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Associação entre sobrepeso/obesidade e cárie dentária em crianças/adolescentes brasileiros: uma revisão sistemática e meta-análise

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Monografia apresentada à Disciplina de Trabalho de Conclusão de Curso da Faculdade de Odontologia da Universidade Federal de Juiz de Fora, como parte dos requisitos para obtenção do título de Cirurgiã-Dentista.

Orientadora: Profa. Dra. Rosangela Almeida Ribeiro

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Aprovado em 29 de agosto de 2022.

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Dedico este trabalho aos meus amados pais, Rose e Marcus, e a minha irmã, Gabriela, por estarem sempre ao meu lado durante essa jornada.

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RESUMO

Esta revisão sistemática com meta-análise avaliou a associação entre sobrepeso e/ou obesidade e cárie dentária em crianças/adolescentes brasileiros. Foram realizadas buscas nas bases Web of Science, Scopus, Cochrane, PubMed, SciELO, Lilacs e literatura cinzenta até janeiro de 2022. O risco de viés foi avaliado com as escalas do *Joanna Briggs Institute*. Um total de 41 publicações foram incluídas e 13 meta-análises foram realizadas. Foram analisadas as diferenças de médias (DM) ponderadas e razão de chances e seus intervalos de confiança (IC) (95%) correspondentes para cárie dentária entre crianças/adolescentes eutróficos e com obesidade e/ou sobrepeso. Não houve associação entre crianças/adolescentes eutróficos e com obesidade e/ou sobrepeso em relação à cárie dentária para dentes decíduos e permanentes para nenhuma meta-análise, exceto a que incluiu estudos com adolescentes em dentição permanente e classificou obesidade com o índice de massa corporal (IMC) baseado na curva de referência atropométrica do CDC (2000). Esta meta-análise mostrou que adolescentes obesos apresentaram menor média de cárie dentária comparados aos eutróficos (MD=0,61; IC 95%=0,08-1,15). Conclui-se que não há associação entre sobrepeso e/ou obesidade e cárie dentária em crianças/adolescentes brasileiros para a maioria das curvas antropométricas de referência utilizando o IMC. A força da evidência dos resultados foi considerada muito baixa, baixa e moderada.

Palavras-chave: Obesidade. Sobrepeso. Cárie dentária. Criança. Revisão Sistemática.

ABSTRACT

This systematic review with meta-analysis evaluated the association between overweight and/or obesity and dental caries in Brazilian children/adolescents. Searches were performed in the Web of Science, Scopus, Cochrane, PubMed, SciELO, Lilacs and grey literature databases until January 2022. The risk of bias was assessed using the Joanna Briggs Institute scales. A total of 41 publications were included and 13 meta-analyses were performed. We analyzed the differences in weighted means (MD) and odds ratios and their corresponding confidence intervals (CI) (95%) for dental caries among eutrophic and obese and/or overweight children/adolescents. There was no association between normal weight and obese and/or overweight children/adolescents in relation to dental caries for primary and permanent teeth for any meta-analysis, except the one that included studies with adolescents in permanent dentition and classified obesity with body mass index (BMI) based on the CDC (2000) anthropometric reference curve. This meta-analysis showed that obese adolescents had a lower mean of dental caries compared to normal-weight adolescents (MD=0.61; 95% CI=0.08-1.15). It was concluded that there is no association between overweight/obesity and dental caries in Brazilian children/adolescents for most anthropometric reference curves using BMI. The strength of the evidence of the results was considered very low, low and moderate.

Keywords: Obesity. Overweight. Dental. Caries. Child. Systematic Review.

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overweight/obesity using BMI for age and sex percentiles from the WHO BMI 2006 expressed by the Z-score.

LISTA DE ABREVIATURAS E SIGLAS

IMC	Índice de massa corporal
NCD	Risk Factors for Chronic Non-communicable Diseases
OMS	Organização Mundial da Saúde
WHO	World Health Organization
SISVAN	Sistema de Vigilância Alimentar e Nutricional
CPOD	Índice para dentes permanentes cariados, perdidos ou obturados
ICDAS	Sistema Internacional de Detecção e Avaliação de Cárie
SB	Saúde Bucal
Ceo	Índice para dentes decíduos cariados, com extração indicada ou obturados
PROSPERO	International Prospective Register of Systematic Reviews
IJPD	International Journal of Paediatric Dentistry
FNDE	Fundo Nacional de Desenvolvimento da Educação
MD	weighted means
CI	confidence intervals
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
OD	odds ratios
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
LILACS	Latin American and Caribbean Health Sciences
GRADE	Grading of Recommendations Assessment, Development and Evaluation
SoF	Summary of Findings
GDT	Guideline Development Tool
IOTF	International Obesity Task Force
DMFT	Decayed, missing, or filled teeth in permanent tooth
Dmft	Decayed, missing, or filled teeth in primary tooth
ECC	Early Childhood Caries
SiC index	Significant Caries Index

IBGE	Instituto Brasileiro de Geografia e Estatística
IgA-s	A antibody
DXA	radiographic densitometry

LISTA DE SÍMBOLOS

%	Percentual
+	Mais
=	Igual
#	Cerquila
-	Menos
≤	Menor ou igual
®	Marca registrada
>	Maior
<	Menor
≥	Maior ou igual
±	Para mais ou para menos
kg/m²	Quilograma por metro quadrado

SUMÁRIO

1 INTRODUÇÃO

A obesidade é uma doença multifatorial atribuída a fatores genéticos, como alterações de genes específicos, não genéticos, como falta de atividade física e padrões alimentares ricos em açúcares e gorduras, e ainda a processos biopsicossociais, nos quais os ambientes político, econômico, social ou cultural também devem ser analisados (DIAS et al., 2017; GUNGOR, 2014; WHO, 2021). É caracterizada pelo excesso de gordura corporal ou adiposidade, sendo definida pelo índice de massa corporal (IMC), fórmula matemática que leva em consideração o peso e a altura. A epidemia de obesidade na população de 2 a 18 anos tem sido um importante problema de saúde pública em países desenvolvidos e em desenvolvimento, uma vez que a obesidade infantil e em adolescentes pode acompanhar o indivíduo na idade adulta estando relacionada com doenças crônicas, como diabetes tipo 2, hipertensão e doenças cardiovasculares (LEE e YOON, 2018).

O sobrepeso e a obesidade em crianças e adolescentes, anteriormente considerados uma condição restrita a países de alta renda, está aumentando em todo o mundo devido à exposição prolongada a carboidratos refinados, especialmente açúcares, combinada com a falta de exercício físico (NCD RISK FACTOR COLLABORATION, 2016). A obesidade é considerada uma epidemia mundial, e a Organização Mundial da Saúde (OMS) estima que mais de 340 milhões de crianças e adolescentes de 5 a 19 anos estavam acima do peso ou obesos em 2016 (WHO, 2021). De acordo com o Atlas Mundial da Obesidade e a OMS, o Brasil estará em quinto lugar no ranking de países com o maior número de crianças e adolescentes com obesidade em 2030, com apenas 2% de chance de reverter essa situação se nada for feito (WHO, 2019). Em uma revisão sistemática e meta-análise que analisou a prevalência de sobrepeso e obesidade em crianças e adolescentes brasileiros de 5 a 19 anos, foi encontrado que em crianças, as prevalências de sobrepeso nas meninas variaram de 8,4% a 24,1%, enquanto nos meninos as prevalências encontradas foram entre 8,7% e 21,8%. Em relação à obesidade, as prevalências encontradas para meninas variaram entre 1,5% e 15,8%, e 1,7% e 20,3%, nos meninos. As maiores prevalências de sobrepeso e obesidade foram encontradas nos estudos realizados na região Sul e em crianças do sexo feminino (GUEDES, 2021). Em adolescentes, a variação de prevalência de sobrepeso em meninas foi de 9,8% a 22,8%. Já nos indivíduos do sexo masculino, a menor prevalência variou de 5,6% a 21,6%. Quanto

à obesidade, as taxas de prevalências variaram de 1,2% a 11,6% no sexo feminino e de 1,1% a 14,4% no sexo masculno. No tocante à prevalência combinada (sobrepeso + obesidade) as taxas extremas ficaram entre 11,4% e 27,2%, e 9,5% e 26,9%, nas moças e nos rapazes, respectivamente. Semelhante ao que foi identificado em crianças, em geral, as prevalências de sobrepeso e obesidade mais elevadas foram encontradas nos estudos realizados na região Sul. Contudo, moças e rapazes apresentaram taxas de prevalência similares (GUEDES, 2021). De acordo com dados do Sistema de Vigilância Alimentar e Nutricional (Sisvan), de 3.489.438 crianças avaliadas em 2018, 14,3% daquelas com idade entre 2 e 4 anos apresentavam excesso de peso, sendo o estado com maior índice o Ceará, com 20,1%. Já a média nacional para obesidade foi 6,5%, e os estados do Sergipe e Ceará lideraram o ranking com 9,5% (BRASIL, 2019). Quando se avaliou o excesso de peso em crianças de 5 a 9 anos, em 4.181.800 crianças avaliadas, a média nacional foi 29,3%, sendo o Rio Grande do Sul o estado que liderou o ranking, com 38,4%. Já a média nacional para obesidade foi 13,2%, sendo o Rio Grande do Sul também o estado com o maior índice (18,4%) (BRASIL, 2019).

A dieta é o fator determinante primário da obesidade. Uma dieta pobre pode ter impacto negativo na saúde por meio dos seus efeitos sobre o funcionamento do sistema imunológico, crescimento, desenvolvimento, envelhecimento e também sobre a saúde bucal (HAYDEN et al., 2013). Uma má saúde bucal é representada pelo estabelecimento da cárie dentária, que ainda é uma das doenças crônicas mais altamente prevalentes entre crianças em todo o mundo (HAYDEN et al., 2013; MANOHAR et al., 2019). A cárie dentária é considerada uma doença dinâmica, multifatorial e mediada por biofilme, resultando no desequilíbrio da desmineralização e remineralização dos tecidos duros dentários (PITTS et al., 2019). Entre os fatores de risco para o desenvolvimento da doença, o açúcar na dieta é sugerido por diversos estudos (SHQAIR et al., 2021). A cárie dentária tem efeitos negativos na qualidade de vida da criança, podendo levar ao desconforto, dor, alteração dos hábitos de sono e má nutrição. Além disso, pode levar a dificuldades no desempenho escolar, socialização e autoestima do paciente, bem como pode comprometer o dia a dia dos pais ou cuidadores (ÇOLAK et al., 2013; MANOHAR et al., 2019; MARTINS-JUNIOR et al., 2013). As principais medidas para avaliar cárie dentária em crianças são o índice CPO-D (dentes permanentes cariados, perdidos e obturados), que avalia a prevalência da cárie dentária nas diversas regiões do mundo e o ICDAS (Sistema

Internacional de Detecção e Avaliação de Cárie), método visual para a detecção de cárie. De acordo com dados da última Pesquisa Nacional de Saúde Bucal – SB Brasil, a proporção de indivíduos sem experiência de cárie (ceo/CPO = 0) diminui conforme o aumento da idade: 46,6% das crianças brasileiras com 5 anos de idade apresentam-se livres de cárie na dentição decídua; aos 12 anos, esse número cai para 43,5% para dentição permanente. De 15 a 19 anos, o número de adolescentes livres da experiência de cárie é ainda menor: 23,9%. Encontrou-se ainda que o percentual de crianças e adolescentes com CPOD = 0 é sempre menor nas regiões Centro-Oeste, Norte e Nordeste quando comparados com o percentual das regiões Sul e Sudeste. Aos 5 anos de idade, há o predomínio do componente cariado, sendo o ceo-d médio de 2,43 dentes com experiência de cárie. As maiores médias desse índice são encontradas nas regiões Norte, Centro-Oeste e Nordeste. Nas regiões Sudeste e Sul, há predomínio do componente restaurado. Em crianças de 12 anos de idade, a média do índice CPO-D é de 2,07 e em adolescentes de 15 a 19 anos é de 4,25, sendo os menores índices nas regiões Sudeste e Sul (BRASIL, 2010).

Embora a literatura científica forneça suporte para a coexistência de sobrepeso/obesidade e cárie dentária, apontando fatores etiológicos comuns, como hábitos alimentares e privação socioeconômica, anteriormente mencionados, resultados conflitantes têm sido descritos em diferentes populações, resultando em evidências questionáveis sobre essa associação (HAYDEN et al., 2013; SILVA et al., 2013). As revisões sistemáticas publicadas sobre esse tema incluíram, na sua maiorira, estudos publicados em inglês, fato que pode ter impedido o conhecimento dessa associação em populações de países em desenvolvimento, que não têm o inglês como idioma oficial, como o Brasil, por exemplo. Compreender como a obesidade e a cárie dentária estão relacionadas pode fornecer estratégias preventivas mais amplas com base em seus fatores de risco. Isso poderia apoiar os gestores de saúde brasileiros no processo de tomada de decisão em saúde, além de facilitar abordagens colaborativas e multidisciplinares entre especialistas em Saúde Pública, Nutrição, Medicina e Odontologia envolvidos no cuidado de crianças e adolescentes. Assim, o objetivo desta revisão sistemática e meta-análise foi avaliar a associação entre sobrepeso e obesidade e cárie dentária em crianças e adolescentes brasileiros.

2 PROPOSIÇÃO

Esta revisão sistemática e meta-análise se propõe a avaliar a associação entre sobrepeso e obesidade e cárie dentária em crianças e adolescentes brasileiros.

3 ARTIGO CIENTÍFICO

O estudo que deu origem ao presente manuscrito foi registrado no *International Prospective Register of Systematic Reviews* (PROSPERO) sob o número de registro #CRD42021056843 (ANEXO A).

A redação do manuscrito, intitulado **"Association between overweight/obesity and dental caries in Brazilian children/adolescents: a systematic review and meta-analysis"** seguiu as Instruções aos Autores do periódico *International Journal of Paediatric Dentistry (IJPD* – ANEXO B), Qualis A1 na área da Odontologia, fator de impacto 3.455.

TITLE PAGE

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Short title: Overweight/obesity and dental caries

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Main Text

Título: Association between overweight/obesity and dental caries in Brazilian children/adolescents: a systematic review and meta-analysis

Abstract

Background: Conflicting results have been described about the association between overweight/obesity and dental caries in different populations. **Aim:** To assess the association between overweight/obesity and dental caries in Brazilian children/adolescents. **Design:** Searches were performed in the Web of Science, Scopus, Cochrane, PubMed, SciELO, Lilacs and grey literature databases until January 2022. The risk of bias was assessed using the Joanna Briggs Institute scales. A total of 41 publications were included and 13 meta-analyses were performed. We analyzed the differences in weighted means (MD) and odds ratios and their corresponding confidence intervals (CI) (95%) for dental caries among eutrophic and obese and/or overweight children/adolescents. **Results:** Meta-analyses showed that there was no difference between overweight and normal weight children/adolescents regarding dental caries in primary and permanent teeth, for studies that assessed overweight using BMI (Body Mass Index) based on the CDC (2000), for obesity and overweight/obesity of children/adolescents in primary dentition, and for overweight/obesity in individuals in primary and permanent dentitions. In studies with children/adolescents in permanent dentition, a higher mean of dental caries prevalence was shown in eutrophic compared to obese individuals (MD = 0.61, 95% CI 0.08-1.15). There was no difference between overweight and normal weight children/adolescents regarding untreated dental caries for overweight using BMI for WHO (2007) by Z-score, as well as for obesity and overweight/obesity. There was no difference between overweight/obese and normal weight children/adolescents in relation to dental caries for studies that evaluated overweight using BMI for WHO (2007), by percentiles and for those who assessed overweight using BMI for WHO (2006) by Z-score. **Conclusions:** It was concluded that there is no association between overweight and/or obesity and dental caries in Brazilian children/adolescents for most anthropometric reference curves using BMI. A greater experience of dental caries was associated with well-nourished adolescents in permanent dentition compared to obese individuals in

the same dentition, classified by the CDC 2000 curve. The strength of the evidence of the results was considered very low, low and moderate.
Keywords: obesity, overweight, dental caries, child, systematic review.

Introduction

Overweight and obesity in children and adolescents, previously considered a condition restricted to high-income countries, is increasing worldwide due to prolonged exposure to refined carbohydrates, especially sugars, combined with lack of physical exercise.[1] Obesity is a multifactorial disease, being attributed to genetic factors, such as alterations in specific, non-genetic genes, such as lack of physical activity and eating patterns rich in sugars and fats, as well as to biopsychosocial processes, in which political, economic, social or cultural should also be analyzed.[2-4] It is characterized by excess body fat or adiposity, being defined by the body mass index (BMI), a mathematical formula that takes into account weight and height. The obesity epidemic in the population aged 2 to 18 years has been an important public health problem in developed and developing countries, since childhood and adolescent obesity can accompany the individual in adulthood and is related to chronic diseases, such as type diabetes 2, hypertension and cardiovascular disease.[5]

Diet is the primary determinant of obesity. A poor diet can have a negative impact on health through its effects on the functioning of the immune system, growth, development, aging and also on oral health.[6] Poor oral health is represented by the establishment of dental caries, which is still one of the most highly prevalent chronic diseases among children worldwide.[6,7] Dental caries is considered a dynamic, multifactorial and biofilm-mediated disease, resulting in the imbalance of demineralization and remineralization of dental hard tissues.[8] Among the risk factors for the development of caries, sugar in the diet is suggested by several studies.[9] It is considered a sugar-dependent polymicrobial dysbiosis, capable of leading to mineral loss of the dental hard tissues.[10] Inadequate dietary practices, especially the increased consumption of ultra-processed foods and frequent intake of sucrose, can influence not only oral health, but also general health.[11] Dental caries has negative effects on the child's quality of life, which can lead to discomfort, pain, changes in sleep habits and poor nutrition. In addition, it can lead to difficulties in the patient's school performance, socialization and self-esteem, as well as compromising the daily life of parents or caregivers.[7,12,13]

Although the scientific literature supports the coexistence of overweight/obesity and dental caries, pointing out to common etiological factors, such as dietary habits and socioeconomic deprivation, as aforementioned, conflicting results have been described in different populations, resulting in questionable evidence about this association.[6,14] The systematic reviews published on this topic include, for the most part, studies published in English, a fact that may have prevented the knowledge of this association in populations from developing countries, which do not have English as an official language, such as Brazil, for example. Understanding how obesity/overweight and dental caries are related can provide broader preventive strategies based on your risk factors. This could support Brazilian health managers in the health decision-making process, in addition to facilitating collaborative and multidisciplinary approaches between specialists in Public Health, Nutrition, Medicine and Dentistry involved in the care of children and adolescents. Thus, the objective of this systematic review and meta-analysis was to evaluate the association between overweight and obesity and dental caries in Brazilian children and adolescents.

Materials and methods

Protocol and registration

A protocol for this study has been registered in the International Prospective Register of Systematic Reviews (PROSPERO) under registration number #CRD42021056843. This systematic review and meta-analyses comply with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[15]

Eligibility criteria

The inclusion criteria for this systematic review and meta-analysis were observational studies (cross-sectional, case-control, and cohort studies) and clinical trials that evaluated the association between overweight/obesity and dental caries in ≤ 19-year-old Brazilian children of both sexes. The included studies should have used the BMI (Body Mass Index) for assessment of overweight/obesity and standardized caries indices for evaluation of dental caries.

The PECO question was as follows:

P (Patients): Brazilian children who were ≤ 19 years

E (Exposure): High BMI

C (Comparison): Normal BMI

O (Outcome): Dental caries

Case reports, case series, systematic reviews, abstracts of meetings, or studies whose full texts were unpublished or unavailable were excluded. No restrictions were placed on publication year and publication language.

Information sources and search strategy

Searches in Cochrane Library, LILACS (Latin American and Caribbean Health Sciences), PubMed, Scopus, and Web of Science were carried out. The searches were conducted from databases' date of inception until 2022. Keywords and MeSH terms were selected and electronic search strategies were developed for each database: An additional search in the grey literature (Open Grey), in Google Scholar, and a hand search of the references of the included studies were also performed. In Open Grey and Google Scholar, searches were restricted to the first 300 hits by order of relevance.[16] Endnote software (EndNote X7®, Clarivate Analytics, Toronto, Canada) was used to collect references and remove duplicates. Information concerning appropriate truncation and word combinations for each specific database is available in Figure 1.

Study selection

Study selection was carried out independently by two review authors (JFP and MVSZ) in two phases. In Phase 1, titles and abstracts were screened according to the eligibility criteria using an online software (Rayyan, Qatar Computing Research Institute). Those that appeared to satisfy the eligibility criteria were assessed in Phase 2. In Phase 2, the full-texts of studies selected in Phase 1 were screened, applying the same criteria. The studies whose full texts fulfilled the eligibility criteria were included. In both phases, discrepancies between review authors were resolved by means of discussion and a third review author (PVTD) was consulted if discrepancies persisted.

Data collection process

Data collection was conducted by two independent reviewers (JFP and MVSZ). The following data were extracted: author/year of publication, study design, sample size, participants' age, aim of the study, measurements evaluated and indices used to assess overweight/obesity and dental caries, statistical analysis, results of the association between dental caries and obesity in Brazilian children, and main

conclusion of the study. The authors of the included studies were contacted if the required data were incomplete. In case of missing data, three attempts to contact authors were carried out by means of the corresponding author's email address and Research Gate (http://www.researchgate.net/).

Risk of bias within studies

Risk of bias was assessed with the Joanna Briggs Institute Critical Appraisal Checklist according to the design of the included studies. Separately, two reviewers (JFP and MVSZ) performed the risk of bias evaluation and categorized each included article as a 'high risk' study when the study bias rating 'low risk of bias' score was between 0% and 49% of all items of the tool, a 'moderate risk' study when the study bias rating 'low risk of bias' score was between 50% and 69% of all items of the tool, and a 'low risk' study when the study bias rating 'low risk of bias' score was above 70% of all items of the tool. In cases of discordance between the two reviewers in rating bias, the third reviewer (PVTD) was consulted to resolve the disagreement.

Summary measures

The main outcome assessed was the association between overweight and dental caries, between obesity and dental caries, and between overweight/obesity and dental caries. The summary measure considered odds ratios (OR) in dichotomous variables, with 95% confidence intervals (CI). For continuous variables, the mean difference (MD) and median range (MR) were considered, also with 95% confidence intervals (CI).

Synthesis of results

Statistical heterogeneity was quantified using the I^2 test, and a value > 50% was considered as an indicator of substantial heterogeneity among studies, according to the appropriate Cochrane Guidelines. As a result, the random effect method was chosen to be the appropriate method for the meta-analysis. [17] On the other hand, when I^2 was lower than 50%, the fixed effect model is recommended.[17] The software RevMan 5.4 (Review Manager 5.4, The Cochrane Collaboration) was used to perform all the meta-analyses and create figures.

Strength of the evidence assessment

A summary of the overall strength of evidence available was provided using the 'Grading of Recommendations Assessment, Development and Evaluation' (GRADE). Summary of Findings (SoF) tables were produced with the aid of the GRADE online software (GRADEpro GTD, Copenhagen, Denmark) provided by the GRADE Working Group in association with the Cochrane Collaboration and Members of McMaster University (GRADEpro GDT: GRADEpro Guideline Development Tool [Software]. McMaster University and Evidence Prime, 2022. Available from gradepro.org).

Results

Study selection

A total of 1,405 references were retrieved within all searches. After the removal of duplicate hits, 1,362 remained for screening of title and abstract in Phase 1. After screening, 81 references were selected to Phase 2. After applying the eligibility criteria to the full text, 40 articles were excluded. Thus, 41 articles were finally included in this systematic review (Figure 1).

Study characteristics

Thirty-seven cross-sectional studies, three cohorts, and one case-control study were included. The Brazilian cities and regions where the studies had been performed were: Camboriú[18], Londrina[19,20], Porto Alegre[21,22], Pato Branco[23], Pelotas [9,24,25], Santa Cruz do Sul[26], Florianópolis[27], Califórnia[28] and Curitiba[11] in the South region; Diadema[29], Juiz de Fora[30], Piracicaba[31-33], Araraquara[34], São Paulo[35,36], Bauru[37,38], Dois Córregos[39], Araçatuba[40], Nova Friburgo[41], Ribeirão Preto[42], Diamantina[43], and Alfenas[44] in the Southeast region; Goiânia[45] in the Mid-west region; Acrelândia[46], Manaus[47-49], and Barcelos[50] in the North region; Carauru[51], Cabo de Santo Agostinho[52], Campina Grande[53,54], Teresina[55], and São Luis[56] in the Northeast region.

The studies were published between 2008 and 2021. The number of participants of the study with the largest sample was 1,528 individuals[21] and the number of participants in the study with the smallest sample was 54.[27] The age range of the participants varied from 12 months[29] to 19 years old[18,19,55]. Information regarding study characteristics can be found in Table 1.

Nutritional status was classified based on BMI in all studies, and the following reference curves were used to define obesity in children: National Center for Health Statistics 1993-1997[34,35,51]; Centers for Disease Control and Prevention (NCHS/CDC 2000)[18,19,23,31,42,52]; International Obesity Task Force (IOTF)[30]; WHO/2006[9,11,20,29,35,37,40,43,44,48,56]; WHO/2007[21,22,24,27,32,33,36,38,39,42,45,46,47,49,50,53,55], Hammer et al. (1991) criteria[41]; Conde e Monteiro (2006)[26]; and Cole et al. (2000)[25].

Six studies[18,19,23,31,51,52] assessed child and adolescent overweight and obesity using the BMI for age and gender percentiles from the 2000 Centers for Disease Control and Prevention (CDC) growth charts for children and adolescents from 2 to 20 years old (overweight: ≥ 85th percentile < 95th percentile and obesity: ≥ 95th percentile), while one paper[41] used similar parameters, based on Hammer et al. (1991). Ten studies used BMI for age and gender from WHO (2006) for children younger than five years, expressed by percentiles (overweight: ≥ 85th percentile < 97th percentile and obesity: ≥ 97th percentile)[20,37,40,43,44] or expressed by Z-score (overweight: Z-score > 1 and obesity: Z-score > 2)[9,11,29,48,56]. In one study, BMI for age and gender from WHO (2006) was used, but the classification used (percentiles or Z-score) was not reported[40]. Seventeen studies used BMI for age and gender from WHO (2007) for children and adolescents between five and 19 years, expressed by percentiles (overweight: ≥ 85th percentile < 97th percentile and obesity: ≥ 97th percentile)[27,36,38,39,42] or expressed by Z-score (overweight: Z-score > 1 and obesity: Z-score > 2)[21,22,24,45-47,49,50,53,55]. In two studies, BMI for age and gender from WHO (2007) was used, but the classification used (percentiles or Z-score) was not reported[32,33]. In four studies, overweight and obesity were identified from the curves equivalent to the BMI 25.0 kg/m^2 and 30.0 kg/m^2, respectively, which is recommended by Cole et al. (2000)[25,30,34] and by Conde e Monteiro (2006)[26]. One study[54] assessed child and adolescent overweight using standards for adult overweight (BMI > 24,9 kg/m^2) recommended by the WHO (1995). In one study, the reference curve that had been used to assess childhood overweight and obesity based on BMI was not reported[28].

Twenty-nine studies assessed dental caries using the DMFT/dmft indices[9,11,18-21,23-28,30-34,37-42,46-48,50,51,54], four studies used the component decayed of the DMFT/dmft[39,46,49,52], one study used the dft (decayed and filled primary teeth)[35], and one study used the disaggregated components of the dmft index[47]. Two studies evaluated decayed, missing, or filled surfaces in primary tooth (dmfs)[22,29]. One study assessed early childhood caries (ECC) (including cavitated and active non-cavitated

lesions as well as missing teeth and filled cavities) in primary teeth of children younger than 71 months of age[56]. Two studies took into consideration the severity of dental caries in their analyses using the dmft ≥ 6 (S-ECC)[45] and the dmfs ≥ 6 (S-ECC)[29]. Three studies assessed caries severity with the Significant Caries Index (SiC index)[30,39,45]. Five studies assessed dental caries using the ICDAS index[36,43,44,53,55]. White spot lesions (WSL) were also evaluated in one study[41].

Results of individual studies

Overweight x dental caries

Twenty-three studies tested the association between overweight and dental caries[9,11,19,20,22-24,26,28,32,33,36,37,41,42,44-50,55]. Of these, 21 found no association between the two variables investigated in children/adolescents[9,11,19,20,22,23,26,28,32-34,37,40-42,45-49,55]. Three studies concluded that overweight children/adolescents were less likely to exhibit dental caries than their normal weight peers[36,44,50].

Obesity x dental caries

Twenty-three studies tested the association between obesity and dental caries[9,19,20,22,23,26,28,29,32,33,34,35,37,40,41,42,44,46,47,48,49,52,55]. Of these, 18 found no association between these two variables investigated in children/adolescents[9,19,20,23,26,28,29,32-34,37,40-42,46,47,49,55]. Three studies demonstrated that obesity was associated with greater experiences of dental caries in children/adolescents[35,48,52]. Among these three studies, in one, the measurement of the association was limited to bivariate analysis[52]. Two studies showed that obesity was associated with fewer experience of dental caries in children/adolescents[22,44].

Overweight/obesity x dental caries

Fourteen studies tested the association between overweight/obesity and dental caries[18,21,24,25,30,31,38,39,43,44,51,53,54,56]. Of these, 10 found no association between these two variables investigated in children/adolescents[18,21,24,30,31,38,44,51,53,54]. Four studies demonstrated that overweight/obesity were associated with fewer experience of dental caries in children/adolescents[25,39,43,56]. Among these four studies, in one, the measurement of the association was limited to bivariate analysis[39].

Risk of bias within studies

In the cross-sectional studies, 30 studies exhibited low risk of bias[9,11,18,19,21,23,25-27,29-32,34,36-39,41-47,49,50,52,53,55], while five studies exhibited moderate risk of bias[20,28,33,35,48]. In addition, two studies showed a high risk of bias[40,54]. Eleven studies increased the risk of bias when evaluating the reliability of the exposure measure[20,24,26,28,32,33,36,40,43,44,54]. Of these, one[28] did not report the anthropometric curve used for BMI index and 10[20,24,26,32,33,36,40,43,44,54] showed errors in the description of parameters to assess obesity and overweight using BMI index. In general, the question which most commonly contributed to increase the risk of bias was "Were strategies to deal with confounding factors stated?". Only 22 studies declared strategies to deal with confounders[11,21,25-27,29,32,34-36,38,39,42-46,49,50,52,53,55]. The same happened with the case-control[51] study, which was considered to have a low risk of bias, receiving a negative score only for the question about strategies to deal with confounding factors stated. In the cohort studies, all studies exhibited low risk of bias[22,24,56] and the confounding factors were controlled in all of them. Further information about the criteria for grading the questions as 'low risk of bias' or 'high risk of bias' can be found in the Supplementary Table 1, Supplementary Table 2 and Supplementary Table 3.

Synthesis of results

Meta-analyses were performed according to the reference curves that had been used to define overweight and obesity in children and adolescents.

Overweight x dental caries

Of the studies that evaluated overweight children and adolescents using BMI for age and sex percentiles from the 2000 Centers for Disease Control and Prevention (CDC) growth charts, four meta-analyses were performed. Two meta-analyses for continuous outcome studies using the mean difference and inverse analysis of variance method and two meta-analyses for dichotomous data using odds ratios (OR) were performed. For continuous outcomes, a meta-analysis with two studies[23,41] with children in primary dentition showed that there was no difference between overweight and normal weight children in relation to dental caries (mean difference [MD] = 0.31 95% CI -0.10, 0.73) (Supplementary Figure 1). And other meta-analysis, which included two studies[19,23] with children/adolescents in permanent dentition, also showed that there was no difference between overweight and normal

weight children/adolescents in relation to dental caries (mean difference [MD] = -0.06 95% CI -1, 03, 0.91) (Supplementary Figure 2). For dichotomous outcomes, a meta-analysis with two studies[23,41] with children in primary dentition showed that there was no difference between overweight and normal weight children in relation to dental caries (odds ration [OR] = 1.02 95% CI 0.69, 1.53) (Supplementary Figure 3). And other meta-analysis, which included two studies[19,23] with children/adolescents in permanent dentition, also showed that there was no difference between overweight and normal weight children/adolescents in relation to dental caries (odds ration [OR] = 1.01 95% CI 0.43, 2.35) (Supplementary Figure 4).

Of the studies that evaluated overweight using the WHO BMI for age and sex (2007) for children/adolescents between 5 and 19 years old, expressed by the Z-score, a meta-analysis was performed with two studies[47,49] that evaluated the d component measured as untreated dental caries. No difference between overweight and normal weight children/adolescents in relation to untreated dental caries was found (mean difference [MD] = 0.03 95% CI -0.24, 0.30) (Supplementary Figure 5).

Obesity x dental caries

Of the studies that evaluated obesity children and adolescents using BMI for age and sex percentiles from the 2000 Centers for Disease Control and Prevention (CDC) growth charts, two meta-analyses were performed. One meta-analyse for continuous outcomes studies using the mean difference and inverse analysis of variance method and two meta-analyses for dichotomous data using odds ratios (OR). For continuous outcome, a meta-analysis with two studies[23,41] with children in primary dentition showed there was no difference between obesity and normal weight children in relation to dental caries (mean difference [MD] = -0.34 95% CI -0.96, 0.27) (Supplementary Figure 6). And other meta-analysis, which included two studies[19,23] with children/adolescents in permanent dentition, showed a higher mean of dental caries in children/adolescents with normal weigth (mean difference [MD] = (0.61 95% CI 0.08, 1.15) (Supplementary Figure 7).

Of the studies that evaluated obesity using the WHO BMI for age and sex (2007) for children/adolescents, expressed by the Z-score, a meta-analysis was performed with two studies[47,49] that evaluated the d component measured as untreated dental caries. No difference between overweight and normal weight

children/adolescents in relation to untreated dental caries was found (mean difference [MD] = 0.20 95% CI -0.03, 0.59) (Supplementary Figure 8).

Overweight/obesity x dental caries

Of the studies that evaluated overweight/obesity children and adolescents using BMI for age and sex percentiles from the 2000 Centers for Disease Control and Prevention (CDC) growth charts, two meta-analyses were performed for continuous outcome. One meta-analysis with two studies[23,41] included children in primary dentition showed there was no difference between overweight/obesity and normal weight children in relation to dental caries (odds ration [OR] = 0.83 95% CI 0.45, 1.54) (Supplementary Figure 9). And other meta-analysis, which included three studies[19,23,51] with children/adolescents in permanent dentition, showed there was no difference between overweight/obesity and normal weight children in relation to dental caries (odds ratio [OR] = 1.18 95% CI 0.71, 1.95) (Supplementary Figure 10).

Of the studies that evaluated overweight/obesity using the WHO BMI for age and sex (2007) for children/adolescents, expressed by the Z-score, a meta-analysis with two studies was performed[21,23]. No difference between overweight/obesity and normal weight children/adolescents in relation to dental caries was found (odds ration [OR] = 0.93 95% CI 0.78, 1.12) (Supplementary Figure 11).

Of the studies that evaluated overweigth/obesity using the WHO BMI for age and sex (2007) for children/adolescents, expressed by the percentiles, a meta-analysis was performed with two studies[38,39]. No difference between overweight/obesity and normal weight children/adolescents in relation to dental caries was found (odds ration [OR] = 0.83 95% CI 0.35, 1.94) (Supplementary Figure 12).

Of the studies that evaluated overweigth/obesity using the BMI for age and gender from WHO (2006) for children younger than five years, expressed by the Z-score, a meta-analysis was performed with three studies[9,11,56]. No difference between overweight/obesity and normal weight children/adolescents in relation to dental caries was found (odds ration [OR] = 0.86 95% CI 0.60, 1.22) (Supplementary Figure 13).

Strength of the evidence assessment

Based on the GRADE assessment the strength of evidence was rated “very low” for the results of the meta-analyses that used the anthropometric reference curves: CDC 2000 for obesity in children with primary teeth, CDC 2000 for overweight

and obesity in children/adolescents with permanent and deciduous teeth and CDC 2000 for overweight for children and adolescents with permanent and deciduous teeth; WHO 2007 Percentile for overweight and obesity in children and adolescents with permanent teeth; and WHO 2006 Z-Score for overweight and obesity in children with primary and permanent teeth. The strength of evidence was rated “low” for the results of the meta-analyses that used the anthropometric reference curves WHO 2007 Z-Score to assess obesity in children with untreated dental caries, the WHO 2007 Z-Score to assess overweight in children with untreated dental caries, and the WHO 2007 Z-Score to assess obesity and overweight in children and teenagers with permanent teeth. The strength of evidence was rated “moderate” for the meta-analysis outcome that used the CDC 2000 anthropometric reference curve for obesity in children/adolescents in permanent dentition. Additional information on the strength of evidence assessment is available in Supplementary Tables 4, 5, 6 and 7.

Discussion

The current systematic review and meta-analysis provides information on the association between overweight and obesity (as determined by BMI) and dental caries in Brazilian children and adolescents. The current review indicated that the evidence of an association between overweight and obesity and dental caries is contrasting and not consistent, as evaluated in other systematic reviews in which studies from several countries of the world were included.[6,14,57,58] The results of the meta-analyses showed, with very low or low strength of evidence, no association between dental caries with obesity, overweight, and overweight/obesity for most anthropometric reference curves employed to assess BMI. Moderate strength of evidence was found for the meta-analysis showing a greater experience of dental caries in the permanent dentition in normal weight adolescents compared to obese individuals, classified by the CDC 2000 curve.

The explaination of the non-association between high BMI and dental caries relies on the hypothesis that poor eating habits, including sucrose consumption, do not provide sufficient energy intake to promote significant changes in nutritional status of children and adolescents; however, when combined with a lack of inadequate hygiene or difficulties in accessing preventive care, inappropriate eating habits may interfere with oral health conditions. Inequalities in oral health of the Brazilian population portray the quite unequal wealth distribution across the country[59]. In terms of social and

economic characteristics, Brazil has a heterogeneous population, stressing the weight that living and working conditions have on determining the epidemiological patterns of heath outcomes linked to social exclusion.[60] These factors are considered to be potential effect modifiers that can lead to a weak association between obesity and dental caries.

Additionaly, as it was pointed out in a previous study, parents/caregivers may begin to restrict their children's consumption of foods with a high energy content in an attempt to control weight[61], which could influence the incidence of dental caries. In a Brazilian study, it was observed that the children with excess body weight were submitted to a greater control of snack consumption. Excess body weight was a protection factor against dental caries when it was analyzed separately. However, when it was controlled for the level of parental restriction regarding snack consumption, the association between excess body weight and dental caries lost its statistical significance.[11] Although obesity and dental caries in children have a multifactor etiology and the development of these two conditions involves important social-behavioral components, it must be considered that the volume, frequency and quality of the foods ingested are the most important factors in obesity[62], while the frequency and quality of eating practices are suggested to have a greater impact on dental caries than the systemic effect of nutrient intake[63].

In the literature, there have been other attempts to explain the lower prevalence of dental caries in obese individuals. The first suggests that the observed association between lower prevalence of dental caries and high BMI may be due to the increased consumption of high-fat and non-high-sugar diets, which are positively associated with obesity rather than dental caries. There are also reports in the literature of a possible protective effect of fatty foods on the frequency of dental caries.[64] Many studies also suggest that both caries and obesity are strongly influenced by socioeconomic factors[18,21,28,38,43,44,46,51,53]. Families with better social conditions have greater access to dental treatments, leading to lower rates of dental caries. At the same time, those families also have more access to foods that contribute to obesity. According to a national survey exploring data evaluating nutrient consumption, the caloric participation of lipids in the diet of the population of the Brazilian Southeast region is higher compared to other Brazilian regions and the national average.[65] For instance, the state of São Paulo, which belongs to the Southeast region, has the largest Gross Domestic Product of the country, while the state of Roraima, belonging to the

North region, has the lowest Gross Domestic Product.[66] In another proposed theory, the lower prevalence of dental caries in obese children is justified by the fact that overweight/obese children have high levels of the immunoglobulin A antibody (IgA-s) in their saliva[67,68], which is an important factor that has influence on the microbial adhesion on tooth surfaces and, consequently, may interfere in the process of caries development and prevention.[22,36,44]

Few studies included in this systematic review and meta-analysis showed an association between obesity, overweight and overweight/obesity with greater experience of dental caries in Brazilian children/ adolescents.[48,52] The primary studies, in which this association was found, showed a plausible mechanism explaining the increased prevalence and/or severity of caries in overweight/obese individuals. This association might be due to the diet and particularly high consumption of carbohydrates.[35,52] Taking into account that the diet of overweight individuals is characterised by a high consumption of carbohydrates and that sugar is widely recognised as an aetiological factor in caries development, this mechanism seems reasonable.[48] A systematic review[69] that evaluated the association between dental caries and obesity in studies developed worldwide highlighted that Swedish researchers found a reduced salivary flow in obese adolescents compared to their normal weight peers.[70] The authors suggested that reduced salivary flow affects the development of dental caries and therefore obese adolescents may be at an increased risk of caries due to the reduced amount of saliva.[70]

Studies that evaluated the association between dental caries and obesity indicate a variety of factors to be discussed that allow one to fully understand this relationship. The first question refers to the methods for diagnosing both outcomes.[69] In an attempt to reduce the heterogeneity between/among studies, the present systematic review and meta-analysis included only studies that evaluated dental caries using the visual method in clinical exams assessing teeth or surfaces, excluding those that used radiographic methods. There are also aspects that can interfere in the measurement of overweight and obesity. All studies included in this systematic review and meta-analysis evaluated overweight and obesity by meas of the measurement of BMI. There was no study that measured obesity using other diagnostic methods, such as skinfolds, waist circumference, waist-to-hip ratio, or radiographic densitometry (DXA). However, there was great variation between/among the studies in relation to the anthropometric reference curve employed to classify the participant as an

overweight or obese individual. These factors may also account for the heterogeneity of results among the primary studies included herein.

These findings reinforce the evidence that the association between BMI and caries is complex. Differences in methodology, such as experimental design, population and sample size, socioeconomic status, gender, educational level, occupation of the parents, lifestyle, dental caries index, BMI classification, physical activity, dietary habits, use of fluoride and oral hygiene, should be considered in attempting to explain the conflicting data.

Based on current published literature, there appears to be no association between obesity and/or overweight and dental caries in Brazilian children/adolescents for most anthropometric reference curves using BMI. A greater experience of dental caries was associated with well-nourished adolescents in permanent dentition compared to obese adolescents, classified by the CDC 200. Caution should be exercised due to the very low, low, and moderate strenght of evidence of the results to support such an association. Assessments with stronger methods and more standardised prospective studies, using a universal measurement system for both overweight/obesity and dental caries, considering possible effect-modifying factors, such as access to health services, fluoride use, oral health habits, socioeconomic status, and diet, are needed to increase the quality of evidence to confirm or not this possible association and to help in clarifying the direction of the association between these two important health conditions.

Conclusion

It was concluded that there is no association between obesity and/or overweight and dental caries in Brazilian children/adolescents for most anthropometric reference curves using BMI. A higher rate of dental caries was associated with healthy adolescents in permanent dentition compared to obese adolescents in the same dentition, classified by the CDC 2000. The strength of the evidence of the results, however, was considered very low, low and moderate.

Bullet Points (Why ihis Study is important for pediatric dentists)

- Acording to the available literature, it seens to be no association between obesity and/or overweight and dental caries in Brazilian children/adolescents for most anthropometric reference curves using BMI.

- The strenght of the evidence on this matter indicates that assessments with stronger methods and more standardised prospective studies are needed to help in clarifying the direction of the association between these variables and the factors which could be involved on it.
- Understanding how obesity/overweight and dental caries are related can provide broader preventive strategies based on your risk factors. This could support Brazilian health managers in the health decision-making process, in addition to facilitating collaborative and multidisciplinary approaches between specialists in Public Health, Nutrition, Medicine and Dentistry involved in the care of children and adolescents.

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Tables

Table 1 – Summary of descriptive characteristics of included articles

Author, Year	Study design	Sample/Setting	Age	Aim	Measurements Dental measurements/ Anthropometric measurements	Statistical Analysis	Findings	Main Conclusion
Oliveira, Sheiham, Bönecker 2008	Cross-Sectional	1.018 children randomly selected from all children attending each of the 17 health centres in the city of Diadema. Diadema, São Paulo, Brazil.	12-59 months	To assess whether dental caries was related to nutritional status in preschool urban Brazilian children aged 12–59 months.	Dental caries prevalence and severity were measured using the dmfs index. Two levels of severity were used, dichotomous dmfs (dmfs < 6 and dmfs ≥ 6). The anthropometric measurements were obtained according to WHO (2006) guidelines. The WHO Child Growth Standards Reference, was used to evaluate nutritional status. Z-score curves were generated, and cut-offs [± 2 standard deviations (SD)] were used to identify children at significant risk for either inadequate (< - 2 SD) or excessive (> +2 SD) growth for the following indicators:	Unconditional logistic regression Chi-square test/Fisher's exact test	BAZ - 2 ≤ Z-score ≤+2 With caries n= 209 (Total= 877) Z-score < -2 With caries n= 10 (Total= 20) OR (95% CI) = 3.20 (1.31–7.78) p= 0.007 Z-score > +2 With caries n= 19 (Total= 121) OR (95% CI) = 0.60 (0.36–1.00) p= 0.046 Logistic regression analysis model for	There was an association between nutritional and socio-economic factors, and dental caries. Where children with low Z-scores were more likely to have experienced dental caries; however, having over two Z-scores had a protective effect. Underweight children and those with adverse socio-economic conditions were

		weight-for-age (WAZ), height-for-age (HAZ), weight-for-height (WHZ), and BMI-for-age (BAZ).	factors associated with the prevalence of dental caries in Brazilian preschool children (Adjusted for mother´s level of education) BAZ Z-score < -2 OR (95% CI) = 3.20 (1.30–7.84) p= 0.011 Z-score > +2 OR (95% CI)= 0.58 (0.34–0.96) p= 0.036 BAZ - 2 ≤ Z-score ≤+2 dmfs < 6 n= 804 (Total= 877) dmfs ≥ 6 n=73 (Total= 877) Z-score < -2 dmfs < 6 n= 16 (Total= 20) dmfs ≥ 6 n= 4 (Total = 20) OR (95% CI) = 2.75 (0.90–8.45) p= 0.085	more likely to have caries experience.

							Z-score > +2 dmfs < 6 n= 115 (Total= 121) dmfs ≥ 6 n= 6 (Total= 121) OR (95% CI) = 0.57 (0.24–1.35) p= 0.199	
Carvalho *et al.* 2009	Cross-sectional	(480 students from public school Juiz de Fora, Minas Gerais, Brazil	4 – 18 years	Analyzed the influence of school snacks on the prevalence of dental caries and obesity.	DMFT, dmft and SiC Index. Anthropometric measurements used the body mass index (BMI) for age of each student recommended by the International Obesity Task Force to describe the prevalence of obesity in children and adolescents that were detected by the 85th and 95th percentiles respectively. (This was obtained from the division of weight by height squared of the individual (kg/m²)).	Descriptive statistics Parametric ANOVA test.	DMFT Eutrophic sample: 405 | Total: 1293 | Average: 3,1926 Obese and overweight sample: 75 | Total: 236 | Average: 3,1467 dmft: Eutrophic sample: 405 | Total: 558 | Average: 1,3778 Obese and overweight sample: 75 | Total: 83 | Average: 1,1067 p value= 0,92	The mean dmft was 1.33 and the mean DMFT was 3.18. There were no statistically significant differences (p = 0.92) in the mean DMFT according to the BMI and in the DMFT according to the BMI. The quality of school snacks did not influence the obesity and the prevalence of dental caries.
Crispim *et al* 2010	Cross-Sectional	(313 adolescents enrolled at the Colégio Agricultural School of Camboriú, unit of	5-19 years	To assess the oral health of adolescents and its association with nutritional	The dental measurements were obtained using DMFT index. This index was assessed using the form proposed by the WHO for epidemiological surveys in	Chi-square test, Dunn test,	DMFT= 0 Low weight n=1 (Total= 59) Normal Weight n=52 (Total= 59)	The results of this research point to the association gender, age and socioeconomic status of the

		the Federal University of Santa Catarina. Comboriú, Santa Catarina, Brazil.		status and socioeconomic condition	oral health. Dichotomous DMFT (DMFT= 0 and DMFT> 0). To assess nutritional status, the BMI was calculated, classified in accordance with the standard reference of the NCHS/CDC (2000) and the cut off points recommended by the WHO.	Kruskal-Wallis tests	Overweight and Obesity n=6 (Total= 59) DMFT> 0 Low weight n=7 (Total= 254) Normal Weight n=225 (Total= 254) Overweight and Obesity n=22 (Total= 254) p= 0.084 x^2 = 0.33	adolescents, but not their nutritional status, with their oral health.
Jamelli, Rodrigues, Lira 2010	Case control	(689 12-year-olds at public schools in the municipality of Caruaru - Cross-Sectional/ and a sample of 647 12-year-olds children enrolled at the selected schools - Case-control: 465 cases (DMFT≥ 1) and 182 controls/(DMFT=0) Carauru, Pernambuco, Brazil	12 years.	To investigate the possibility that malnutrition and overweight/obesity might act as factors associated with dental caries among 12-year-old children.	The dental measurements were obtained using DMFT index. Dichotomous DMFT (DMFT= 0 and DMFT≥ 1). Anthropometric weight and height evaluations, using the reference standard of the NCHS (Organización Munidal de la Salud, Organización Panamericana de La Salud, 1993|) were used to assessed nutricional status. Underweight and risk of overweight and overweight/obesity were identified in accordance with the criteria adopted by the Dietary and Nutritional Surveillance System (SISVAN). This consists of a	Bivariate analysis Chi-square test	P5 to < P85 With caries n= 368 (Total= 520) < P5 With caries n= 35 (Total= 46) OR (95% CI) = 1.31 (0.62-2.83) p= 0.55 ≥ P85 With caries n= 62 (Total= 81) OR (95% CI)= 1.35 (0.76–2.42) p= 0.35	In the present study, overweight/obesity was not found to be a factor associated with dental caries.

					percentile classification of the BMI according to age and gender on the NCHS standard reference scale (underweight = < P5, adequate weight = P5 to < P85, risk of overweight = ≥ P85 to < P95 and overweight/obesity = ≥ P95).			
Tambelini *et al.* 2010	Cross-Sectional	424 school-age adolescents of both genders enrolled at high schools of the Londrina (Paraná, Brazil) public school system. Londrina, Paraná, Brazil.	15-19 years	To evaluate the prevalence of dental caries and investigate its association with sociodemographic factors and excess weight in adolescents.	The dental measurements, caries prevalence and severity, were obtained using DMFT index, according to the criteria defined by the WHO. The body mass index (BMI) using the BMI percentile curves defined by the CDC (2000), was used to determined the Nutricional status.	Univariate analysis Chi-square test Mann-Whitney test Kruskal-Wallis tests	Low weight With caries n= 17 (Total= 23) p= 0.122 Dental caries severity Mean (SD) Low weight= 2.48 (2.11) p= 0.160 Normal weight With caries n= 225 (Total= 306) Dental caries severity Mean (SD) Normal weight= 2.92 (2.87) Overweight With caries n= 48 (Total= 59)	Sociodemographic factors have an important influence on the prevalence of dental caries in the study population. Greater excess weight was not associated with dental caries.

							Dental caries severity Mean (SD) Overweight= 3.46 (3.01) Obese With caries n= 19 (Total= 36) Dental caries severity Mean (SD) Obese= 2.39 (3.14)	
Tureli, Barbosa, Gavião 2010	Cross-Sectional	(97 Children from the public schools of Piracicaba. Piracicaba, São Paulo, Brazil	8 -12 years	To evaluate the masticatory performance (MP) of children while also considering body mass index (BMI) and dental conditions.	Dental measurements were appraised by dmf (primary teeth)/DMFT (permanent teeth) indexes, according to WHO (2006) criteria. The anthropometric measurements were establish using the criteria provided by the American Academy of Pediatrics (AAP) according to CDC (2000). BMI was calculated as the body weight (kg) divided by the height squared (m2). The percentiles for each child were determined by considering the following categories: obese if BMI was at or	Shapiro-Wilks W-test Analysis of variance Tukey's test as posthoc. Pearson's/ Spearman's coefficients Chi-square test	Normal weight n= 43 (Total= 97) DMFT (±SD) = 0.88±1.33 dmf (±SD) = 1.28±1.96 Underweight n= 24 (Total= 97) DMFT (±SD) = 0.75±1.23 dmf (±SD) = 0.67±1.40 Overweight/obese n= 30 (Total= 97) DMFT (±SD) = 0.97±1.71 dmf (±SD) = 0.77±1.48 p>.05	No significant differences in dental variables were observed among children with different BMI in this study.

					above the 95th percentile for age; overweight if BMI was at or above the 85th percentile and below the 95th percentile; normal weight if BMI was at or above the fifth percentile and below the 85th percentile; and underweight if BMI was below the fifth percentile.			
Campos *et al.* 2011	Cross-sectional	602 preschool children Araraquara, São Paulo, Brazil	5 years	To conduct a spatially analysis of the distribution of dental caries and the nutritional status (NS) of 5-year-old preschool children of public schools in the city of Araraquara, São Paulo, Brazil.	dmft index. The anthropometric indicators of the nutritional status to determine BMI were obtained by observing the weight (Kg) and height (cm) and classificated by the z score, according to the LMS parameters recommended by the National Center of Health Statistics; to study of malnutrition the z score was calculated by the indicators of weight/age (W/A), height/age (H/A), weight/height (W/H) and body mass index (BMI)	Descriptive statistical analysis was conducted and a thematic map.	It was revealed that both variables presented a pure nugget effect showing the absence of a spatial correlation, in other words the dmft and nutritional status are not regionalized variables, and their values do not reveal direct spatial dependence.	Dental caries and nutritional status are health conditions that do not reveal spatial dependence. Ultimately, the combination of these indicators with others can produce spatial dependence effects.

					and its classification was accomplished according to the recommendation of the WHO (1995).			
Silva *et al.* 2013	Cross-Sectional	(119 children from 3 to 5 years of age among whom 106 were residents in shantytowns in the Vila Mariana region, and 13 children followed up by CREN (Centro de Recuperação e Educação Nutricional). São Paulo, São Paulo, Brazil	3 -5 years	To measure the relationship between childhood obesity and dental caries in pre-schoolchildren, by means of two anthropometric growth curves.	The dental measurements were obtained using dft index. Dichotomous dft (dft= 0 and dft> 1). To evaluation the nutricional status the NCHS (1997) classification and WHO (2006) reference were used.	Univariate analysis Multivariate logistic regression	Dental caries (evaluated by the NCHS) dft = 0 n= 45 (Total= 119) dft > 1 n= 74 (Total= 119) NCHS dft> 1 Undernourished n= 16 (Total= 31) Eutrophic n= 41(Total= 67) Obese n=17 (Total= 21) WHO dft> 1 Undernourished n= 2 (Total= 10) Eutrophic n= 49 (Total= 75)	For the NCHS criterion there was association of dental caries with obesity, irrespective of the other factors evaluated. No association was found when evaluated by the WHO. Caution is needed on the decision about the method for nutritional diagnosis.

							Obese n= 23 (Total= 34) Factors associated with obesity, according to growth curves, values obtained by logistic regression NCHS adjusted dft> 1 PR (CI 95%) = 1.23 (1.00-1.50) p < 0.05 ANTHRO adjusted dft> 1 PR (CI 95%) = 1.27 (0.68-2.35).	
Alves *et al.* 2013	Cross-Sectional	(1528 schoolchildren aged 12 years old who were attending public and private schools were examined. Porto Alegre, Rio Grande do Sul, Brazil.	12 years	To assess the association between weight status and dental caries among 12-year-old Brazilian schoolchildren.	The dental measurements were obtained using DMFT index, according to WHO criteria. Caries prevalence was defined as the percentage of schoolchildren having at least one decayed, missing or filled tooth. Dichotomous DMFT (DMFT= 0 and DMFT ≥ 1).	Wald tests adjusted for multiple comparisons Survey Poisson regression models	Normal weight n= 986 (Total= 1528) Caries prevalence Mean (95% CI)= 55.86% (44.77–66.95) Caries extent Mean (95% CI) = 1.46 (1.11–1.81) Overweight n= 335 (Total= 1528) Caries prevalence Mean (95% CI) = 54.20% (41.33–67.07) Caries extent Mean	The independ study found no association between dental caries and weight status among South Brazilian schoolchildren. The findings indicate that overweight and obese adolescents should not be regarded as at higher risk of

					Anthropometric data were gathered to allow the calculation of body mass index (BMI) [weight (kg)/height (m^2)]. Overweight and obesity were defined according to WHO (2007) categories for BMI (body mass index)-for-age Z-scores. The sample was categorized as follows: normal weight (BMI-for-age Z-score ≤ +1 SD), overweight (BMI-for-age Z-score > +1 SD to ≤ +2 SD), and obese (BMI-for-age Z-score > +2 SD).		(95% CI) = 1.30 (0.78–1.81) Obese n=207 (Total= 1528) Caries prevalence Mean (95%CI) = 53.89% (44.36–63.41) Caries extent Mean (95%CI) = 1.19 (0.94–1.45) p > 0.05 Association between caries prevalence and predictor variables adjusted Poisson regression analysis Overweight PR (95% CI)= 0.99 (0.89–1.10) p= 0.88 Obese PR (95% CI)= 1.00 (0.87–1.16) p= 0.91	dental caries in this population.
Costa; Daher;	Cross-sectional	(269 children with caregivers	≅ 6 years	Investigate the association in children from low-income	DMFT-index, ECC, ECC and SiC-index.	Descriptive analyze Bivariate analyze	dmft > 0 (carie experience) Severe thinness or thinness: 1	BMI was not associated with any of the three categories of

Queiroz; 2013	Goiania, Goias, Brazil	families in Goiania, Goias, Brazil and considered the role of several social determinants	Anthropometric measures were weight and height, analyzed using the nutritional inquiry model of the WHO AnthroPlus v1.0.4 software (2007). Growth reference data for children and adolescents (5–19 years) were calculated, generating Z scores and percentile curves and cutoff points based on standard deviations (SD) from the median. Children were categorized as severely thin (<−3SD), thin (<−2SD), normal weight (−2SD to +1SD), overweight (> +1SD, equivalent to 25 kg/m 2 BMI at 19 years of age), or obese (> + 2SD, equivalent to BMI 30 kg / m 2 at 19 years).	Logistic regression analyze	Adequate: 114 Overweight: 18 Obesity: 10 Total = 143 6> dmft > 0 (active ECC) Severe thinness or thinness: 0 Adequate: 97 Overweight: 15 Obesity: 9 Total = 121 dmft ≥ 6 (active S-ECC): Severe thinness or thinness: 0 Adequate: 39 Overweight: 5 Obesity: 2 Total = 143 p value > 0,05 Independet variables: Children being overweight or obese: OR(95% CI) = 1,32 (0.70–2.50) p value= 0.40	dental caries (p > 0.05). In contrast, higher family incomes were significantly associated with the lack of caries experience in children (OR 1.22, 95%CI 1.01–1.50), but the mother's level of education was not significantly associated with ECC.

Xavier *et al.* 2013	Cross-Sectional	(229 preschool children between 3 and 5 years of in both genders. Bauru,São Paulo, Brazil	3-5 years	To evaluate the relationship between dental caries and nutritional status of preschool children attending public schools in a city in the State of São Paulo, Brazil.	The dental measurements were obtained using dmft index, and evaluating the percentage of individuals without caries. To evaluation the nutricional status the Body Mass Index (BMI) was used in accordance with the recommendations of the WHO (2006).	Spearman Correlation test	Thiness With caries n= 5 (Total= 8) dmft (sd) 4.00 (3.66) p= 0.538 Normal weight With caries n= 65 (Total= 153) dmft (sd) 1.60 (2.79) p= 0.252 Overweigh With caries n= 15 (Total= 48) dmft (sd) 1.27 (2.58) p= 0.151 Obesity With caries n= 9 (Total= 20) dmft (sd) 1.95 (3.46) p = 0.303 BMI x dmft (p= 0.088) decay p= 0.141 missing p = 0.470 fillings p = 0.328	Did not identify a significant correlation between dental caries and nutritional status of the preschool children, however, children with malnutrition showed higher prevalence of dental caries than those with normal nutritional status, overweight or obesity.
dos Santos	Cross-Sectional	(320 preschoolers Cabo de Santo Agostinho,	3 – 4 years	To assess the prevalence of early childhood	ECC Anthropometric measures to assess	Pearson's test Chi-square Multivariate Poisson test	- With ECC: Underweight: 2 (Total = 2)	The prevalence of early ECC was related to low family income,

Junior *et al.* 2014		Pernambuco, Brazil		caries (ECC), perinatal factors (gestational age, teenage pregnancy and birth weight), family income and nutritional risk in children.	nutritional risk were according to the CDC (Center for Disease Control) 2000, which analyzes the BMI (Body Mass Index) curve by age and sex from 2 to 19 years of age. The child was considered underweight when the value was below the 5th percentile, normal weight when between the 5th (inclusive) and below the 85th, overweight when between the 85th (inclusive) and 95th, and obese when above the 95th percentile.		Normal weight: 57 (Total = 310) Obesity: 5 (Total = 8) - Without ECC: Underweight: 0 (Total = 2) Normal weight: 253 (Total = 310) Obesity: 3 (Total = 8) p value: 0.01 Multivariate Poisson Regression PR (CI 95,0%): Obesity: 6,24 (3.06-12.72) p value < 0.001	premature birth and infant obesity.
Frazão *et al.* 2014	Cross-Sectional	(203 schoolchildren who lived in the urban area of a small town within the western Brazilian Amazon. Schoolchildren who were enrolled in urban schools in 2010 and who had participated in the 2007 census household survey formed the	7-9 years	To assess whether food insecurity is an associated factor for dental caries in 7- to 9-yr-old children living in the western Brazilian Amazon.	The dental measurements were obtained using (dmft/DMFT) index, criteria recommended by the WHO. To the evaluation was considered the sum of decayed deciduous and permanent teeth. The nutritional status was measured by Z-score for BMI in	Kruskal–Wallis test Mann–Whitney U-test, Robust Poisson regression	Decayed (deciduous/permanent) Lower quintile n= 38 (Total= 191) Mean (SD)= 4.53 (3.70) p= 0.205 Second quintile n= 38 (Total= 191) Mean (SD)= 3.32 (2.90)	Reduced caries experience was observed in children from the upper quintile of Z-scores for BMI in the crude analysis and in Model 2. The relationship between nutritional status and dental caries is controversial.

	basis for the present study. Acrelândia, Acre, Brazil.	accordance with the recommendations of the WHO (2007). The Z-scores for BMI were calculated, and children were classified in quintiles.	Third quintile n= 39 (Total= 191) Mean (SD)= 3.82 (3.29) Fourth quintile n=38 (Total= 191) Mean (SD)= 3.66 (3.49) Upper quintile n= 38 (Total= 191) Mean (SD)= 2.84 (3.20) p≤0.20 Adjusted hierarchical analysis for dental caries (Untreated decayed deciduous and permanent teeth) according to robust Poisson regression Second quintile RR (95% CI)= 0.70 (0.48–1.02) p= 0.067 Third quintile RR (95% CI)= 0.82 (0.56–1.21) p= 0.319

							Fourth quintile RR (95% CI)= 0.77 (0.53–1.12) p= 0.172 Upper quintile RR (95% CI)= 0.65 (0.41–1.02) p=0.059	
Freitas *et al.* 2014	Cross-Sectional	202 adolescents, 12 years of age, enrolled in five public schools, distributed in each region of the city. Dois Córregos, São Paulo, Brazil.	12 years	To evaluate the association between dental caries activity, quality of life and obesity in Brazilian adolescents.	The dental measurements were obtained using DMFT and significant caries (SiC) indices, in accordance with the WHO recommendations for epidemiological studies. The variable 'Dental Caries Activity' (DCA) was used, but just only for the permanent decayed teeth analysed. In anthropometric evaluation, the body mass index (BMI)-for-age percentiles, used by the WHO (2007) was applied. The BMI-for-age was used to divide the adolescents	Pearson correlation tests	Group N With caries n= 72 (Total= 101) DMFT mean 2.12 (D = 1.03; M = 0.02; F = 1.07) Group O With caries n= 58 (Total= 101) DMFT mean 1.67 (D = 0.65; M = 0.00; F = 1.02) p> 0.05 BMI-for-age x DCA OR (95% CI)= 0.579 (0.198–0.630) p < 0.000 BMI-for-age x SiC	No association was found between overweight/obese, dental caries and the oral impact on daily performance. Dental caries activity was not associated with obesity because this condition was most observed in the normal-weight adolescents.

					into two groups: overweight/obesity (Group O) - (BMI ≥ 85th percentile) and normal weight - (Group N) (3rd percentile ≥ BMI < 85th percentile).		OR (95% CI) = 0.649 (1.093–4.010) p = 0.024	
Lima *et al.* 2014	Cross-Sectional	(385 schoolchildren enrolled in public schools in 2006. Pato Branco, Paraná, Brazil.	6-15 years	To investigate possible associations between dental caries, obesity, sweet taste preference and sensitivity to bitter taste in children and adolescents.	The dental measurements were obtained using the criteria of WHO (dmft/DMFT indexes). The prevalence of dental caries was assessed (proportion of subjects with dmft / DMFT ≥1), and the severity / intensity of the disease (average dmft / DMFT in the group) Nutritional status was assessed using anthropometric criteria, adopting the reference standards of CDC. The BMI was calculated and the classification was made taking as reference the curves of CDC (2000) for children and	Chi-square test Kruskal Wallis test	Caries Prevalence Deciduous – Underweight n= 4 (Total= 10) Eutrophy n= 127 (Total= 283) Overweight n= 28 (Total= 58) Obesity n= 28 (Total= 34) Total n= 177 (Total= 385) p= 0.304 Permanent – Underweight n= 5 (Total= 10) Eutrophy n= 136 (Total= 283) Overweight n= 22 (Total= 58) Obesity	When the relationship between oral and anthropometric conditions was evaluated, statistically significant association was found (p <0.05), and the lowest DMFT index was recorded in the obese group.

					adolescents aged 2-20 years. Students with BMI below the 5th percentile were diagnosed as underweight. Those with BMI above the 95th percentile (p95) were classified as obese; and those with BMI between the 85th percentile (p85) and the 95th percentile (p95) were considered overweight.		n= 9 (Total= 34) Total n= 172 (Total= 385) p= 0.009 Caries Severity dmft Mean (SD) Underweight= 2.00 (3,05) Eutrophy = 1,75 (2.52) Overweight= 1.59 (2.20) Obesity= 2.38 (2.65) Total= 1.79 (2.50) p= 0.423 DMFT Mean (SD) Underweight= 1.50 (2.01) Eutrophy = 1.35 (2.08) Overweight= 0.90 (1.32) Obesity= 0.71(1.69) Total= 1.23 (1.96) p= 0.042	
Martins *et al.* 2014	Cross-Sectional	(91 children enrolled in a charity institution that serves as a	2-5 years	To determine the association between dental caries,	The dental measurements were obtained using the dmft index, according	Chi-square test of independence	dmft= 0 Thinness n= 1 (Total= 91)	The BMI classification was independent

		nursery and kindergarten in Araçatuba. Araçatuba, São Paulo, Brazil.		Body Mass Index (BMI) and sugar intake in children attending primary school in the countryside of Araçatuba, SP, Brazil.	to WHO criteria. Dichotomous dmft (dmft= 0 and dmft ≥ 1). Anthropometric assessment was evaluated using the BMI. Weight and height taken from each child were transformed in the corresponding z scores by age and sex. Furthermore complying with the recommendations of the WHO (2006), thinness, normal weight, risk for overweight, overweight and obesity were defined according to the criteria percentile for weight and height related to each sex and age group.	Contingency Coefficient C	Ideal weight n= 37(Total= 91) Risk of Overweight n= 12 (Total= 91) Overweight n= 7 (Total= 91) Obesity n= 4 (Total= 91) Total n= 61 (Total= 91) dmft≥ 1 Thinness n= 0 (Total= 91) Ideal weight n=20 (Total= 91) Risk of Overweight n= 5 (Total= 91) Overweight n= 3 (Total= 91) Obesity n= 2 (Total= 91) Total n= 30 (Total= 91) Chi-square = 0.1447 p = 0.7036	of the presence of dental caries, and no statistically significant association was found.
Silva 2014	Cohort	(1010 adolescents belonging to the	11-18 years	To evaluate the association between obesity	The dental measurements were obtained using the DMFT index and	Poisson regression	Poisson regression analysis of DMFT increment from 12 to 18 years according to	In conclusion, no association was found between the

		1993 birth cohort sample. Pelotas, Rio Grande do Sul, Brazil		throughout adolescence and dental caries at 18 years of age.	increase in the DMFT index from 12 to 18 years. The BMI was calculated according to WHO (2007) criteria for children and adolescents. Those with scores – z less than +1 standard deviation were considered as "normal BMI", those with z-scores between +1 and +2 standard deviations were considered as "overweight" and those with more than +2 z-scores were considered as “obesity”.		trajectory of BMI at 11 and 18 years in the birth cohort of Pelotas n= 1010 Overweight/Obesity at 11 years olds RR (95% CI) = 0,80(0,49-1,29) Overweight/Obesity at 18 years olds RR (95% CI) = 1,10(0,61-2,01) Always Overweight/Obesity RR (95% CI) = 0,84(0,55-1,27) p= 0,684	trajectory of obesity in adolescence and dental caries.
Aznar, 2015	Cross-Sectional	(153 adolescents - G1 - Overweight / Obesity (n = 65) and G2 - Eutrophic (n = 88). Bauru, São Paulo, Brazil	12 years	To analyze the relationship between oral health conditions and quality of life of adolescents overweight / obesity and eutrophic in	DMFT and dmft (WHO, 1997), fluorosis (Dean and Community fluorosis Indexes), CPI, DWI, DAI and salivary flow (ml / min) Anthropometric assessment was performed using BMI and analyzed	T-student’s Mann-Whitney Chi-Square Odds Ratio	DMFT = 0: G1: n= 32 (Total = 65) | G2: n = 49 (Total = 88) DMFT > 0: G1: n = 33 (Total = 65) | G2: n = 39 (Total = 88) OR (CI 95%): 0,642 (0,405 – 1,468) p value: 0,429	Overweight / obese adolescents presented with a lower prevalence of dental caries and periodontal changes compared to

				Bauru - São Paulo.	according to cutoff points and percentiles for age and gender, as recommended by the WHO (2007)	Pearson's Linear Correlation Coefficient	Carie = 0: G1: n = 47 (Total = 65) | G2: n = 56 (Total = 88) Carie > 0: G1: n = 18 (Total = 65) | G2: n = 32 (Total = 88) OR (CI 95%): 0,965 (0,334 – 1,343) p value = 0,258	eutrophic, but without significant differences.
Antunes *et al*. 2016	Cross-Sectional	488 children from 25 public day care centers in Nova Friburgo. Nova Friburgo, Rio de Janeiro, Brazil.	2-6 years	To evaluate the association of polymorphisms in genes MTR (rs1805087) and MTRR (rs1801394) with susceptibility of early childhood caries (ECC) and with body mass index alterations.	The dental measurements were obtained using the dmft index. White spot lesions (WSL) were also evaluated. Individuals were classified according to the presence or absence of caries as: Children WSL free (WSL = 0) or with WSL experience (WSL ≥ 1); Children caries free (dmft = 0) or with caries experience (dmft≥ 1); and Children without disease (WSL = 0 and dmft = 0) and children with disease (WSL ≥ 1 and/or dmft ≥ 1) BMI (weight/height^2) was calculated and compared with the international gender-and age-specific charts for BMI-for-age determination. The BMI-for-	Student t test $\chi 2$ test Pearson correlation tests	Underweight With caries = 20 (Total= 36) dmft mean ± SD= 2.19 ± 3.53 p= 0.16 WSL mean ± SD= 2.50±3.87 p= 0.05 Normal weight With caries n= 145 (Total= 334) dmft mean ± SD= 1.33 ± 2.50 WSL mean ± SD= 1.18 ± 2.57 Overweight n= 23 (Total= 59) dmft mean ± SD= 0.90 ± 1.89 p= 0.20 WSL mean ± SD= 0.88	The correlation test between caries experience and BMI did not demonstrate a relationship between these 2 continuous variables (R^2= 0.032, 0.152). This study did not find a significant association between ECC and overweight/obese BMIs.

		age categories were classified according to Hammer *et al*. (1991) as: BMI percentile of <5 for age: underweight; BMI percentile of ≥ 5 or <85: normal; BMI percentile of ≥ 85 or <95: overweight; BMI percentile ≥ 95: obese.	± 2.53 p= 0.41 Obese n= 25 (Total= 59) dmft mean ± SD= 1.46 ± 3.00 p= 0.72 WSL mean ± SD= 0.95±2.39 p= 0.52 Overweight + obese dmft mean ± SD= 1.18 ± 2.51 p= 0.57 WSL mean ± SD= 0.92 ± 2.45 p= 0.33 Normal weight versus underweight Caries experience= 112/15 p= 0.22 WSL experience= 189/16 WSL>0= 89/16 p= 0.04 With disease= 145/20 p= 0.16 Normal weight versus overweight Caries experience= 112/15

		p= 0.28 WSL experience= 189/36 WSL>0= 89/12 p= 0.33 With disease= 145/23 p= 0.52 Normal weight versus obese Caries free= 189/34 Caries experience= 112/19 p= 0.84 WSL experience= 189/34 WSL>0= 89/15 p= 0.84 With disease= 145/25 p= 0.88 Underweight versus obese Caries free= 16/34 Caries experience= 15/19 p= 0.25 WSL experience= 16/34 WSL>0= 16/15 p= 0.07 With disease= 20/25 p= 0.21

Aragão *et al.* 2016	Cross-sectional	(60 girls from public and private school Campina Grande, Paraíba, Brazil	15 -18 years	To evaluate the relationship between nutritional status and dental caries in Brazilian female adolescents with and without behavioral risk for eating disorders	The dental measurements were obtained using DMFT index Anthropometric measurements according to WHO (1995) to determine BMI: BMI value less than 18.5 is considered below normal; between 18.5 and 24.9 is considered normal; and greater than 24.9 is considered above normal) Questionnaire to collect sociodemographic data and BITE questionnaire.	Descriptive statistics Pearson chi-square or Fisher's exact test.	DMFT = 0 BMI normal or below normal: 6 (Total = 48)| BMI above normal: 2 (Total = 12) DMFT ≥ 1 BMI normal or below normal: 42 (Total = 48)| BMI above normal: 10 (Total = 12) p value= 0.655	The nutritional status was not associated with dental caries, however the monitoring of girls with high Body Mass Indexis important due to the increased risk of eating disorders.
Assi *et al.* 2016	Cross-Sectional	(169 children from public school Manaus, Amazonas, Brazil	9 – 12 years	To assess the relationship between periodontal disease, tooth decay and body weight in children from a public school in Manaus, AM, Brazil.	DMFT, dmft, CPI and BOP according WHO (2013). Anthropometric measurements based on WHO (1998) to determine BMI and classification in percentile Escore-z table.	Chi square test Kruskal-Wallis test	DMFT: Decayed: Obese: 0.5 ± 0.8 Overweight: 0.6 ± 0.9 Normal: 0.7 ± 1.1 Lean: 1.0 ± 2.4 p value= 0.8936 Missing: Obese: 0 ± 0 Overweight: 0.03 ± 0.2 Normal: 0 ± 0 Lean: 0 ± 0 p value= 0.9939 Filled: Obese: 0.25 ± 0.6	There was no relationship between body weight and the occurrence of dental caries and periodontal disease in the studied population. Obesity and overweight showed no negative influence on the increase in the prevalence of these diseases.

		Overweight: 0.3 ± 1.1 Normal: 0.2 ± 0.6 Lean: 0.2 ± 0.4 p value= 0.9730 Healthy: Obese: 17.25 ± 4.9 Overweight: 18.6 ± 5.0 Normal: 18.4 ± 5.6 Lean: 16.0 ± 6.6 p value= 0.8367 def: decayed: Obese: 0.25 ± 0.45 Overweight: 0.2 ± 0.5 Normal: 0.4 ± 0.9 Lean: 1.2 ± 1.8 p value= 0.7243 extracted: Obese: 0.3 ± 0.8 Overweight: 0.2 ± 0.5 Normal: 0.3 ± 0.8 Lean: 0 ± 0 p value= 0.8653 filled Obese: 0± 0 Overweight: 0.3± 0.65 Normal: 0.1 ± 0.4 Lean: 0.2 ± 0.4 p value= 0.6983 Healthy: Obese: 5.5 ± 4.9 Overweight: 3.5 ± 4.1

							Normal: 3.6 ± 3.9 Lean: 3 ± 2.9 p value= 0.5314	
Borges *et al.* 2016	Cross-sectional	623 adolescents Santa Cruz do Sul, Rio Grande do Sul, Brazil	12 – 17 years	To identify factors associated with obesity indicators and the manifestation of dental caries in schoolchildren in Santa Cruz do Sul-RS, Brazil.	DMFT. BMI was assessed by the ratio of total body mass (kg)/height² (m) and later classified using the protocol by Conde and Monteiro (2006), WC and %BF.	Descriptive statistics Poisson regression models Chi-square test.	Prevalence of caries: Normal or low weight: n=299 (Total = 468) Overweight: n= 63 (Total = 97) Obese: n= 34 (Total = 58) p value= 0,700 DMFT Normal or low weight PR (CI 95%): 1 DMFT overweight PR IC 95%: 1.01 (0.8-1.1) p value= 0,842 DMFT obesity PR (CI 95%): 0.91 (0.7-1.1) p value= 0,457	The findings demonstrated no associations between BMI, WC and %BF and dental caries in schoolchildren in southern Brazil. However, we emphasize that the low socioeconomic status and rural housing were associated with dental caries. These findings underscore the importance of implementing public health policies and preventive measures for the promotion of oral health.
da Silva *et al.* 2016	Cross-Sectional	237 children and adolescents seeking dental treatment at the School of	3 – 15 years	To evaluate the association between caries and body mass	The dental measurements were obtained using the dmft/DMFT index.	Shapiro-Wilk test,	Multivariate Analyses of the Caries Experience (adjusted for dietary, social, and	The results of this study suggest that BMI deviations are not associated with caries experience

	Dentistry of Ribeirão Preto, University of São Paulo between 2014 and 2015. Ribeirão Preto, São Paulo, Brazil,	index (BMI) deviations in Brazilian schoolchildren and adolescents.	BMI was calculated based on the subject's age, and was classified according to CDC (2000): BMI percentile less than five for age (underweight); at least five or less than 85 (healthy weight); at least 85 or less than 95 (overweight); and less than 95 (obese).	One-way analysis of variance Tukey's test Pearson's coefficient test Logistic regression analysis Multivariate analyses	oral hygiene factors) Overall caries experience Underweight p= 0.72 OR (95%CI) = 1.50 (0.16-13.8) Overweight p= 0.64 OR (95%CI) = 0.81 (0.35-1.91) Obese p= 0.20 OR= 0.32 (0.05-1.84) Obese + overweight p= 0.61 OR (95%CI) = 0.77 (0.55-1.98) caries experience x BMI r^2= 0.004 p= 0.293 Primary teeth caries experience Underweight p= 0.26 OR (95%CI) = 3.62 (0.23-1.72)	in a Brazilian population of children and adolescents.

	Overweight p= 0.41 OR (95%CI) = 0.72 (0.33-1.56) Obese p= 0.63 OR (95%CI) = 0.65 (0.11-3.69) Obese + overweight p= 0.55 OR (95%CI) = 0.69 (0.38-1.44) caries experience x BMI r^2= 0.012 p= 0.130 Permanent teeth caries experience Underweight p= 0.54 OR (95%CI) = 0.59 (0.11-3.19) Overweight p= 0.59 OR (95%CI) = 0.83 (0.42-1.61) caries experience x BMI r^2= 0.0005 p= 0.755

Gonçalves *et al.* 2016	Cross-sectional	(54 families son/daughter who also had a child (five to 12 years old) Florianópolis, Santa Catarina, Brazil	5 – 12 years	To assess intergenerational associations between dental caries and nutritional status, oral hygiene habits, and diet.	dmft/DMFT indexes. BMI was obtained from weight divided by height squared and categorized based on BMI for age percentile based on WHO growth charts (2007).	Poisson regression analysis	Higher BMI Coefficient (95% CI): -1.329 (-2.382; -0.275) value: 0.013	When children/ adolescents had a higher body mass index and they consumed fruits/vegetables as snacks more frequently, their caries experiences were lower. When their parents' did not visit the dentist regularly and they consumed sugar between meals more frequently, the children's caries experiences were higher.
Pinto-Sarmento *et al.* 2016	Cross-Sectional	(843 children enrolled at private and public preschools in the city of Campina Grande. Campina Grande, Paraíba, Brazil.	3-5 years	To determine factors associated with dental caries and lesion activity in the primary dentition using the ICDAS as the diagnostic criteria.	The dental measurements, dental caries and lesion activity, were obtained using the International Caries Detection and Assessment System (ICDAS). Nutritional status was determined using the Anthroplus software programme, according to WHO (2007) which provides BMI. Z scores were used to determine nutritional status based on standard deviations (SD) of	Logistic regression model	Logistic regression model considering design effect (unadjusted odds ratio) for dental caries and independent variables Malnutrition/severe malnutrition With caries n= 42 (Total= 56) OR (95%CI)= 1.46 (0.63–3.36) Ideal range With caries n= 366 (Total= 539)	Nutricional status was not a significant predictor for dental caries.

					the BMI. Children with a Z score < -1 for their height/weight ratio were classified with malnutrition/severe malnutrition; children with a score of -1 SD ≥ Z ≤ +1 SD for their height/weight ratio were considered in the ideal range; children with a score of + 1 SD ≥ Z ≤ 3 SD for their height/weight were considered overweight/obese.		OR (95%CI)= 1.50 (1.01–2.22) Overweight/obese With caries n= 151 (Total= 248) p > 0.05	
Porcelli et al. 2016	Cross-sectional	(285 schoolchildren Califórnia, Paraná, Brazil	6–17 years	To evaluate the relationships among dental caries prevalence, nutritional status, and social and demographic factors, as well as behavioral factors, in 285 schoolchildren aged between 6 and 17 years enrolled in the public education system in the	dmf-t and DMF-T index (WHO, 2012) To assess the nutritional status, the Body Mass Index (BMI) was used, following the recommendation of the American Medical Association - AMA Questionnaire about oral health behavior, eating behaviors and social and demographic characteristics.	Chi-square Mann-Whitney test Kruskal-Wallis test	dmft (SD) Low weight: 0,33 (0,72) Eutrophic: 0,74 (1,59) Overweight: 0,10 (0,31) Obesity: 0,86 (1,35) p value= 0,366 DMFT (SD) Low weight: 2,40 (2,02) Eutrophic: 1,72 (2,21) Overweight: 1,90 (1,91) Obesity: 0,82 (1,290 p value= 0,065	The fact that, in the obese group, the manifestation of caries disease is less in the dentition permanent and greater in the deciduous, shows the multifactorial character of the disease and suggests that studies are conducted.

				city of California-PR, southern Brazil.				
Araújo *et al.* 2017	Cross-Sectional	(	313 children Piracicaba, São Paulo, Brazil	8 – 10 years	Evaluated the association between excess weight and quality of life (QoL), symptoms of anxiety, caries experience and socio-economic factors in a representative sample of 8- to 10-year-old children from three public schools of Piracicaba (SP, Brazil).	DMFT/dmft indexes according WHO (1997). Anthropometric measurements according to WHO (2007) to determine BMI for age and sex.	Kolmogorov–Smirnov normality test Descriptive statistics Chi-square test ANOVA or Kruskal–Wallis (and Dunn post-test) test multiple logistic regression model.	DMFT (SD) Normal weight (n=188): 0.3 (0.8) Overweight (n=67): 0.4 (1.0) Obesity (n=54): 0.2 (0.7) dmft (SD) Normal weight (n=188): 1.0 (1.5) Overweight (n=67): 0.8 (1.3) Obesity (n=54): 0.7 (1.7) Multiple logistic regression model: DMFT: p value = 0.711 dmft: p value = 0.091	High prevalence of excess weight was observed among prepubertal children, emphasizing the need for continued health programmes to limit risk factors for obesity. QoL, anxiety scores and caries experience did not differ between subjects with different body weights, although children from public schools with higher ownership of goods and services were more likely to present excess weight.
Fernández *et al*. 2017	Cross-sectional	(	1,210 children from 20 private and public schools in Pelotas	8 – 12 years	To determine the association between dental caries and weight	Dental caries experience (DMFT), dental caries prevalence (DMFT≥1) and	Descriptive analyses, multivariate Poisson Regression,	DMFT ≥ 1 obese/overweight: RP (CI 95%): 0.79 (0.65–0.97)	Obesity/overweight and physical activity level presented an inverse

		Pelotas, Rio Grande do Sul, Brazil		status, and between dental caries and physical activity in Brazilian schoolchildren aged 8 to 12 years.	visible gingival bleeding index. Height (in meters) and weight (in kilograms) for the calculation of BMI. After, BMI data were categorized considering the age- and sex-specific cut off points and children were classified as normal or overweight/obese accordingly.	Chi-squared test, prevalence ratio	Mean DMFT (obese/overweight: RP (CI 95%): 0.73 (0.57–0.94) Model adjusted for socioeconomic variables (type of school, family income and mother's education) and demographic variable (sex and age).	relationship with dental caries. Longitudinal studies investigating the complexity of this relationship are required.
Lima, 2017	Cross-Sectional	(360 adolescents Teresina, Piauí, Brazil	12 – 19 years	Evaluate the relationship between tooth decay, periodontal condition and obesity in 360 obese or overweight adolescents, in the age group 12 to 19 years old, divided into 3 groups (1- eutrophic, 2- overweight and 3- obese).	ICDAS II, PSR and IP. The body mass index (BMI) was determined by dividing the individual's mass (kg) by the square of their height (m). Overweight and obesity were classified using cutoff points, adjusted for age and sex, proposed by Cole et al. (2000). Weight and height data were converted into anthropometric indices for age and BMI for age in z-scores using the World Health Organization growth curves (WHO, 2007).	Descriptive data analysis Chi-square Fisher's exact test Odds Ratio / Prevalence Ratio.	ICDAS (1-6>0) - With Carie: Eutrophic: 65 (18,1%) Overweight: 77 (21,4%) Obesity: 62 (17,2%) Total = 204 (56,7%) - Without Carie: Eutrophic - 55 (15,3%) Overweight - 43 (11,9%) Obesity - 58 (16,1%) Total = 156 (43,3%) p value= 0,118 ICDAS (4-6>0) - With Carie: Eutrophic: 31 (8,6%) Overweight: 28 (7,8%) Obesity: 22 (6,1%) Total = 81 (22,5%)	The overall prevalence of dental caries (present or absent), in the two cutoff points used, did not show a significant association with the groups according to the BMI.

							- Without Carie: Eutrophic: 89 (24,7) Overweight: 92 (25,6) Obesity: 98 (27,2) Total = 279 (77,5) p value= 0,367	
Ribeiro *et al.* 2017	Historical Cohort	I	388 children São Luis, Maranhão, Brazil	2 – 5,9 years (24–71 months)	To investigated the association between being overweight or obese and early childhood caries (ECC) in a developing country testing the confounding effects of socioeconomic factors and frequency of sugar consumption based on theoretical models depicted in directed	ECC. Height (cm) and body weight (kg) to determine BMI. BMI values were expressed as Z-scores, and these were calculated using WHO Anthro software 3.2.2 for the children up to 60 months in age, and WHO Anthro Plus software 1.4.0 for children older than 60 months of age. The cutoff point of >+2 standard deviation (SD) classifies high body mass index/age as overweight or obese16, while <1 SD was used to identify thin or very thin and values from 1 ≥ SD < 2 eutrophic (WHO, 2006).	Poisson regression models, density ratios	ECC Eutrophic (Total = 323) Overweight/obesity (Total = 26): IR (95% CI): 1.52 (1.03–2.22) p value= 0.033 Thin/very thin (Total = 39): IR (95% CI): 1.97 (1.52–2.54) p value < 0.001	Being overweight or obese (IR = 1.52; 95% CI: 1.03–2.22) was independently associated with ECC. Being thin or very thin (IR = 1.97; 95% CI: 1.52–2.54), a high frequency of sugar consumption (IR = 1.83; 95% CI: 1.42–2.38), and age (IR = 3.62; 95% CI: 2.58–5.08) were associated with ECC.

				acyclic graphs (DAGs).				
Soares *et al.* 2017	Cross-sectional	(285 children allocated to three groups: underweight, ideal weight and overweight/obesity. Diamantina, Minas Gerais, Brazil	3-5 years	To determine the influence of masticatory function, dental caries and socioeconomic status on the body mass index (BMI) of preschool children.	ICDAS, masticatory performance (MP) and the swallowing threshold (ST). BMI was calculated as weight (kg) divided by height (m) squared (kg/m2). The values were plotted on a growth curve established based on age and sex, according WHO (2006).	Kruskal-Wallis test Mann-Whitney test Chi-square test Simple and multiple linear regression analyses.	N° of cavitated teeth − mean (SD) Ideal: 1.07 (± 0.30) Overweight/obesity: 0.69 (± 0.18) Underweight: 1.49 (± 0.28) p value: nderweight Multiple linear regression for N° of cavitated teeth and BMI: B: −0.173 Standart error: 0.061 Beta: −0.180 95% CI (Lower-Upper): −0.293 (−0.054) t: −2.854 p[a]: 0.005	Children whose food test resulted in large particles and those from families with a higher monthly income had a higher BMI. Children with a greater number of teeth with cavitated dental caries had a lower BMI.
Fraiz *et al.* 2019	Cross-Sectional	(686 preschool children and their parents/caregivers. Curitiba, Paraná, Brazil	4 – 5,11 years	To evaluate the relationship between excess body weight (EBW) and the prevalence of dental caries in	dmft-index (WHO, 1997). Anthropometric measures (weight and height) to calculate BMI, according to WHO (1995) and classification of the nutritional status based on the BMI of children less than five years of age was	Univariate and multivariate Poisson regression analysis.	dmft = 0 Ideal weight: 180 (Total = 404) Excess body weight: 152 (Total = 278) p value: 0.011 PRcrude: 1 dmft ≥ 1	Among the preschoolers analyzed in the present study, excess body weight was not significantly associated with dental caries, whereas a lower

				preschoolers considering parental control regarding snack consumption.	performed using the child growth curves proposed by the WHO (2007) categorized by z-score references considering age and sex.		Ideal weight: 224 (Total = 404) Excess body weight: 126 (Total = 278) PRcrude (CI 95%): 0.817 (0.699-0.955) Multivariate Poisson regression: Ideal Weight: p value = 0.056 | PR = 1 | Excess Body Weight: PR (95% CI) = 0.841 (0.704-1.004)	parental limit regarding snack consumption by the children was independently associated with a higher prevalence rate of dental caries.
Guaré *et al.* 2019	Cross-Sectional	(91 children/ adolescents São Paulo, São Paulo, Brazil	6 – 12 years	To compare (a) enamel carious (EC) and dentin carious (DC) lesions and (b) caries risk, between normal-weight (NW) and overweight/obese (OW) children/ adolescents.	ICDAS. Anthropometric measurements were weight and height to calculate BMI and classification according to the Z score (WHO, 2007).	Logistic regression analysis Odds Ratios Descriptive and inferential statistics (association tests) Kolmogorov-Smirnov and Levene tests Fisher's exact test Chi-square, test Student's t test Mann-Whitney test	"EC/DC" (ICDAS 1-3/4-6) No caries - Normal weight: 5 (Total = 50) - Overweight: 6 (Total = 41) Low caries - Normal weight: 6 (Total = 50) - Overweight: 11 (Total = 41) Moderate-high caries - Normal weight: 9 (Total = 50) - Overweight: 6 (Total = 41)	OW children/adolescents had lower caries experience, at both ICDAS thresholds, and lower caries risk, compared to NW children/adolescents.

						Spearman rank correlation (rho)	Very high caries - Normal weight: 30 (Total = 50) - Overweight: 18 (Total = 41) p value= 0. 2295	
Lock *et al.* 2019	Cohort	(	801 12-years-old schoolchildren of public and private schools, who were followed-up for 2.5 ± 0.3 years. Porto Alegre, Rio Grande do Sul, Brazil.	12 years	To assess the association between weight status and ΔDMFS among 12-year-old schoolchildren from South Brazil.	The dental measurements were obtained using the DMFS index, and difference between DMFS at follow-up and baseline (ΔDMFS). BMI-for-age Z-scores were measured, and the sample was categorized using cutoffs recommended by the WHO (2007) as: normal weight (BMI-for-age Z-score ≤ +1 SD), overweight (BMI-for-age Z-score > +1 SD to ≤ +2 SD), and obese (BMI-for-age Z-score > +2 SD).	Chi-square test Wald tests Negative binomial regression models (unadjusted and adjusted) Multivariable fractional polynomial model, Multivariable linear regression model	ΔDMFS Mean Normal weight 0.86 (95%CI) = (0.65–1.07) Overweight= 0.91 (95% CI) = (0.59–1.23) Obese= 0.42 (95%CI) = (0.03–0.80) p < 0.05 Association between predictor variables and ΔDMFS (adjusted Negative binomial regression analysis) Overweight IRR (95% CI) = 0.92 (0.69–1.21) p= 0.54 Obese IRR (95% CI) = 0.75 (0.51–1.12)	In conclusion, this population-based longitudinal study showed an inverse association between obesity and ΔDMFS over a 2.5-year period among South Brazilian adolescents.

							p= 0.16	
Porcelli *et al.* 2019	Cross-sectional	(191 childrens Londrina, Paraná, Brazil	4 – 5 years	To evaluate the sweetness taste preference levels and their relationship with the nutritional and dental caries patterns among preschool children.	dmf-t index according WHO (1997). Values of weight, height and to dertmine BMI; After, BMI were transformed into z scores and percentiles based on the World Health Organization child growth standards (2006).	Univariate descriptive analysis Nonparametric tests Chi-square Kruskal-Wallis	- Caries Free: Underweight: 3 (Total = 7) Eutrophy: 63 (Total = 131) Overweight: 21 (Total = 44) Obesity: 5 (Total = 9) - With caries: Underweight: 4 (Total =7) Eutrophy: 68 (Total = 131) Overweight: 23 (Total = 44) Obesity: 4 (Total = 9) p value= 0.721 Caries severety: Mean dmft (SD) Underweight: 2.71 (± 3.98) Eutrophy: 1.87 (± 2.61) Overweight: 1.83 (± 2.81) Obesity: 2.57 (± 3.60) p value= 0.977	No significant associations could be stablished between the sweetness taste preference and the diseases studied, nor between excess weight and dental caries. However, the findings of high patterns of sweet preference, excess weight and untreated caries experience, highlight the need for the implementation of integrated public policies aimed at controlling both nutritional and of oral health problems in the studied population.

Vasconcelos *et al*. 2019	Cross-Sectional	(197 students from public schools at Manaus. Manaus, Amazonas, Brazil.	10-12 years	To evaluate the association between dental caries and nutritional status in a group of Brazilian schoolchildren, from Manaus (Amazonas).	The dental measurements were obtained using the dmft/DMFT index. The nutricional status was classified according to the parameters of WHO (2006). BMI Z-score was calculated using variables such as individual height, weight, age, and gender. The nutritional status was classified as underweight, eutrophic, overweight, and obese (BMI Z-score- Underweight <−2; Eutrophic ≥−2 and ≤+1; Overweight >+1 and ≤+2; Obese +2/ Percentile Underweight <3; Eutrophic ≥3 and ≤85; Overweight >85 and ≤97; Obese >97).	Shapiro–Wilk's test A one-way ANOVA Tukey's post test	dmft/DMFT Mean Eutrophic= 1.57 (SD 2.00) Overweight= 1.44 (SD 1.86) Obese= 3.12 (SD 2.63) - $p < 0.05$	The study demonstrated that dental caries is associated with obesity, but not with overweight and underweight, in school children from Manaus.
Aranha *et al.* 2020	Cross-Sectional	(1090 children and adolescents from public school. Only 1074 underwent dental examinations. Barcelos, Amazonas, Brazil	5 – 17 years	To verify the association of the prevalence of short body height and excess weight with the experience of dental caries in children and adolescents, enrolled in	The dental measurements were obtained using DMFT and dmft. Anthropometric indices body height for age (H/A), BMI for age in Z-score values (standard deviation units), compared to the reference standard of the WHO (2007). For the classification of short body	Mantel-Hanzel Stratification Method Logistic regression	Overweight with caries experience: 128 (Total = 817) Overweight without caries: 63 (Total = 257) p value (multiple) = 0,008	Overweight was the most prevalent nutritional problem, and students with caries experience were less likely to be overweight than caries-free students.

				elementary school and in the public school system.	stature, the cutoff points < -2 Z-score were used, and for the classification of excess weight. weight by the BMI index for age, cutoff points >+1 Z-score were used, according to the classification of the Nutritional Surveillance System.		OR (CI 95%): 0,62 (0,44-0,88)	
Araujo *et al*. 2020	Cross-Sectional	(248 consented adolescents who were selected from 12 public schools of the municipality of Piracicaba. Piracicaba, São Paulo, Brazil	14–17 years	To evaluate the cross-sectional relationship between salivary microbiota, gingival health status, and excess weight in adolescents.	The presence of caries experience was examined using the DMFT index. Anthropometric and nutritional assessments involved measurements of height, weight, body fat mass, skeletal muscle mass, and intracellular and extracellular water. Body mass index (BMI= Kg/m^2) was used to classify the sample into normal-weight, overweight, and obesity. It was calculated in accordance with the recommendations of the WHO (2007).	Kruskal-Wallis test	Girls normal-weight n= 66 (Total= 248) DMFT index (Median 25-75%) = 0 (0–2) Boys normal-weight n= 76 (Total= 248) DMFT index (Median 25-75%) = 0 (0–3) Girls overweight n= 30 (Total= 248) DMFT index (Median 25-75%) = 1.5 (0–6) Boys overweight n= 32 (Total= 248) DMFT index (Median 25-75%) = 1 (0–2) Girls obesity n= 23(Total= 248)	This study showed that there was no difference in caries experience between groups classified according to BMI.

							DMFT index (Median 25-75%) = 1 (0–2) Boys obesity n= 21 (Total= 248) DMFT index (Median 25-75%) = 0 (0–1) Caries experience male p = 0.536 female p = 0.124	
Rego *et al.* 2020	Cross-Sectional	(406 12-year-old children living with limited economic resources. Manaus, Amazonas, Brazil	12 years	To investigate the relationship between nutritional status and dental caries in 12-year-old low-income children.	The dental measurements were obtained using the decayed (D) component of DMFT index. BMI was calculated by dividing the weight by the height squared. WHO growth curves (2006) were used as the reference standards of BMI-for-age to classify the individuals according to the Z-scores for BMI-for-age. The children were categorized into four groups (WHO, 2007) - (Underweight (z-score <−2), normal weight (z-score ≥-2 to z-score <+1), overweight (z-score ≥+1 to z-score <+2), and obese (z-score ≥+2)).	Bivariate/ multivariate multilevel Poisson regression	Underweight n= 14 (Total= 406) Decayed teeth mean (SD) = 1.50 (2.50) Normal n= 295 (Total= 406) Decayed teeth mean (SD) = 0.87 (1.52) Overweight n= 69 (Total= 406) Decayed teeth mean (SD) = 0.91 (1.47) Obesity n= 28 (Total= 406) Decayed teeth mean (SD)= 0.54 (0.96) Multilevel Poisson	The findings suggest that malnutrition is associated with dental caries among children from low-income families. Underweight children were more likely to have greater number of untreated dental caries than normal-weight children even when potential confounders were taken into account.

							regression of the association between socio-economic position, demographics, behavioural and biological factors, material circumstances, psychosocial factors, and number of untreated dental caries (adjusted associations) Underweight RR (95%CI) = 1.60 (1.13-2.57) p=< .01 Overweight RR (95%CI) = 0.94 (0.71-1.26) Obesity RR (95%CI) = 0.73 (0.42-1.27)	
Barbosa *et al.* 2021	Cross-Sectional	353 schoolchildren Alfenas, Minas Gerais, Brazil	8 – 11 years	To evaluate if nutritional status is associated with caries and gingivitis in Brazilian schoolchildren.	ICDAS and CPI Nutritional status was calculated for each child using a Z-score body mass	Parametric analyzes Chi-square Oneway ANOVA with	Non-cavitaded caries lesion vs Cavitade caries lesion Eutrophic: ICDAS (0-2): 132 (Total = 202)	Overweight, Obese and Overweight + Obese children presented less cavitated caries lesion than Eutrophic children (P < .05).

		index (BMI) calculator, according to WHO (2006) Questionnaire about oral health behavior and dietary habit.	Tukey's post-test Odds Ratio	ICDAS (3-6): 115 (Total = 151) Underweight: ICDAS (0-2): 8 (Total = 202) ICDAS (3-6): 8 (Total = 151) P value= 0.78 OR (95% CI): 1.14 (0.41 – 3.15) Overweight: ICDAS (0-2): 43 (Total = 202) ICDAS (3-6): 21 (Total = 151) P value= 0.04 OR (95% CI): 0.56 (0.32 – 0.99) Obese: ICDAS (0-2): 19 (Total = 202) ICDAS (3-6): 7 (Total = 151) P value= 0.05 OR (95% CI): 0.42 (0.15 – 1.0) Overweight + obese: ICDAS (0-2): 62 (Total = 202) ICDAS (3-6): 28 (Total = 151) P value= 0.01

			OR (95% CI): 0.51 (0.31 – 0.87) Health vs Caries Eutrophic: ICDAS (0): 125 (Total = 189) ICDAS(1-6): 122 (Total = 164) Underweight: ICDAS (0): 8 (Total = 189) ICDAS (1-6): 8 (Total = 164) p value: 0.96 OR (95% CI): 1.02 (0.37 – 2.81) Overweight: ICDAS (0): 38 (Total = 189) ICDAS (1-6): 26 (Total = 164) P value= 0.21 OR (95% CI): 0.70 (0.40-1.22) Obese: ICDAS (0): 18 (Total = 189) ICDAS (1-6): 8 (Total = 164) P value= 0.07 OR (95% CI): 0.45 (0.20 – 1.1)

							Overweight + obese: ICDAS (0): 56 (Total = 189) ICDAS (1-6): 34 (Total = 164) P value= 0.05 OR (95% CI): 0.62 (0.37 – 1.00)	
Shqair *et al.* 2021	Cross-Sectional	(580 children aged 8 years enrolled in 20 public schools. Pelotas, Rio Grande do Sul, Brazil	8 years	To assess eating behavior traits in children with or without dental caries.	The dental measurements were obtained using WHO criteria, DMFT/dmft index. Dichotomous DMFT/dmft (DMFT/dmft = 0 and DMFT/dmft ≥1). BMI for age z-scores were calculated. The cut-offs recommended by the WHO (2006) were used: overweight > + 1 Z-score and obesity > + 2 z-score).	Chi-squared test χ^2 test	dmft/DMFT ≥1 Eutrophic n= 204 (Total= 315) Overweight n= 75 (Total= 121) Obesity n= 83 (Total= 139) p= 0.572	The nutricional status was not associated with the higher prevalence of dental caries.

Figures and legends

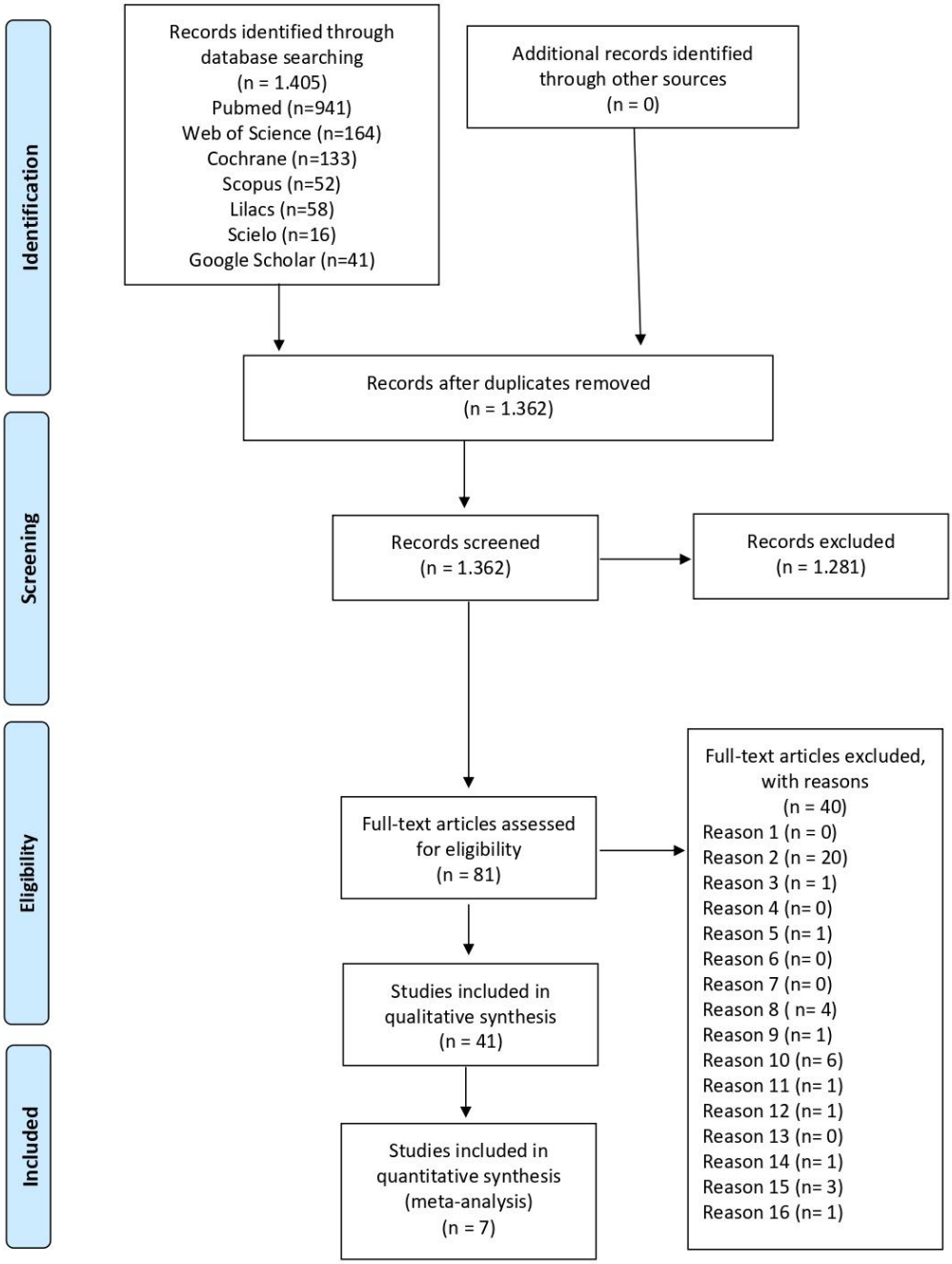


Figure 1- Flow diagram of literature search and selection criteria

Appendices

SUPPLEMENTARY TABLES

S1 Table: Study quality for cross-sectional studies

AUTHORS	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?
Oliveira, Sheiham and Bönecker 2008	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Carvalho et al. 2009	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Crispim *et al.* 2010	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Tambelini *et al.* 2010	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Tureli, Barbosa and Gavião 2010	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Silva *et al.* 2013	Unclear	Yes	Unclear	Unclear	Yes	Yes	Yes	Yes
Campos et al. 2011	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Alves *et al.* 2013	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Costa, Daher and Queiroz, 2013	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Xavier *et al.* 2013	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
dos Santos Junior et al. 2014	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Frazão *et al.* 2014	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Freitas *et al.* 2014	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lima *et al.* 2014	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Martins *et al.* 2014	Yes	Yes	Yes	Yes	Unclear	No	Yes	Yes

Aznar, 2015	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Antunes *et al.* 2016	Yes	Yes	No	No	Yes	No	Yes	Yes
Aragão et al. 2016	Yes	No	Yes	Yes	No	No	Yes	Yes
Assi et al. 2016	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
da Silva *et al.* 2016	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Borges et al. 2016	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Gonçalves et al. 2016	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pinto-Sarmento *et al.* 2016	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Porcelli et al. 2016	Yes	Yes	Unclear	Yes	Yes	No	Yes	Yes
Araújo et al. 2017	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fernández et al. 2017	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Soares et al. 2017	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fraiz et al. 2019	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Guaré et al. 2019	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Lima, 2017	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes
Porcelli et al. 2019	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Vasconcelos *et al.* 2019	No	Yes	Yes	Yes	No	No	Yes	Yes
Aranha et al. 2020	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Araujo *et al.* 2020	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Rego *et al.* 2020	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Barbosa et al. 2021	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shqair et al. 2021	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes

S2 Table: Study quality for case-control studies

Author, year	Were the groups comparable other than presence of disease in cases or absence of disease in controls?	Were cases and controls matched appropriately ?	Were the same criteria used for identification of cases and controls?	Was exposure measured in a standard, valid and reliable way?	Was exposure measured in the same way for cases and controls?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were outcomes assessed in a standard, valid and reliable way for cases and controls?	Was the exposure period of interest long enough to be meaningful?	Was appropriate statistical analysis used?
Jamelli, Rodrigues, Lira 2010	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes

S3 Table: Study quality for coorte studies

Author, year	**Were the two groups similar and recruited from the same population?**	**Were the exposures measured similarly to assign people to both exposed and unexposed groups?**	**Was the exposure measured in a valid and reliable way?**	**Were confounding factors identified?**	**Were strategies to deal with confounding factors stated?**	**Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?**	**Were the outcomes measured in a valid and reliable way?**	**Was the follow up time reported and sufficient to be long enough for outcomes to occur?**	**Was follow up complete, and if not, were the reasons to loss to follow up described and explored?**	**Were strategies to address incomplete follow up utilized?**	**Was appropriate statistical analysis used?**
Silva, 2014	Not applicable	Not applicable	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Ribeiro et al., 2017	Not applicable	Not applicable	Yes	Yes	Yes	No	Yes	Yes	Yes	Not appicable	Yes
Lock et al. 2019	Not applicable	Not applicable	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes

S4 Table: Assessment of the certainty of the evidence of studies that used WHO 2007 Z score as an anthropometric curve of the BMI

Certainty assessment							№ of patients		Effect			
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Obesity/ Overweight and Obesity/ Overweight**	**Normal Weight**	**Relative (95% CI)**	**Absolute (95% CI)**	**Certainty**	**Importance**
WHO 2007 Z Score_Obesity_D_Mean												
2	observational studies	serious[a]	not serious	not serious	not serious	all plausible residual confounding would reduce the demonstrated effect	40	416	-	MD **0.28 higher** (0.03 lower to 0.59 higher)	⊕⊕◯◯ Low	IMPORTANTE
WHO 2007 Z Score_Overweight_D_Mean												
2	observational studies	serious[b]	not serious	not serious	not serious	all plausible residual confounding would reduce the demonstrated effect	99	416	-	MD **0.03 higher** (0.24 lower to 0.3 higher)	⊕⊕◯◯ Low	IMPORTANT
WHO 2007 Z Score_Overweight and Obesity_DMFT_Dichotomous												
2	observational studies	not serious	not serious	not serious	not serious	none			not estimable	not estimable	⊕⊕◯◯ Low	IMPORTANT
							-	0.0%				

CI: confidence interval; **MD:** mean difference

Explanations

a. One of the included studies did not mention the strategies used to deal with confounders.

b. One of the included studies did not mention the strategies used to deal with confounders.

S5 Table: Assessment of the certainty of the evidence of studies that used WHO 2007 percentil as an anthropometric curve of the BMI

Certainty assessment							№ of patients		Effect			
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Overweight and Obesity**	**Normal weight**	**Relative (95% CI)**	**Absolute (95% CI)**	**Certainty**	**Importance**
WHO 2007 Percentil_Overweigth and Obesity_DMFT_Dichotomous												
2	observational studies	not serious	serious[a]	not serious	serious[b]	none	91/166 (54.8%)	111/189 (58.7%)	**OR 0.83** (0.35 to 1.94)	**46 fewer per 1.000** (from 255 fewer to 147 more)	⊕◯◯◯ Very low	IMPORTANT

CI: confidence interval; **OR:** odds ratio

Explanations

a. i^2=74. There is no similarity of effect estimates on overlapping confidence intervals.

b. Although the CI is small (0.35-1.94), the number of events is less than 300.

S6 Table: Assessment of the certainty of the evidence of studies that used WHO 2006 z scorel as an anthropometric curve of the BMI

Certainty assessment							№ of patients		Effect			
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Obesity/ Overweight and Obesity/ Overweight**	**Normal Weight**	**Relative (95% CI)**	**Absolute (95% CI)**	**Certainty**	**Importance**
WHO 2006 Z Score_Overweight and Obesity_dmft_Dichotomous												
3	observational studies	serious[a]	serious[b]	serious[c]	not serious	none			not estimable		⨁◯◯◯ Very low	IMPORTANT
WHO 2006 Z Score_Overweight and Obesity_DMFT_DIchotomous												
2	observational studies	not serious	serious[d]	not serious	not serious	none			not estimable		⨁◯◯◯ Very low	IMPORTANT

CI: confidence interval

Explanations

a. Some included studies did not mention the strategies used to deal with confounders. One study did not report whether groups/participants were outcome-free at baseline (or at the time of exposure).

b. i^2=74%. There is no similarity of effect estimates on overlapping confidence intervals.

c. Although the results refer only to the primary dentition, the children included in the studies ranged from 2 to 8 years old.

d. i^2=85%. There is no similarity of effect estimates on overlapping confidence intervals.

S7 Table: Assessment of the certainty of the evidence of studies that used CDC 2000 scorel as an anthropometric curve of the BMI

Certainty assessment							№ of patients		Effect			
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Obesity/ Overweight and Obesity/ Overweight**	**Normal Weight**	**Relative (95% CI)**	**Absolute (95% CI)**	**Certainty**	**Importance**
CDC 2000_Obesity_DMFT_Dichotomous												
2	observational studies	serious[a]	not serious	serious[b]	not serious	very strong association all plausible residual confounding would reduce the demonstrated effect	28/70 (40.0%)	361/589 (61.3%)	**OR 2.53** (1.49 to 4.29)	**187 more per 1.000** (from 89 more to 259 more)	⊕⊕⊕◯ Moderate	IMPORTANTE
CDC 2000_Obesity_dmft_Dichotomous												
2	observational studies	serious[c]	serious[d]	serious[e]	serious[f]	all plausible residual confounding would reduce the demonstrated effect	53/93 (57.0%)	272/616 (44.2%)	**OR 0.44** (0.08 to 2.61)	**183 fewer per 1.000** (from 382 fewer to 232 more)	⊕◯◯◯ Very low	IMPORTANTE
CDC 2000_Obesity_DMFT_Mean												

Certainty assessment							№ of patients		Effect			
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Obesity/ Overweight and Obesity/ Overweight**	**Normal Weight**	**Relative (95% CI)**	**Absolute (95% CI)**	**Certainty**	**Importance**
2	observational studies	serious[g]	not serious	serious[h]	not serious	all plausible residual confounding would reduce the demonstrated effect	70	589	-	MD **0 0.61** (0.08 higher to 1.15 higher)	⊕◯◯◯ Very low	IMPORTANT E
CDC 2000_Obesity_dmft_Mean												
2	observational studies	serious[i]	not serious	serious[j]	not serious	all plausible residual confounding would reduce the demonstrated effect	93	617	-	MD **0 - 0.34** (0.96 lower to 0.27 higher)	⊕◯◯◯ Very low	IMPORTANT E
CDC 2000_Overweight and Obesity_DMFT_Dichotomous												
3	observational studies	serious[k]	serious[l]	serious[m]	not serious	strong association all plausible residual confounding would reduce the demonstrated effect	160/268 (59.7%)	729/1109 (65.7%)	**OR 1.18** (0.71 to 1.95)	**36 more per 1.000** (from 81 fewer to 132 more)	⊕◯◯◯ Very low	IMPORTANT E
CDC 2000_Overweight and Obesity_dmft_Dichotomous												

Certainty assessment							№ of patients		Effect			
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Obesity/ Overweight and Obesity/ Overweight**	**Normal Weight**	**Relative (95% CI)**	**Absolute (95% CI)**	**Certainty**	**Importance**
2	observational studies	serious[n]	serious[o]	serious[p]	serious[q]	all plausible residual confounding would reduce the demonstrated effect	101/210 (48.1%)	272/616 (44.2%)	**OR 0.83** (0.45 to 1.54)	**45 fewer per 1.000** (from 179 fewer to 108 more)	⊕◯◯◯ Very low	IMPORTANTE
CDC 2000_Overweight_DMFT_Dichotomous												
2	observational studies	serious[r]	serious[s]	serious[t]	serious[u]	strong association all plausible residual confounding would reduce the demonstrated effect	70/117 (59.8%)	361/589 (61.3%)	**OR 1.01** (0.43 to 2.35)	**2 more per 1.000** (from 208 fewer to 175 more)	⊕◯◯◯ Very low	IMPORTANTE
CDC 2000_Overweight_dmft_Dichotomous												
2	observational studies	serious[v]	not serious	serious[w]	serious[x]	strong association all plausible residual confounding would reduce the demonstrated effect	51/117 (43.6%)	272/617 (44.1%)	**OR 1.02** (0.69 to 1.53)	**5 more per 1.000** (from 89 fewer to 106 more)	⊕◯◯◯ Very low	IMPORTANTE

Certainty assessment							№ of patients		Effect			
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Obesity/ Overweight and Obesity/ Overweight**	**Normal Weight**	**Relative (95% CI)**	**Absolute (95% CI)**	**Certainty**	**Importance**
CDC 2000_Overweight_DMFT_Mean												
2	observational studies	serious[y]	serious[z]	serious[aa]	serious[ab]	all plausible residual confounding would reduce the demonstrated effect	117	329	-	MD **0.06 lower** (1.03 lower to 0.91 higher)	⊕◯◯◯ Very low	IMPORTANTE
CDC 2000_Overweight_dmft_Mean												
2	observational studies	serious[ac]	not serious	serious[ad]	serious[ae]	all plausible residual confounding would reduce the demonstrated effect	117	617	-	MD **0.31 higher** (0.1 lower to 0.73 higher)	⊕◯◯◯ Very low	IMPORTANTE

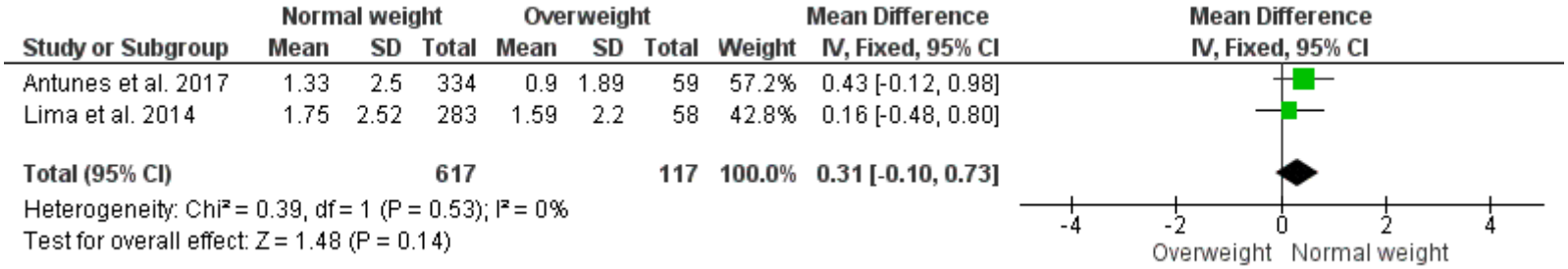
CI: confidence interval; **MD:** mean difference; **OR:** odds ratio

Explanations

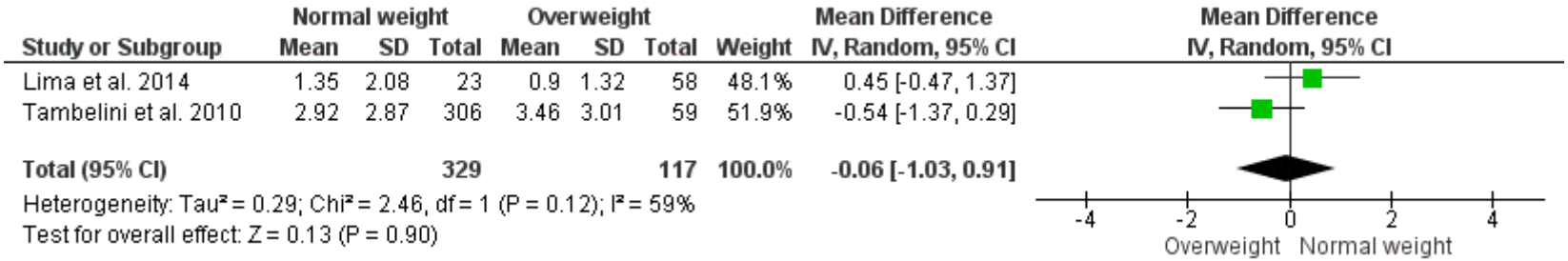
a. The included studies did not mention the strategies used to deal with confounders. Thus, we believe that the studies have serious methodological limitations.
b. Although the results refer only to permanent dentition, the children and adolescents of the included studies ranged from 6 to 19 years old.
c. The included studies did not mention the strategies used to deal with confounders. Thus, we believe that the studies have serious methodological limitations.
d. i²=91%
e. Although the results refer only to the primary dentition, the children included in the studies ranged from 2 to 15 years old.
f. The number of effects was less than 300. The CI ranged from 0.08-2.61. The prism passes through the null line.
g. Although the results refer only to permanent dentition, the children and adolescents of the included studies ranged from 6 to 19 years old.
h. The included studies did not mention the strategies used to deal with confounders. Thus, we believe that the studies have serious methodological limitations.
i. The included studies did not mention the strategies used to deal with confounders. Thus, we believe that the studies have serious methodological limitations.
j. Although the results refer only to the primary dentition, the children included in the studies ranged from 2 to 15 years old.

k. The included studies did not mention the strategies used to deal with confounders. Thus, we believe that the studies have serious methodological limitations. Two of the studies included in the meta-analysis are cross-sectional and one is a case-control study.
l. i^2=65% and there is no similarity of effect estimates on overlapping confidence intervals.
m. Although the results refer only to permanent dentition, the children and adolescents of the included studies ranged from 6 to 19 years old.
n. The included studies did not mention the strategies used to deal with confounders. Thus, we believe that the studies have serious methodological limitations.
o. i^2=73% and there is no similarity of effect estimates on overlapping confidence intervals.
p. Although the results refer only to the primary dentition, the children included in the studies ranged from 2 to 15 years old.
q. Although the CI is small (0.45-1.54), the number of events is less than 300.
r. The included studies did not mention the strategies used to deal with confounders. Thus, we believe that the studies have serious methodological limitations.
s. i^2=71% and there is no similarity of effect estimates on overlapping confidence intervals.
t. Although the results refer only to permanent dentition, the children and adolescents of the included studies ranged from 6 to 19 years old.
u. The number of effects was less than 300. The CI ranged from 0.43-2.35. The prism passes through the null line.
v. The included studies did not mention the strategies used to deal with confounders. Thus, we believe that the studies have serious methodological limitations.
w. Although the results refer only to the primary dentition, the children included in the studies ranged from 2 to 15 years old.
x. Although the CI is small (0.69-1.53), the number of events is less than 300.
y. The included studies did not mention the strategies used to deal with confounders. Thus, we believe that the studies have serious methodological limitations.
z. i^2=59% and there is no similarity of effect estimates on overlapping confidence intervals.
aa. Although the results refer only to permanent dentition, the children and adolescents of the included studies ranged from 6 to 19 years old.
ab. Although the sample was greater than 400, the CI was (-1.03-0.91). The prism passes through the null line.
ac. The included studies did not mention the strategies used to deal with confounders. Thus, we believe that the studies have serious methodological limitations.
ad. Although the results refer only to the primary dentition, the children included in the studies ranged from 2 to 15 years old.
ae. Although the sample was greater than 400, the CI was (-0.10-0.73). The prism passes through the null line.

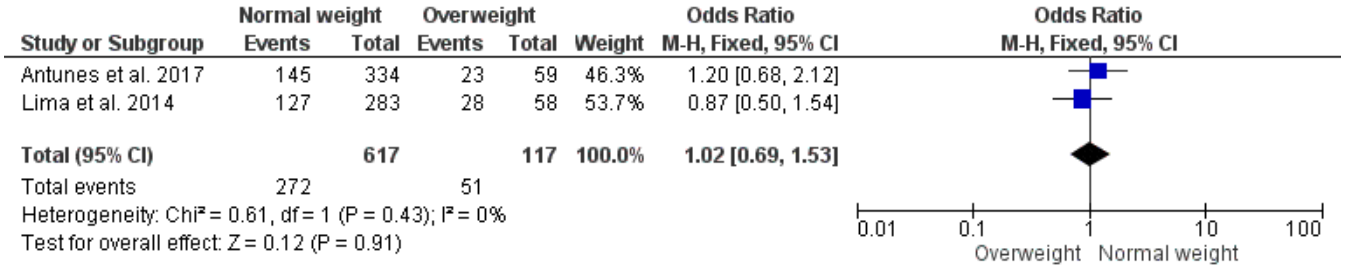
SUPPLEMENTARY FIGURES



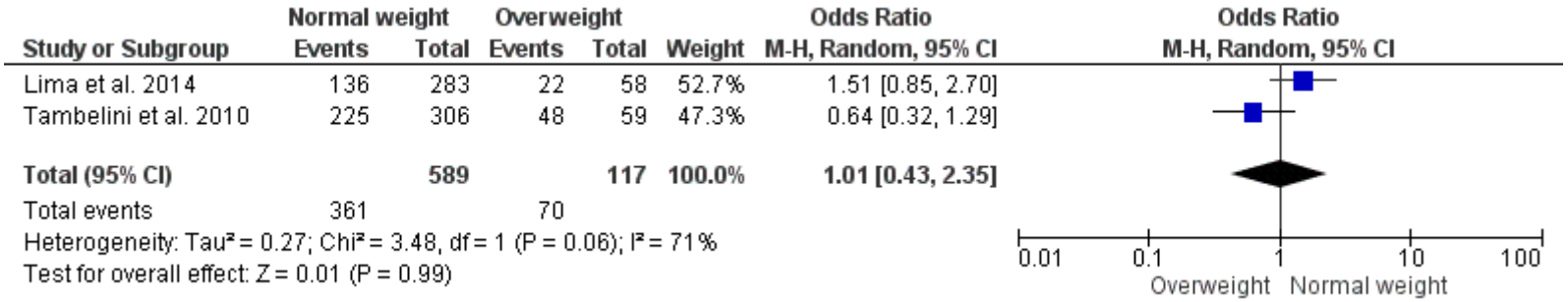
S1 Figure: Forest plot of meta-analysis for continuous outcome studies evaluating dental caries in children with primary dentition with normal and overweight using BMI for age and sex percentiles from the 2000 Centers for Disease Control and Prevention (CDC) growth charts.



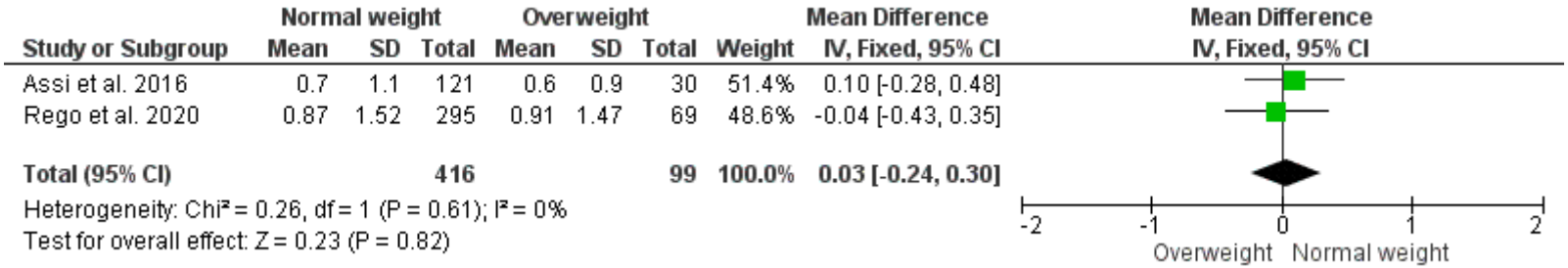
S2 Figure: Forest plot of meta-analysis for continuous outcome studies evaluating dental caries in children/adolescents in permanent dentition with normal and overweight using BMI for age and sex percentiles from the 2000 Centers for Disease Control and Prevention (CDC) growth charts.



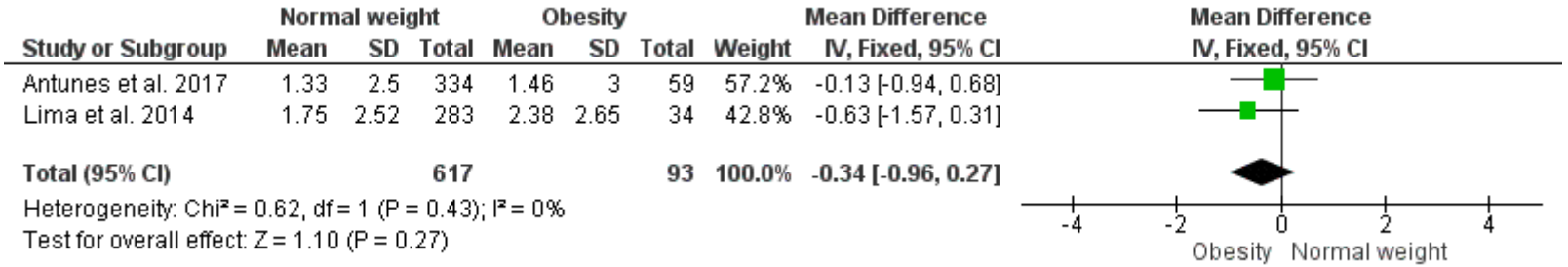
S3 Figure: Forest plot of meta-analysis for dichotomous outcome studies evaluating dental caries children in primary dentition with normal and overweightu sing BMI for age and sex percentiles from the 2000 Centers for Disease Control and Prevention (CDC) growth charts.



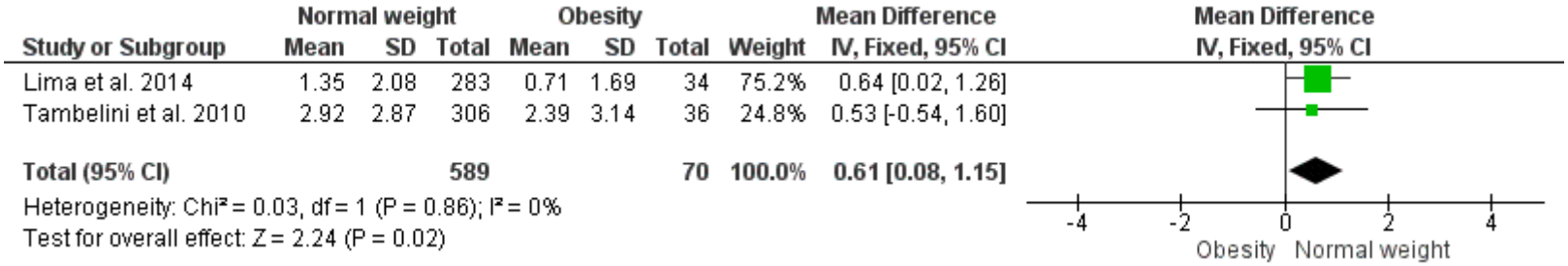
S4 Figure: Forest plot of meta-analysis for dichotomous outcome studies evaluating dental caries children/adolescents in permanent dentition with normal and overweight using BMI for age and sex percentiles from the 2000 Centers for Disease Control and Prevention (CDC) growth charts.



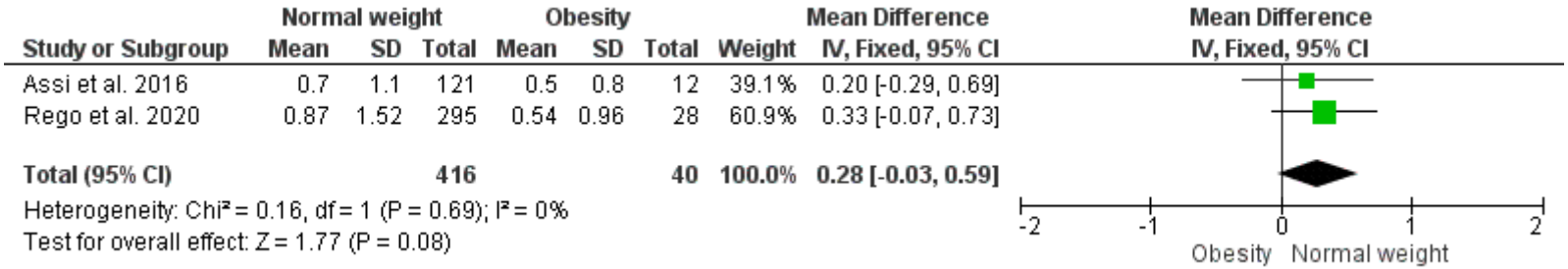
S5 Figure: Forest plot of meta-analysis for dichotomous outcome studies evaluating untreated dental caries in children/adolescents with normal and overweightusing BMI for age and sex percentiles from the WHO BMI 2007 expressed by the Z-score.



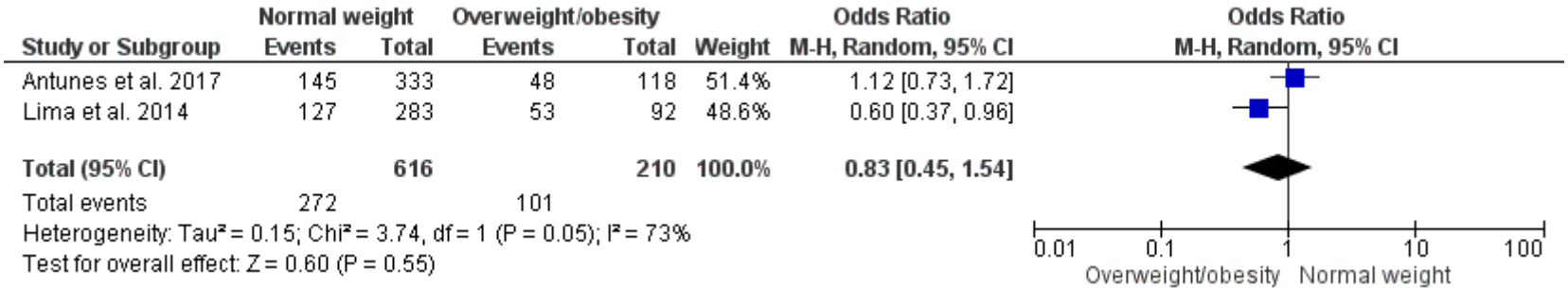
S6 Figure: Forest plot of meta-analysis for continuous outcomes studies evaluating dental caries children and adolescents with normal and obesity using BMI for age and sex percentiles from the 2000 Centers for Disease Control and Prevention (CDC) growth charts.



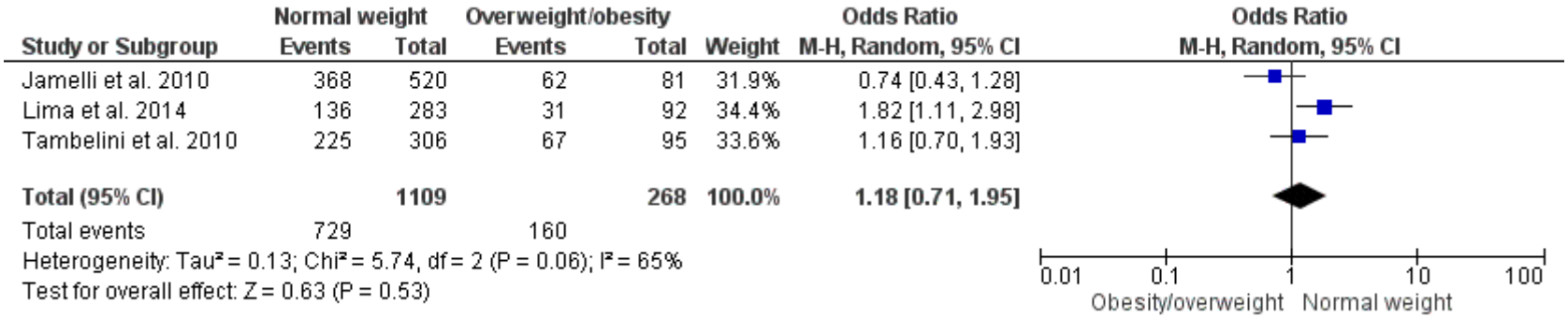
S7 Figure: Forest plot of meta-analysis for continuous outcomes studies evaluating dental caries in children/adolescents in permanent dentition dentition with normal and obesity using BMI for age and sex percentiles from the 2000 Centers for Disease Control and Prevention (CDC) growth charts.



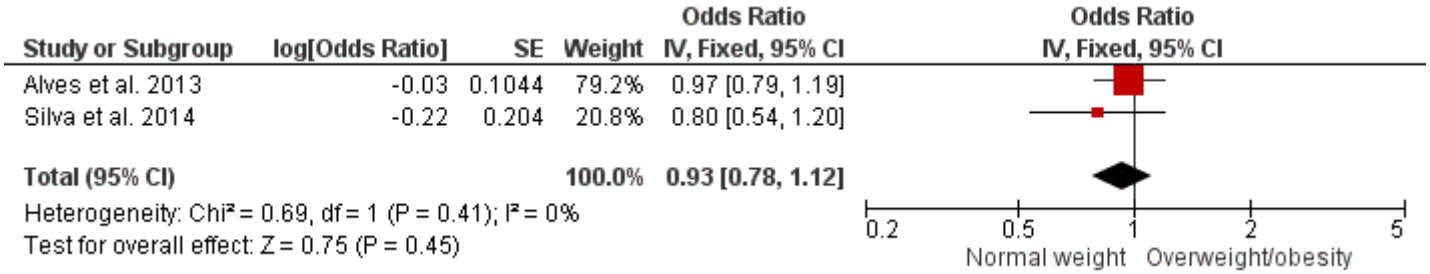
S8 Figure: Forest plot of meta-analysis for continuous outcome studies evaluating untreated dental caries in children/adolescents with normal and obesity using BMI for age and sex percentiles from the WHO BMI 2007 expressed by the Z-score.



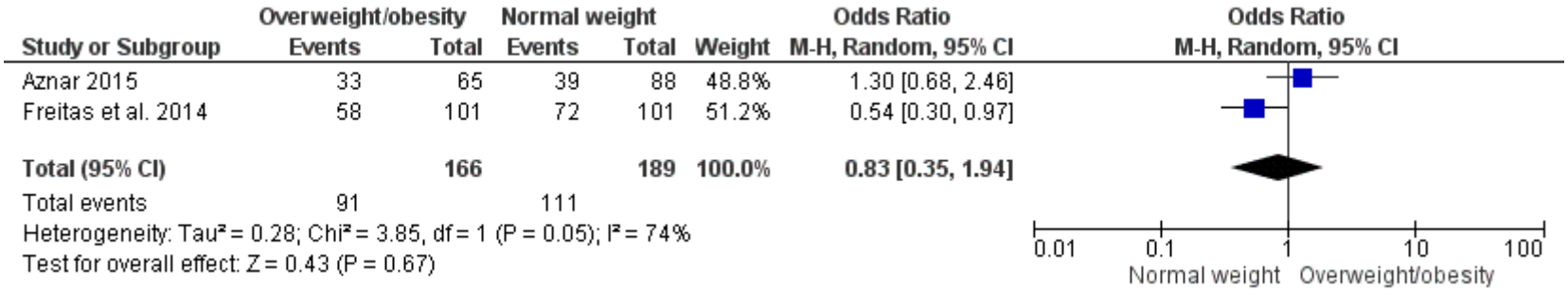
S9 Figure: Forest plot of meta-analysis for dicothomous outcomes studies evaluating dental caries children in primary dentition with normal and overweight/obesity using BMI for age and sex percentiles from the 2000 Centers for Disease Control and Prevention (CDC) growth charts.



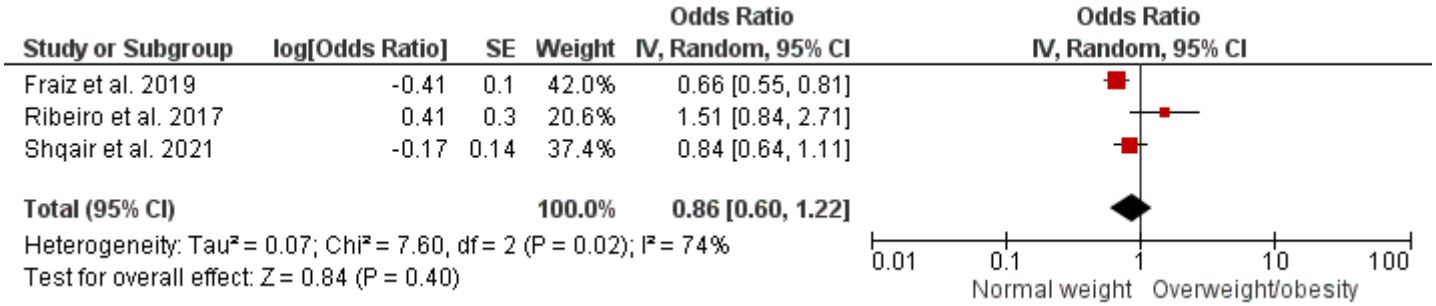
S10 Figure: Forest plot of meta-analysis for dichotomous outcomes studies evaluating dental caries children/adolescents in permanent dentition with normal and overweight/obesity using BMI for age and sex percentiles from the 2000 Centers for Disease Control and Prevention (CDC) growth charts.



S11 Figure: Forest plot of meta-analysis for dichotomous outcome studies evaluating dental caries in children/adolescents with normal and overweight/obesity using BMI for age and sex percentiles from the WHO BMI 2007 expressed by the Z-score.



S12 Figure: Forest plot of meta-analysis for dichotomous outcome studies evaluating dental caries in children/adolescents with normal and overweight/obesity using BMI for age and sex percentiles from the WHO BMI 2007 expressed by the percentiles.



S13 Figure: Forest plot of meta-analysis for dichotomous outcome studies evaluating dental caries in children with normal and overweight/obesity using BMI for age and sex percentiles from the WHO BMI 2006 expressed by the Z-score.

4 CONSIDERAÇÕES FINAIS

Embora a literatura científica apoie a associação entre sobrepeso/obesidade e cárie dentária, apontando fatores etiológicos comuns, como hábitos alimentares e privação socioeconômica, resultados conflitantes têm sido descritos em diferentes populações, resultando em evidências questionáveis sobre essa associação. Dessa forma, o objetivo desta revisão sistemática e meta-análise foi avaliar a associação entre sobrepeso e obesidade e cárie dentária em crianças e adolescentes brasileiros. Com base na literatura atual publicada, parece não haver associação entre obesidade e/ou sobrepeso e cárie dentária em crianças/adolescentes brasileiros para a maioria das curvas antropométricas de referência usando o IMC. Uma maior experiência de cárie dentária foi associada a adolescentes de peso normal em dentição permanente em comparação com adolescentes obesos, classificados pelo CDC 200. Deve-se ter cautela devido a muito baixa, baixa e moderada certeza da evidência dos resultados para apoiar tal associação. Avaliações com métodos mais fortes e estudos prospectivos mais padronizados, usando um sistema de medida universal tanto para sobrepeso/obesidade quanto para cárie dentária, considerando possíveis fatores de confusão, são necessários para aumentar a qualidade das evidências em confirmar ou não essa possível associação e ajudar a esclarecer a direção da associação entre essas importantes condições de saúde.

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ANEXO A

PROSPERO

NIHR | National Institute for Health Research

PROSPERO
International prospective register of systematic reviews

Citation

Rosangela Ribeiro, Karina Devito, Lucas Abreu, Flávia Scalioni, Paulo Victor Doriguêtto, Camila Carrada. Association between obesity and dental caries in Brazilian children/adolesce nts: a systematic review. PROSPERO 2021 CRD42021056843 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021056843

Review question

Is there association between obesity and dental caries in Brazilian children/adolescents?

P – Brazilian children/adolescents

E – Obesity/Over weight (High body mass index)

C – Normal weight (Normal body mass index)

O – Dental caries

Searches

Searches will be conducted in PubMed, Web of Science, Cochrane, Scopus, LILACS and EMBASE from their date of inception. Gray literature will be searched in OpenGrey, limiting the search to the first 200 hits. A search in Google Scholar also restricted to the first 200 hits will be carried out as well. Finally, a manual search in the reference lists of the included articles will be performed.

Types of study to be included

Case-control, cohort and cross-sectional studies

Condition or domain being studied

Dental caries is a dysbiosis of the oral microbiome leading to the overproduction of acids from carbohydrate and sugars. It is a very prevalent oral disorder among children. There has been reports of the association of dental caries with systemic conditions in children/adolescents. Childhood/adolescence obesity has become a global health concern. In developing countries, such as Brazil, the number of obsess children/adolescents has increased substantially. Obesity is a multifactorial disorder, influenced by environmental and genetic risk factors.

Participants/population

Inclusion criteria: Brazilian children/adolescents who are 18 years or younger of both sexes.

Exclusion criteria: Brazilian children/adolescents with syndromes, cognitive disorders or any other special needs.

Intervention(s), exposure(s)

Inclusion criteria: Obesity/over-weight assessed by means of the body mass index. The Body mass index (BMI) is calculated dividing a person's weight in kilograms by the square of his/her height in meters (kg/m2). It is the most reproducible index of weight-for-height, and is commonly used to classify overweight and obesity.

Exclusion criteria: estimates of obesity/over-weight obtained by means of the calculation of any other index different from the BMI.

Comparator(s)/control
Inclusion criteria: Normal weight (Normal BMI)

Exclusion criteria: under-weight

Context
Dental caries in Brazilian children/adolescents

Main outcome(s)
Depending on the analyses conducted in the included studies, the following effect measures will be collected: mean difference and standard deviation, median and interquartile range, relative risk, odds ratio, confidence interval and standard error. For dichotomous outcomes, the number of affected individuals and the total number of individuals assessed.

Measures of effect

Not applicable

Additional outcome(s)
Not applicable

Measures of effect

Not applicable

Data extraction (selection and coding)
The study selection will be carried out by two review authors (PVTD and CFC) in two phases. In phase 1, both authors will read the titles/abstracts retrieved during the search. Titles/abstracts that met the eligibility criteria will be included straight away in the systematic review. References whose title/abstracts do not give enough information for a decision on inclusion or otherwise will be evaluated in Phase 2. The independent reviewers will evaluate the complete text of the references in Phase 2. References that meet the eligibility criteria in Phase 2 will be included as well. If there are discrepancies between reviewers with respect to inclusion of the study, a consultant in Paediatric Dentistry will arrive at a decision.

Data extraction will be conducted by two independent reviewers (PVTD and CFC). The following data will be extracted author/year of publication, country where the study was conducted, study setting, sample size, participants' age and sex, measurements of BMI and dental caries and results obtained on the association between obesity/overweight and dental caries in Brazilian children/adolescents.

Risk of bias (quality) assessment
Risk of bias will be evaluated with the tool of the Joanna Briggs Institute (JBI) of the University of Adelaide.

In cohort studies, 11 items will evaluate participants' recruitment, the exposure measurement, the validity of the instrument to measure the exposure, strategies to handle confounders, the validity of the instrument to assess the outcome, follow-up period, losses and statistical analysis.

In case control studies, 11 items will evaluate the selection and matching of cases and controls, validity of the instrument to measure the exposure, strategies to handle confounders, validity of the instrument to assess the outcome, adequate time of period to assess the exposure and the statistical analysis.

In cross-sectional studies, eight items will evaluate inclusion criteria, sample size, study's setting and time period, validity of the instrument to measure the exposure, criteria to assess the condition, response rate and statistical analysis.

In each study, 'low risk of bias', 'high risk of bias' or 'unclear risk of bias' may be assigned to the items.

Two review authors will evaluate the risk of bias of the included studies independently. If any disagreements between reviewers take place, a discussion with a consultant in Paediatric Dentistry will be caried out.

Strategy for data synthesis

Meta-analyses will be conducted with the software Review Manager 5.3. Heterogeneity across studies will be measured by means of I^2 statistics. The fixed effect model will used when the I^2 was less than 25%. The random effect model will be used when the I^2 was higher than 25%.

Dichotomous outcomes and continuous outcomes will be considered. For the former, the results of meta-analysis will be reported in odds ratio and confidence interval. For the latter, mean difference and confidence interval will be provided instead.

The strength of evidence from the selected studies for the meta?analyses will be assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system. Risk of bias, inconsistency, imprecision, publication bias and indirectness will be assessed.

Analysis of subgroups or subsets

Subgroup analyses will be conducted, separating the studies incorporated into meta-analyses according the study design (longitudinal/case-control/cross-sectional) and the age of participants (children/adolescents). In the subgroup analyses with I^2 higher than 25%, sensitivity analyses will be carried out to assess the influence of each study on the estimates.

Contact details for further information

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Organisational affiliation of the review

Universidade Federal de Juiz de Fora (UFJF)

Review team members and their organisational affiliations

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Professor Flávia Scalioni. UFJF
Mr Paulo Victor Doriguêtto. UFJF
Professor Camila Carrada. School of Medical and Health Sciences from Juiz de Fora

Type and method of review

Epidemiologic, Meta-analysis, Systematic review

Anticipated or actual start date

17 October 2020

Anticipated completion date

17 December 2021

Funding sources/sponsors

This review has no funding sources/sponsors

Conflicts of interest

Language

(there is not an English language summary)

Country

Brazil

Stage of review

Review Ongoing

Subject index terms status

Subject indexing assigned by CRD

Subject index terms
MeSH headings have not been applied to this record

Date of registration in PROSPERO
11 March 2021

Date of first submission
08 February 2021

Details of any existing review of the same topic by the same authors
Not applicable

Stage of review at time of this submission

Stage	Started	Completed
Preliminary searches	Yes	Yes
Piloting of the study selection process	Yes	Yes
Formal screening of search results against eligibility criteria	Yes	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

The record owner confirms that the information they have supplied for this submission is accurate and complete and they understand that deliberate provision of inaccurate information or omission of data may be construed as scientific misconduct.
The record owner confirms that they will update the status of the review when it is completed and will add publication details in due course.

Versions
11 March 2021
11 March 2021

ANEXO B

Normas do periódico International Journal of *Paediatric Dentistry*

Author Guidelines

Sections

1. SUBMISSION

Authors should kindly note that submission implies that the content has not been published or submitted for publication elsewhere except as a brief abstract in the proceedings of a scientific meeting or symposium.

Once the submission materials have been prepared in accordance with the Author Guidelines, manuscripts should be submitted online at https://mc.manuscriptcentral.com/ijpd

Data protection

By submitting a manuscript to or reviewing for this publication, your name, email address, and affiliation, and other contact details the publication might require, will be used for the regular operations of the publication, including, when necessary, sharing with the publisher (Wiley) and partners for production and publication. The publication and the publisher recognize the importance of protecting the personal information

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Preprint policy

Please find the Wiley preprint policy here.
This journal accepts articles previously published on preprint servers.
International Journal of Paediatric Dentistry will consider for review articles previously available as preprints. Authors may also post the submitted version of a manuscript to a preprint server at any time. Authors are requested to update any pre-publication versions with a link to the final published article.

For help with submissions, please contact: IJPDedoffice@wiley.com

2. AIMS AND SCOPE

International Journal of Paediatric Dentistry publishes papers on all aspects of paediatric dentistry including: growth and development, behaviour management, diagnosis, prevention, restorative treatment and issue relating to medically compromised children or those with disabilities. This peer-reviewed journal features scientific articles, reviews, case reports, short communications and abstracts of current paediatric dental research. Analytical studies with a scientific novelty value are preferred to descriptive studies. Case reports illustrating unusual conditions and clinically relevant observations are acceptable but must be of sufficiently high quality to be considered for publication; particularly the illustrative material must be of the highest quality.

3. MANUSCRIPT CATEGORIES AND REQUIREMENTS

i. Original Articles

Divided into: Summary, Introduction, Material and methods, Results, Discussion, Bullet points, Acknowledgements, References, Figure legends, Tables and Figures arranged in this order. 3500 word limit, with an exception of qualitative papers which allow a 5000 word limit.

- Summary should be structured using the following subheadings: Background, Hypothesis or Aim, Design, Results, and Conclusions and should be less than 200 words.
- Introduction should be brief and end with a statement of the aim of the study or hypotheses tested. Describe and cite only the most relevant earlier studies. Avoid presentation of an extensive review of the field.
- Material and methods should be clearly described and provide enough detail so that the observations can be critically evaluated and, if necessary repeated. Use section subheadings in a logical order to title each category or method. Use this order also in the results section. Authors should have considered the ethical aspects of their research and should ensure that the project was approved by an appropriate ethical committee, which should be stated. Type of statistical analysis must be described clearly and carefully.
- Results should clearly and concisely report the findings, and division using subheadings is encouraged. Double documentation of data in text, tables or figures is not acceptable. Tables and figures should not include data that can be given in the text in one or two sentences.
- Discussion section presents the interpretation of the findings. This is the only proper section for subjective comments and reference to previous literature. Avoid repetition of results, do not use subheadings or reference to tables in the results section.
- Bullet Points: Authors will need to provide no more than 3 ‘key points’ that summarise the key messages of their paper to be published with their article. The key points should be written with a practitioner audience in mind under the heading: *Why this paper is important to paediatric dentists.

References: Maximum 30.

ii. Review Articles

May be invited by the Editor.

iii. Systematic reviews

We consider publishing systematic reviews if the manuscript has comprehensive and unbiased sampling of literature and covering topics related to Paediatric Dentistry.

References: Maximum 30.

Articles for the *International Journal of Paediatric Dentistry* should include: a) description of search strategy of relevant literature (search terms and databases), b) inclusion criteria (language, type of studies i.e. randomized controlled trial or other, duration of studies and chosen endpoints, c) evaluation of papers and level of evidence. For examples see:

Twetman S, Axelsson S, Dahlgren H et al. Caries-preventive effect of fluoride toothpaste: a systematic review. Acta Odontologica Scandivica 2003; 61: 347-355.

Paulsson L, Bondemark L, Söderfeldt B. A systematic review of the consequences of premature birth on palatal morphology, dental occlusion, tooth-crown dimensions, and tooth maturity and eruption. Angle Orthodontist 2004; 74: 269-279.

iv. Short Communications

Brief scientific articles or short case reports may be submitted, which should be no longer than three pages of double-spaced text and include a maximum of three illustrations. They should contain important, new, definitive information of sufficient significance to warrant publication. They should not be divided into different parts and summaries are not required.

References: Maximum 30.

v. Brief Clinical Reports/Case Reports

Short papers not exceeding 800 words, including a maximum of three illustrations and five references may be accepted for publication if they serve to promote communication between clinicians and researchers. If the paper describes a genetic disorder, the OMIM unique six-digit number should be provided for online cross reference (Online Mendelian Inheritance in Man).

A paper submitted as a Brief Clinical/Case Report should include the following:

- a short Introduction (avoid lengthy reviews of literature);

- the Case report itself (a brief description of the patient/s, presenting condition, any special investigations and outcomes);
- a Discussion which should highlight specific aspects of the case(s), explain/interpret the main findings and provide a scientific appraisal of any previously reported work in the field.
- Bullet Points: Authors will need to provide no more than 3 'key points' that summarise the key messages of their paper to be published with their article. The key points should be written with a practitioner audience in mind under the heading: *Why this paper is important to paediatric dentists.

vi. Letters to the Editor

Letters should be no more than 1,500 words, with no more than 10 references. There should be no abstract, tables or figures.

4. PREPARING THE SUBMISSION

Before you submit, you will need:

- Your manuscript: this should be an editable file including text, figures, and tables, or separate files – whichever you prefer. All required sections should be contained in your manuscript, including abstract, introduction, methods, results, and conclusions. Figures and tables should have legends. Figures should be uploaded in the highest resolution possible. References may be submitted in any style or format, as long as it is consistent throughout the manuscript. Supporting information should be submitted in separate files. If the manuscript, figures or tables are difficult for you to read, they will also be difficult for the editors and reviewers, and the editorial office will send it back to you for revision. Your manuscript may also be sent back to you for revision if the quality of English language is poor.
- An ORCID ID, freely available at https://orcid.org. *(Why is this important? Your article, if accepted and published, will be attached to your ORCID profile. Institutions and funders are increasingly requiring authors to have ORCID IDs.)*
- The title page of the manuscript, including:

- Your co-author details, including affiliation and email address. *(Why is this important? We need to keep all co-authors informed of the outcome of the peer review process.)*
- Statements relating to our ethics and integrity policies, which may include any of the following *(Why are these important? We need to uphold rigorous ethical standards for the research we consider for publication):*
  - data availability statement
  - funding statement
  - conflict of interest disclosure
  - ethics approval statement
  - patient consent statement
  - permission to reproduce material from other sources
  - clinical trial registration

If you are invited to revise your manuscript after peer review, the journal will also request the revised manuscript to be formatted according to journal requirements as described below.

Cover Letters

Cover letters are not mandatory; however, they may be supplied at the author's discretion.

Parts of the Manuscript

The manuscript should be submitted in separate files: title page; main text file; figures.

Title page

The title page should contain:

i. A short informative title that contains the major key words. The title should not contain abbreviations (see Wiley's best practice SEO tips);

ii. A short running title of less than 50 characters;

iii. The full names of the authors and a statement of author contributions, e.g.

Author contributions: A.S. and K.J. conceived the ideas; K.J. and R.L.M. collected the data; R.L.M. and P.A.K. analysed the data; and A.S. and K.J. led the writing;

iv. The author's institutional affiliations where the work was conducted, with a footnote for the author's present address if different from where the work was conducted;
v. Acknowledgments;
vi. Word count (excluding tables)

Authorship

Please refer to the journal's authorship policy the Editorial Policies and Ethical Considerations section for details on eligibility for author listing.

Acknowledgments

Contributions from anyone who does not meet the criteria for authorship should be listed, with permission from the contributor, in an Acknowledgments section. Financial and material support should also be mentioned. Thanks to anonymous reviewers are not appropriate.

Conflict of Interest Statement

Authors will be asked to provide a conflict of interest statement during the submission process. For details on what to include in this section, see the section 'Conflict of Interest' in the Editorial Policies and Ethical Considerations section below. Submitting authors should ensure they liaise with all co-authors to confirm agreement with the final statement.

Main Text File

As papers are double-blind peer reviewed the main text file should not include any information that might identify the authors.
The main text file should be presented in the following order:
i. Title, abstract and key words;
ii. Main text;
iii. References;
iv. Tables (each table complete with title and footnotes);
v. Figure legends;
vi. Appendices (if relevant).
Figures and supporting information should be supplied as separate files.

Abstract

Abstracts and keywords are required for some manuscript types. For details on manuscript types that require abstracts, please refer to the 'Manuscript Types and Criteria' section.

Keywords

Please provide 3-6 keywords. Keywords should be taken from the list provided at submission in ScholarOne.

Main Text

- As papers are double-blind peer reviewed, the main text file should not include any information that might identify the authors.
- The journal uses British spelling; however, authors may submit using either option, as spelling of accepted papers is converted during the production process.

References

All references should be numbered consecutively in order of appearance and should be as complete as possible. In text citations should cite references in consecutive order using Arabic superscript numerals. For more information about AMA reference style please consult the AMA Manual of Style

Sample references follow:

Journal article

1. King VM, Armstrong DM, Apps R, Trott JR. Numerical aspects of pontine, lateral reticular, and inferior olivary projections to two paravermal cortical zones of the cat cerebellum. J Comp Neurol 1998;390:537-551.

Book

2. Voet D, Voet JG. Biochemistry. New York: John Wiley & Sons; 1990. 1223 p.

Internet document

3. American Cancer Society. Cancer Facts & Figures 2003. http://www.cancer.org/downloads/STT/CAFF2003PWSecured.pdf Accessed March 3, 2003

Tables

Tables should be self-contained and complement, not duplicate, information contained in the text. They should be supplied as editable files, not pasted as images. Legends should be concise but comprehensive – the table, legend, and footnotes must be understandable without reference to the text. All abbreviations must be defined in footnotes. Footnote symbols: †, ‡, §, ¶, should be used (in that order) and *, **, *** should be reserved for P-values. Statistical measures such as SD or SEM should be identified in the headings.

Figure Legends

Legends should be concise but comprehensive – the figure and its legend must be understandable without reference to the text. Include definitions of any symbols used and define/explain all abbreviations and units of measurement.

Figures

Although authors are encouraged to send the highest-quality figures possible, for peer-review purposes, a wide variety of formats, sizes, and resolutions are accepted.
Click here for the basic figure requirements for figures submitted with manuscripts for initial peer review, as well as the more detailed post-acceptance figure requirements.
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Figures submitted in colour may be reproduced in colour online free of charge. Please note, however, that it is preferable that line figures (e.g. graphs and charts) are supplied in black and white so that they are legible if printed by a reader in black and white.

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The journal supports the Resource Identification Initiative, which aims to promote research resource identification, discovery, and reuse. This initiative, led by the Neuroscience Information Framework and the Oregon Health & Science University Library, provides unique identifiers for antibodies, model organisms, cell lines, and

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3. Click on the “Cite This” button to obtain the citation and insert the citation into the manuscript text.

If there is a resource that is not found within the Resource Identification Portal, authors are asked to register the resource with the appropriate resource authority. Information on how to do this is provided in the “Resource Citation Guidelines” section of the Portal. If any difficulties in obtaining identifiers arise, please contact rii-help@scicrunch.org for assistance.

Example Citations

Antibodies: "Wnt3 was localized using a rabbit polyclonal antibody C64F2 against Wnt3 (Cell Signaling Technology, Cat# 2721S, RRID: AB_2215411)"

Model Organisms: "Experiments were conducted in c. elegans strain SP304 (RRID:CGC_SP304)"

Cell lines: "Experiments were conducted in PC12 CLS cells (CLS Cat# 500311/p701_PC-12, RRID:CVCL_0481)"

Tools, Software, and Databases: "Image analysis was conducted with CellProfiler Image Analysis Software, V2.0 (http://www.cellprofiler.org, RRID:nif-0000-00280)"

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5. EDITORIAL POLICIES AND ETHICAL CONSIDERATIONS

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The acceptance criteria for all papers are the quality and originality of the research and its significance to journal readership. Manuscripts are double-blind peer reviewed. Papers will only be sent to review if the Editor-in-Chief determines that the paper meets the appropriate quality and relevance requirements.
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Medicines Agency Guidelines for Good Clinical Practice. It should also state clearly in the text that all persons gave their informed consent prior to their inclusion in the study. Patient anonymity should be preserved. When detailed descriptions, photographs, or videos of faces or identifiable body parts are used that may allow identification, authors should obtain the individual's free prior informed consent. Authors do not need to provide a copy of the consent form to the publisher; however, in signing the author license to publish, authors are required to confirm that consent has been obtained. Wiley has a standard patient consent form available for use. Where photographs are used they need to be cropped sufficiently to prevent human subjects being recognized; black eye bars should not be used as they do not sufficiently protect an individual's identity).

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