Nutritional status and feeding practices of First Nations and Metis children and their association with early childhood caries

Bachelor of Science in Dentistry (B.Sc. Dent.) Thesis

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Abstract

Objective – To investigate the baseline nutritional status and feeding practices of First Nations and Metis children in Manitoba participating in a community-based participatory oral health study and whether there were any associations with early childhood caries (ECC).

Methods – This cross-sectional study assessed the oral health status of Indigenous children <72 months of age while their parent(s)/caregiver(s) completed a questionnaire, which included the Nutrition Screening Tool for Every Preschooler (NutriSTEP) and questions on children's dietary practices. The analysis included descriptive statistics, bivariate analyses, and linear regression. A p value ≤0.05 was significant.

Results – Overall, 146 children were recruited at a mean age of 40.8±20.4 months, and 59.6% had ECC. The mean decayed, missing, and filled primary teeth (dmft) score was 4.9±5.3 (range 0–20). While the mean NutriSTEP score was 19.9±6.2 (median 19.5) suggesting a low risk for impaired nutritional status, 50.0% of children were at moderate or high risk for impaired nutritional status. There was no significant difference in NutriSTEP scores between First Nations and Metis children (p=0.29), and no association was found between NutriSTEP risk categories and ECC (p=0.77). Children who frequently ate meat, fish, poultry, or alternatives (NutriSTEP Q5) were significantly more likely to have ECC (p=0.032). Children who never received nutritional supplements (NutriSTEP Q13, p=0.05) were significantly more likely to have ECC. Children who used a pacifier were less likely to have ECC than children who did not (p<0.01).

Conclusions – Although half of the children classified using the NutriSTEP were at low risk, the other half were at moderate and high risk. Children classified as high risk were not shown to have a statistically significant association with ECC. Specific NutriSTEP questions, however, were shown to be significant for ECC. In addition, numerous childhood feeding practices were found to play a significant role in the prevalence of ECC.

Introduction

Early childhood caries (ECC) is defined as the presence of decay (caries) on primary teeth in children < 72 months of age (AAPD, 2016). ECC can have an impact on children's nutrition and overall well-being by affecting eating, sleeping, and speaking (Davidson et al., 2016; Lee et al., 2021; Schroth et al., 2013, 2022). Additionally, ECC can lower self-esteem and increase the risk for future caries (Pierce et al., 2019; Schroth et al., 2009). This disease disproportionately affects Indigenous children in Canada. In some Indigenous communities, over 90% of children are affected by severe ECC (S-ECC), which is an aggressive form of ECC (Holve et al., 2021; Schroth et al., 2005). Data from a recent national report reveals that pediatric day surgeries under general anesthesia (an option for treating ECC) are almost ten times higher in northern and rural Manitoba and eight times higher in communities with larger Indigenous populations (Schroth et al., 2016). Statistics Canada also reports that Manitoba is home to almost 1/6th of Canada's indigenous population, with 60% identifying as First Nations and 40% as Metis (*Aboriginal Population Profile, 2016 Census*, 2018).

The etiology of caries has been traditionally ascribed to the presence of fermentable carbohydrates, bacteria, time, and host factors like susceptible tooth surfaces (Seow, 2018). However, there is mounting evidence that there are numerous other risk factors and risk markers. Contributing factors include oral hygiene habits, dietary habits, quality and quantity of saliva, fluoride exposure, immune health, genetics, socioeconomic status, education of parents, and lifestyle (Mathur & Dhillon, 2018; Seow, 2018). Key dietary risk factors associated with ECC often involve infant feeding practices (i.e., bottle-feeding and prolonged breastfeeding beyond 1 year of age), sugars, snack-type (sticky/acidic/liquid/solid), and snacking frequency. (Feldens et al., 2018; Mathur & Dhillon, 2018; Mobley et al., 2009)

Some studies have investigated the relationship between nutritional status and ECC (Schroth et al., 2013, 2020; Williams et al., 2021). Findings from a case-control study revealed that preschool

children with S-ECC are more likely to have significantly lower 25(OH)D (vitamin D) levels than caries-free children (Williams et al., 2021). Alternatively, children who had higher vitamin D, higher calcium concentrations, and were breastfed in infancy were significantly and independently associated with lower likelihoods of S-ECC (Williams et al., 2021). However, there are very limited data available on the nutritional status of Indigenous preschool children. Food insecurities in low socioeconomic status Indigenous families can contribute to the nutritional status of Indigenous children and further influence their academic success and future employment opportunities (Kim, 2019). As previously stated, Indigenous children are disproportionately affected by ECC and S-ECC. However, it is unknown whether Indigenous children with ECC have nutritional problems as none have specifically explored whether nutritional status is also a concern among Indigenous children and whether there is any relationship between nutritional status and caries in First Nations and Metis children. Therefore, further studies are warranted.

The purpose of this paper is to investigate the baseline nutritional status and feeding practices of First Nations and Metis children in Manitoba participating in a community-based participatory oral health study and whether there were any associations with ECC.

Methods

A cross-sectional study design was initiated to study nutritional status via NutriSTEP and associated feeding practices in young First Nations and Metis children from four Manitoba communities participating in a community-based participatory research project, the Scaling up the HSHC initiative. This project adhered to the ethical principles of First Nations Ownership, Control, Access, and Possession (OCAP) and Metis Ownership, Control, Access, and Stewardship (OCAS). Ethical approval was provided by the University of Manitoba's Health Research Ethics Board. The First Nations Health and Social Secretariat of Manitoba (FNHSSM) and the Manitoba Metis Federation (MMF) were partners in this study and approved this research.

Data Collection

Participants for this study were recruited from the following communities: Winnipeg, Pine Creek First Nation (total size: 328), and two Metis communities from the Northwest Metis Federation Region (referred to as Metis community 1 (total size: 487), and Metis community 2 (total size: 349)). Additional details on this study are reported in another prior publication (Lee et al., 2021). All interested and willing parent(s) or caregiver(s) from these communities with a child <72 months of age were eligible to participate in the study. Participating children who were just beyond the age cut-off (≥72 months) in rural areas were also included due to this screening being their first dental check-up. They were also included to see the degree of caries in the primary dentition and the history of ECC. Recruitment lasted from October 2018 to December 2019 and participants consisted of 146 First Nations or Metis children from Winnipeg (69), Pine Creek First Nation (18), Metis community 1 (23), and Metis community 2 (36).

A baseline questionnaire was administered after written informed consent was received. The questionnaire included a section on early childhood feeding practices which asked more specific questions regarding frequencies of breastfeeding, bottle-feeding, sippy cup use, lidless cup use, soother use, and snacking between meals. Parents and caregivers were also asked which foods (solids and liquids) were given and if sweeteners were used. In addition, the questionnaire included a section on Nutrition Screening Tool for Every Preschooler (NutriSTEP, 3-5 year old children only). NutriSTEP is a 17-item questionnaire for the parent(s)/caregiver(s) of toddlers and preschoolers. Risk scores can be derived from responses to the questionnaire. The main goal of NutriSTEP is to identify if a child is a healthy eater. Unhealthy eating can lead to anemia, growth problems such as obesity, and lifelong poor eating habits (Randall Simpson et al., 2008). Children are divided into three categories based on the risk score: low risk (no immediate follow up is needed), moderate risk (recommend health resources to parents/caregivers), and high risk (will benefit from follow up from a health care provider) (Randall Simpson et al., 2008). NutriSTEP allows for early identification and intervention of nutritional problems,

along with providing an avenue for parental/caregiver nutritional education, and parental/caregiver self-monitoring for their child's nutritional health (Randall Simpson et al., 2008). NutriSTEP scores of 20 or less indicate low risk, 21-25 indicate moderate risk, and 26 or greater indicate high risk (Randall Simpson et al., 2008).

All participating children underwent a dental examination at a local community centre or health centre. All dentist examiners were trained and standardized. Kappa statistics were calculated to determine intra-examiner agreement for ECC; decayed, missing, and filled primary teeth (dmft); and decayed, missing, and filled surfaces (dmfs) for 21 (14%) children. The population was sampled through convenience sampling methods as participants were recruited based on if they had attended our community-based research events. ECC and S-ECC were defined according to established clinical case definitions (AAPD, 2016).

All participants received a gift card, toothbrush, and toothpaste after the appointment.

Data Analysis

Study data were collected and managed using Research Electronic Data Capture (REDCap) hosted at Children's Hospital Research Institute of Manitoba. REDCap is a secure, web-based software platform designed to support data capture for research studies. Data from the questionnaires and oral exams were entered into REDCap software for processing. Data were converted into a numerical format and transferred to an Excel workbook (Microsoft Office, Redmond Washington). REDCap then generated a data dictionary for translating the numerical data whenever needed. Frequency tables and descriptive statistics reports were generated using Number Cruncher Statistical Software (NCSS Version 2021) (Kaysville, Utah). The frequency tables were used to clean the data by removing or recoding any inconsistencies. Statistical analysis included descriptive statistics (frequencies, means, standard deviations (SD)), bivariate analyses (chi-square analysis, T-tests, analysis of variance (ANOVA), and linear regression. A p value ≤ 0.05 was significant.

Results

Out of 146 participants, the mean age was 40.8±20.4 months with an evenly balanced gender distribution. Overall, 47.3% were from Winnipeg, 15.8% were from Metis community 1, 24.7% were from Metis community 2, and 12.3% were from Pine Creek Frist Nation. Most participants were from rural communities (52.7%), and 70.6% of participants identified as First Nations. Many parents/caregivers believed their child had tooth decay (43.1%) and the majority of participants had some form of dental insurance (93.5%). Refer to Table 1 for additional participant characteristics. Demographics have been interpreted in greater detail in a previously published paper from the same study group (Lee et al., 2021).

The total mean NutriSTEP score was 19.9±6.2 (median 19.5) indicating that the average child was at low risk for impaired nutritional status. No statistically significant differences were found between caries free participants (19.7±6.6, low risk category) or participants with ECC (20.0±6.0, moderate risk category) and mean NutriSTEP scores ($p=0.74$). No statistically significant differences were found between First Nations (20.3±5.9, moderate risk category) or Metis children (18.9±6.9, low risk category) with mean NutriSTEP scores ($p=0.25$). Based on the NutriSTEP scores, participants were classified as low risk (ECC 28.6% + caries free 21.4%=50.0%), moderate risk (ECC 22.1% + caries free 13.6% =35.7%), or high risk (ECC 9.3% + caries free 5.0% =14.3%) for impaired nutritional status. Children from rural communities had significantly lower mean NutriSTEP scores ($p<0.001$) and were more likely to be classified as low risk ($p<0.001$) than urban dwelling children. Frequent daily intake of milk products (NutriSTEP Q2) (69.3% of participants, ≥2 times per day), meat, fish, poultry, and alternatives (54.2% of participants, ≥2 times per day), and moderate daily intake of fruits (43.8% of participants, ≥3 times per day), vegetables (37.5% of participants, ≥2 times per day), and nutritional supplements (40% of participants had taken nutritional supplements at some point, whereas 60% of

participants had never taken any nutritional supplements) was observed. Table 2 provides complete data on NutriSTEP responses for participants.

Most participants were exclusively breastfed (72.7%) for an average of 5.3±2.5 months. Many participants continued to be breastfed after the introduction of solid foods (47.8%) for an average of 6.1±5.7 months. Solid foods were first introduced at a mean age of 8.3±4.5 months. At the time of this survey, most mother(s)/caregiver(s) had stopped breastfeeding (90.9%) at an average age of 7.6±6.1 months. Most participants had experience with bottle feeding (94.5%), with an average introductory age of 2.2±3.7 months, and many stopped using a bottle (57.9%) at an average age of 20.8±11.6 months. Sippy cups were used by most participants (83.1%) at an average starting age of 13.8±6.1 months and an average stopping age of 27.7±10.1 months. Most participants were never given a soother (60.8%). Table 4 provides in-depth data regarding participant feeding history.

There was a significant association between the frequent consumption of meat, fish, poultry, or alternatives (NutriSTEP Q5) with an increased prevalence of ECC ($p=0.032$). When comparing children who were taking nutritional supplements (NutriSTEP Q13) such as but not limited to multivitamins, iron drops, and cod liver oil to those who were not, there was a significant increase in the prevalence of ECC in the group that never took any supplements ($p=0.05$).

There was no significance found between the NutriSTEP risk categories (low, moderate, or high risk) and ECC ($p=0.77$). Additionally, there was no significant difference in total mean NutriSTEP scores between children with ECC and those caries-free ($p=0.74$). Similarly, there was no significant difference in total mean NutriSTEP scores between children with S-ECC and those without ($p=0.91$).

Of the 137 children ($n=145$) that were bottle-fed, there was a significant increase in ECC associated with participants who were bottle-fed tea ($p=0.006$). Participants who were bottle-fed "other" beverages had a significantly reduced occurrence of ECC ($p=0.0034$). Interestingly, participants who were given a pacifier were significantly less likely to have ECC than participants who did not use a

soother (p=0.007). Participants who consumed soda/pop (p=0.04) as their most frequent drink between meals were significantly more likely to have ECC. Participants who consumed "other beverage" as their most frequent drink between meals were significantly less likely to have ECC (p=0.01). Participants who drank fruit juice using a sippy cup had a significantly increased occurrence of ECC (p=0.006). Parent(s)/caregiver(s) who did not learn most about feeding from health care professionals had significantly increased prevalence of ECC for their children (p=0.046). Refer to Table 4 for in-depth data regarding child feeding history.

Lastly, we explored whether dmft scores and dmfs scores were correlated with total mean NutriSTEP scores. Overall, there were very weak and insignificant correlations with dmft (r=0.11) and dmfs (r=0.27) scores and mean NutriSTEP scores. Analysis of variance revealed that there were no significant correlations between dmft (p=0.093) and dmfs (p=0.20) scores and the NutriSTEP risk categories.

Discussion

This cross-sectional study assessed the nutritional status of young First Nations and Metis children from 4 participating communities. Particularly, this investigation focused on the prevalence of ECC in relation to the NutriSTEP and feeding practices. To our knowledge, this is the first paper that examines the NutriSTEP in relation to ECC. Overall, there were no significant findings to indicate that the total NutriSTEP score or its predetermined risk categories were an indicator for ECC. Our participants fell into the risk categories as follows: low risk (50.0%), moderate risk (35.7%), and high risk (14.3%). These results were similar to an Ontario, Canada study where the majority of participants fell into the low risk category, followed by moderate risk, then high risk (Walton et al., 2015)(Andrade et al., 2020). Although half of the children were at low risk, the other half were at moderate or high risk for unhealthy eating. This indicates that at least half of the participants and their parent(s)/caregiver(s) would benefit from receiving health resources, or even a direct follow up with a health care provider. The Ontario, Canada

study found the mean NutriSTEP score to be 21.6±8.26 for the control group (n=21) and the mean age to be 3.0±0.91 years (Walton et al., 2015). This value is quite similar to our mean total score (19.9±6.2), but the small sample size should be considered.

There was a significant correlation between the frequent consumption of meat, fish, poultry, or alternatives (NutriSTEP Q5, 2 or more times per day) with an increased prevalence of ECC (p=0.0202). This is a surprising finding as generally it should be healthy to have a diet rich in meat, fish, and alternatives. Some possible explanations could include that the participants were getting these foods from unhealthy sources like fast food or processed foods. Another explanation could be related to the age at which meat, fish and alternatives were introduced to the participants. Since it is known that caries prevalence increases with age due to more time available for teeth to experience decay (Kutsch, 2014; Lee et al., 2021; Seow, 2018).

When comparing children who were taking nutritional supplements (NutriSTEP Q13) such as but not limited to multivitamins, iron drops, and cod liver oil to those who were not, there was a significant increase in the prevalence of ECC in the group that never took any supplements (p = 0.049). This result is not surprising as the protection of teeth from caries is dependent partly on vitamin and mineral bioavailability (Neel et al., 2016). A recent article reported an inverse relation between calcifediol (active form of Vitamin D) levels and the number of decayed primary teeth (Schroth et al., 2020). Another article reported children with low vitamin D status were significantly more likely to have SECC when compared to the caries-free group (Schroth et al., 2013).

There was no correlation found between the NutriSTEP risk categories (low, moderate, or high risk) and ECC (p=0.77) or NutriSTEP mean scores and ECC (p=0.74). Since no previous studies were found, a comparison of these findings cannot be made. Given that two NutriSTEP questions were found to be significant for ECC, further studies on the relationship between NutriSTEP and ECC are justified.

Of the 137 children (N=145) that were bottle-fed, there was a significant increase in ECC associated with participants who were bottle-fed tea (p=0.0057). Even though this is a significant finding, “tea” includes a very broad category. As the questionnaire did not include a section for the parent(s)/caregiver(s) to specify the type of tea, no further information can be harvested from this finding. In addition, generic homemade “tea” could be confused with commercial “iced tea” which can be an acidic and sugary drink similar to pop. A study from Germany tested 44 products and found that iced tea(s) have significant cariogenic and erosive potential, even though they were brewed using fluoridated water (Behrendt et al., 2002).

Interestingly, participants who were given a pacifier were significantly less likely to have ECC than participants who did not use a pacifier (p=0.0072). This makes sense as the act of sucking stimulates salivary flow. It is well established that saliva has protective functions against caries including pH buffering, tooth remineralization, and anti-microbial activity (Tikhonova et al., 2018).

Participants that consumed soda/pop (p=0.04) as their most frequent drink between meals were significantly more likely to have ECC. This finding is expected as frequent intake of an acidic and sugary beverage complements the well-understood etiology of tooth decay (Tikhonova et al., 2018).

Participants who drank fruit juice using a sippy cup had a significantly increased occurrence of ECC (p=0.006). Often parent(s)/caregiver(s) have the misconception that fruit juice is a healthy alternative to beverages such as pop/soda. Although it may be more nutritious, fruit juice, such as orange juice, can still be a very acidic and sugary beverage. Combined with frequent sipping as allowed using a sippy cup, it can be a very cariogenic habit (Heyman & Abrams, 2017; Tikhonova et al., 2018).

Participants who drank “other beverage(s)” as their most frequent drink between meals (p=0.01) or who were bottle-fed (p=0.0034) “other” beverage(s) had a significantly reduced occurrence of ECC. As we do not know what these “other” beverage(s) were, these findings are of limited value.

Children of parent(s)/caregiver(s) who identified that they had not learned most about feeding from health care professionals were significantly associated with increased ECC (p=0.046). All health care professionals, with their advanced education, are perfectly situated to give advice regarding diet and feeding practices for children. Since 73.3% had not received most of their feeding advice from health care professionals, more attention should be directed at initiatives to address these shortcomings. Oral health professionals have a unique opportunity to provide this advice to parent(s)/caregiver(s) during the child's first dental visit. The first dental visit should occur within 6 months of the first erupted tooth, or at 12 months of age (*Canadian Dental Association*, n.d.).

The main limitation of this study was the small sample size as only 146 children participated. A small sample can reduce the statistical power and increase the margin of error of a study. Even so, this study was representative of the three rural Indigenous communities as nearly all children that met the requirements had participated. Still, this sample cannot be representative of other Indigenous communities across Canada. Several other limitations can be identified such as response bias and recall bias. Since questions were of a retrospective nature, parent(s)/caregiver(s) may have had difficulty remembering answers. Additionally, parent(s)'/caregiver(s)' answers may differ from the child's own nutrition/feeding history due to parent(s)/caregiver(s) wanting to select the right answer. Moreover, since this was a cross-sectional study, all data were only collected in one time period. Therefore, assumptions on causation cannot be made.

Conclusions

Although half of the children classified using the NutriSTEP were at low risk, the other half were at moderate or high risk for unhealthy eating. Even so, children classified as high risk were not shown to have a statistically significant correlation with the prevalence of ECC. Specific NutriSTEP questions, however, were shown to be significant for ECC. In addition, numerous childhood feeding practices

played a significant role in the prevalence of ECC. These findings can be used to further benefit screening initiatives and determine if children are at risk for developing ECC.

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Table 1 Participant Characteristics

Variable	Number (%)
Sex of child	
Male	72 (49.32)
Female	74 (50.68)
Community	
Metis community 1	23 (15.75)
Metis community 2	36 (24.66)
Winnipeg	69 (47.26)
Pine Creek First Nation	18 (12.33)
Indigenous group	
First Nations	103 (70.55)
Metis	43 (29.45)
Relationship to child	
Mother	126 (86.30)
Father	14 (9.59)
Grandparent	5 (3.42)
Other (Foster parent)	1 (0.68)
Child has dental insurance	
Yes	129 (89.04)
No	9 (6.38)
Don't Know	2 (1.42)
Insurance Plan	
First Nations and Inuit (NIHB)	76 (52.05)
Employment and Income Assistance	60 (41.10)
Employee sponsored plan	7 (4.79)
Private insurance plan	2 (1.37)
Don't know	1 (0.68)
Other	1 (0.68)
Missing	5 (3.42)
Believe child has tooth decay	
Yes	62 (43.06)
No	82 (56.94)
Describe child's dental health	
Very good	26 (18.06)
Good	54 (37.50)
Fair	46 (31.94)
Poor	17 (11.81)
Very poor	1 (0.69)
Child ever had a problem eating	
Yes	14 (9.59)
No	126 (86.30)
Don't know	4 (2.74)
Refuse	1 (0.68)
Other	1 (0.68)

Dental Status	
ECC (including past history of ECC)	
No	59 (40.41)
Yes	87 (59.59)
S-ECC	
No	65 (44.52)
Yes	81 (55.48)
Mean dmft score	4.94 ± 5.31
Mean dmfs score	14.5 ± 20.41

Table 2 Participant responses to NutriSTEP

NutriSTEP Question	Number (%)
Q1 Grain products	
More than 5 times a day	12 (8.57)
4-5 times a day	35 (25.00)
2-3 times a day	78 (55.71)
Less than 2 times a day	15 (10.71)
Q2 Milk products	
More than 3 times a day	67 (47.86)
3 times a day	30 (21.43)
2 times a day	24 (17.14)
Once a day or less	19 (13.57)
Q3 Fruits	
More than 3 times a day	35 (24.31)
3 times a day	29 (20.86)
2 times a day	40 (28.78)
Once a day	29 (20.86)
Not at all	6 (4.32)
Q4 Vegetables	
More than 2 times a day	32 (23.53)
2 times a day	19 (13.97)
Once a day	59 (43.38)
Not at all	26 (19.12)
Q5 Meat, fish, poultry, or alternatives	
More than 2 times a day	43 (30.71)
2 times a day	37 (26.43)
Once a day	35 (25.00)
Few times a week	19 (13.57)
Not at all	6 (4.29)
Q6 Fast food	
4 or more times a week	3 (2.14)
2-3 times a week	18 (12.86)
Once a week	23 (16.43)
A few times a month	61 (43.57)
Once a month or less	35 (25.00)
Q7 Difficulty buying food	
Once a month or less	57 (41.61)
Rarely	22 (16.06)
Sometimes	45 (32.85)
Most time	13 (9.49)
Q8 Difficulty chewing, swallowing, gagging, choking when eating	
Never	111 (79.29)
Rarely	21 (15.00)
Sometimes	6 (4.29)

Most time	2 (1.43)
Q9 Drinks all day, not hungry at meal time	
Never	38 (27.54)
Rarely	45 (32.61)
Sometimes	46 (33.33)
Most time	9 (6.52)
Q10 Times per day child eats	
5 times per day	33 (23.57)
3 to 4 times per day	78 (55.71)
More than 5 times per day	18 (12.86)
2 times per day	11 (7.86)
Less than 2 times per day	0
Q11 Let child decide how much to eat	
Always	46 (33.33)
Most time	39 (28.26)
Sometimes	44 (31.88)
Rarely	7 (5.07)
Never	2 (1.45)
Q12 Eats while watching TV	
Never	32 (22.86)
Rarely	17 (12.14)
Sometimes	58 (41.43)
Most time	22 (15.71)
Always	11 (7.86)
Q13 Child usually takes supplements	
Never	84 (60.00)
Rarely	15 (10.71)
Sometimes	16 (11.43)
Most time	8 (5.71)
Always	17 (12.14)
Q14 Child's physical activity	
Gets enough	107 (76.43)
Needs more	33 (23.57)
Q15 Watched TV, computer, plays video games	
1 hour or less a day	39 (27.86)
2 hours a day	40 (28.57)
3 hours a day	22 (15.71)
4 hours a day	20 (14.29)
5 or more hours a day	19 (13.57)
Q16 Comfortable with child's growth	138 (99.28)
Yes	1 (0.72)
No	

Q17 My child's weight	
Is about right	115 (82.14)
Should weigh more	11 (7.86)
Should weigh less	14 (10.00)
Total NutriSTEP Score (mean)	19.9 ±6.2
NutriSTEP risk categories	
Low	70 (50.0)
Moderate	50 (35.7)
High	20 (14.3)

TABLE 3: Relationship between NutriSTEP Responses and ECC

NutriSTEP Question	Number	(%)	Caries free	(%)	ECC	(%)	p value
Q1 Grain products							
4 or more times a day	47	(33.3)	17	(12.1)	30	(21.3)	0.54
3 or less times a day	94	(66.7)	39	(27.7)	55	(39.0)	
Q2 Milk products							
3 or more times a day	97	(69.3)	43	(30.7)	54	(38.6)	0.12
2 or less times a day	43	(30.7)	13	(9.3)	30	(21.4)	
Q3 Fruits							
3 or more times a day	64	(43.8)	28	(19.2)	36	(24.7)	0.47
2 or less times a day	82	(56.2)	31	(21.2)	51	(34.9)	
Q4 Vegetables							
2 or more times a day	51	(37.5)	25	(18.4)	26	(19.1)	0.11
once a day or less	85	(62.5)	30	(22.1)	55	(40.4)	
Q5 Meat, fish, poultry, or alternatives							
2 or more times a day	80	(54.8)	26	(17.8)	54	(37.0)	**0.032**
once a day or less	66	(45.2)	33	(22.6)	33	(22.6)	
Q6 Fast food							
2 times a week or more	21	(15.0)	7	(5.0)	14	(10.0)	0.50
once a week or less	119	(85.0)	49	(35.0)	70	(50.0)	
Q7 Difficulty buying food							
Less than once a month (rarely)	79	(57.7)	34	(24.8)	45	(32.9)	0.55
Most times (sometimes)	58	(42.3)	22	(16.1)	36	(26.3)	
Q8 Difficulty chewing, swallowing, gagging, choking when eating							
Never	111	(79.3)	44	(31.4)	67	(47.9)	0.87
Sometimes (rarely-most times)	29	(20.7)	12	(8.6)	17	(12.1)	
Q9 Drinks all day, not hungry at meal time							
Rarely	83	(59.7)	34	(24.5)	49	(35.3)	0.68
Most times (sometimes)	56	(40.3)	21	(15.1)	35	(25.2)	
Q10 Times per day child eats							
5 times per day or more	51	(36.4)	25	(17.9)	26	(18.6)	0.099
4 times per day or less	89	(63.6)	31	(22.1)	58	(41.4)	
Q11 Let child decide how much to eat							
Most times	85	(61.6)	39	(28.3)	46	(33.3)	0.067
Rarely (sometimes - Never)	53	(38.4)	16	(11.6)	37	(26.8)	
Q12 Eats while watching TV							

Rarely or never	49	(35.0)	20	(14.3)	29	(20.7)	0.89
Sometimes, Most times, or Always	91	(65.0)	36	(25.7)	55	(39.3)	
Q13 Child usually takes supplements							
Never	84	(60.0)	28	(20.0)	56	(40.0)	**0.049**
Sometimes, Most times, or Always	56	(40.0)	28	(20.0)	28	(20.0)	
Q14 Child's physical activity							
Gets enough	107	(76.4)	42	(30.0)	65	(46.4)	0.75
Needs more	33	(23.6)	14	(10.0)	19	(13.6)	
Q15 Watched TV, computer, plays video games							
2 hours a day or less	79	(54.1)	31	(21.2)	48	(32.9)	0.75
3 hours a day or more	67	(45.9)	28	(19.2)	39	(26.7)	
Q16 Comfortable with child's growth							
Yes	138	(99.3)	56	(40.3)	82	(59.0)	0.31
No	1	(0.7)	0	(0.0)	1	(0.7)	
Q17 My child's weight							
Is about right	115	(82.1)	45	(32.1)	70	(50.0)	0.65
Should be more / Should be less	25	(17.9)	11	(7.9)	14	(10.0)	
Total NutriSTEP Score (mean)	19.9	±6.2	56	(40.0)	84	(60.0)	0.74
NutriSTEP Risk Categories							
Low risk	70	(50.0)	30	(21.4)	40	(28.6)	0.77
Moderate risk	50	(35.7)	19	(13.6)	31	(22.1)	
High risk	20	(14.3)	7	(5.0)	13	(9.3)	

Table 4: Relationship between dietary behaviours, feeding history, and ECC

Variable	Number	(%)	Caries free	(%)	ECC	(%)	p value
Ever taken sweetened medication for more than one week?							
No	93	(66.0)	40	(28.4)	53	(37.6)	0.53
Yes	48	(34.0)	18	(12.8)	30	(21.3)	
Has child ever been breastfed?							
No	75	(52.1)	30	(20.7)	46	(31.7)	0.75
Yes	69	(47.9)	29	(20.0)	40	(27.6)	
When is your child breastfed?							
Mealtime							
Never	7	(10.9)	2	(3.1)	5	(7.8)	0.74
Sometimes	18	(28.1)	7	(10.9)	11	(17.2)	
Usually	39	(60.9)	17	(26.6)	22	(34.4)	
Naptime							
Never	11	(17.2)	2	(3.1)	9	(14.1)	0.21
Sometimes	12	(18.8)	6	(9.4)	6	(9.4)	
Usually	41	(64.1)	18	(28.1)	23	(35.9)	
Bedtime							
Never	6	(9.4)	2	(3.1)	4	(6.3)	0.86
Sometimes	13	(20.3)	6	(9.4)	7	(10.9)	
Usually	45	(70.3)	18	(28.1)	27	(42.2)	
Child crying							
Never	6	(9.4)	2	(3.1)	4	(6.3)	0.30
Sometimes	21	(32.0)	6	(9.4)	15	(23.4)	
Usually	37	(57.8)	18	(28.1)	19	(29.7)	
On demand							
Never	4	(6.3)	1	(1.6)	3	(4.7)	0.77
Sometimes	8	(12.5)	3	(4.7)	5	(7.8)	
Usually	52	(81.3)	22	(34.4)	30	(46.9)	
Exclusively breastfed?							
No	18	(27.3)	11	(16.7)	7	(10.6)	0.060
Yes	48	(72.7)	17	(25.8)	31	(47.0)	
If yes for exclusively Breastfed, how many months?	5.3	±2.5					
Breastfed after introduction of other solids?							

No	35 (52.2)	18 (26.9)	17 (25.4)	0.094
Yes	32 (47.8)	10 (14.9)	22 (32.8)	
If yes for breast-fed after introduction of other solids, how many months?	6.1 ±5.7			
Have you stopped breastfeeding your child?				
Yes	60 (90.9)	24 (36.4)	36 (54.6)	0.39
Still breastfeeding	6 (9.1)	4 (6.1)	2 (3.0)	
How old was child when breast-feeding stopped? (months)	7.6 ±6.1			
Was child ever bottle-fed?				
No	8 (5.5)	3 (2.1)	5 (3.5)	1.00
Yes	137 (94.5)	56 (38.6)	81 (55.9)	
What age did you start bottle feeding your child? (months)	2.2 ±3.7			
What did you put in the bottle?				
Brest milk				
No	102 (75.0)	38 (27.9)	64 (47.1)	0.19
Yes	34 (25.0)	17 (12.5)	17 (12.5)	
Cow's milk				
No	78 (57.8)	35 (25.9)	43 (31.9)	0.18
Yes	57 (42.2)	19 (14.1)	38 (28.2)	
Formula				
No	8 (5.9)	3 (2.2)	5 (3.7)	1.00
Yes	128 (94.1)	52 (38.2)	76 (55.9)	
Plain water				
No	34 (25.0)	12 (8.8)	22 (16.2)	0.48
Yes	102 (75.0)	43 (31.6)	59 (43.4)	
Tea				
No	126 (92.7)	55 (40.4)	71 (52.2)	**0.006**
Yes	10 (7.4)	0 (0.0)	10 (7.4)	
Soft Drinks				
No	123 (91.1)	51 (37.8)	72 (53.3)	0.76
Yes	12 (89.9)	4 (3.0)	8 (5.9)	
Fruit juice				

No	78	(57.8)	36	(26.7)	42	(31.1)	0.13
Yes	57	(42.2)	19	(14.1)	38	(28.2)	
Drink Crystals/mixes							
No	103	(75.7)	41	(30.2)	62	(45.6)	0.79
Yes	33	(24.3)	14	(10.3)	19	(14.0)	
Other Beverage							
No	129	(95.6)	48	(35.6)	81	(60.0)	**0.003**
Yes	6	(4.4)	6	(4.4)	0	(0.0)	
Did you add sugar or sweetener to any of these drinks?							
Breast milk							
No	137	(100.0)	56	(40.9)	81	(59.1)	-
Yes	0	(0.0)	0	(0.0)	0	(0.0)	
Cow's milk							
No	131	(96.3)	55	(40.4)	76	(55.9)	0.081
Yes	5	(3.7)	0	(0.0)	5	(3.7)	
Formula							
No	133	(97.8)	53	(39.0)	80	(58.8)	0.57
Yes	3	(2.2)	2	(1.5)	1	(0.7)	
Plain water							
No	114	(83.8)	46	(33.8)	68	(50.0)	0.96
Yes	22	(16.2)	9	(6.6)	13	(9.6)	
Tea							
No	130	(95.6)	54	(39.7)	76	(55.9)	0.40
Yes	6	(4.4)	1	(0.7)	5	(3.7)	
Soft Drinks							
No	135	(99.3)	54	(39.7)	81	(59.6)	0.40
Yes	1	(0.7)	1	(0.7)	0	(0.0)	
Fruit juice							
No	132	(97.1)	53	(39.0)	79	(58.1)	1.00
Yes	4	(2.9)	2	(1.5)	2	(1.5)	
Drink Crystals/mixes							
No	134	(98.5)	54	(39.7)	80	(58.8)	1.00
Yes	2	(1.5)	1	(0.7)	1	(0.7)	
Other Beverage							
No	134	(100.0)	54	(40.3)	80	(59.7)	-
Yes	0	(0.0)	0	(0.0)	0	(0.0)	
When did you give the bottle?							
Mealtime							
Never	29	(21.3)	11	(8.1)	18	(13.2)	0.84
Sometimes	37	(27.2)	14	(10.3)	23	(16.9)	
Usually	70	(51.5)	30	(22.1)	40	(29.4)	
Naptime							

Never	18	(13.3)	7	(5.2)	11	(8.2)	0.96
Sometimes	38	(28.2)	15	(11.1)	23	(17.0)	
Usually	79	(58.5)	33	(24.4)	46	(34.1)	
Bedtime							
Never	17	(12.6)	7	(5.2)	10	(7.4)	0.81
Sometimes	23	(17.0)	8	(5.9)	15	(11.1)	
Usually	95	(70.4)	40	(29.6)	55	(40.7)	
Child crying							
Never	25	(18.9)	9	(6.8)	16	(12.1)	0.80
Sometimes	53	(40.2)	23	(17.4)	30	(22.7)	
Usually	54	(40.9)	21	(15.9)	33	(25.0)	
On demand							
Never	24	(17.8)	10	(7.4)	14	(10.4)	0.97
Sometimes	49	(36.3)	19	(14.1)	30	(22.2)	
Usually	62	(45.9)	25	(18.5)	37	(27.4)	
Other occasions							
Never	119	(96.0)	51	(41.1)	68	(54.8)	0.19
Sometimes	3	(2.4)	0	(0.0)	3	(2.4)	
Usually	2	(1.6)	1	(0.8)	1	(0.8)	
Do you prop bottle during feeding?							
No	79	(59.0)	30	(22.4)	49	(36.6)	0.65
Yes	55	(41.0)	23	(17.2)	32	(23.9)	
Have you stopped bottle feeding?							
No	56	(42.1)	28	(21.1)	28	(21.1)	0.060
Yes	77	(57.9)	26	(19.6)	51	(38.4)	
At what age did you stop giving your child a bottle? (months)	20.8	±11.6					
Would you stop bottle by 1 year if you thought it prevented tooth decay?							
No	39	(29.3)	15	(11.3)	24	(18.1)	0.75
Yes	94	(70.7)	39	(29.3)	55	(41.4)	
Did child ever use a Sippy cup?							
No	24	(16.9)	11	(7.8)	13	(9.2)	0.53
Yes	118	(83.1)	46	(32.4)	72	(50.7)	
At what age did child start using	13.8	±6.1					

Sippy cup? (months)								
What did you put in the Sippy cup?								
Breast milk								
No	115	(97.5)		44	(37.3)		71 (60.2)	0.56
Yes	3	(2.5)		2	(1.7)		1 (0.9)	
Cow's milk								
No	47	(39.8)		17	(14.4)		30 (25.4)	0.61
Yes	71	(60.2)		29	(24.6)		42 (35.6)	
Formula								
No	101	(85.6)		40	(33.9)		61 (51.7)	0.42
Yes	17	(14.4)		5	(4.2)		12 (10.2)	
Plain water								
No	16	(13.5)		6	(5.0)		10 (8.4)	0.92
Yes	103	(86.6)		40	(33.6)		63 (52.9)	
Tea								
No	102	(85.7)		40	(33.6)		62 (52.1)	0.76
Yes	17	(14.3)		6	(5.0)		11 (9.2)	
Soft Drinks								
No	99	(83.2)		39	(32.8)		60 (50.4)	0.71
Yes	20	(16.8)		7	(5.9)		13 (10.9)	
Fruit juice								
No	30	(25.2)		18	(15.1)		12 (10.1)	**0.006**
Yes	89	(74.8)		28	(23.5)		61 (51.3)	
Drink Crystals/mixes								
No	74	(62.2)		33	(27.7)		41 (34.5)	0.088
Yes	45	(37.8)		13	(10.9)		32 (26.9)	
Other Beverage								
No		(92.6)		43	(36.4)		69 (58.5)	0.68
Yes		(5.0)		3	(2.5)		3 (2.5)	
At what age did child stop using Sippy cup?	27.7	±10.1						
Would changing to an open cup be problematic?								
No	98	(70.0)		36	(25.7)		62 (44.3)	0.23
Yes	42	(30.0)		20	(14.3)		22 (15.7)	
Do you give your child a soother/pacifier?								
No	87	(60.8)		27	(18.9)		60 (42.0)	**0.007**
Yes	56	(39.2)		30	(21.0)		26 (18.2)	
At what age did you stop giving your child a	12.7	±8.5						

soother? (months)						
Do you dip soother in something sweet? (Like honey)						
No	49	(84.5)	29	(50.0)	20 (34.5)	0.068
Yes	9	(15.5)	2	(3.5)	7 (12.1)	
When did you give the sweetened soother?						
Naptime						
Never	6	(66.7)	2	(22.2)	4 (44.4)	0.39
Sometimes	1	(11.1)	0	(0.0)	1 (11.1)	
Usually	2	(22.2)	0	(0.0)	2 (22.2)	
Bedtime						
Never	6	(66.7)	2	(22.2)	4 (44.4)	0.39
Sometimes	1	(11.1)	0	(0.0)	1 (11.1)	
Usually	2	(22.2)	0	(0.0)	2 (22.2)	
Child crying						
Never	2	(22.2)	0	(0.0)	2 (22.2)	0.54
Sometimes	3	(33.3)	1	(11.1)	2 (22.2)	
Usually	4	(44.4)	1	(11.1)	3 (33.3)	
On demand						
Never	4	(44.4)	1	(11.1)	3 (33.3)	0.76
Sometimes	1	(11.1)	0	(0.0)	1 (11.1)	
Usually	4	(44.4)	1	(11.1)	3 (33.3)	
How old was child when solid foods introduced?	8.3	±4.5				
Snack between meals?						
Never	5	(3.5)	3	(2.1)	2 (1.4)	0.20
1 time a day	14	(9.8)	7	(4.9)	7 (4.9)	
2 times a day	59	(41.3)	17	(11.9)	42 (29.4)	
3 times a day	43	(30.1)	21	(14.7)	22 (15.4)	
4 or more times a day	22	(15.4)	9	(6.3)	13 (9.1)	
Most frequent drink between meals						
White milk						
No	106	(72.6)	40	(27.4)	66 (45.2)	0.28
Yes	40	(27.4)	19	(13.0)	21 (14.4)	
Chocolate milk						

No	127	(87.0)	52	(35.6)	75	(51.4)	0.73
Yes	19	(13.0)	7	(4.8)	12	(8.2)	
Juice							
No	85	(58.6)	39	(26.9)	46	(31.7)	0.13
Yes	60	(41.4)	20	(13.8)	40	(27.6)	
Soft drink/Pop							
No	138	(95.2)	59	(40.7)	79	(54.5)	**0.042**
Yes	7	(4.8)	0	(0.0)	7	(4.8)	
Water							
No	85	(58.6)	36	(24.8)	49	(33.8)	0.63
Yes	60	(41.4)	23	(15.9)	37	(25.5)	
Drink Crystals/Mixes							
No	142	(97.3)	56	(38.4)	86	(58.9)	0.30
Yes	4	(2.7)	3	(2.1)	1	(0.7)	
Other							
No	141	(96.6)	54	(37.0)	87	(59.6)	**0.010**
Yes	5	(3.4)	5	(3.4)	0	(0.0)	
Learned most about feeding from Grandparents							
No	109	(74.7)	44	(30.1)	65	(44.5)	0.99
Yes	37	(25.3)	15	(10.3)	22	(15.1)	
Other family							
No	105	(71.9)	45	(30.8)	60	(41.1)	0.34
Yes	41	(28.1)	14	(9.6)	27	(18.5)	
On my own							
No	87	(59.6)	39	(26.7)	48	(32.9)	0.19
Yes	59	(40.4)	20	(13.7)	39	(26.7)	
Health Professionals							
No	107	(73.3)	38	(26.0)	69	(47.3)	**0.046**
Yes	39	(26.7)	21	(14.4)	18	(12.3)	
Other							
No	122	(83.6)	47	(32.2)	75	(51.4)	0.30
Yes	24	(16.4)	12	(8.2)	12	(8.2)	

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