	
Formula feeding is the better choice if the mother plans to go out to work.*	Not modified	
The benefits of breast milk last only as long as the baby is breastfed.*	Not modified	
Mothers who formula feed miss one of the great joys of motherhood.	Not modified	
A mother who occasionally drinks alcohol should not breastfeed her baby. *	Not modified	
Formula feeding is more reliable because you can calculate the exact quantity of milk the baby is getting.*	Not modified	
Current infant formulas are nutritionally equivalent to breast milk.*	Not modified	
Women should not breastfeed in public places such as restaurants.*	Not modified	
Around what age do you recommend solids be introduced to a breastfed infant?	Not modified	
For how long do you recommend to a mother that she continue to breastfeed her infant?	Not modified	
A woman with mastitis should express and discard her milk from that breast until treatment is complete.*	Deleted	Level of knowledge too high
A nulliparous woman is able to lactate to breastfeed an adopted baby.	Deleted	Level of knowledge too high

A correctly positioned baby will suck at the breast with a different action to that used by a baby feeding from a bottle.	Deleted	Level of knowledge too high
Breastfed infants require extra water in hot weather.*	Deleted	Level of knowledge too high
It is expected that breastfed infants will regain their birth-weight by two weeks of age.	Deleted	Level of knowledge too high
Exclusive breastfeeding (no other fluids or solids) is the most beneficial form of infant feeding for the first six months of life.	Not modified	
In the first few weeks after birth a normal breastfed infant will usually feed 8-12 times in 24 hours.	Deleted	Level of knowledge too high
A breastfeeding woman should be advised to wean if she becomes pregnant.*	Deleted	Level of knowledge too high
It is normal for an adequately breastfed 2 - week old infant to only pass a bowel motion every 3 days or so.*	Deleted	Level of knowledge too high
Women who have breastfed have a lower incidence of premenopausal breast cancer.	Not modified	
A mother who weaned her baby because of a low milk supply will be unlikely to produce enough milk for any subsequent babies.*	Deleted	Level of knowledge too high
A woman who has had a previous benign breast biopsy is usually unable to breastfeed.*	Deleted	Level of knowledge too high
Amoxycillin is the drug of choice to treat mastitis in a woman 3 months postpartum.*	Deleted	Level of knowledge too high
Breastfed infants are less likely to become obese children.	Not modified	

All women with cracked nipples should express their milk and rest the nipples for 24 hrs.*	Deleted	Level of knowledge too high
Increasing her fluid intake will increase a mother's milk supply.*	Deleted	Level of knowledge too high
The nutritional properties of breast milk are only effective for 9 months postpartum.*	Deleted	Level of knowledge too high
Breastfeeding protects against rubella. *	Deleted	Level of knowledge too high
High maternal prolactin levels are essential for the initiation of lactation.	Deleted	Level of knowledge too high
Introducing complementary feeds (water or formula) interferes with the establishment of breastfeeding.	Deleted	Level of knowledge too high
Antenatal nipple preparation prevents nipple soreness in the first week postpartum.*	Deleted	Level of knowledge too high
A nipple shield should be used if there are any problems with the infant attaching to the breast.*	Deleted	Level of knowledge too high
Removal of breast milk (either by breastfeeding or expressing) is essential to maintain milk production.	Deleted	Level of knowledge too high
Premature infants who are fed breast milk are less likely to develop necrotising enterocolitis.	Deleted	Level of knowledge too high
Breastfeeding is contraindicated for women with Hepatitis C.*	Deleted	Level of knowledge too high
The nutritional content of breast milk changes throughout a breastfeed.	Not modified	
A woman with nipple and breast pain during and following a breastfeed may have a thrush infection of the nipple.	Deleted	Level of knowledge too high

Formula fed infants have more ear infections than breastfed infants.	Not modified	
A change to infant formula will improve the symptoms of a breastfed baby with ‘colic’. *	Not modified	
The most common cause of cracked nipples is poor positioning and attachment of the infant at the breast.	Deleted	Level of knowledge too high
In most cases a breastfeeding mother must temporarily wean her baby while she is taking prescription medications. *	Not modified	
Growth of breastfed infants differs from that of formula fed infants.	Not modified	
In general, the most appropriate advice to give a woman with a low milk supply is to increase the frequency of breastfeeds.	Deleted	Level of knowledge too high
Regular dummy use in the first month postpartum has been associated with a reduction in breastfeeding duration.	Deleted	Level of knowledge too high
Formula feeding has been associated with improved neurodevelopment.*	Deleted	Level of knowledge too high
A ‘top-up’ bottle after each breastfeed is the best way to manage an infant who is not gaining weight adequately.*	Deleted	Level of knowledge too high
A woman with a breast abscess can continue to breastfeed on both breasts.	Deleted	Level of knowledge too high
A woman being treated for postpartum depression can continue to breastfeed.	Deleted	Level of knowledge too high
Breastfeeding reduces the incidence of gastroenteritis in the infant.	Deleted	Level of knowledge too high

Only feeding from one breast at each feed is a management option for a woman with an oversupply of breast milk.	Deleted	Level of knowledge too high
What is your gender?	Not modified	
In what year were you born?	Deleted	Identifying
In what country were you born?	Changed to: Did you spend most of your childhood years living in an area with a population <10,000?	More appropriate for research question.
In what year did you complete your medical degree?	Deleted	Not applicable
What Regional Training Provider are you enrolled with now?	Deleted	Not applicable
At what stage are you in your GP training?	Changed to: In which year of medical school are you?	Not applicable
Where would you like to practice after completing your GP training?	Deleted	Not applicable
Did your mother breastfeed you?	Not modified	
Do you have children of your own?	Not modified	
Were any of your children breastfed?	Not modified	
What is the TOTAL length of the personal breastfeeding experience of you or your partner?	Not modified	
Overall, how was the personal breastfeeding experience of you or your partner?	Not modified	

In the past 3 months, how many patients have you seen in TOTAL who were pregnant, were mothers of infants under 12 months of age or were infants under 12 months of age? (please mark the most appropriate response)	Not modified	
In the past 3 months how many patients have you seen with a problem related to breastfeeding? (please mark the most appropriate response)	Not modified	

Appendix 5 Mean Attitude and Mean Knowledge Scores with Different Types of Imputation.

Questions with between 10-25% missingness were imputed as described in the methods section (no imputation, cold-deck or hot-deck). Mean attitude scores and mean knowledge scores were calculated using each of these methods. There is little difference between mean attitude and mean knowledge scores using each of these methods of imputation.

Mean Score	No imputation (omission)	Cold-deck imputation	Hot-deck imputation
Mean attitude score	4.15 +/- 0.53	4.09 +/- 0.50	4.14 +/- 0.53
Mean knowledge score	3.89 +/- 0.39	3.80 +/- 0.44	3.93 +/- 0.39

Appendix 6 Semi-structured interview guide used for interviews with local breastfeeding educators.

What is your occupation?
What opportunities do you have to instruct medical students about breastfeeding?
When considering medical students in your work environment, do you feel their knowledge on breastfeeding is adequate for their level of learning?
Can you describe medical students' attitudes towards breastfeeding?
Can you elaborate and provide examples of these attitudes?
In your observation, what is the quality of breastfeeding information provided to patients by medical students?
If you could change the medical school curriculum to improve breastfeeding teaching, what would you suggest?

Appendix 7 Informed consent form for interviews.

Informed Consent Form

Title: **Knowledge and Attitudes Towards Breastfeeding among Memorial University Medical Students.**

Researcher(s): Dr. Amanda Pendergast

You are invited to take part in a research project entitled "**Knowledge and Attitudes Towards Breastfeeding among Memorial University Medical Students.**." This study is being conducted as part of a Master's Program at Western University.

This form is part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. It also describes your right to withdraw from the study. In order to decide whether you wish to participate in this research

study, you should understand enough about its risks and benefits to be able to make an informed decision. This is the informed consent process. Take time to read this carefully and to understand the information given to you. Please contact the researcher, *Dr. Amanda Pendergast*, if you have any questions about the study or would like more information before you consent.

It is entirely up to you to decide whether to take part in this research. If you choose not to take part in this research or if you decide to withdraw from the research once it has started, there will be no negative consequences for you, now or in the future.

Participation, or lack of participation, is not a requirement of your program, and will not be reported to your supervisor.

Introduction:
I am an Assistant Professor with the Discipline of Family Medicine within the Faculty of Medicine at Memorial University. There is no agency funding this research.

Purpose of Study:
Breastfeeding has many health benefits for the mother and baby. Breastfeeding rates in Newfoundland and Labrador are the lowest in Canada. The purpose of this study is to determine knowledge and attitude gaps in medical students noted by breastfeeding educators. If we understand medical students' knowledge and attitudes, this will help shape the breastfeeding curriculum at Memorial University, which could translate to better educated physicians who are more comfortable addressing breastfeeding obstacles in their practices.

What You Will Do in this Study:
You will be invited to participate in an interview.

Length of Time:
The total length of time to complete the interview will be 30-45 minutes.

Withdrawal from the Study:

- If you decide to withdraw from the study during the interview, the interview will be stopped and the recording deleted.
- If you decide to withdraw from the study after the interview, you may do so within 30 days by notifying Dr. Pendergast.

Possible Benefits:
Benefits to society will be to understand medical students' attitudes and knowledge about breastfeeding which may help shape the curriculum at Memorial.

Possible Risks:
There are no risks in completing the study.

Confidentiality:
All results will remain confidential.

Anonymity:
All results will be anonymous in terms of name. The only identifying feature will be occupation.

Recording of Data:
The interviews will be audio recorded. Notes will also be taken during the interviews.

Use, Access, Ownership, and Storage of Data:

- Data will be stored in a locked filing cabinet in a locked office within the medical school. Electronic data will be stored on an ecrypted and password protected USB key.
- Dr. Pendergast will be the only person with access to the data.
- Data will be kept for five years, as required by Memorial University's policy on Integrity in Scholarly Research, and then destroyed.

Reporting of Results:
Results may be reported in a thesis, journal article, poster, conference presentation.

Sharing of Results with Participants:
Results will not be shared with participants.

Questions:
You are welcome to ask questions before, during, or after your participation in this research. If you would like more information about this study, please contact: Dr. Amanda Pendergast at amandalp@mun.ca

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

Consent:
Your signature on this form means that:

- You have read the information about the research.
- You have been able to ask questions about this study.
- You are satisfied with the answers to all your questions.
- You understand what the study is about and what you will be doing.
- You understand that you are free to withdraw participation in the study without having to give a reason, and that doing so will not affect you now or in the future.

- You understand that if you choose to end participation **during** data collection, any data collected from you up to that **point will be destroyed**.

- You understand that if you choose to withdraw **after** data collection has ended, your data can be removed from the study up to 30 days.

I agree to be audio-recorded ☐ Yes ☐ No

I agree to the use of direct quotations ☐ Yes ☐ No

By signing this form, you do not give up your legal rights and do not release the researchers from their professional responsibilities.

Your Signature Confirms:

☐ I have read what this study is about and understood the risks and benefits. I have had adequate time to think about this and had the opportunity to ask questions and my questions have been answered.

☐ I agree to participate in the research project understanding the risks and contributions of my participation, that my participation is voluntary, and that I may end my participation.

☐ A copy of this Informed Consent Form has been given to me for my records.

_____ _____

Signature of Participant Date

Researcher's Signature:

I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

_____ _____

Signature of Principal Investigator Date

This project has been reviewed and approved by the Western University Health Science Research Ethic Board (HSREB) on December 21, 2018.

This project has received secondary review and approval by Memorial University's Interdisciplinary Committee on Ethics in Human Research (ICEHR).

Curriculum Vitae

Name:	Amanda Pendergast
Post-secondary Education and Degrees:	University of Ottawa Ottawa, Ontario, Canada 1991-1995 B.Sc. (Hons) Magna Cum Laude University of Ottawa Ottawa, Ontario, Canada 1995-1999 M.D. University of British Columbia Victoria, British Columbia, Canada 1999-2001 Family Medicine Residency The University of Western Ontario London, Ontario, Canada 2013-2019 M.Cl.Sc
Honours and Awards:	Dr. J.F. Sangster Graduate Studies Family Medicine M.Cl.Sc Award 2017 Janus CPD Award, College of Family Physicians of Canada 2016 President's Award for Public Engagement Partnerships Memorial University 2015 F.C.F.P designation by the College of Family Physicians of Canada 2013 C.C.F.P. designation by the College of Family Physicians of Canada 2001
Related Work Experience	Assistant Professor Memorial University of Newfoundland 2015-present

Phase 1 Lead, Undergraduate Medicine
Memorial University of Newfoundland
2016-present

Publications:

Bishop L, Darcy S, Avery S, Pendergast A, Duggan N, Barnes L (2019). It Takes a Team: Caring for patients taking opioids for chronic non-cancer pain. *College of Family Physicians of Canada and Canadian Pharmacists Association*. Integration of Pharmacists into Interprofessional Teams. Ontario https://www.cfpc.ca/uploadedFiles/Health_Policy/IPC-2019-Pharmacist-Integration.pdf

Dawe R, Pendergast A, Bishop J, Avery S, Monaghan K, Duggan N, Aubrey-Bassler K (2017). Cesarean delivery rates among family physicians versus obstetricians: a population-based cohort study using instrumental variable methods. *Canadian Medical Association Journal Online*, 5(4).

Maddalena V, Pendergast A, McGrath G (2017). Quality Improvement in curriculum development. *Leadership in Health Services*, 31(4), 409-412.

Rockwood N, Pendergast A (2016). The association between female–factor infertility and depression and anxiety. *University of British Columbia Medical Journal*, 8(1), 14-16.