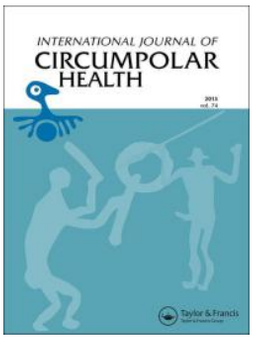

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Early life nutrition in Nunavut, Canada: a retrospective descriptive study of food security, vitamin D and rickets

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ABSTRACT

Northern regions of Canada have the highest reported incidence of childhood rickets in the country, yet this public health problem remains poorly described. The goal of this research was to explore the food and vitamin D supplementation experiences in pregnancy and infancy and examine associations with rickets diagnosis. Data were collected systematically through a retrospective chart review of Inuit children from 18 communities in Nunavut born from 2010–2013. Although most pregnant people reported consuming country food daily or weekly, one in three pregnant people reported being food insecure. Fewer than half of infants were reported to have received daily vitamin D supplement at two months of age, and frequency of supplement use declined with age. Rickets diagnosis was present in 1.63% of children (95% CI = 1.20%–2.20%). The odds of rickets diagnosis were higher for children whose mothers experienced food insecurity during pregnancy than for those whose mothers had never experienced food insecurity (OR = 5.279; 95% CI = 1.248–16.191). Enhanced support for food security, breastfeeding and vitamin D supplementation in early life is needed. In the context of social determinants of health, this study highlights the far-reaching and negative impacts of food insecurity on the health of Inuit children in Nunavut.

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Vitamin D; inuit health; early life nutrition; food security; rickets; Nunavut

Introduction

Inuit communities continue to experience a complex nutrient transition [1], in part characterized by a decreased intake of locally harvested country food and an increased intake of market food; this shift has affected overall diet quality, in part as high nutrient dense country food has been replaced by increased intake of nutrient poor, yet energy dense, retail foods [1–7]. The negative impacts of this nutrition transition on the vitamin D (25(OH)D) status of Inuit women and children are concerning [8–13], particularly since micronutrient status, including vitamin D status, in the first 1000 days of life (conception to age 2 years) is critical for development [14,15]. Research into the developmental origins of health and disease suggests that improving early-life environments, including the nutrition environment, can reduce noncommunicable disease risk and improve health outcomes over the lifespan [16].

The most crucial point in the human lifespan for vitamin D status is during reproduction [15], when adequate vitamin D supports skeletal development and growth, tooth enamel development, and bone metabolism for the mother and the infant [17]. Relationships between vitamin D deficiency during pregnancy and the pathogenesis of conditions such as preeclampsia and gestational diabetes have also

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been identified [17,18], and factors such as smoking in the presence of vitamin D deficiency may further increase the risk of gestational diabetes [19]. Vitamin D deficiency has been associated with increased risk for chronic diseases, including diabetes and various cancers, and early life may be a time of increased susceptibility [20]. Furthermore, maternal vitamin D deficiency during pregnancy is also an important risk factor for infant vitamin D deficiency [21,22], which can lead to cardiomyopathy, failure to thrive, delayed growth, seizures, dental abnormalities and caries, leg pain, fractures, delayed motor milestones, and increased susceptibility to infection [21,23,24]. Despite guidelines for prevention, nutritional rickets in children persists in Canada, and indigenous children—particularly Inuit children in Nunavut—are disproportionately impacted [21,24,25].

Communities at northern latitudes have unique considerations related to vitamin D. Humans obtain vitamin D from three sources: UV-B radiation, diet, and supplementation [9]. Although limited research suggests that some dermal vitamin D is produced at high latitudes of 70° north [26], endogenous vitamin D synthesis is believed to be limited to a few months per year for humans residing above 52° north [9]. The evidence suggests that Inuit depend on vitamin D-rich country food, such as marine mammals and fish, to supply vitamin D from the diet [5,9]. Indeed, higher vitamin D status has been associated with increased consumption of country food for Inuit and other northern indigenous peoples, and older Inuit individuals have higher vitamin D levels attributed to increased country food consumption [2,8,26–29]. For Inuit preschoolers (aged 3 to 5 years), the major contributor to vitamin D intake was found to be vitamin D-fortified milk [12]; the role of country food and retail food in supporting healthy vitamin D status in younger children and infants in Nunavut requires further understanding [13].

In addition to UV-B radiation and food, supplements can provide a source of vitamin D. According to the Canadian Pediatric Society, the optimum method for supporting vitamin D sufficiency in pregnancy and infancy is to offer vitamin D supplementation [24], particularly for those living in northern regions [21]. Vitamin D supplementation for Inuit children has been recommended by the Canadian Pediatric Society since 1988 [30], and the Government of Nunavut has implemented these recommendations over the past 25 years [30–32]. However, healthy vitamin D status remains a concern for women and children in Nunavut, and lactating Inuit women have demonstrated low prevalence of healthy vitamin D levels [27]. Additionally, inadequate dietary intake of vitamin D has been described in Inuit women of childbearing age [8] and vitamin D deficiency and insufficiency have been documented to be highly prevalent in Inuit preschoolers [12]. While the vitamin D status of Inuit infants in Canada is poorly described [9], children living in northern regions are reported to have the highest incidence of vitamin D deficiency rickets in Canada [30] and vitamin D deficiency rickets have been identified as a concern emerging in other regions of the Circumpolar North [32].

Although preventable, rickets in Nunavut is neither new nor straightforward. Vitamin D deficiency rickets has been reported as a concern for Inuit children for decades [33] and it is likely that nutritional rickets is influenced by a range of geographical and cultural factors [34,35]. The goal of this research was to describe the food and vitamin D supplementation experiences of pregnant women and their infants and to examine how these experiences impact the odds of rickets diagnosis in Nunavut, Canada.

Methods

Setting and ethics

Nunavut is home to more than 30,000 Inuit living in 25 communities [36] and is one of four regions of Inuit Nunangat (Inuit homeland located in the Arctic region in Canada). Inuit in Canada represent a population among the youngest in the country, with a birth rate higher than that of non-Inuit Canadians; Inuit representative organizations have expressed a need for culturally appropriate perinatal care to reflect this reality [33,37]. Healthcare, including prenatal care, is offered through community health centres in all Nunavut communities, and generally, women travel to regional centres in Nunavut, or larger facilities outside of Nunavut, to give birth. Social determinants of health, such as food insecurity and inadequate housing, remain challenges for many Inuit in Nunavut [36]. Simultaneously, country food is an important component of Nunavut food systems; a high percentage (70%) of adults participate in country food

harvesting activities, and both country food and harvesting are considered by Inuit as central to culture, community and well-being [36,38].

Data source

Medical charts of Inuit children ($n = 2522$) born from 1 January 2010, to 31 December 2013, from 18 Nunavut communities were reviewed for the original study, described elsewhere [39], representing Nunavut communities with more than 20 births per year (~90% of the births during that time period). Prenatal charts and delivery records were also reviewed. Well-baby forms derived from the baby Rourke record were developed considering maternal and early child health priorities between 2008 and 2010 for the Nutaqqavut (Our Children) Health Information system (NHIS), which was in effect from 2011–2014 [40]. The forms developed for the NHIS were utilized to a variable and increasing extent in Nunavut communities by health care providers beginning in 2010. Well-baby visits were documented on these forms, which were developed for health care priority data collection at 2 months, 6 months, 12 months, 2–3 years, and 4–5 years. Information such as breastfeeding practices, food insecurity, country food use, and other variables were included in the forms until at least 2014, when new forms developed by the Department of Health were put in place. For those charts without the NHIS forms, vitamin D information was derived from nursing notes on the well-baby charts, although that information was less consistently available. Rickets diagnosis was gleaned from the well-baby forms when in effect, as well as medical chart information outside the forms. All information was collected by chart abstractors at community health centres for the index study [41]. Children were classified as Inuit if either the mother or father identified as Inuit when this information was recorded at the first prenatal visit.

Variables utilized

Variables obtained for the current study included community name, prenatal food insecurity status (never, sometimes, often), prenatal country food consumption (daily, weekly, monthly, occasionally, never), rickets diagnosis (yes or no; health care providers were asked to indicate yes if the child had a *physician confirmed* case of rickets), prenatal vitamin D use (yes or no), breastfeeding initiation (yes or no, if no, then formula feeding was considered initiated), and vitamin D supplementation of the infant (where the caregiver indicated to the healthcare provider that vitamin D supplementation was given to the child daily, sometimes never). Food insecurity was assessed in the first and third trimesters by asking "whether there were times when food did not last for mothers or families and there was no money to buy more", with options being never (indicating no food insecurity) or sometimes or often (indicating that women experienced some degree of food insecurity).

Data analysis

Descriptive statistics were used to explore supplement use in pregnancy and infancy, food security and country food consumption in pregnancy, rickets diagnosis, geographic distribution of reported rickets, and the infant feeding method. Exact logistic regression models were used to examine the associations between independent variables and rickets diagnosis. First, prior to any regression analyses, a causal model diagram was created to guide the statistical analyses. Based on the causal diagram, the independent variables explored in the models were prenatal food insecurity, prenatal country food consumption, prenatal vitamin D supplement use, infant vitamin D supplementation, and breastfeeding initiation. Given the statistically low number of rickets cases and given that information was missing/incomplete in varying parts of the charts and forms, exact logistic regressions were applied to determine the exact tests of the parameters in the logistic regression model [42]. To avoid collinearity between independent variables, Spearman rank correlation analysis was used to assess correlations between independent variables, with a cutoff value of |70|%. Correlations above |70|% were managed by using the most biologically appropriate variable in model building [43]. A purposive model-building approach was used to fit the multivariable

exact logistic regression model. First, univariable exact logistic regressions were used to explore the unconditional associations between rickets and each independent variable. Then, to build the best fit model, the variables were iteratively examined for differences between the full and reduced models. All analyses were conducted in Stata® (version 16.1, Stata Corp, College Station, TX, USA). A p value less than 0.05 was considered statistically significant. All accompanying figures and tables were generated using Microsoft® Office software.

A sensitivity analysis was carried out to compare key variables (maternal age, gestational age, prematurity and heavy smoking) in those with food security information and those without food security information to assess the potential generalizability of the results. Welch's t test was used to calculate P values for maternal age and gestational age, while Fisher's exact test was used to compare proportions of prematurity and smoking more than 10 cigarettes.

Results

The following Nunavut communities were included in this study: Arctic Bay, Arviat, Baker Lake, Cambridge Bay, Clyde River, Coral Harbour, Gjoa Haven, Igloolik, Iqaluit, Kinngait, Kugaaruk, Kugluktuk, Naujaat, Pangnirtung, Pond Inlet, Rankin Inlet, Taloyoak, and Whale Cove. A summary of independent variables and the available records for study for each variable is summarized in Table 1.

Rickets

A total of 41 children received a diagnosis of rickets between the ages of 0 and 5 years (prevalence of 1.63%). Rickets diagnosis varied considerably by geographic region of Nunavut, with the majority of rickets diagnoses in this study population occurring in communities in the northern Qikiqtani region of Nunavut. The average age at which children were diagnosed with rickets was 18.2 months (ranging from 3.7–53.4 months) (Figure 1).

Table 1. Prenatal and infant nutrition experiences as reported in well baby charts for Inuit children ($n = 2522$) from 18 Nunavut communities born between 1 January 2010 and 31 December 2013).

Variable		n	Proportion (%) [95% Confidence Interval]
Prenatal food security (trimester 1)		1211	
	Food secure	816	67.38 [64.69, 69.97]
	Sometimes food insecure	329	27.17 [24.73, 29.75]
	Often food insecure	66	5.54 [4.30, 6.88]
Prenatal food security (trimester 3)		500	
	Food secure	343	68.60 [64.39, 72.53]
	Sometimes food insecure	138	27.60 [23.85, 31.69]
	Often food insecure	19	3.80 [2.43, 5.89]
Prenatal country food (trimester 1)		555	
	Daily/weekly	281	50.63 [46.47, 54.79]
	Monthly/occasionally	235	42.34 [38.28, 46.51]
	Never	39	7.03 [5.17, 9.48]
Prenatal country food (trimester 3)		430	
	Daily/weekly	222	51.63 [46.89, 56.33]
	Monthly/occasionally	172	40.00 [35.46, 44.72]
	Never	36	8.37 [6.09, 11.40]
Prenatal vitamin D supplement use		1292	
	Yes	839	67.01 [64.36, 69.57]
	No	413	32.99 [30.43, 35.64]
Rickets diagnosis		2522	
	Yes	41	1.63 [1.20, 2.20]
	No	2480	98.37 [97.80, 98.80]
Infant feeding		2308	
	Breastfeeding initiated	1707	73.96 [72.13, 75.71]
	Formula initiated	601	26.04 [24.29, 27.87]
Infant vitamin D supplement use (any)		1687	
	Yes	1299	77.00 [74.93, 78.95]
	No	388	23.00 [21.05, 25.07]

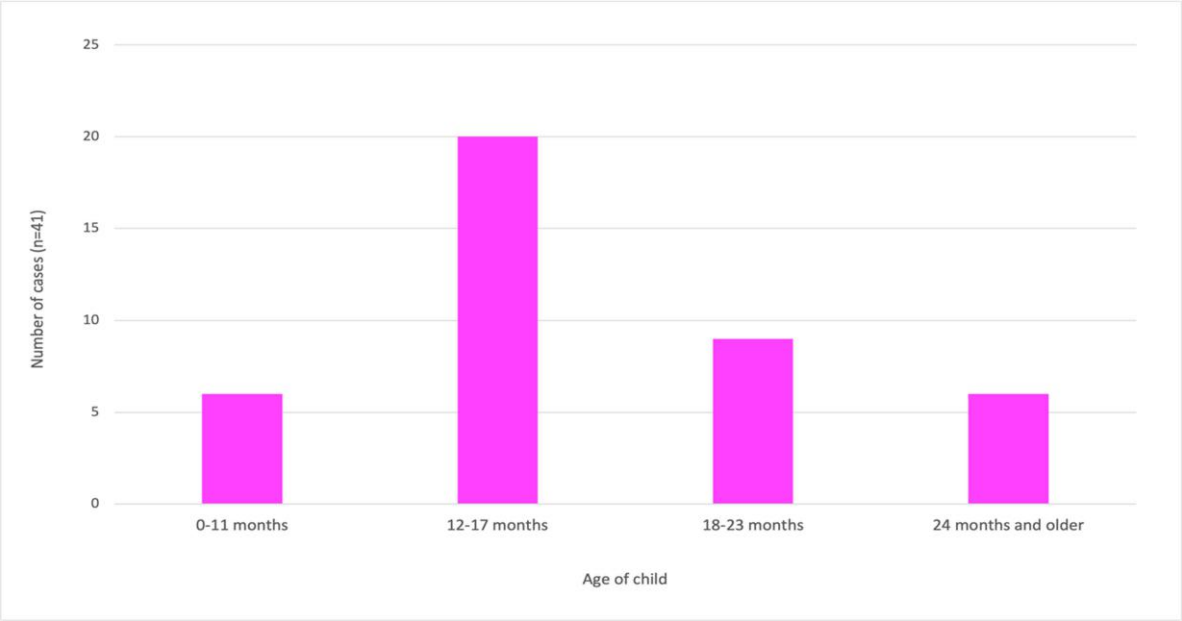

Figure 1. Age of child at the time of rickets diagnosis ($n = 41$) in Nunavut, Canada from 2010–2013 food security and country food.

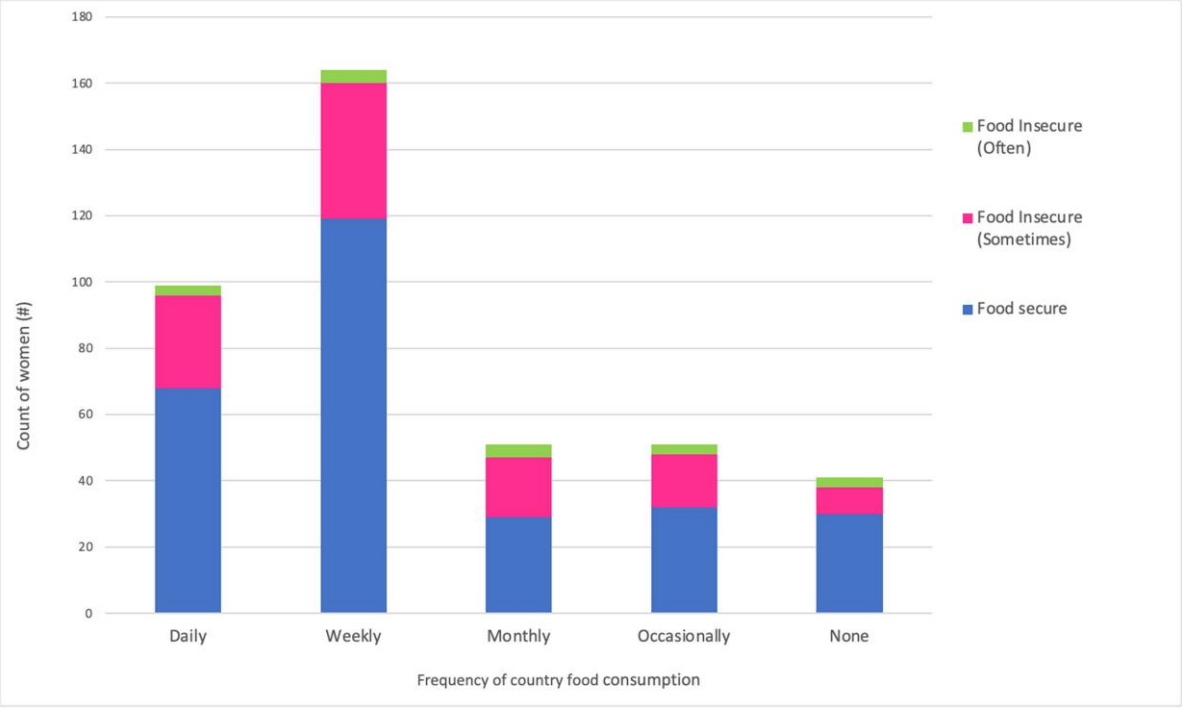

Figure 2. Frequency of country food consumption by food security status during pregnancy in Nunavut, Canada (2010–2013).

Over 30% of pregnant people for whom data are available reported experiencing food insecurity during pregnancy; most people who reported food insecurity during pregnancy were "sometimes" food insecure. A lower proportion of pregnant people indicated that they were "often" food insecure in the third trimester than in the first trimester. Most pregnant people consumed country food during pregnancy, and half consumed country food either daily or weekly (Figure 2).

Infant feeding and vitamin D supplement use

The majority of participants for whom data are available reported taking a vitamin D supplement (one or more times) at some point during their pregnancy. Overall, 77% of the infants were given a vitamin D supplement at some point in the first year of life. At 2 months of age, fewer than half of the infants for whom data are available received daily vitamin D supplementation, and the frequency of vitamin supplement use decreased as the infants aged. Breastfeeding has been reported to have been initiated for more than three-quarters of infants.

Regression analysis

Univariate exact logistic regression analysis revealed significantly higher odds of rickets diagnosis in children born to mothers who were food insecure during pregnancy than in those born to mothers who were food secure (Table 2). In the final multivariable exact logistic regression model (Table 3), the odds of rickets diagnosis were lower for children born to mothers who were never food insecure and lower for infants who were formula-fed compared to infants for whom breastfeeding was initiated.

Table 2. Univariable, unconditional exact logistic regression, examining the odds of rickets diagnosis in Inuit children in Nunavut, Canada (2010–2013).

Univariable, unconditional exact logistic regression results					
Variable		n	Odds ratio	*p**	95% CI
Prenatal food insecurity[a]		1260			
	No	1210			
	Yes	50	4.911	0.030*	1.178–15.401
Prenatal vitamin D supplement[b]		1252			
	No	413	ref		
	Yes	839	0.984	1.000	0.368–2.905
Prenatal country food intake (trimester 1)		555			
	Never	39	ref		
	Monthly	235	0.659	1.000	0.063–33.248
	Daily/weekly	281	0.689	1.000	0.074–33.407
Infant vitamin D supplement		1687			
	No	388	ref		
	Yes	1299	0.962	1.000	0.438–2.330
Formula feeding initiated		2308			
	No	1707	ref		
	Yes	601	0.311	0.021*	0.080–0.873

* $p < 0.05$ was considered statistically significant.
[a] Pregnant person reporting food insecurity at any point during pregnancy.
[b] Sample size based on prenatal/ child pairs where rickets diagnosis information was available.

Table 3. Multivariable exact logistic regression examining the odds of rickets diagnosis for Inuit children in Nunavut, Canada (2010–2013).

Multivariable exact logistic regression results					
Variable		n	Odds ratio	*p**	95% CI
Prenatal food insecurity[a]					
	No	1150	ref		
	Yes	47	5.279	0.025*	1.248–16.919
Formula feeding initiated					
	No	904	ref		
	Yes	293	0.122	0.013*	0.003–0.757

* $p < 0.05$ was considered statistically significant.
[a] Pregnant person reporting food insecurity at any point during pregnancy.

Sensitivity analysis

Although there was little difference between those with food security data and those without for maternal age, gestational age and heavy smoking (as a marker for other risk factors), there was a significant difference in rates of prematurity. There was a higher rate of prematurity in those with missing food insecurity data (17.2%) than in those with missing data (13.9%), suggesting that there may be different characteristics between the two groups (see Supplemental Data Table 1).

Discussion

This study revealed that the prevalence of diagnosed rickets persisted at 1.63% for Inuit children living in Nunavut, Canada, between 2010 and 2013. Rickets is a public health problem for children around the world (46); in Canada, rickets disproportionately impact indigenous children [24,25]; and in the US, Alaskan Native children have a higher incidence of rickets compared to other indigenous peoples do in the country [32]. In 2002–2004, the overall pediatric surveillance assessment of rickets was estimated to be 2.9 cases/100,000 infants and children (0–18 years) in Canada [44].

Like other studies in Nunavut, our study highlights that food insecurity exists for Inuit women [45–47]; this work adds new evidence that being food insecure during pregnancy negatively impacts child health. Specifically, our study revealed that the odds of rickets diagnosis were significantly higher in children born to mothers who experienced food insecurity during pregnancy than in those born to mothers who experienced food security. It is well-established that household food insecurity is associated with heightened nutritional vulnerability and a range of negative physical and mental health outcomes across the lifecycle, and these outcomes are independent of income, education and other social determinants of health [45,48]. Being food insecure is known to increase the risk of nutrient inadequacies in adults and adolescents [49,50] and has been associated with lower intakes of important nutrients for Inuit, including vitamin D [51,52]. There is an increased risk of numerous poor health outcomes for children born to mothers who are food insecure during pregnancy [53], and maternal food insecurity has been associated with rickets diagnosis in Manitoba children [25].

Our study contributes to the current understanding of the impacts of food insecurity in Nunavut by linking prenatal food insecurity with negative childhood health outcomes (rickets) in children. Inuit have expressed that food security is complex, rooted in historical and ongoing colonization and racism, and encompasses the high cost of living in Inuit homelands, the poverty experienced by many Inuit communities, and the environmental factors facing Inuit communities, such as climate change [54–57]. For Inuit in Nunavut, food security is tightly linked to locally harvested country food [36,38,56,57] community-led solutions to support food security for children and their families, including supporting access to country food [21,36,38]. In this study, most pregnant people reported consuming country food, yet the circumstances of country food security during pregnancy are less clear, For instance if there is a desire for more access to country food during pregnancy or if country food is in fact more available during pregnancy in Nunavut. Across Nunavut, access to country food can be a challenge; over half of the adult participants in the Inuit Health Survey reported that they would prefer to eat more traditional food than they had access to [58]. Not only is country food important for food security but also the consumption of country food, particularly marine mammals (such as seals and whales) and fatty fish, is associated with improved vitamin D blood levels for circumpolar indigenous peoples [12,59–61].

Indeed, the vitamin D content of some country foods (including Arctic char, beluga blubber, and seal liver) is high, and even the consumption of low to moderate amounts of country food containing vitamin D provides protection against vitamin D deficiency [9]. It has also been established that some of these food sources are subject to environmental impacts, including the bioaccumulation of methylmercury, and this is a critical consideration for sensitive subpopulations such as pregnant women and children [62]. Given that effective nutrition interventions are informed by, and reflect, cultural perspectives of the community where the intervention occurs [63,64], research engaging Inuit women related to country food preference and access may serve to ensure that programs and support are appropriately offered for this vulnerable period of life.

Our study also explored infant feeding methods and rickets diagnoses and found that the odds of rickets were significantly lower in infants who were formula-fed. Clearly, breastfeeding is the nutritional standard for infants and is a global public health recommendation given the plethora of positive health impacts that breastfeeding offers mothers and infants [65]. For indigenous communities and those in rural and remote areas, breastfeeding is considered "the most secure and economically advantageous" method of feeding infants and is important for infant food security [66]. All infant formula sold in Canada must be fortified with vitamin D [67], and in Nunavut, vitamin D supplementation (provided free of charge in all communities) is recommended for both formula-fed and breastfed infants [34].

Our study revealed that the proportion of infants reported to receive daily vitamin D supplementation was low. Fewer than half of the infants received daily vitamin D supplementation at 2 months of age, and daily supplement use declined with increasing infant age. Although low or lack of vitamin D supplementation for infants was not significantly associated with rickets in this study, it is clear that vitamin D supplementation in infants supports healthy vitamin D status, particularly for infants who are exclusively breastfed, and vitamin D supplementation is critical for preventing rickets in Nunavut children [21,23,24]. The topic of vitamin D and Inuit has been of interest to many diverse observers for decades, with both broad consensus regarding current scientific understanding and some limited suggestions that supplementation may not be warranted in some populations. [68]. In this study, we confined ourselves to exploring the utilization of Canada's evidence-based national and regional recommendations; alternate views of the basics of the recommendations are not our focus. The Canadian Pediatric Society endorses increased vitamin D supplementation for Indigenous infants considered at high risk [34], and the Infant Feeding Joint Working Group representing Health Canada, the Canadian Paediatric Society, Dietitians of Canada and the Breastfeeding Committee for Canada [69] recommend that all infants who are breastfed exclusively or partially be provided with a vitamin D supplement.

Our findings align with previous Canadian studies showing that breastfed Indigenous infants not receiving a vitamin D supplement are disproportionately impacted by rickets, particularly infants in northern [34] China. For high-risk groups, including mothers and their children living in northern regions, daily supplementation with vitamin D during pregnancy and infancy is the optimal method for preventing vitamin deficiency [24], and calls for increased attention to vitamin D supplementation in children have been issued [70]. Alternatives to daily infant supplementation, such as intermittent large-dose vitamin D, have been proposed in high-risk populations (21); more research is needed to explore the safety of these promising practices [71].

At the same time, limited research has explored the barriers that parents and caregivers in Nunavut experience in providing vitamin D supplements to their children and in taking vitamin D supplements during pregnancy. Further understanding of the concerns of Inuit women and families in Nunavut related to vitamin D supplementation is needed (73); such efforts may serve to support community-acceptable supplementation practices for this high-risk group. The use of vitamin D from food and supplements in the context of healthy feeding for all infants might also include exploration of the role of national food and breastfeeding as the first foods for infants, a concept central to indigenous food sovereignty [72].

While understanding individual actions that impact rickets diagnosis and nutrition in early life is crucial for addressing these public health concerns, our study also draws attention to wider societal and socioeconomic factors that impact early life in Inuit communities [12,73]. The social determinants of child health are profoundly influenced by both social and political decisions [74], which are especially blatant for indigenous peoples, for whom food security, nutrition and malnutrition are embedded in histories of colonization and disconnection from land and knowledge systems over generations [75]. Programs and policies (such as prenatal nutrition programs and country food sharing networks) to support diet quality and access to country food for Inuit communities must consider economic, social, and cultural well-being, as these factors are strongly associated with nutrition and health outcomes [58]. Strengthening opportunities to support the consumption of vitamin D-rich foods by women and their children, in particular, are urgently needed to support overall nutritional health in Nunavut [13,21,38,76].

Although this is the largest study involving Inuit to date on this topic, there are limitations. The nature of retrospective clinical chart reviews has inherent limitations. For example, approximately 50% of the charts were missing food security data, and our results may not reflect those in the category of missing results. Our sensitivity analysis suggested that some differences in characteristics, especially differences in the rates of prematurity were notable. Therefore, we caution that the analysis we conducted should not be generalized

to the full population; additional studies will be needed to determine the generalizability to the larger population.

Furthermore, because of limitations related to health systems in the circumpolar regions, including healthcare provider resource limitations, all variables may not have been completed [77]. In Nunavut, the NHIS forms that included country food use and food insecurity were initiated at various times within communities in 2010 and were discontinued in 2014, being replaced by forms that likely did not document that information. This limited the completeness of the data that could be collected between 2010 and 2011 and for the follow-up period. Another limitation of these data is that we could not verify whether a medical professional actually ever recommended to the caregiver that the infant receive vitamin D supplementation; however, vitamin D recommendations for infants are regularly communicated across Nunavut at occasions other than through health centre visits, including community-led prenatal nutrition programmes and community health representative-led radio programmes.

Furthermore, data collection in such a retrospective chart review includes subjective information collected during prenatal and well-baby appointments, such as food security status during pregnancy and the frequency of supplement administration. The sharing of information between Inuit and healthcare providers may be influenced by a range of factors, including access to trauma-informed care, the cultural competence of healthcare providers, and environments of cultural safety, which have been identified as challenges in circumpolar regions [77]. Challenges, including health worker shortages and high staff turnover, are common in Nunavut and may affect the quality of care, including the completeness and accuracy of record keeping [78]. There is no routine testing of vitamin D status or investigation of rickets in Nunavut. Additionally, rickets associated with underlying disease (such as fat malabsorption, liver disease, renal insufficiency, or vitamin D deficiency secondary to heritable disorders) were not reported in the chart review. Radiographic confirmation of rickets cases was not available. There may have been undiagnosed cases of rickets that were not considered in this study.

Conclusion

Rickets remains a persistent and preventable public health concern for child health in Nunavut. Our study adds to previous calls that rickets prevention should start during pregnancy [79]. Supporting perinatal food security, as well as appropriate infant feeding, breastfeeding and vitamin D supplementation practices, are important considerations for the prevention of rickets in Nunavut, highlighting that both individual and societal efforts are needed to address these substantial child health concerns. Inuit communities are well positioned to inform acceptable vitamin D supplementation practices and to guide best practices for supporting healthy infant feeding and healthy vitamin D levels in the first 1000 days; further understanding and attention to the concerns of Inuit women and families utilizing qualitative research may be a positive step toward understanding the barriers experienced by Inuit and may support improved vitamin D supplement use in Inuit communities. Assessment of vitamin D status during pregnancy and infancy in Nunavut would help in understanding the magnitude of risk for rickets in early childhood.

For those working to improve socioeconomic conditions in Inuit communities, this study offers a pressing example of the far-reaching and negative impacts of prenatal food insecurity on the health of Inuit infants and children. The nutritional health of women is closely linked “to the health of the social collective” [75], and evidence strongly suggests that improving early-life environments results in improved health over the life course [16]. Furthermore, the health status of infants and young children can be seen as a “barometer of a population's health”, reflecting the well-being of the most vulnerable citizens and informing projected optimum growth and development [16,73]. Supporting nutrition in the first 1000 days must engage individuals and families, and importantly policy makers and others in power to act to address structural and societal factors driving economic inequities for families in Nunavut, ultimately impacting health across generations [16].

Disclosure statement

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