MARCELA PINTO MONTEIRO DE OLIVEIRA

RELATIONSHIP AMONG NUTRITIONAL STATUS, CARIES, SUGAR EXPOSURE AND SOCIAL FACTORS IN 3-TO-5-YEAR-OLD PRESCHOOLERS

RELAÇÃO ENTRE ESTADO NUTRICIONAL, CÁRIE, EXPOSIÇÃO AO AÇÚCAR E FATORES SOCIAIS EM PRÉ-ESCOLARES DE 3 A 5 ANOS DE IDADE

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UNIVERSIDADE ESTADUAL DE CAMPINAS
FACULDADE DE ODONTOLOGIA DE PIRACICABA

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Thesis presented to the Piracicaba Dental School of the University of Campinas in partial fulfillment of the requirements for the degree of Doctor in Dentistry, in the Pediatric Dentistry area.

Tese apresentada à Faculdade de Odontologia de Piracicaba, da Universidade Estadual de Campinas, para obtenção do título de Doutora em Odontologia, Área de Concentração em Odontopediatria.

Orientadora: Profa. Dra. Marines Nobre dos Santos Uchoa

Este exemplar corresponde à versão final da tese defendida por Marcela Pinto Monteiro de Oliveira e orientada pela Profa. Dra Marines Nobre dos Santos Uchoa

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ABSTRACT

This cross-sectional study aimed to investigate the relationship among body mass index (BMI), dental caries, sugar exposure and social factors, as well as the presence of visible biofilm in 303 three-to-five-year-old preschoolers in the city of Teresina-PI, Brazil. Dental caries was recorded according to the World Health Organization criteria (WHO) + early caries lesions (ECL). Body weight/height was determined and BMI was calculated. Data regarding the sugar exposure was recorded using the mean exposure of 72-hour recall diet frequency chart. The presence of clinically visible dental biofilm on maxillary incisors was also recorded. Behavioral and social economic status of the study subjects were assessed using an interview applied to the mother. Data were analyzed by chi-square test followed by multiple logistic regression analysis ($\alpha = 0.05$, confidence interval = 95%). The results showed that 10.6% of the children were malnourished, 17.2% were underweight, 44.9% had health weight, 15.5% were at risk of overweight, and 11.9% were obese; 24.8% were caries free and 75.2% had early childhood caries (ECC). The mean dmfs score was 10.8 (± 11.2). Preschool children with ECC were 0.3 times more likely to be obese than caries free children ($p = 0.0049$). In the same way, those who consumed liquid sugar more than 2 times a day, were 2.7 times more likely to be obese ($p = 0.0339$). No association was found between overweight and caries ($p=0.3640$) and dental biofilm ($p= 0.3190$). Preschool children who slept with a bottle were 2.3 times more likely to have underweight than children who did not sleep with a bottle ($p = 0.0174$). Female preschool children were 0.3 times more likely to be malnourished than boys ($p = 0.00797$). Moreover, preschool children with presence of dental biofilm were 3.1 times more likely to be malnourished than children with absent biofilm ($p = 0.0247$). In conclusion, our results suggest that preschool children having early childhood caries and a high liquid sugar consumption were more likely to be obese and those who were bottle fed during the night showed a higher chance of having underweight.

Key-words: Dental caries, obesity, BMI, preschoolers.

RESUMO

Este estudo transversal objetivou investigar a relação entre o estado nutricional, cárie dentária, exposição diária ao açúcar e fatores sociais, assim como a presença de biofilme visível em 303 pré-escolares de 3 a 5 anos da cidade de Teresina-PI. A cárie dentária foi determinada por meio do critério da Organização Mundial de Saúde (OMS) incluindo lesões iniciais de mancha branca (LMB). O peso e altura corporais foram mensurados e o Índice de massa corporal (IMC) obtido foi plotado em diagrama segundo gênero e faixa etária para obter-se o ranking do percentil segundo o Centers for Disease Control and Prevention (CDC). Os dados de exposição diária ao açúcar (líquido, sólido e total) foram obtidos pelo diário de dieta, usando-se a média de exposição diária de 72 horas. A presença de biofilme clinicamente visível nos incisivos superiores foi também registrada. Os fatores comportamentais e socioeconômicos foram coletados por meio de uma entrevista com as mães ou responsáveis pelas crianças. Os dados foram analisados por meio do teste qui quadrado seguido de regressão logística múltipla ($\alpha = 0,05$, intervalo de confiança = 95%). Os resultados mostraram que 10,6% das crianças eram malnutridas, 17,2% tinham baixo peso, 44,9% apresentaram peso normal, 15,5% tinham sobrepeso e 11,9% eram obesos; 24,8% estavam livres de cárie e 75,2% apresentavam cárie precoce da infância (CPI). A média do ceo-s + LMB foi 10,8 ($\pm$ 11,2). Crianças com experiência de cárie apresentaram 0,3 mais chance de serem obesas do que aquelas livres de cárie ($p = 0,0049$). Da mesma forma, aquelas que consumiam líquidos açucarados mais de 2 vezes por dia apresentaram 2,7 mais chance de serem obesas ($p = 0,0339$). Nenhuma associação foi encontrada ente cárie e sobrepeso ($p = 0,3640$) e a presença de biofilme ($p= 0,3190$). Crianças que apresentaram o hábito de dormir com a mamadeira mostraram 2,3 vezes mais chance de terem baixo peso do que aquelas sem esse hábito ($p = 0,0174$). O gênero feminino apresentou a probabilidade 0,3 vezes maior de serem malnutridas do que o masculino ($p = 0,00797$). Além disso, pré-escolares com a presença de biofilme tiveram 3,1 vezes

mais chance de serem malnutridas do que aquelas sem biofilme visível (p = 0,0247). Este estudo mostrou que houve relação entre experiência de cárie, consumo de líquidos açucarados e obesidade. Também mostrou relação entre o uso da mamadeira noturna e baixo peso na infância. Fatores socioeconômicos não foram relacionados ao estado nutricional da criança.

Palavras-chave: Cárie dentária, obesidade, Índice de massa corporal (IMC), pré-escolares.

SUMÁRIO

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INTRODUÇÃO

A obesidade, caracterizada pelo acúmulo de tecido gorduroso, regionalizado ou em todo o corpo, é uma doença crônica, complexa e de etiologia multifatorial. A importância desta condição na infância ocorre em função da complexidade do tratamento e da elevada possibilidade de persistência deste quadro na vida adulta e da sua associação a outras doenças não transmissíveis, ainda em idades precoces (RNPI, 2014).

A importância de se controlar a obesidade infantil não se deve somente a necessidade de se evitar consequências na vida adulta, pois esta doença acarreta diversos problemas de saúde e sofrimento durante a infância. As consequências da obesidade infantil e na adolescência incluem diabetes do tipo 2, hipertensão arterial, puberdade precoce, irregularidades menstruais e síndrome do ovário policístico, esteato-hepatite, apnéia do sono, asma, hipertensão intracraniana benigna, lesões músculo-esqueléticas e problemas psicológicos (Lakshman et al., 2012; Nedeau et al., 2011; Albert et al., 2004).

Vários fatores têm contribuído para o aumento da obesidade na infância, dentre eles o consumo excessivo de refrigerante e sucos de fruta, grandes porções de comida servidas nos últimos 10 anos, menor consumo de frutas e vegetais, atividade física reduzida em decorrência da grande popularidade da televisão e dos jogos eletrônicos (Birch & Davison, 2001; Dietz, 2001; Davies et al., 1994).

A literatura tem mostrado um crescente aumento na prevalência de obesidade em crianças em todo o mundo. Com base na análise de 450 estudos nacionais representativos de 144 países, a Organização Mundial da Saúde (OMS) estima que a prevalência de crianças com idade inferior a 5 anos de idade com obesidade aumentou de 4,2% em 1990 para 6,7% em 2010, e deve chegar a 9,1% em 2020.

A prevalência de sobrepeso infantil dobrou na faixa etária dos 6 aos 11 anos de idade e triplicou na faixa dos 12 aos 17 anos de idade nos últimos 20

anos (Speiser et al., 2005). Nos EUA, o número de crianças com sobrepeso quase triplicou de 1980 a 2002 (Flores et al., 2002; Hedley et al., 2004; American Academy of Pediatrics Committee on School Health, 2004; Speiser et al., 2005).

Este fenômeno não está confinado apenas aos EUA, mas afeta crianças em todo o mundo (Ogden & Carroll, 2010; Rolland-Cachera & Peneau, 2010; Ogden et al., 2012). Estima-se que cerca de 3,8 milhões (cerca de 9,7%) de crianças menores de cinco anos na América Latina apresentem excesso de peso (sobrepeso e/ou obesidade). Dados de diferentes países e pesquisas demonstram aumento nesta prevalência (Rivera et al., 2014), corroborando informações do relatório da OPAS (2014), que demonstra aumento de 50% nas taxas de obesidade entre crianças na primeira infância, nos últimos 15 anos, em países como El Salvador, República Dominicana, Peru e países caribenhos. No Brasil, dados oficiais do SISVAN (2014), baseados no índice IMC/idade, demonstram um aumento de 0,94% no risco de sobrepeso nos últimos cincos anos, entre crianças na primeira infância. Todas as regiões do país superam prevalências consideradas aceitáveis (2,3%), sendo a região Nordeste a que apresentou maiores prevalências de sobrepeso e obesidade (8,4% e 8,5%, respectivamente) no ano de 2013.

No Brasil, resultados da Pesquisa de Orçamentos Familiares (POF-IBGE, 2008-2009) concluíram que o excesso de peso e a obesidade são encontrados com grande frequência, a partir de 5 anos de idade, em todas as regiões brasileiras. O excesso de peso atinge 33,5% das crianças de cinco a nove anos de idade e 21,5% dos adolescentes. A pesquisa mostrou também que a renda familiar está diretamente vinculada ao excesso de peso: ocorre três vezes mais entre os meninos de maior renda do que naqueles de menor renda (34,5% contra 11,5%) e para o gênero feminino, a diferença foi de 24% para 14,2%.

Considerando as consequências que o excesso de peso pode trazer tanto para a infância quanto quanto para a vida adulta, e o crescente aumento da sua prevalência a nível mundial, a obesidade tem sido considerada um importante problema de saúde pública. A dieta tem um papel relevante no desenvolvimento

da obesidade, e os hábitos alimentares das crianças têm passado por grandes mudanças nos últimos 30 anos (de Onis et al., 2010). Neste contexto, um estudo recente mostrou que o risco de sobrepeso e obesidade está relacionado com os tipos de alimentos consumidos assim como os padrões alimentares (Santos et al., 2011).

A cárie dentária também é considerada uma doença de alta prevalência em âmbito mundial, e causadora de múltiplas consequências que afetam o bem-estar psicossocial da população e podem interferir no desempenho de atividades diárias (Agostini et al., 2001; Bastos et al., 2008; Moura-Leite et al., 2011). A cárie dentária foi considerada a doença não tratada mais prevalente, dentre as 291 doenças analisadas em estudo sobre a Carga Global de Condições Bucais entre os anos de 1990 e 2010. Esta doença afeta 35% da população mundial e foi classificada como a 10ª condição mais prevalente quando considerou-se somente dentes decíduos, afetando 9% da população mundial (Marcenes, 2013). Considerada uma doença multifatorial causada pela ingestão de alimentos ricos em carboidratos fermentáveis, microbiota cariogênica e fatores comportamentais e sociais, a cárie dentária possui um fator de risco em comum com a obesidade: a dieta. Portanto, a relação entre ambas seria biologicamente possível. Este fato tem causado um crescente interesse em se pesquisar a relação entre obesidade e cárie na infância. Entretanto, os mecanismos pelos quais a obesidade estaria associada à cárie dentária são complexos e difíceis de serem estabelecidos. A esse respeito, Macek & Mitola (2006) sugeriram a hipótese de que a conhecida associação entre obesidade e cárie seja causada pela relação entre o consumo de carboidratos refinados e o desenvolvimento da obesidade, e a ligação entre o consumo de carboidratos refinados e o desenvolvimento de cárie. No entanto, ambas são doenças complexas com múltiplos fatores contribuidores como os biológicos, genéticos, socioeconômicos, culturais, dietéticos, ambientais e de estilo de vida (Wang, 2001).

Alguns estudos identificaram uma associação positiva entre cárie e obesidade na infância (Reifsnider, Mobley & Mendez, 2004; Willerhausen et al.,

2004) e sugeriram que crianças obesas apresentam um risco aumentado de desenvolver cárie. Por outro lado, uma associação negativa entre essas duas doenças tem sido relatada (Ayhan, Susan & Yildirim, 1996; Acs et al., 1999) e estudos adicionais não observaram qualquer associação entre obesidade e cárie (Tuomi, 1989; Chen et al. 1998). Neste contexto, Kantovitz et al. (2006), revisaram sistematicamente esta relação em três artigos com metodologia precisa e observaram que apenas um encontrou relação entre obesidade e cárie. Dessa forma os autores concluíram que não havia evidência científica de associação entre obesidade e cárie. Posteriormente, uma revisão sistemática e meta-análise encontrou evidência científica de que no geral, existe associação entre obesidade e cárie dentária. No entanto, quando esta associação foi investigada nas dentições decídua e permanente separadamente, os autores não encontraram evidência de associação significativa entre essas duas doenças (Hayden et al., 2013).

Hooley et al. (2012), em revisão sistemática de 47 trabalhos relacionando cárie e Índice de massa corporal (IMC) de crianças e adolescentes, sugeriram que a cárie e o IMC estão relacionados de modo não linear, com mais casos de cárie acontecendo em indivíduos tanto com altos ou baixos IMC. Ainda apontam os fatores metodológicos, incluindo amostras demográficas, sensibilidade do exame dentário, e a natureza da análise dos dados como fortes influenciadores sobre a capacidade do estudo em detectar ou não a associação ente cárie e IMC.

Baseados nos dados expostos acima, a realização desta pesquisa justifica-se pelo fato de que os dados da literatura sobre a relação entre obesidade e cárie dentária ainda são escassos e conflitantes, havendo assim a necessidade de estudos com delineamento preciso e amostra representativa da população para obtenção de resultados confiáveis. Sendo assim, o objetivo do presente estudo foi verificar se existe associação entre o estado nutricional, cárie dentária, exposição ao açúcar e fatores sociais em pré-escolares.

Esta tese está baseada na Resolução CCPG UNICAMP nº 228/2013 que regulamenta o formato alternativo para teses de Mestrado e Doutorado e permite a inserção de artigos científicos de autoria ou co-autoria do candidato. Sendo assim, esta tese é composta de um capítulo, submetido à publicação no periódico "International Journal of Paediatric Dentistry" (Anexo 2), conforme descrito abaixo:

CAPÍTULO 1

"Relationship among nutritional status, caries, sugar exposure and social factors in 3-to-5-year-old preschoolers"

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ABSTRACT

This cross-sectional study aimed to investigate the relationship among body mass index (BMI), dental caries, sugar exposure and social factors, as well as the presence of visible biofilm in 303 three-to-five-year-old preschoolers in the city of Teresina-PI, Northeastern Brazil. Dental caries was recorded according to the World Health Organization criteria (WHO) + early caries lesions (ECL). Body weight/height was determined and BMI was calculated. Data regarding the sugar exposure was recorded using the mean exposure of 72-hour recall diet frequency chart. The presence of clinically visible dental biofilm on maxillary incisors was also recorded. Behavioral and social economic status of the study subjects were assessed using an interview applied to the mother. Data were analyzed by chi-square test followed by multiple logistic regression analysis ($\alpha = 0.05$, confidence interval = 95%). The results showed that 10.6% of the children were malnourished, 17.2% were underweight, 44.9% had health weight, 15.5% were overweight, and 11.9% were obese; 24.8% were caries free and 75.2% had early childhood caries (ECC). The mean dmfs score was 10.8 (± 11.2). Preschool children with ECC were 0.3 times more likely to be obese than caries free children ($p = 0.0049$). In the same way, those who consumed liquid sugar more than 2 times a day, were 2.7 times more likely to be obese ($p = 0.0339$). No association was found between overweight and caries ($p=0.3640$) and dental biofilm ($p= 0.3190$). Preschool children who slept with a bottle were 2.3 times more likely to have underweight than children who did not sleep with a bottle ($p = 0.0174$). Female preschool children were 0.3 times more likely to be malnourished than boys ($p = 0.00797$). Moreover, preschool children with presence of dental biofilm were 3.1 times more likely to be malnourished than children with absent biofilm ($p = 0.0247$). In conclusion, our results suggest that preschool children having early childhood caries and a high liquid sugar consumption were more likely to be obese and those who were bottle fed during the night showed a higher chance of having underweight.

INTRODUCTION

Obesity is the accumulation of fat tissue, regionalized or not and is considered a complex, chronic and multifactorial disease. This condition in childhood is of high importance if we consider the complexity of the treatment and the high possibility of persistence of this status in adult life and its association with other diseases, even at early ages (RNPI, 2014).

The need to prevent and control childhood obesity lies not only in the avoidance of poor adult health. Childhood obesity leads to many acute health problems and much suffering during childhood. These body mass index (BMI)-related childhood and adolescent outcomes include type 2 diabetes, hypertension, early puberty, menstrual irregularities and polycystic ovary syndrome, steatohepatitis, sleep apnea, asthma, benign intracranial hypertension, musculoskeletal disorders and psychological problems (Lakshman et al., 2012; Nedeau et al., 2011; Albert et al., 2004).

Increases in obesity prevalence have been observed even in very young preschool children and are predicted to continue. The prevalence of childhood overweight has doubled in the age group of 6 to 11 years of age and tripled in the range of 12 to 17 years of age in the last 20 years (Speiser et al., 2005). In the United States of America, the prevalence of obesity has enhanced almost 50% between 1997 and 2012 in adults and by 300% over the past two decades in children (Ogden et al., 2012; Ogden et al., 2012).

This phenomenon is not only confined to the USA but affects children worldwide (Messiah et al., 2013; Pinto et al., 2007). In Brazil, data from the Household Budget Survey (POF-IBGE, 2008-2009) concluded that overweight and obesity are found very frequently, from 5 years old, in all regions of Brazil. Overweight affects 33.5% of children aged five to nine years old and 21.5% of adolescents. All regions of Brazil have outweighed the prevalence considered acceptable (2.3%), and the Northeast region is the one with the highest prevalence of overweight and obesity (8.4% and 8.5%, respectively) in 2013.

Considering the consequences that overweight can bring to both adult and children, and the increasing worldwide prevalence, obesity has been considered a major public health problem. Diet plays an important role in the development of obesity and eating habits of children have gone through major changes over the last 30 years (de Onis et al., 2010). In this context, a recent study showed that the risk of overweight and obesity is associated with the types of foods consumed as dietary patterns (Santos et al., 2011).

Dental caries is also considered a highly prevalent disease worldwide, causing multiple consequences that affect the psychosocial wellbeing of population and can affect the performance of activities of daily living (Agostini et al., 2001; Bastos et al., 2008; Moura-Leite et al., 2011). It was considered the more prevalent untreated disease among the 291 diseases analyzed in a Global Burden of Oral Conditions from 1990 to 2010, affecting 35% of the worldwide population and ranked as the 10th most prevalent condition when only deciduous teeth were considered (Marcenes et al., 2013). Dental caries is a multifactorial disease caused by eating foods rich in carbohydrates, cariogenic microbiota and behavioral and social factors that has a common risk factor with obesity: diet. Therefore, the relationship between both diseases can be possible.

Obesity and dental caries are both multifactorial diseases that affect children's health and psychosocial development (Wake et al., 2007). These two diseases share common influences such as diet and lifestyle. There has been a growing interest in the relationship between dental caries and childhood obesity. Some studies have identified a positive association between these two common childhood conditions and have suggested that obese children are at an increased risk for dental caries (Reifsnider et al., 2004; Willerhausen et al., 2004; dos Santos Junior et al., 2014). Other studies however, have reported a negative association based on the failure to thrive among children with early childhood caries and the corresponding lower body mass index (BMI) (Ayhan et al., 1996; Acs et al., 1999). Additional studies have also reported no association between dental caries and childhood obesity (Tuomi, 1989; Chen et al., 1998). These conflicting findings are

probably related to the effect of confounders such as age, socioeconomic status of the sample country of origin (industrialized or nonindustrialized) and type of dentition (deciduous or permanent) as well as parameters used to analyze nutritional status and to perform caries diagnosis.

A recent systematic review and meta-analysis found that overall there was a significant relationship between childhood obesity and dental caries. However, when permanent and primary dentitions were individually analyzed, a nonsignificant association between obesity and dental caries was observed (Hayden, 2013). The association between dental caries and obesity is complicated because both are complex conditions with multiple contributing factors, including biological, genetic, socioeconomic, cultural, dietary, environmental, and lifestyle issues. Family lifestyles have a big impact on the nutritional and behavioral choices of children, together with social and economic factors, such as place of residence, parental educational level and economic affluence (Langnase, 2002).

It is well known that there is an inverse relationship between socio-economic conditions and health status in developed countries (Kenae, 2012). Specifically, studies have also shown an inverse relationship between children's Body Mass Index (BMI) and family educational level (Langnase, 2002; Gnavi, 2000). Nevertheless, identifying the mechanisms by which dental caries is associated with overweight or obesity is difficult, once both are complex diseases involving multiple support factors such as biologic, genetic, socioeconomic, dietary and cultural, environmental and of living (Wang, 2001).

In this context and considering that the literature about the relationship between obesity and dental caries is scarce and conflicting there is a need for further studies with accurate experimental design and representative sample of the population to obtain reliable results. Thus, the aim of this cross-sectional study was to investigate the relationship among body mass index (BMI), dental caries, sugar exposure and social factors in 3-to-5-year-old preschoolers in the city of Teresina-PI, Brazil.

MATERIALS AND METHODS

Ethical considerations

This study was approved by the Ethical Committee in Research of FACID (Integral Diferential College/DeVry (Protocol number 34784914.0.0000.5211/2014 – Attachment 1) and the preschoolers also granted permission for the study. The children's parents signed a written informed consent (Appendix 1). All children included in this study and diagnosed with one of two analyzed diseases (caries or pathological nutritional status) were forwarded for convenient treatment.

Sample

Prior to data collection, the sample size calculation was performed considering the caries prevalence of the 5 year old children of the city of Teresina, PI (Moura et al., 2010). Thus, a confidence interval of 95% and margin of error of 7% were adopted, resulting in a sample size of 377 preschool children (Rosenblatt & Zarzar, 2002).

Six public nurseries/preschools were selected in the urban area of Teresina-PI/Brazil, and all 3-to-5-year-old children enrolled in these centers were invited to participate in the study. This age range was chosen because all primary teeth are believed to be erupted during this stage of life, and permanent teeth should not be present in the mouth. Teresina town is the capital of Piaui state, has a population of about 814,230 inhabitants and has a human development index of 0.64 (IBGE, Censo Demográfico 2010). All households have access to a public water supply with fluoride level between 0.6 and 0.8 ppm.

Preschoolers were included in the study if they were 3-to-5-year-old and had no syndrome or chronic systemic disease. Children whose parents refused to sign the informed consent document and who did not cooperate with the clinical examinations were excluded from the study without prejudice. Moreover, preschoolers whose parents or guardians did not attend the scheduled school

meeting at start/end time to understand the study's importance or refused to complete the chart that was used to evaluate sugar exposure were also dismissed. Due to these reasons, from the 630 children invited to participate, 303 (143 females and 160 males) were included in the final sample size (Fig. 1).

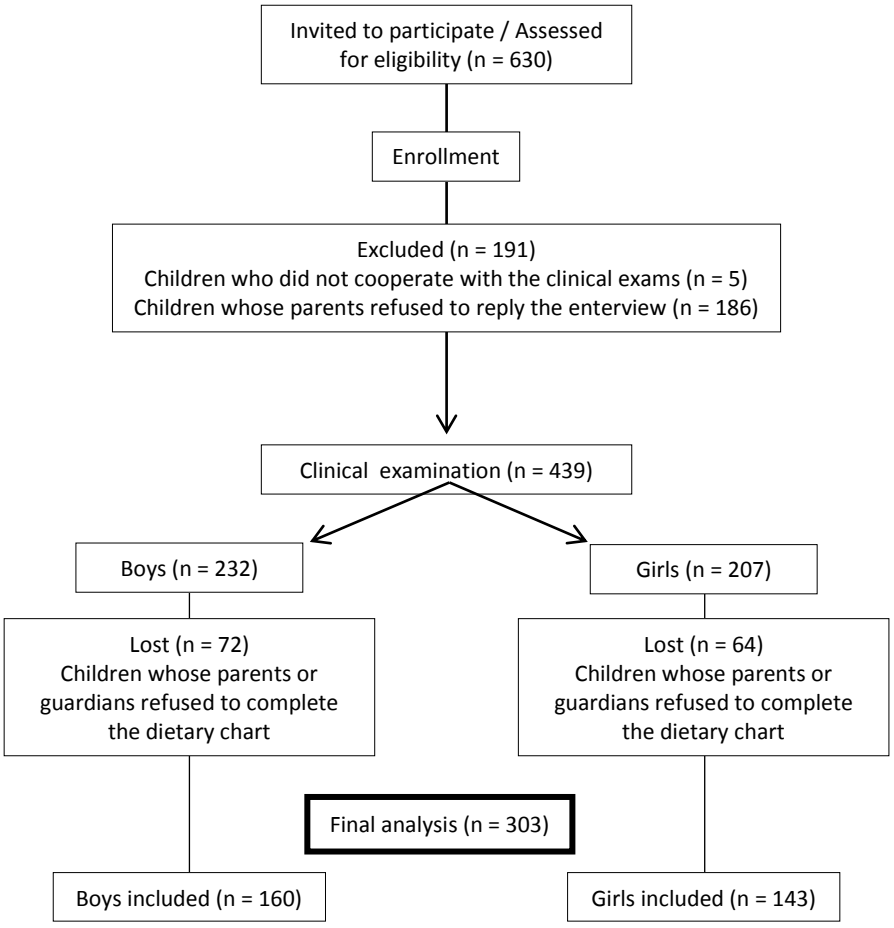

Fig. 1 – Subjects disposition

Caries assessment

In this study, the criteria used for the diagnosis of early childhood caries (ECC) were WHO + early caries lesion (ECL) - Table 1 (Parisotto et al., 2010).

According to WHO + ECL criteria, ECL was defined as caries, and surfaces were classified as sound ⁄ caries-free when the dmfs-index value was equal to 0 and normal enamel translucency was observed after the teeth were dried with gauze. A white spot lesion without surface breakdown was considered an early caries lesion. The units of evaluation used in the clinical exams were dmfs (decayed, missing, and filled surfaces).

Table 1 – Summary of caries diagnosis criteria codes, according to World Health Organization + early caries lesion (Parisotto et al., 2010)

Codes	
A	Sound, excluding early caries lesions
ECL	Early caries lesions (white chalky spot lesions)
B	Cavitated, with no ECL
BECL	Cavitated + ECL
C	Filled + chronic cavity
CECL	Filled + cavity + ECL
D	Filled, no cavity
DECL	Filled + ECL
4	Missing, as a result of caries
5	Missing due to any other reason

The clinical examinations were conducted at the nurseries and preschools under field conditions (without access to a dental unit and radiography) with a focusable flashlight, and a mirror and a ball-ended probe were used to confirm questionable findings. Ball-ended probes were primarily used to remove debris and to enhance visualization, and gauze was employed to dry or clean the teeth, favoring the identification of ECL. A portable flashlight was also used to improve the identification of non-cavitated lesions. The dental examiner sat behind the child, who laid on a table and was assisted by a scribe. All examinations were

carried out by a single dentist (M.P.M.O.), and strict cross-infection control measures were applied.

Intra-examiner reliability was measured using a Kappa calculation, with regard to all dmfs components including the early caries lesions. Caries diagnosis was performed in 49 children. After a 10 days interval, children were reexamined. The Kappa coefficient achieved at the tooth level was 0.724 (Hunt, 1986).

The presence or absence of clinically visible biofilm on the maxillary incisors was recorded (Ainamo & Bay, 1975).

Anthropometric assessment

Weight and height were measured during a physical examination. Children were measured wearing school uniforms and not wearing shoes. Weight was measured with a digital scale (Mondial, Manaus, Brazil) and a 200 cm tape (Corrente, São Paulo, Brazil) as used according to National Center for Health Statistics guidelines. BMI was calculated using the standard formula: weight (kg) divided by height in meter squared (m^2). Children were classified into four categories using age- and gender-specific criteria recommended by the Centers for Disease Control and Prevention (CDC, 2006). The child was considered to be malnourished when the value of BMI was below 11.6 (Kouhkan et al., 2004; Parsons et al., 2011), underweight when the value was below the 5^{th} percentile, helath weight when between the 5^{th} (inclusive) and below the 85^{th}, overweight when between the 85^{th} (inclusive) and 95^{th} and obese when above the 95^{th} (Fig. 2).

Dietary sugar exposure evaluation

The parents and/or guardians of the preschools participating in the study were asked to complete a diet chart for three consecutive days during the workweek (Appendix 2). The diet chart was filled during the workweek because in the weekend the diet can be modified. This chart included the time of day that the children ate and drank anything as well as the content of all meals and snacks.

Using this chart, the mean of daily frequency of liquid, solid and total sugar exposure was calculated.

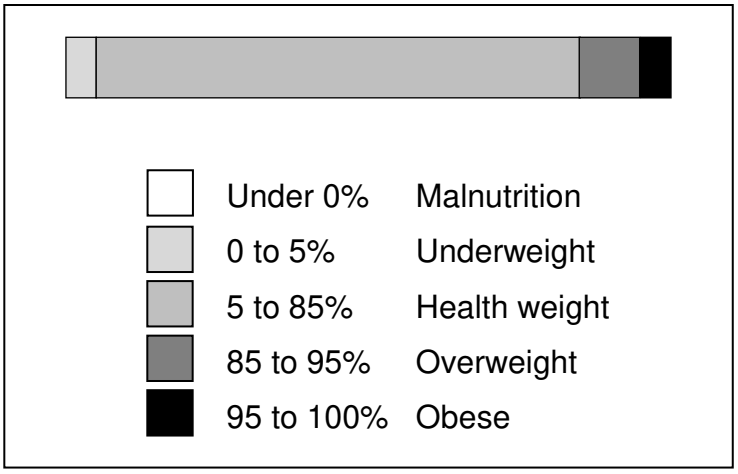

Fig. 2 – Preschooler weight classification

Assessment of habits and socioeconomic factors

The children's parents/guardians were asked to answer a standardized interview, with 16 closed questions and 2 open questions, to assess social and behavioral variables. The interview encompassed information regarding family income, mother's level education, period of breast- and bottle-feeding, bottle consumption with sweetened liquids, and habits of sleeping with breast/bottle (Appendix 3).

Statistical analysis

Data were analyzed using the Software R version 3.1.1 (AT&T Research, USA). Descriptive statistics and frequency distributions were determined (Table 2).

A bivariate analysis (chi-square test) was initially performed in order to verify possible associations between the dependent and independent variables. Independent variables were entered into the regression analysis if they exhibited p values lower than 0.2 in the bivariate analysis. The associations between the dependent and independent variables were expressed as odds ratios (OR) with their respective confidence intervals of 2.5% or 97.5%. The multivariate modelling fitting was assessed by the Hosmer & Lemeshow test. The level of significance was set as $\alpha \leq 0.05$. Then, four multivariate modelling analyses were tested. In the first modelling, the categories of the dependent variables were preschool children with obesity (OB) and children without obesity (Table 3). In the second one, the categories of the dependent variables were children with overweight (OW) and children without overweight (Table 4). In the third and the fourth multivariate modellings the categories of dependent variables were children with underweight (UW) (Table 5) and malnutrition (MN) (Table 6), respectively. The independent variables were: gender, caries, dental biofilm, solid, liquid and total sugar exposure, social factors (mother's level of education and family income) and children´s habits (breastfeeding period, bottle-feeding period, and the use of bottle to sleep or in the middle of the night). All independent variables were dichotomized based on their median values.

RESULTS

Characteristics of the 3- to 5-year old children are summarized in Table 2. About 10.6% were malnourished, 17.2% were underweight, 44.9% had health weight, 15.5% were at risk of overweight, and 11.9% were obese; 24.8% were caries free and 75.2% had early childhood caries (ECC). The mean dmfs score was 10.8 ($\pm$ 11.2). All 303 children included in this study were enrolled in six public nurseries/preschools in the urban area of Teresina-PI. The selected sample showed a mean age of 4.41 ($\pm$0.89) years old and 143 (47.2%) were female and

160 (52.8%) were male. The distribution of corporal variables, considering weight and height, and according to CDC Classification, is displayed in Table 2.

Tables 3, 4, 5 and 6 show the bivariate analysis between obesity (OB), overweight (OW), underweight (UW) and malnourish (MN), respectively and the related factors studied.

After bivariate analysis, the factors that showed statistically significant association with obesity (OB) were caries, liquid, solid and total sugar exposure ($p < 0.2$). These variables were selected for the model shown in table 7, in order to obtain the best model possibility. According to Obesity Model (Table 7), preschool children with ECC were 0.3 times more likely to be obese than caries free children ($p = 0.0049$). Moreover, preschool children who consumed liquid sugar more than two times a day, were 2.7 times more likely to be obese than children consuming liquid sugar less than 2 times ($p = 0.0339$).

The bivariate modeling between overweight (OW) and related factors (Table 4) showed significant association with caries and dental biofilm ($p < 0.2$). According to Overweight Model (Table 8), no association was found between overweight and caries ($p=0.3640$) and dental biofilm ($p= 0.3190$).

The bivariate modeling between underweight (UW) and related factors (Table 5) showed significant association with gender, dental biofilm, liquid sugar exposure, sleep with a bottle and the use of bottle in the middle of the night ($p < 0.2$). As stated in Underweight Model (Table 9), preschool children who slept with a bottle were 2.3 times more likely to have underweight than children who did not sleep with a bottle.($p = 0.0174$). The last bivariate modelling tested the association between malnourish (MN) and related factors and showed significant association only with gender and dental biofilm variables ($p < 0.2$) (Table 6). The Malnourish Modell (Table 10) showed that female preschool children were 0.3 times more likely to be malnourished than boys ($p = 0.00797$). Moreover, preschool children with presence of dental biofilm were 3.1 times more likely to be malnourished than children with absent biofilm ($p = 0.0247$).

Table 2 – Sample characteristics

Variables		Number (%)	Mean (SD)
Age			4.41 (± 0.89)
dmfs			10.83 (± 11.25)
Weight			17.02 (± 4.35)
Height			105.12 (± 7.58)
Gender	Female	143 (47.19)	
	Male	160 (52.81)	
Caries	ECC	228 (75.20)	
	Caries free	75 (24.80)	
Biofilm	Without biofilm	99 (32.70)	
	With bofilm	204 (67.30)	
BMI Classification	Malnutrition	32 (10.56)	
	Underweight	52 (17.16)	
	Health weight	136 (44.88)	
	Overweight	47 (15.51)	
	Obese	36 (11.88)	
Daily sugar exposure	Liquid		1.33 (± 0.70)
	Solid		1.38 (± 0.85)
	Total		2.71 (± 1.22)
Mother´s education level	≤ incomplete 1st grade	81 (26.74)	
	≥ complete 1st grade	222 (73.26)	
Family income	≤ R$1,400.00	280 (92.41)	
	> R$ 1,400.00	23 (7.59)	
Responsible for oral hygiene	Mother/guardian	83 (27.40)	
	Child	220 (72.60)	
Breastfeeding period	≤ 06 months	78 (25.74)	
	> 06 months	225 (74.26)	
Bottlefeeding	≤ 06 months	135 (44.56)	
	> 06 months	168 (55.44)	
Sleep with bottle	No	208 (68.65)	
	Yes	95 (31.35)	
Bottle in the middle of the night	No	264 (87.13)	
	Yes	39 (12.87)	
General health	Good	266 (87.80)	
	Bad	37 (12.20)	

Table 3 - Bivariate analysis of the relationship between obesity (OB) and related factors.

Variables	No OB		OB		TOTAL	
	n	%	n	%	n	%
Gender			**p-value: 0.3758**			
Female	129	43%	14	5%	143	47%
Male	138	46%	22	7%	160	53%
Caries			***p-value: 0.1717**			
Caries free	112	37%	20	7%	132	44%
With early childhood caries	155	51%	16	5%	171	56%
Dental biofilm			**p-value: 0.7800**			
Absent	86	28%	13	4%	99	33%
Present	181	60%	23	8%	204	67%
Liquid sugar exposure/day			***p-value: 0.0107**			
< 2	174	57%	15	5%	189	62%
≥ 2	93	31%	21	7%	114	38%
Solid sugar exposure/day			***p-value: 0.1228**			
< 2	159	52%	16	5%	175	58%
≥ 2	108	36%	20	7%	128	42%
Total sugar exposure/day			***p-value: 0.0275**			
< 4	193	64%	19	6%	212	70%
≥ 4	74	24%	17	6%	91	30%
Mother's education level			**p-value: 0.2101**			
≤ incomplete 1st grade	75	25%	6	2%	81	27%
≥ complete 1st grade	192	63%	30	10%	222	73%
Family income			**p-value: 0.8760**			
≤ R$1,400.00	246	81%	34	11%	280	92%
> R$ 1,400.00	21	7%	2	1%	23	8%
Breastfeeding period			**p-value: 0.6166**			
≤ 11 months	67	22%	11	4%	78	26%
≥ 12 months	200	66%	25	8%	225	74%
Bottlefeeding			**p-value: 0.8471**			
≤ 11 months	120	40%	15	5%	135	45%
≥ 12 months	147	49%	21	7%	168	55%
Sleep with bottle			**p-value: 0.3970**			
No	186	61%	22	7%	208	69%
Yes	81	27%	14	5%	95	31%
Bottle in the middle of the night			**p-value: 0.9435**			
No	232	77%	32	11%	264	87%
Yes	35	12%	4	1%	39	13%
General health			**p-value: 0.3007**			
Good	231	76%	34	11%	265	87%
Bad	35	12%	3	1%	38	13%

* p-value ≤ 0.2

Table 4 - Bivariate analysis of the relationship between overweight (OW) and related factors.

Variables	No OW		OW		TOTAL	
	n	%	n	%	n	%
Gender			**p-value: 0.3939**			
Female	124	41%	19	6%	143	47%
Male	132	44%	28	9%	160	53%
Caries			***p-value: 0.2032**			
Caries free	116	38%	16	5%	132	44%
With early childhood caries	140	46%	31	10%	171	56%
Dental biofilm			***p-value: 0.1919**			
Absent	88	29%	11	4%	99	33%
Present	168	55%	36	12%	204	67%
Liquid sugar exposure			**p-value: 0.5517**			
< 2	162	53%	27	9%	189	62%
≥ 2	94	31%	20	7%	114	38%
Solid sugar exposure			**p-value: 0.8357**			
< 2	149	49%	26	9%	175	58%
≥ 2	107	35%	21	7%	128	42%
Total sugar exposure			**p-value: 0.6317**			
< 4	181	60%	31	10%	212	70%
≥ 4	75	25%	16	5%	91	30%
Mother's education level			**p-value: 0.7027**			
≤ incomplete 1st grade	70	23%	11	4%	81	27%
≥ complete 1st grade	186	61%	36	12%	222	73%
Family income			**p-value: 1**			
≤ R$1,400.00	237	78%	43	14%	280	92%
> R$ 1,400.00	19	6%	4	1%	23	8%
Breastfeeding period			**p-value: 0.8842**			
≤ 11 months	65	21%	13	4%	78	26%
≥ 12 months	191	63%	34	11%	225	74%
Bottlefeeding			**p-value: 0.4358**			
≤ 11 months	117	39%	18	6%	135	45%
≥ 12 months	139	46%	29	10%	168	55%
Sleep with bottle			**p-value: 0.5462**			
No	178	59%	30	10%	208	69%
Yes	78	26%	17	6%	95	31%
Bottle in the middle of the night			**p-value: 0.4918**			
No	225	74%	39	13%	264	87%
Yes	31	10%	8	3%	39	13%
General health			**p-value: 0.2968**			
Good	222	73%	43	14%	265	87%
Bad	34	11%	4	1%	38	13%

* p-value ≤ 0.2

Table 5 - Bivariate analysis of the relationship between underweight (UW) and related factors.

Variables	No UW		UW		TOTAL	
	n	%	n	%	n	%
Gender			***p-value: 0.1238**			
Female	124	41%	19	6%	143	47%
Male	127	42%	33	11%	160	53%
Caries			**p-value: 0.9623**			
Caries free	110	36%	22	7%	132	44%
With early childhood caries	141	47%	30	10%	171	56%
Dental biofilm			***p-value: 0.07346**			
Absent	76	25%	23	8%	99	33%
Present	175	58%	29	10%	204	67%
Liquid sugar exposure			***p-value: 0.0564**			
< 2	150	50%	39	13%	189	62%
≥ 2	101	33%	13	4%	114	38%
Solid sugar exposure			**p-value: 0.6363**			
< 2	147	49%	28	9%	175	58%
≥ 2	104	34%	24	8%	128	42%
Total sugar exposure			**p-value: 0.3001**			
< 4	172	57%	40	13%	212	70%
≥ 4	79	26%	12	4%	91	30%
Mother's education level			**p-value: 1**			
≤ incomplete 1st grade	67	22%	14	5%	81	27%
≥ complete 1st grade	184	61%	38	13%	222	73%
Family income			**p-value: 0.7969**			
≤ R$1,400.00	231	76%	49	16%	280	92%
> R$ 1,400.00	20	7%	3	1%	23	8%
Breastfeeding period			**p-value: 0.6978**			
≤ 11 months	63	21%	15	5%	78	26%
≥ 12 months	188	62%	37	12%	225	74%
Bottlefeeding			**p-value: 0.6090**			
≤ 11 months	114	38%	21	7%	135	45%
≥ 12 months	137	45%	31	10%	168	55%
Sleep with bottle			***p-value: 0.0008**			
No	183	60%	25	8%	208	69%
Yes	68	22%	27	9%	95	31%
Bottle in the middle of the night			***p-value: 0.02873**			
No	224	74%	40	13%	264	87%
Yes	27	9%	12	4%	39	13%
General health			**p-value: 1**			
Good	219	72%	46	15%	265	87%
Bad	31	10%	6	2%	37	12%

* p-value ≤ 0.2

Table 6 - Bivariate analysis of the relationship between malnutrition (MN) and related factors.

Variables	No MN		MN		TOTAL	
	n	%	n	%	n	%
Gender			***p-value: 0.0165**			
Female	121	40%	22	7%	143	47%
Male	150	50%	10	3%	160	53%
Caries			**p-value: 1**			
Caries free	118	39%	14	5%	132	44%
With early childhood caries	153	50%	18	6%	171	56%
Dental biofilm			***p-value: 0.0482**			
Absent	94	31%	5	2%	99	33%
Present	177	58%	27	9%	204	67%
Liquid sugar exposure			**p-value: 0.8350**			
< 2	168	55%	21	7%	189	62%
≥ 2	103	34%	11	4%	114	38%
Solid sugar exposure			**p-value: 0.7102**			
< 2	158	52%	17	6%	175	58%
≥ 2	113	37%	15	5%	128	42%
Total sugar exposure			**p-value: 0.7168**			
< 4	191	63%	21	7%	212	70%
≥ 4	80	26%	11	4%	91	30%
Mother's education level			**p-value: 0.6896**			
≤ incomplete 1st grade	71	23%	10	3%	81	27%
≥ complete 1st grade	200	66%	22	7%	222	73%
Family income			**p-value: 1**			
≤ R$1,400.00	250	83%	30	10%	280	92%
> R$ 1,400.00	21	7%	2	1%	23	8%
Breastfeeding period			**p-value: 0.5894**			
≤ 11 months	68	22%	10	3%	78	26%
≥ 12 months	203	67%	22	7%	225	74%
Bottlefeeding			**p-value: 1**			
≤ 11 months	121	40%	14	5%	135	45%
≥ 12 months	150	50%	18	6%	168	55%
Sleep with bottle			**p-value: 1**			
No	186	61%	22	7%	208	69%
Yes	85	28%	10	3%	95	31%
Bottle in the middle of the night			**p-value: 0.7297**			
No	235	78%	29	10%	264	87%
Yes	36	12%	3	1%	39	13%
General health			**p-value: 0.3677**			
Good	239	79%	26	9%	265	87%
Bad	31	10%	6	2%	37	12%

* p-value ≤ 0.2

Table 7 - Multivariate modelling for obesity (OB).

Variables	OBESITY						
	No OB		OB		Model p-value [a] **	OR	95% CI
	n	%	n	%			
Caries							
Caries free	112	37%	20	7%	0.0049*	0.307	(0.13 - 0.68)
With early childhood caries	155	51%	16	5%			
Liquid sugar exposure							
< 2	174	57%	15	5%	0.0339*	2.696	(1.08 – 6.87)
> 2	93	31%	21	7%			
Solid sugar exposure							
< 2	159	52%	16	5%	0.5573	1.394	(0.43 – 4.11)
> 2	108	36%	20	7%			
Total sugar exposure							
< 4	193	64%	19	6%	0.427	1.712	(0.46 – 6.66)
> 4	74	24%	17	6%			

OR: odds ratio; CI: confidence interval.
[a] x^2 = 2.2872; freedom-degrees = 3; Hosmer & Lemeshow test = 0.515
** Number of Fisher Scoring iterations: 5

Table 8 - Multivariate modelling for overweight (OW).

Variables	OVERWEIGHT						
	No OW		OW		Model p-value [a] **	OR	95% CI
	n	%	n	%			
Caries							
Caries free	116	38%	16	5%	0.3640	1.387	(0.69 - 2.86)
With early childhood caries	140	46%	31	10%			
Dental biofilm							
Absent	88	29%	11	4%	0.3190	1.490	(0.69 - 3.37)
Present	168	55%	36	12%			

OR: odds ratio; CI: confidence interval.
[a] x^2 = 2.2872; freedom-degrees = 3; Hosmer & Lemeshow test = 0.515
** Number of Fisher Scoring iterations: 5

Table 9 - Multivariate modelling for underweight (UW).

Variables	UNDERWEIGHT						
	No UW		UW		Model p-value [a] **	OR	95% CI
	n	%	n	%			
Gender							
Female	124	41%	19	6%	0.0728*	1.799	(0.95 - 3.47)
Male	127	42%	33	11%			
Dental biofilm							
Absent	76	25%	23	8%	0.1239	0.605	(0.31 - 1.15)
Present	175	58%	29	10%			
Liquid sugar exposure							
< 2	150	50%	39	13%	0.0977	0.553	(0.26 - 1.09)
> 2	101	33%	13	4%			
Sleep with bottle							
No	183	60%	25	8%	0.0174*	2.323	(1.15 - 4.64)
Yes	68	22%	27	9%			
Bottle in the middle of the night							
No	224	74%	40	13%	0.382	1.475	(0.60 - 3.49)
Yes	27	9%	12	4%			

OR: odds ratio; CI: confidence interval.
[a] $x^2 = 2.2872$; freedom-degrees = 3; Hosmer & Lemeshow test = 0.515
** Number of Fisher Scoring iterations: 5

Table 10 - Multivariate modelling for malnutrition (MN).

Variables	MALNUTRITION						
	No MN		MN		Model p-value [a] **	OR	95% CI
	n	%	n	%			
Gender							
Female	121	40%	22	7%	0.00797*	0.342	(0.14 - 0.73)
Male	150	50%	10	3%			
Dental biofilm							
Absent	94	31%	5	2%	0.0247*	3.132	(1.25 - 9.55)
Present	177	58%	27	9%			

OR: odds ratio; CI: confidence interval.
[a] $x^2 = 2.2872$; freedom-degrees = 3; Hosmer & Lemeshow test = 0.515
** Number of Fisher Scoring iterations: 5

DISCUSSION

The association between nutritional status and dental caries, sugar exposure and social factors was assessed in a sample of 303 3- to 5-year-old children. We found dental caries to be associated only with obesity nutritional status, since the multivariate analysis showed that obese children have 0.3 times more chance to have ECC ($p = 0.0049$) than health children. This result can partially be explained by the nature of the clinical examination method used to detect dental caries, which identified the early caries lesion, and also because our investigation included a reasonable number of children representing all nutritional status. This finding is in agreement with several previous studies. However, except for the study performed in the Northeast of Brazil (dos Santos Junior et al., 2014) most reported data is about developed countries (Hong, 2008; Ismail, 2009; Reifsnider, Mobley & Mendez, 2004; Vázquez-Nava et al., 2010; Hooley et al., 2012). Moreover, a recent review of literature and meta-analysis showed that overall, a significant relationship between childhood obesity and dental caries was found (Hooley et al., 2012). Childhood obesity and dental caries does co-occur probably, as a result of common confounding risk factors such as frequency of intake of cariogenic foods and drinks, and poor oral hygiene (Hilgers et al., 2006).

Our results also showed that 11.9% of the preschool children were obese. Worldwide, in 2010, 6.7% of all pre-school-aged children – 43 million – were estimated to be overweight or obese (de Onis et al., 2010). One in four U.S. children under age 5 is either overweight (between the 85th and 95th percentiles of BMI for age and sex) or obese. This percentage is higher than that reported by Alm et al. (2011) for 3 and 6 year-old children.

Considering dental caries we found it to be a highly prevalent disease. In fact, the present study showed that in this city of Northeast region of Brazil 75.2% of preschoolers had ECC. This result is not in agreement with Moura et al. (2010) who found that in the same city, dental caries occurred in only 24.7% of the 5 to 60 months old children. This discrepancy can be explained by the following

reasons. Firstly, different from the present study, these authors did not include the early caries lesion (ECL) in their caries diagnosis and it is known that adding the early caries lesions to World Health Organization threshold, the caries detection method significantly increases caries prevalence. In line with this assumption, previous investigations have shown that dmfs scores were significantly higher when WHO+ECL criteria was used (Parisotto et al., 2011; Rihs et al., 2007; Autio-Gold and Tomar, 2005; González et al., 2003; Waren, Levy and Kanellis, 2002; Amarante et al., 1998). Secondly, in the study of Moura et al. (2010), 35.5% of the sampled children were 5 to 12 months old and had a low number of teeth and a short period for caries to develop at the time the caries diagnosis was performed. In the same way, dos Santos Junior et al. (2014) also found a lower caries prevalence (20%) in the three to four year old children. However, these authors also used the same method to perform caries diagnosis as Moura et al. (2010) and registered the presence of ECC as yes or no. These procedures may have underestimated the percentage of children with ECC. It is worth mentioning that all 6 public nurseries/preschools included in the study were within the area for public service dental care. However, the lack of organization of basic health care, once a logic of organization and operation schedule are not adequately planned, creates a big gap in relation to demand and provided dental care.

Regarding BMI scores, we found that almost half of children were health weight. However, about 10.6% were malnourished, 17.2% were underweight, 15.5% were overweight and 11.8% were obese (Table 2). In general, these observations are consistent with other studies reporting childhood obesity (Vázquez-Nava et al., 2010; Kopycka-Kedzierawski et al., 2008). The mean weight and height of preschoolers of our study are in line with that given in the literature considering the same country, macro-region and city (POF-IBGE, 2008-2209). The general prevalence of child obesity among Brazilian preschooler founded in the present study corroborates the results of a survey developed in the same macro-region in the Northwest of the country (Recife-PE) with 2.651 1-to-5-year-old preschoolers (Granville-Garcia et al., 2008). These authors found a 9% prevalence

of obesity. However, most studies found higher percentages of health weight children than the one we obtained (Hong et al., 2008; Marshals et al., 2007; Alm et al., 2011). Most importantly, the identification of children being overweight early in life may give health care providers and parents the opportunities for early intervention to decrease the risk for both obesity and caries. Moveover, it should be highlighted that there is strong evidence indicating that obesity in childhood is a good predictor of obesity in adulthood (Doak et al., 2006; Mulvihill & Quigley, 2003; Muller et al., 2003).

Our study also demonstrated that children who consumed liquid sugar more than 2 times a day were 2.7 times more likely to be obese ($p = 0.033$). The literature shows a relationship between excessive consumption of obesogenic food and beverages and obesity. In a study performed with american preschoolers, the authors found a positive association between the consumption of sweetened beverages and BMI, and a 4% increased risk of developing overweight for every additional 30 ml of sweetened beverages consumed (Lim et al., 2009; RNPI, 2014). In addition to the energy content of foods, a number of other properties also have important roles in determining the amount we eat, including palatability, macronutrient composition, cooking methods, food quality, energy density, and form (Pan & Frank, 2011). Several human studies have investigated the contribution of the physical form of carbohydrates, and tested whether a preload with either solid or liquid sugar would affect subsequent intake of a meal (Pan & Frank, 2011; Oosterman et al., 2014; la Fleur et al., 2014; Ritze et al., 2014). Overall, it was shown that liquid sugars generally produce less satiety than the solid form (Ritze et al., 2014; DiMeglio & Mattes, 2000). In this respect, Ritze et al. (2014) demonstrated that with regard to feeding behavior, the form of sugar intake (liquid versus solid) is presumably more important than the type of sugar, intestinal sugar uptake and liver fat accumulation in mice. It is possible that the rapid transit of liquids through the stomach and intestines may lead to reduced stimulation of satiety signals, differences in the regulation of thirst and hunger, and lower cognitive perception of energy content (DiMeglio & Mattes, 2000; Mourao et al.,

2007; Mattes & Campbell, 2009). The effects of physical forms (solid or liquid) of carbohydrates on satiety and total energy intake have been an important focus of recent research (Mattes & Campbell, 2009).

Nevertheless, certain food habits of the Brazilian Northeast may have influenced these results. In this region of the country, salty cassava based foods (a preparation of cassava starch, like a pancake, and couscous prepared with the same starch) are consumed as snacks and meals very often, and thus sweet snacks like cookies and cakes are not widely consumed. Still, to accompany these cassava based foods, people usually drink sweetened liquids such as coffee and juices.

Regarding the overweight model our study found no association between overweight and caries (p=0.3640) and dental biofilm (p= 0.3190). The lack of association between dental caries and overweight in preschool children is in line with previous investigations (Sede & Ehizele 2014; D`mello et al., 2011). On the other side, although the investigation performed by Alm et al. (2011) found a higher prevalence of manifest caries in 6 year-old overweight children, a similar trend was not observed in their 3 year-old children. This finding may be connected to lifestyle habits that it is known to change over life. Moreover, increasing age was found to be predictive of increased caries experience in young children (Sede & Ehizele 2014).

The analysis of overweight model also revealed that dental biofilm was not associated with overweight. This was an expected finding if we consider that presence of visible biofilm may be a sign of frequent sugar exposure and consequently caries activity (Parisotto et al., 2010) and we were not able to detect any association between these variables and overweight.

Another result of our study was that preschool children who had the feeding habit of sleeping with a bottle were 2.3 times more likely to have underweight than children who did not sleep with a bottle (p = 0.0174). The infant appropriate feeding practice in early life can be one of the prevention factors of obesity development (WHO, 2001), and complementary feeding is recommended

only after six months of age, with adequate quality and quantity, frequency and consistency (MS, 2010). However, there is evidence that bottle-feeding is associated with baby low birth weight or difficulty in gaining weight during the first months of life (Buccini et al., 2014). Moreover, it is well known that bottle feeding during the first year of life can affect breastfeeding and induce alteration in the children's health (North et al., 1999; Victora et al., 1997; Vogel et al., 2001). Despite being difficult to explain the association between bottle-feeding habit and low weight, we believe that the mother or guardian keeps the bottle-feeding for the child, especially at night, which generates a vicious circle that hampers further the child's weight gain and nutritional status. This probably happens because the frequent use of feeding bottle will make the child feel momentary satiation as consequence of milk intake. Consequently, the child refuses to eat other solid, more nutritious food.

The association between general health and nutritional status is well known. Some studies indicate that obesity and overweight can cause diseases and systemic alterations in childhood. Moreover, obese children tend to become obese adults. Thus, in a decade, young adults will likely have much higher risks of chronic disease, which has tremendous implications for the healthcare system (Lakshman et al., 2012; Nedeau et al., 2011; Albert et al., 2004). Other authors relate malnutrition and underweight with severe systemic deficiencies and causing other diseases (Lhachimi et al., 2015; Batool et al., 2015; Molnar et al., 2014). However, data obtained from this epidemiological survey was not able to verify this association. This finding can be explained because no medical examination was performed to detect any systemic change of the examined children. The children general health in this study, was classified as "good" or "bad" by parents and/or guardians who answered the questionnaire used, and this way, any abnormality in the children health was reported only if he/she had any clear demonstration the called the parent/guardian attention, and that the child was be able to point during the interview.

Based on our results, we could not find any association between social variables (family income and mother´s education level) and overweight or obesity. However, several previous studies have reported an association among these variables (Hang, 2010; Singh, 2010). In our study, data of mother's education level and family income was obtained through an interview. We believe that the sample characteristics were responsible for the results. Firstly, mother's education level of 73.26% of the population studied were completed first grade or a higher education level and the homogeneity of the sample for this classification may have been responsible for the observed result. Secondly, the homogeneity and classification trend of family income, since over 92% of the study population received the amount equal to or less than R$ 1,400.00 (equivalent to approximately 2 times the minimum wage).

One limitation of the present study is that the study sample is from a specific region of Brazil, and this aspect deserves attention in relation to the generalization of results. The other limitation is that the cross-sectional design of the study did not allow an assessment of the temporality of facts. However, the present study helped to identify models that may be helpful for early identification of children with overweight and obesity and more importantly, provides valuable information for the establishment of preventive measures if we consider that the early childhood may be the best time to prevent obesity. Moreover, the analyzed outcomes can generate hypotheses for the development of longitudinal studies.

In conclusion, the results from this study with a large regional sample of young children suggest that preschool children having early childhood caries and a high liquid sugar consumption were more likely to be obese and those who were bottle fed during the night showed a higher chance of having underweight.

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REFERENCES

Albert SG, Mooradian AD. Low-dose recombinant human growth hormone as adjuvant therapy to lifestyle modifications in the management of obesity. J Clin Endocrinol Metab. 2004; 89(2): 695-701.

Acs G, Lodolini G, Kaminsky S, Cisneros GJ. Effect of nursing caries on body weight in a pediatric population. Pediatr Dent. 1992; 14: 302–305.

Acs G, Lodolini G, Shulman R, Chussid S. The effect of dental rehabilitation on the body weight of children with failure to thrive: case reports. Compend Contin Educ Dent. 1998; 19(2): 164-168.

Acs G, Shulman R, Ng MW, Chussid S. The effect of oral rehabilitation on the body weight of children with early childhood caries. Pediatr Dent. 1999; 21: 109–113.

Agostini FG, Flaitz CM, Hicks MJ. Dental emergencies in a university-based pediatric dentistry postgraduate outpatient clinic: a retrospective study. J Dent Child. 2001; 8: 316-321.

Ainamo J, Bay I. Problems and proposals for recording gingivitis and plaque. Int Dent J. 1975; 25 (4): 229-235.

Alm A, Isaksson H, Fåhraeus C, Koch G, Andersson-Gäre B, Nilsson M, Birkhed D, Wendts LK. BMI status in Swedish children and young adults in relation to caries prevalence. Swed Dent J. 2011; 35(1): 1-8.

Amarante E, Raadal M, Espelid I. Impact of diagnostic criteria on the prevalence of dental caries in Norwegian children aged 5, 12 and 18 years. Community Dent Oral Epidemiol. 1998; 26: 87–94.

Autio-Gold JT, Tomar SL. Prevalence of noncavitated and cavitated carious lesions in 5-year old head start schoolchildren in Alachua County, Florida. Pediatr Dent. 2005; 27: 54–60.

Ayhan H, Susan E, Yildirim S. The effect of nursing or rampant caries on height, body weight and head circumference. J Clin Pediatr Dent. 1996; 20: 209-212.

Bastos JL, Peres MA, Peres KG, Araujo CL, Menezes AM. Toothache prevalence and associated factors: a life course study from birth to age 12 years. Eur J Oral Sci. 2008; 116: 458-466.

Batool R, Butt MS, Sultan MT, Saeed F, Naz R. Protein-energy malnutrition: a risk factor for various ailments. Crit Rev Food Sci Nutr. 2015; 55(2): 242-253.

Benzian H, Monse B, Heinrich-Weltzien R, Hobdell M, Mulder J, van Palenstein Helderman W: Untreated severe dental decay: A neglected determinant of low Body Mass Index in 12-year-old Filipino children. BMC Public Health. 2011; 11: 558.

Buccini GS, Benício MH, Venancio SI. Determinants of using pacifier and bottle feeding. Rev Saude Publica. 2014; 48(4): 571-582.

Cameron FL, Weaver LT, Wright CM, Welbury RR: Dietary and social characteristics of children with severe tooth decay. Scott Med J. 2006; 51: 26–29.

Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services. National Center for Health Statistics Clinical Growth Charts. Atlanta (GA): Centers for Disease Control and Prevention, U.S. Department of Health and Human Services; 2006 [cited 2006 April 12]. Available from: http:// www.cdc.gov/nchs/about/major/nhanes/growthcharts/clinical_charts.htm.

Chen W, Chen P, Chen SC, Shih WT. Lack of association between obesity and dental caries in three-year-old children. J Chin Pediatr Dent. 1998; 39: 109-111.

Cinar AB, Murtomaa H: Interrelation between obesity, oral health and lifestyle factors among Turkish school children. Clin Oral Investig. 2011; 15: 177–184.

Clarke M, Locker D, Berall G, Pencharz P, Kenny D, Judd P. Malnourishment in a population of young children with severe early childhood caries. Pediatr Dent. 2006; 28: 254–259.

de Onis M, Blossner M, Borghi E. Global prevalence and trends of overweight and obesity among pre- school children. Am J Clin Nutr. 2010; 92: 1257–1264.

Dietz WH. The obesity epidemic in young children: Reduce television viewing and promote playing. Br Med J. 2001; 322: 313-314.

DiMeglio DP, Mattes RD. Liquid versus solid carbohydrate: effects on food intake and body weight. Int J Obes Relat Metab Disord. 2000; 24: 794–800.

D'Mello G, Chia L, Hamilton SD, Thomson WM, Drummon BK: Childhood obesity and dental caries among paediatric dental clinic attenders. Int J Paediatr Dent. 2011; 21: 217–222.

Doak CM, Visscher TL, Renders CM, Seidell JC. The prevention of overweight and obesity in children and adolescents: a review of interventions and programmes. Obes Ver. 2006; 7: 111–113.

dos Santos Junior VE, Sousa RMB, Oliveira MC, Junior AFC, Rosenblatt A. Early childhood caries and its relationship with perinatal, socioeconomic and nutritional risks: a cross-sectional study. BMC Oral Health. 2014; 14 :47.

Floyd B: Associations between height, body mass, and frequency of decayed, extracted, and filled deciduous teeth among two cohorts of Taiwanese first graders. Am J Phys Anthropol. 2009; 140: 113–119.

Freijer K, Lenoir-Wijnkoop I, Russell CA, Koopmanschap MA, Kruizenga HM, Lhachimi SK, Norman K, Nuijten MJ, Schols JM. The view of European experts

regarding health economics for medical nutrition in disease-related malnutrition. Eur J Clin Nutr. 2015. doi: 10.1038/ejcn.2014.280. [Epub ahead of print]

Gnavi R, Spagnoli TD, Galotto C, Pugliese E, Carta A, Cesari L: Socioeconomic status, overweight and obesity in prepuberal children: a study in an area of Northern Italy. Eur J Epidemiol. 2000; 16: 797–803.

González MC, Ruíz JA, Fajardo MC et al. Comparison of the def index with Nyvad's caries diagnostic criteria in 3- and 4-year-old Colombian children. Pediatr Dent. 2003; 25: 132–136.

Granville-Garcia AF, Menezes VA, Lira PI, Ferreira JM, Leite-Cavalcanti A. Obesity and Dental Caries among Preschool Children in Brazil. Rev Salud Pública. 2008; (5): 788-795.

Hang JC, Lawlor DA, Kimm SY: Childhood obesity. Lancet. 2010: 375 (9727): 1737–1748.

Hayden C, Bowler JO, Chambers S, Freeman R, Humphris G, Richards D, Cecil JE. Obesity and dental caries in children: a systematic review and meta- analysis. Community Dent Oral Epidemiol. 2013; 41: 289–308.

Hilgers KK, Kinane DF, Scheetz JP. Association between childhood obesity and smooth-surface caries in posterior teeth: a preliminary study. Pediatr Dent. 2006; 28: 23–28.

Hong L, Ahmed A, McCunniff M, Overman P, Mathew M. Obesity and dental caries in children aged 2-6 years in the United States: National Health and Nutrition Examination Survey 1999-2002. J Public Health Dent. 2008; 68(4): 227-233.

Hooley M, Skouteris H, Boganin C, Satur J, Kilpatrick N. Body mass index and dental caries in children and adolescents: a systematic review of literature published 2004 to 2011. Syst Rev. 2012; 21: 1:57.

Hunt RJ. Percent agreement, Pearson's correlation, and kappa as measures of inter-examiner reliability. J Dent Res. 1986; 65 (2): 128-130.

Instituto Brasileiro de Geografia e Estatística. Rio de Janeiro: IBGE. Pesquisa de Orçamentos Familiares 2008-2009: Antropometria e estado nutricional de crianças, adolescentes e adultos no Brasil. [acesso 2014 dez 14]. Disponível em: http://www.ibge.gov.br/home/estatistica/populacao/condicaodevida/pof/2008_2009_encaa/pof_20082009_encaa.pdf

Instituto Brasileiro de Geografia e Estatística. Rio de Janeiro: IBGE. Censo demográfico 2010. [acesso 2014 nov 30]. Disponível em: http://www.ibge.gov.br/estadosat/temas.php?sigla=pi&tema=idhm

Ismail AI, Sohn W, Lim S, Willem JM. Predictors of dental caries progression in primary teeth. J Dent Res. 2009; 88(3): 270-275.

Kantovitz KR, Pascon FM, Rontani RM, Gavião MB. Obesity and dental caries - A systematic review. Oral Health Prev Dent. 2006; 4(2): 137-144.

Keane E, Layte R, Harrington J, Kearney PM, Perry IJ. Measured parental weight status and familial socio-economic status correlates with childhood overweight and obesity at age 9. PLoS One. 2012; 7(8): e43503.

Kopycka-Kedzierawski DT, Auinger P, Billings RJ, Weitzman M: Caries status and overweight in 2- to 18-year-old US children: findings from national surveys. Community Dent Oral Epidemiol. 2008; 36: 157–167.

la Fleur SE, Luijendijk MC, van der Zwaal EM, Brans MA, Adan RA. The snacking rat as model of human obesity: effects of a free-choice high-fat high-sugar diet on meal patterns. Int J Obes. 2014; 38(5): 643-649.

Langnase K, Mast M, Muller MJ: Social class differences in overweight of prepubertal children in northwest Germany. Int J Obes Relat Metab Disord. 2002; 26: 566–572.

Lim S, Zoellner JM, Lee JM, Burt BA, Sandretto AM, Sohn W, et al. Obesity and sugar-sweetened beverages in African-American preschool children: a longitudinal study. Obesity (Silver Spring). 2009; 17(6):1262-1268.

Marcenes W, Kassebaum NJ, Bernabé E, Flaxman A, Naghavi M, Lopez A, Murray CJL. Global burden of Oral conditions in 1990-2010: A systematic Analysis. J Dent Res. 2013; 92 (7): 592-597.

Marshall TA, Eichenberger-Gilmore JM, Broffitt BA, Warren JJ, Levy SM. Dental caries and childhood obesity: roles of diet and socioeconomic status. Community Dent Oral Epidemiol. 2007; 35(6): 449-458.

Mattes RD, Campbell WW. Effects of food form and timing of ingestion on appetite and energy intake in lean young adults and in young adults with obesity. J Am Diet Assoc. 2009; 109:430–437.

Messiah SE, Lipshultz SE, Natale RA, Miller TL. The imperative to prevent and treat childhood obesity: why the world cannot afford to wait. Clin Obes. 2013; 3(6): 163-171.

Miller J, Vaughan-Williams E, Furlong R, Harrison L. Dental caries and childrens weights. J Epidemiol Community Health. 1982; 36: 49–52.

Molnar JA, Underdown MJ, Clark WA. Nutrition and Chronic Wounds. Adv Wound Care (New Rochelle). 2014; 3(11): 663-681.

Moura MS, Moura LFAD, Mendes RF. Cárie dentária em crianças menores de cinco anos na cidade de Teresina – PI. Rev Odontol UNESP. 2010; 39(3): 143-149.

Moura-Leite FR, Ramos-Jorge J, Ramos-Jorge ML, Paiva SM, Vale MP, Pordeus IA. Impact of dental pain on daily living of five-year-old Brazilian preschool children: prevalence and associated factors. Eur Arch Paediatr Dent. 2011; 12: 293-297.

Mourao DM, Bressan J, Campbell WW, Mattes RD. Effects of food form on appetite and energy intake in lean and obese young adults. Int J Obes. 2007; 31: 1688–1695.

MS. Ministério da Saúde. Dez passos para uma alimentação saudável: guia alimentar para crianças menores de dois anos. 2ª edição; ed. Brasília; 2010.

Muller MJ, Mast M, Asbeck I, Langnäse K, Grund A. Prevention of obesity – is it possible? Obes Rev. 2003; 2: 15–28.

Mulvihill C, Quigley R. The management of obesity and overweight: an analysis of reviews of diet, physical activity and behavioural approaches. Health Development Agency; London, 2003.

Narksawat K, Tonmukayakul U, Boonthum A: Association between nutritional status and dental caries in permanent dentition among primary schoolchildren aged 12–14 years. Southeast Asian J Trop Med Public Health. 2009; 40: 338–344.

Nadeau KJ, Maahs DM, Daniels SR, Eckel RH. Childhood obesity and cardiovascular disease: links and prevention strategies. Nat Rev Cardiol. 2011; 8(9): 513-525.

North K, Fleming P, Golding J. Pacifier use and morbidity in the first six months of life. Pediatr. 1999; 103(3): e34.

Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. JAMA. 2012; 307:483–490.

Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity in the United States, 2009–2010. NCHS Data Brief 2012; 82 : 1–8.

Oosterman JE, Foppen E, van der Spek R, Fliers E, Kalsbeek A, la Fleur SE. Timing of fat and liquid sugar intake alters substrate oxidation and food efficiency in male Wistar rats. Chronobiol Int. 2014; 1–10.

Pan A, Frank BH. Effects of carbohydrates on satiety: differences between liquid and solid food. Cur Op Clin Nutr Metabol Care. 2011; 14: 385–390.

Parisotto TM, Steiner-Oliveira C, Duque C, Peres RC, Rodrigues LK, Nobre-dos-Santos M. Relationship among microbiological composition and presence of dental plaque, sugar exposure, social factors and different stages of early childhood caries. Arch Oral Biol. 2010; 55(5): 365-373.

Pinto A, Kim S, Wadenya R, Rosenberg H. Is There an Association Between Weight and Dental Caries Among Pediatric Patients in an Urban Dental School? A Correlation Study. J Dent Educ. 2007; 71: 1335-1340.

Psoter W, Reid B, Katz R: Malnutrition and dental caries: A review of the literature. Caries Res. 2005; 39: 441–447.

Rede Nacional da Primeira Infância – RNPI. Mapeamento da Ação Finalística "Criança com Saúde" - Obesidade Infantil [internet]. Fortaleza: RNPI; 2014 [acesso 2014 dez 20]. Disponível em: http://alana.org.br/wp-content/uploads/2014/11/Obesidade_na_primeira_infancia.pdf

Reifsnider E, Mobley C, Mendez DB. Childhood obesity and early childhood caries in a WIC population. J Multicult Nurs Health. 2004;10: 24-31.

Rihs LB, Sousa Mda L, Cypriano S, Abdalla NM, Guidini DD, Amgarten C. Dental caries activity in primary dentition, Indaiatuba, São Paulo, Brazil, 2004. Cad Saude Publica. 2007; 23: 593–600.

Ritze Y, Bardos G, D'Haese JG, Ernst B, Thurnheer M, Schultes B, Bischoff SC. Effect of High Sugar Intake on Glucose Transporter and Weight Regulating Hormones in Mice and Humans. PLoS One. 2014; 9: 7.

Rosenblatt A, Zarzar P. The prevalence of early childhood caries in 12- to 36-month-old children in Recife, Brazil. ASDC J Dent Child. 2002; 69(3): 319-324.

Sanchez-Perez L, Irigoyen M, Zepeda M: Dental caries, tooth eruption timing and obesity: a longitudinal study in a group of Mexican schoolchildren. Acta Odontol Scand. 2010; 68: 57–64.

Santos JL, Ho-Urriola JA, González A, Smalley SV, Domínguez-Vásquez P, Cataldo R, Obregón AM, Amador P, Weisstaub G, Hodgson MI. Association between eating behavior scores and obesity in Chilean children. Nutr J. 2011; 10: 108.

Sede MA, Ehizele AO. Relationship between obesity and oral diseases. Nigerian J of Clin Pract. 2014; 17 (6): 683-690.

Sharma A, Hegde AM: Relationship between body mass index, caries experience and dietary preferences in children. J Clin Pediatr Dent. 2009; 34: 49–52.

Singh GK, Kogan MD, Van Dyck PC: Changes in state-specific childhood obesity and overweight prevalence in the United States from 2003 to 2007. Arch Pediatr Adolesc Med. 2010; 164(7): 598–607.

Speiser PW, Rudolf MC, Anhalt H, Camacho-Hubner C, Chiarelli F, Eliakim A, et al. Obesity Consensus Working Group. Childhood obesity. J Clin Endocrinol Metab. 2005; 90: 1871-1887.

Thomas CW, Primosch RE. Changes in incremental weight and well-being of children with rampant caries following complete dental rehabilitation. Pediatr Dent. 2002; 24: 109–113.

Tuomi T. Pilot study on obesity in caries prediction. Community Dent Oral Epidemiol. 1989; 17: 289-291.

Vázquez-Nava F, Vázquez-Rodríguez EM, Saldívar-González AH, Lin-Ochoa D, Martinez-Perales GM, Joffre-Velázquez VM. Association between obesity and dental caries in a group of preschool children in Mexico. J Public Health Dent. 2010; 70(2): 124-130.

Victora CG, Behague DP, Barros FC, Olinto MTA, Weiderpass E. Pacifier use and short breastfeeding duration: cause, consequence, or coincidence? Pediatr. 1997; 99(3): 445-453.

Vogel AM, Hutchison BL, Mitchell EA. The impact of pacifier use on breastfeeding: a prospective cohort study. J Paediatr Child Health. 2001; 37(1): 58-63.

Wake M, Nicholson JM, Hardy P, Smith K. Preschooler obesity and parenting styles of mothers and fathers: Australian national Population study. Pediatrics. 2007; 120: 1520-1527.

Wang Y. Cross-national comparison of childhood obesity: the epidemic and relationship between obesity and socio-economic status. Int J Epidemiol. 2001; 30: 1129-1136.

Warren JJ, Levy SM, Kanellis MJ. Dental caries in the primary dentition: assessing prevalence of cavitated and noncavitated lesions. J Public Health Dent. 2002; 62: 109–114.

WHO. World Health Organization. Complementary feeding: Report of the global consultation. Summary of guiding principles. Geneva, Switzerland: World Health Organization; 2001.

Willerhausen B, Haas G, Krummenauer F, Hohenfellner K. Relationship between high weight and caries frequency in German elementary school children. Eur J Med Res. 2004; 9: 400-404.

CONCLUSÃO

Baseado nos resultados apresentados, pode-se concluir que pré-escolares que possuem cárie precoce da infância e consomem líquidos açucarados em alta frequência possuem maior chance de serem obesos, e aqueles que possuem o hábito de usar mamadeira no meio da noite apresentaram maior probabilidade de terem baixo peso.

Dentro das limitações do presente estudo, não foi possível encontrar associação entre o estado nutricional dos pré-escolares e os fatores sociais analisados.

REFERÊNCIAS *

American Academy of Pediatrics Committee on School Health. Soft drinks in schools. Pediatrics. 2004; 113: 152-154.

Birch LL, Davison K. Family environmental factors influencing the developing behavioural controls of food intake and childhood overweight. Pediatr Clin North Am. 2001; 48: 893-907.

Davies PS, Coward WA, Gregory J, White A, Millis A. Total energy expenditure and energy intake in the preschool child: A comparison. Br J Nutr. 1994; 72: 13-20.

Flores G, Fuentes-Affick E, Barbot O, Carter-Pokras O, Claudio L, Lara M, et al. The health of Latino children: urgent priorities, unanswered questions, and a research agenda. JAMA. 2002; 288: 82-90.

Hedley AA, Ogden CL, Johnson CL, Carroll MD, Curtin LR, Flegal KM. Prevalence of overweight and obesity among US children, adolescents, and adults. JAMA. 2004; 291: 2847-2850.

Lakshman R, Elks CE, MPhil, Ong KK, BChir MB. Childhood obesity. Circulation. 2012; 126(14): 1770–1779.

Macek MD, Mitola DJ. Exploring the association between overweight and dental caries among US children. Pediatr Dent. 2006; 28: 375-380.

Ministério da Saúde: Sistema de vigilância alimentar e nutricional (SISVAN). Módulo gerador de relatórios públicos: estado nutricional dos indivíduos acompanhados por período, fase do ciclo da vida e índice. [Internet]. 2014.

* De acordo com as normas da UNICAMP/FOP, baseadas na padronização do International Committee of Medical Journal Editors. Abreviatura dos periódicos em conformidade com o Medline.

Ogden CL, Carroll MD. Prevalence of Obesity Among Children and Adolescents: United States, Trends 1963-1965 Through 2007-2008 [internet]. Health E-Stat; 2010 [acesso 2014 dez 20]. Disponível em: http:// www.cdc.gov/nchs/data/hestat/obesity_child_07_08/obesity_child_07_08.htm.

OPAS/WHO. Plan of action for the prevention of obesity in children and adolescents. Plan of action for the prevention of obesity in children and adolescents. 2014.

Rivera JA, de Cossio TG, Pedraza LS, Aburto TC, Sanchez TG, Martorell R. Childhood and adolescent overweight and obesity in Latin America: a systematic review. Lancet Diabetes Endocrinol. 2014; 2(4): 321-232.

Rolland-Cachera MF, Peneau S. Stabilization in the prevalence of childhood obesity: a role for early nutrition. Int J Obes. 34:1524–5. 2010 online.

* De acordo com as normas da UNICAMP/FOP, baseadas na padronização do International Committee of Medical Journal Editors. Abreviatura dos periódicos em conformidade com o Medline.

APÊNDICE 1

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO (TCLE)

AVALIAÇÃO DA RELAÇÃO ENTRE SOBREPESO, OBESIDADE E CÁRIE EM PRÉ-ESCOLARES DE 3 A 5 ANOS DE IDADE DA CIDADE DE TERESINA-PI

Você está sendo convidado(a) para participar, como voluntário, em uma pesquisa. Após ser esclarecido(a) sobre as informações a seguir, no caso de aceitar fazer parte do estudo, assine ao final deste documento, que está em duas vias. Uma delas é sua e a outra é do pesquisador responsável. Em caso de recusa você não será penalizado(a) de forma alguma. Em caso de dúvida você poderá procurar o pesquisador responsável, e o Comitê de Ética em Pesquisa – CEP), nos locais e telefones abaixo:

Pesquisador responsável: Marcela Pinto Monteiro de Oliveira
Email: mapmoliveira@yahoo.com.br Fone: 8852-4040

Comitê de Ética em Pesquisa – CEP: Rua Veterinário Bugyja Brito, nº 1354, Bairro Horto Florestal, CEP:64052-410 Teresina - PI - Fone: (86) 3216-7900

INFORMAÇÕES SOBRE A PESQUISA

O objetivo desta pesquisa é verificar se existe relação entre cárie dentária, sobrepeso e obesidade em pré-escolares de 3 a 5 anos de idade da cidade de Teresina-PI. As informações serão obtidas por meio de uma entrevista que será realizada com o responsável pela criança, para coletar alguns dados sobre renda da família, hábitos alimentares da criança e dados de saúde geral da mesma. Depois, a boca de cada criança será examinada pelo pesquisador responsável, para detectar lesões de cárie e acúmulo de placa. A altura e o peso da criança também serão mensurados. A estatura será medida com fita métrica fixada a uma tábua de madeira, e o peso com balança digital.

A pesquisa poderá acarretar algum desconforto ou incômodo à criança, ocasionados pelo exame clínico, que será contornado utilizando delicadeza e cuidado ao manusear os instrumentais odontológicos. Além disso, os dados da estatura e do peso das crianças serão mensurados discretamente e individualmente, e não serão mostrados para outras crianças. O responsável pela criança somente responderão algumas preguntas, e portanto, para esses não há previsão de riscos.

As crianças que forem identificadas com qualquer uma das duas doenças analisadas (cárie ou obesidade) serão encaminhadas para tratamento em locais específicos para tal.

Fica garantido o sigilo do participante e das informações por ele prestadas bem como o direito de retirar o seu consentimento a qualquer tempo sem qualquer ônus.

_____
Marcela Pinto Monteiro de Oliveira – Pesquisadora

Consentimento da Participação da Pessoa como Sujeito
(para o escolar a ser examinado)

Eu,_____,
RG_____, CPF_____, abaixo assinado, concordo em participar da pesquisa AVALIAÇÃO DA RELAÇÃO ENTRE SOBREPESO, OBESIDADE E CÁRIE EM PRÉ-ESCOLARES DE 3 A 5 ANOS DE IDADE DA CIDADE DE TERESINA-PI, como sujeito. Fui devidamente informado e esclarecido pela pesquisadora Marcela Pinto Monteiro de Oliveira sobre a pesquisa, os procedimentos nela envolvidos, dos riscos e benefícios decorrentes de minha participação. Foi-me garantido que posso retirar meu consentimento a qualquer momento, sem que isto leve à qualquer penalidade.

Teresina, _____, de _____ de 2014.

_____
Assinatura do escolar

Consentimento da Participação da Pessoa como Sujeito
(para o responsável legal do escolar e cuidador)

Eu,_____,
RG_____, CPF_____, abaixo assinado, concordo em participar da pesquisa AVALIAÇÃO DA RELAÇÃO ENTRE SOBREPESO, OBESIDADE E CÁRIE EM PRÉ-ESCOLARES DE 3 A 5 ANOS DE IDADE DA CIDADE DE TERESINA-PI, como sujeito. Fui devidamente informado e esclarecido pela pesquisadora Marcela Pinto Monteiro de Oliveira sobre a pesquisa, os procedimentos nela envolvidos, dos riscos e benefícios decorrentes de minha participação. Foi-me garantido que posso retirar meu consentimento a qualquer momento, sem que isto leve à qualquer penalidade.

Teresina, _____, de _____ de 2014.

_____
Assinatura do responsável legal

APÊNDICE 2

DIÁRIO DE DIETA

Nome (filho):_____ Data nasc.: _____/_____/_____
Nome (mãe):_____ Data nasc.: _____/_____/_____
Estado civil (mãe): ( ) SOLTEIRA ( ) CASADA Telefone: _____
Escola:_____ Data exame: _____/_____/_____

HORÁRIO	REFEIÇÃO	DIA: _____/_____	DIA: _____/_____	DIA: _____/_____
	Café da manhã			
	Lanche da manhã			
	Almoço			
	Lanche da tarde			
	Jantar			
	Antes de dormir			

APÊNDICE 3

ENTREVISTA

Nome (filho):_____ Data nasc.: _____/_____/_____
Nome (mãe):_____ Data nasc.: _____/_____/_____
Estado civil (mãe): ( ) SOLTEIRA ( ) CASADA Telefone: _____
Escola:_____ Data exame: _____/_____/_____

1) Grau de estudo da mãe:
a- ( ) sem estudo
b- ( ) primeiro grau completo (1ª a 8ª série)
c- ( ) primeiro grau incompleto
d- ( ) segundo grau completo (1º ao 3º colegial)
e- ( ) segundo grau incompleto
f - ( ) superior completo (faculdade)

2) Renda familiar:
a- ( ) menos de 1 salário mínimo
b- ( ) 1 a 2 salários mínimos
c- ( ) 3 a 4 salários mínimos
d- ( ) 5 a 6 salários mínimos
e- ( ) 7 a 8 salários mínimos
f - ( ) Outro_____

3) Com que idade começou a escovar os dentes do seu filho?
a- ( ) assim que os primeiros dentes nasceram
b- ( ) durante o primeiro ano de idade
c- ( ) durante o segundo ano de idade
d- ( ) durante o terceiro ano de idade

4) Você tem automóvel/carro?
a- ( ) sim
b- ( ) não

5) Você tem plano de saúde?
a- ( ) sim
b- ( ) não

6) Quem escova os dentes do seu filho na maioria das vezes?
a- ( ) mãe ou responsável
b- ( ) seu filho escova sozinho
c- ( ) não escova

7) Quem você acha que deveria escovar os dentes do seu filho?
a- ( ) mãe ou responsável
b- ( ) seu filho sozinho
c- ( ) não escova

8) Quantas vezes por dia seu filho escova os dentes em casa?
a- ( ) 1 vez por dia
b- ( ) 2 vezes por dia
c- ( ) 3 a 4 vezes por dia
d- ( ) às vezes
e- ( ) não escova

9) Quantas vezes por dia você acha que seu filho deveria escovar os dentes por dia?
a- ( ) 1 vez por dia
b- ( ) 2 vezes por dia
c- ( ) 3 a 4 vezes por dia
d- ( ) às vezes
e- ( ) não deveria escovar

10) Qual a pasta dental utilizada?
a- ( ) não utiliza pasta
b- ( ) Tandy
c- ( ) Colgate
d- ( ) Sorriso
e- ( ) Outra_____

11) Por quanto tempo a criança foi amamentada no peito?
a- ( ) Nunca mamou
b- ( ) Menos de 6 meses
c- ( ) 6 meses
d- ( ) 7 a 11 meses
e- ( ) 1 ano
f- ( ) mais de 1 ano
g- ( ) mais de 2 anos

12) Por quanto tempo a criança foi amamentada na mamadeira?
a- ( ) Nunca mamou
b- ( ) Menos de 6 meses
c- ( ) 6 meses
d- ( ) 7 a 11 meses
e- ( ) 1 ano
f- ( ) mais de 1 ano
g- ( ) mais de 2 anos

13) A criança é colocada pra dormir com a mamadeira?
a- ( ) sim
b- ( ) não
c- ( ) às vezes

14) A criança toma mamadeira no meio da noite?
a- ( ) sim
b- ( ) não
c- ( ) às vezes

15) O que tem na mamadeira?
a- ( ) leite puro
b- ( ) leite com açúcar
c- ( ) água
d- ( ) leite com café
e- ( ) leite com achocolatado
f- ( ) suco

ANTECEDENTES MÉDICOS:

1. Saúde da criança:
( ) boa ruim ( )

2. Se ruim, qual o problema?
_____

3. A criança consultou-se com algum médico nos últimos 6 meses?
( ) sim ( ) não
Se sim, por que?
_____

ANEXO 1

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PARECER DE APROVAÇÃO

Ao Pesquisador ***Marcela Pinto Monteiro de Oliveira***

Curso de Odontologia

O Projeto ***avaliação da relação entre sobrepeso, obesidade e cárie em pré-escolares de 3 a 5 anos de idade da cidade de Teresina-PI***, tendo como orientador ***Profª Drª Marinês Nobre dos Santos Uchôa*** entregue na Secretaria do CEP da Faculdade Integral Diferencial – FACID, dia 18/08/2014, CAAE 34784914.0.0000.5211 foi ***APROVADO*** no dia 25/08/2014 pelo Comitê de Ética em Pesquisa (CEP – FACID), instituído nesta Faculdade de acordo com a Resolução nº. 466/12, de 12 de dezembro de 2012, do Conselho Nacional de Saúde (CNS).

Teresina, ***05*** de ***dezembro*** de ***2014***

Nayana Pinheiro Machado de Freitas Coelho
Presidente do CEP/FACID

ANEXO 2

International Journal of Paediatric Dentistry

Submission Confirmation

Thank you for submitting your manuscript to International Journal of Paediatric Dentistry.

Manuscript ID:	IJPD-01-15-4690
Title:	Relationship among nutritional status, caries, sugar exposure and social factors in 3-to-5-year-old preschoolers
Authors:	MONTEIRO-OLIVEIRA, MARCELA Nobre dos Santos, M Costa, Juliana Lacerda-Sousa, Lilian Silva, Cintia Raquel
Date Submitted:	29-Jan-2015

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