

DIETARY PATTERNS AND DENTAL CARIES IN PERMANENT DENTITION: A SCOPING REVIEW

Patrones de dieta y caries dental en la dentición permanente: Una revisión exploratoria

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ABSTRACT

Introduction: Dental caries is influenced by diet components. Dietary patterns are the way people combine foods and drinks. They can be derived through adherence to a standard diet (*a priori*), obtaining patterns from existing diet data (*a posteriori*), or Reduced Rank Regression. Dental caries research has focused on sugar instead of food combinations. The aim of this study was to synthesize the evidence about the relationship between caries in permanent dentition and dietary patterns.

Materials and Methods: A scoping review was conducted by searching in *Web of Science* and *PubMed*. We included articles from 2001 to 2021, that studied dietary patterns or a combination of foods using one of the three methods described. Articles that dealt exclusively with breastfeeding, temporary dentition in children, or specific chronic diseases or disabilities were excluded. We assessed the quality of the articles with the Newcastle Ottawa Scale.

Results: 1095 articles were identified and nine were included in qualitative synthesis. Three articles obtained dietary patterns through *a priori* methods and six with an *a posteriori* approach. Most of the studies (8) were cross-sectional. Some dietary patterns related to caries were “High in sugar-sweetened beverages and sandwiches”, “obesogenic” and “sweet”. Adherence to dietary recommendations like Alternative Healthy Eating Index-2010 and Dietary Approaches to Stop Hypertension (DASH) were associated with lower DMFS index and root caries index, respectively.

Conclusions: An association between dietary patterns and caries was found, but causality cannot be affirmed. To a better understanding of this problem, new investigations are needed that should be focused on dietary styles instead of only some ingredients.

Keywords: *Dietary patterns; Dental caries; diet quality scores; Principal component analysis; Food combinations; Health behavior.*

RESUMEN

Introducción: La caries dental es influenciada por los componentes de la dieta. La forma en la que las personas combinan alimentos y bebidas se denomina patrón de dieta. Las principales maneras de obtener patrones de dieta: adherencia a una dieta estándar (métodos *a priori*), obtención de patrones desde datos existentes (métodos *a posteriori*) y regresión de rango reducido. La investigación en caries dental se ha enfocado en el azúcar en vez de enfocarse en combinaciones de alimentos. El objetivo de este estudio fue sintetizar la evidencia existente sobre la relación entre caries dental en dentición permanente y patrones de dieta.

Materiales y Métodos: Se realizó una revisión exploratoria (scoping review) buscando en *Web of Science* y *PubMed*. Se incluyeron artículos de 2001 hasta 2021, que estudiaran patrones de dieta o combinaciones de alimentos usando uno de los tres métodos descritos. Se usó la escala de Newcastle Ottawa para evaluar la calidad de los artículos.

Resultados: Se identificaron 1095 artículos y nueve se incluyeron en la síntesis cualitativa. Tres artículos obtuvieron patrones de dieta a través de métodos *a priori* y seis lo hicieron mediante el enfoque *a posteriori*. La mayoría de los estudios (8) fueron transversales. Algunos patrones de dieta relacionados con caries dental fueron el patrón “Alto en bebidas azucaradas y sándwiches”, “obesogénico” y “dulce”. La adherencia a recomendaciones de dieta como el Alternative Healthy Eating Index-2010 y la dieta Enfoques Dietéticos para Detener la Hipertensión (DASH) fue asociada con menor índice COPS y menor índice de caries radicular, respectivamente.

Conclusión: Se encontró una asociación entre patrones de dieta y caries, pero no se puede afirmar causalidad. Para comprender mejor este problema, se necesitan nuevas investigaciones que deberían enfocarse en estilos de alimentación y no solo en algunos ingredientes.

Palabras Clave: *Patrones de dieta; Caries dental; Calidad de la dieta; Análisis de componente principal; Combinaciones de alimentos; Conductas relacionadas con la salud.*

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INTRODUCTION

The way in which people combine foods and drinks in their diet has been called dietary pattern. It is defined as “the quantity, variety or combination of different foods and beverages in a diet and the frequency with which they are habitually consumed”.¹ It has been observed that certain habits, foods and behavior can interact synergistically or antagonistically, producing a higher risk of developing chronic diseases when grouped together.^{2,3}

There are three main approaches to derive dietary patterns. The first is based on diet-quality scores according to recommendations or dietary guidelines. This technique, also called a priori, creates patterns evaluating the adherence to a standard diet previously determined.^{4,5}

Secondly, we have the exploratory or a posteriori approach in which the patterns are obtained from existing data, ignoring previous knowledge about ideal habits. Statistical methods used for obtaining these patterns include Principal Components Analysis (PCA), Factorial Analysis (FA) and Cluster Analysis (CA). PCA and AF are strategies to reduce dimensions that group variables forming factors; these techniques have been widely described in nutritional epidemiology.^{5,6}

In these methods, it is assumed that there exists a not-random correlation among variables, but to underlying factors. On the other hand, in CA the observations are grouped according to their similarity, which implies that each observation belongs to only one cluster.^{6,7} Recently, a third approach used to obtain dietary patterns is Reduced Rank Regression (RRR).^{4,5,8-10}

A strategy that identifies combinations of

predictors that explain as much variation as possible in a set of response variables. RRR has been considered as a mix of *a priori* and a posteriori approach.⁵ Dietary patterns derivation has been widely used to assess their impact on chronic conditions such as diabetes, obesity, overweight, among others.⁵⁻⁸ Dental caries has been studied as an outcome of interest for certain foods or components of the diet, such as sugar.¹¹

However, there is evidence that sugar consumption alone is not sufficient to explain the dysbiosis necessary for the development of caries, alerting us to the relevance of carbohydrate combinations in increasing the cariogenicity of foods.^{12,14} This is because sucralose is the main fermentable carbohydrate, but other carbohydrates such as starches or certain types of foods, like dairy, can either enhance or counteract the effects of sucralose.

Many of the studies have been conducted in children, as was shown in a systematic review,¹⁵ or focused on breastfeeding, but there is a lack of reviews about this relationship in adults and young people.

To synthesize the existing evidence that studies the relationship between dental caries in permanent dentition and dietary patterns, the following review was carried out to answer the question: *Is there a relationship between the consumption of foods grouped in patterns and dental caries in permanent dentition and which analytical methods have been used?*

The objective was to make a synthesis of the scientific evidence about the relationship between dental caries in permanent dentition and dietary patterns through the methods a priori, a posteriori and Reduced Rank Regression.

MATERIALS AND METHODS

This scoping review was conducted according to the PRISMA extension for scoping reviews.¹⁶ Scoping reviews are useful to examine how research has been developed on a specific topic through a structured search, even if a clearly defined question is not possible to be answered yet through a systematic review.¹⁷

Inclusion criteria

Primary studies in human beings were included. With an observational or experimental design. We included studies from January 2001 to January 2021, published in English or Spanish. To be included, the outcome considered was dental caries or treatment need for dental caries. Inclusion criteria also required the consideration of dietary patterns, established either *a priori* (via adherence scores to a specific feeding style), *a posteriori* (by grouping foods or feeding behaviors through factorial analysis or similar methods), or through Reduced Rank Regression

Exclusion criteria

We excluded studies that grouped foods without building dietary patterns through the three methods previously described. Likewise, studies focused on breastfeeding and its relationship with caries were excluded. Also, articles studying children with only temporary dentition, studying only persons with specific health conditions like disabilities or chronic diseases were excluded. Editorials, letters to director, other reviews, ecological studies, *in vitro* or in animals, historical and anthropological studies were excluded.

Search strategy

We searched in *Web of Science* and *PubMed* databases during January 2021. Keywords and

boolean operators were used in the following way: “Dental Caries” AND (“Feeding behavior” OR “Dietary Patterns” OR “Dietary pattern” OR “Mediterranean Diet”).

The first term with any other of the following terms had to be present in an article to be included.

Study selection

Summaries and titles were reviewed by two researchers (AC e IE) according to inclusion criteria and they were blind to the decision of the other using Rayyan web tool.¹⁸ Disagreements between the researchers were solved through consensus in telematic meetings.

Studies were classified according to the method of dietary pattern obtainment: *a priori* method (also known as scores of adherence), *a posteriori* or Reduced Rank Regression.

Risk of bias assessment

The quality of each article was assessed through Newcastle Ottawa Scale (NOS) for cross-sectional studies. For the evaluation of the outcome caries, we gave two stars when it was evaluated by a trained examiner or through record linkage. In relation to exposure variables (related to diet), we gave two stars when the use of a validated questionnaire was reported. One star was given when the questionnaire was described and available without being validated.

RESULTS

1094 articles were identified from databases and one article was from other sources; 1095 summaries were screened.

We excluded 992 articles due to presenting one or more of the following exclusion criteria:

not including caries as the outcome; because of evaluating an isolated nutrient or ingredient in the diet instead of identifying patterns or food groups; or because the population was only children younger than 6 years old.

From 103 full-text selected articles, 91 were excluded because of simply groping foods in, for example, “sugary” or “snacks” (Figure 1) without deriving dietary patterns.

Articles description

Nine articles were selected. The bibliometric variables, Table 1.

Studies with *a priori* methods

The three articles that obtained dietary patterns through a score of adherence to a determined diet or feeding style and were associated with dental caries, Table 2.

Regarding the studies that used *a priori* methods, two found association with dental caries. On one hand, Kaye *et al.*,¹⁹ found that men in the highest quartile of adherence to the diet “Dietary Approaches to Stop Hypertension” (DASH), had a 30% less increment in radicular caries incidence (1.86 teeth) (IC 95%: 1.45–2.38) than those in the lowest adherence quartile (2.68 teeth) (IC 95%: 2.13–3.36).

The authors adjusted by covariates as time at risk of root caries and baseline age, smoking status, number of teeth at risk for root caries, existing root caries or restorations, subgingival calculus on one or more surfaces, prophylaxis in past year, and removable denture.

On the other hand, Sanders *et al.*,²⁰ reported a decrease of 2.53 (IC 95%: 3.43-1.62) surfaces affected by caries each 10-unit increase of diet

quality score. They adjusted for age, sex, field center, heritage group, income, education, health insurance, nativity, BMI, waist-hip ratio.

Monteagudo *et al.*,²¹ studied a breakfast quality score. Even though they did not find any relationship with caries frequency ($p=0.753$) considering the whole of foods in the breakfast, they did find a relationship between caries frequency and determined foods. The consumption of bakery products and cereals showed association with caries, and of dairy products showed an inverse association with caries. Nevertheless, in this study they were not adjusted by any potential confounders.

Studies with *a posteriori* methods

The details of the six articles that derived dietary patterns through *a posteriori* methods, Table 3.

From a total of six studies, four studies showed a significant relationship between a dietary pattern and caries. Blostein *et al.*,²² found a pattern characterized by high consumption of sugar-sweetened beverages and sandwiches that showed a positive association with the prevalence of caries experience (PR=1.02, 95%CI: 1.001, 1.03) after adjusting by sociodemographic variables (sex, age, income, education), frequency of snack per day and average breakfast.

A Brazilian study found an obesogenic pattern which showed a higher caries prevalence than prudent pattern (PR = 1.40, 95% CI: 1.04-1.96). It was adjusted by the child's age, age of the caregiver, income, education of the caregiver, household location and energy intake.²³

Perera *et al.*,²⁴ found a positive association between sweet pattern and caries (OR = 1.14,

Figure 1. Flow diagram of the scoping review.

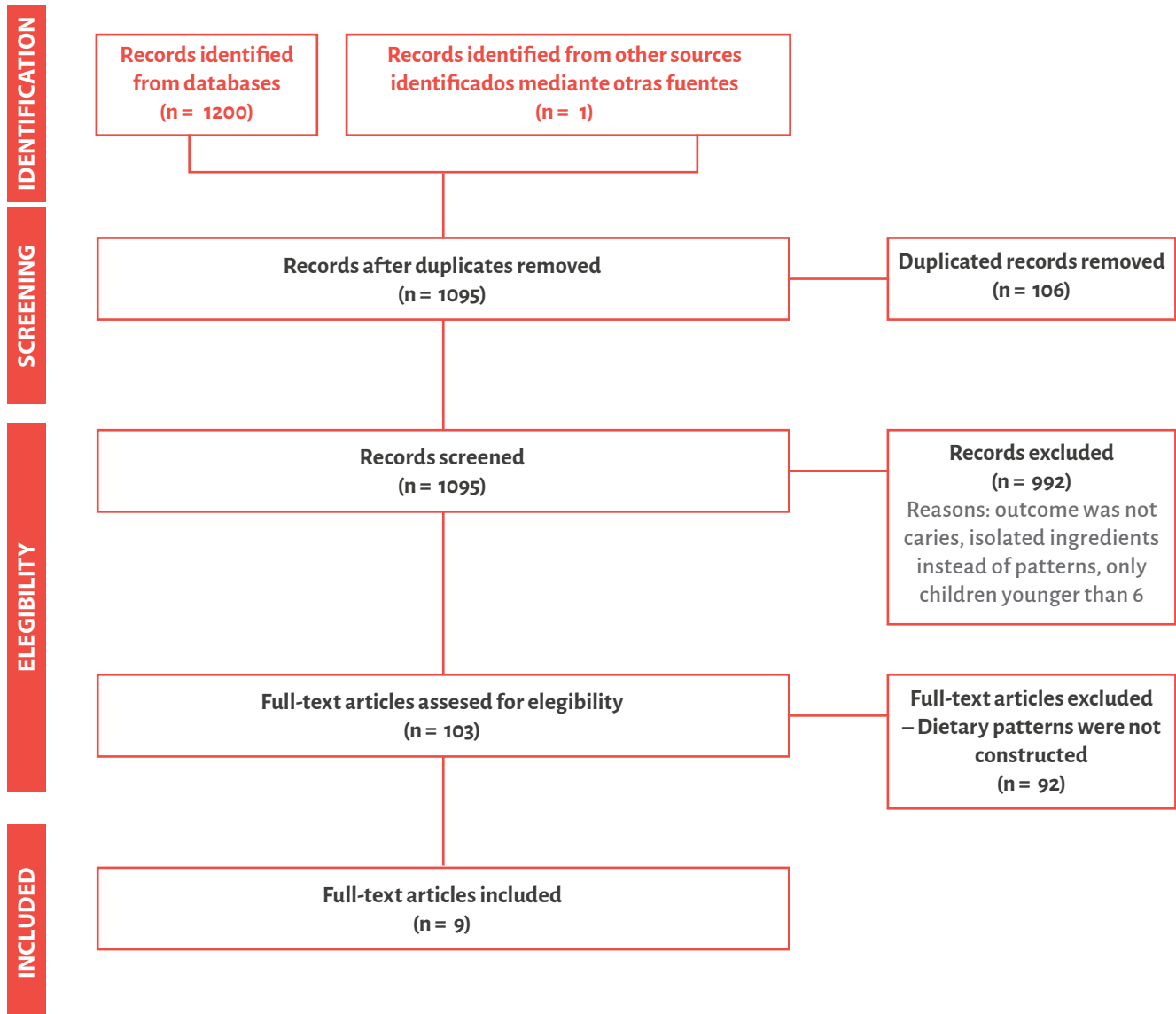


Table 1. Bibliometric variables of the articles included.

AUTHORS	YEAR	IMPACT FACTOR (WOS)	JOURNAL	COUNTRY	STUDY DESIGN
Perera, <i>et al.</i> , ²⁴	2012	0.92	Oral Health & Preventive Dentistry	Sri Lanka	Cross-sectional
Blostein, <i>et al.</i> , ²²	2020	2.135	Community Dentistry and Oral Epidemiology	USA	Cross-sectional
Burt, <i>et al.</i> , ²⁶	2006	2.186	Caries research	USA	Cross-sectional
Cinar, <i>et al.</i> , ²⁵	2011	0.92	Oral Health & Preventive Dentistry	Denmark	Cross-sectional
Cinar, <i>et al.</i> , ²⁷	2011	2.812	Clinical Oral Investigations	Turkey	Cross-sectional
Kaye, <i>et al.</i> , ¹⁹	2015	4.18	Journal of the American Geriatrics Society	USA	Longitudinal. 20 years of follow up
Monteagudo, <i>et al.</i> , ²¹	2015	0.888	Nutrición Hospitalaria	Spain	Cross-sectional
Sanders, <i>et al.</i> , ²⁰	2020	1.743	Journal of public health dentistry	USA	Cross-sectional
Silva, <i>et al.</i> , ²³	2015	Not indexed in WoS	Cadernos Saúde Coletiva	Brazil	Cross-sectional

Table 2. Study characteristics of articles that derived dietary patterns through *a priori* approach.

Author (year) and location	N	Age	Study design	National representativeness	Caries definition	Factors adjusted for in analyses model or confounders	Model used for statistical analysis	Method used to derive dietary patterns	Risk of protection factor in diet for caries	Diet assessment method
Kaye et al. (2015) USA	533	47-90 years old men	Prospective	No, only veteran men from Boston Massachusetts	Radicular caries	Age, number of teeth at risk for root caries, time at risk of root caries, calculus, presence of removable denture, history of dental, prophylaxis, BMI smoking status	Cox models (proportional hazards)	<i>A priori</i> : score of adherence to DASH diet	Higher total consumption of vegetables and cereals are protector for caries	Food frequency questionnaires
Monteagudo et al. (2015) Spain	582	7 years	Cross sectional	No, only participants selected from randomly included schools in Granada, Spain	Not specified	Binary regression, not controlled but assessed age, tooth brushing frequency, fluoride mouthwash, last dental visit, use of dental braces, habits, among others	Logistic regression	<i>A priori</i> : score of adherence to mediterranean diet	Caries was not related to breakfast quality score (p=0.75), but showed a significant association with consumption of breakfast cereals and an inverse association with the intake of dairy products	24 hours recall
Sanders et al. (2020) USA	14517	18-74 years	Cross sectional	No, study in a latin community	Caries experience (DMFT)	Age, sex, heritage group, income, education, health insurance, nativity body mass index and waist-hip ratio	Linear regression for surveys	<i>A priori</i> : score of adherence to AHEI 2010	Each 10-unit increase in diet quality, was associated with 2.53 fewer surfaces affected by caries (DMFS)	Two 24-hours dietary recalls and a food propensity questionnaire

Table 3. Study characteristics of articles that derived dietary patterns through a *posteriori* approach.

Author (year) and location	N	Age	Study design	National representativeness	Caries definition	Dietary patterns identified	Factors adjusted for in analyses model or confounders	Model used for statistical analysis	Method used to derive dietary patterns	Risk of protection factor in diet for caries	Diet assessment method
Burt et al. (2006) USA	1021	14-55+ years	Cross sectional	No, representative group of afro american adults from Detroit, Michigan	Cavitated and not cavitated lesions	Solid foods factor and liquid factor, soft drinks factor	Sex, age, educational level, employment, family income, soft drink consumption and gingival plaque	Linear regression	A <i>posteriori</i> : AF	None of the factors (liquid nor solid) was associated with caries. Soft drinks consumption and gingival plaque was associated with caries. Age was negatively associated with caries	Food frequency questionnaire
Cinar et al. (2011) Denmark	332	15 years	Cross sectional	No, eight municipalities selected	Dentin cavitation (WHO criteria)	Health, Life factors I (no alcohol consumption) and Life factors II (regular physical exercise)	They included lifestyle factors in patterns, did not use them to control confusion (physical activity, tobacco and alcohol consumption)	Logistic regression	A <i>posteriori</i> : PCA	They did not associate caries with some pattern, instead, they included caries in PCA. They found a healthy pattern that grouped not being obese, not being smoker and daily consumption of fruits.	Self-reported questionnaire
Cinar et al. (2011) Turkish	611	10-12 years	Cross sectional	No, one public and one private school	DMFT>0 (with cavitated lesion)	Health and lifestyle factors.	Adjusted for lifestyle factors: daily consumption of milk at breakfast, regular bedtime on school nights, and recommended tooth-brushing	Logistic regression	A <i>posteriori</i> : PCA	They did not associate caries with some pattern, instead, they clustered caries, periodontal index and BMI. In private schools they clustered obesity and high DMFS	Self-administered questionnaire
Perera et al. (2012) Sri Lanka	1218	15 years	Cross sectional	No, only one district from Colombo, Sri Lanka	Dentin cavitation (WHO criteria)	Sweet, healthy and affluent	Household income and oral hygiene status	Multiple logistic regression	A <i>posteriori</i> : PCA	Sweet pattern was associated with caries.	Food frequency questionnaire

Continued Table 3 ↘

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Author (year) and location	N	Age	Study design	National representativeness	Caries definition	Dietary patterns identified	Factors adjusted for in analyses model or confounders	Model used for statistical analysis	Method used to derive dietary patterns	Risk of protection factor in diet for caries	Diet assessment method
Silva et al. (2015) Brazil	1439	6-13 years	Cross sectional	No, only in the municipality of São Francisco do Conde, Salvador, Brasil.	Dentin cavitation (WHO criteria)	Obesogenic and prudent	Gender, age, education of the caregiver, place of residence, per capita income, number of people living in the household and age of the caregiver	Poisson regression	<i>A posteriori</i> : PCA	Obesogenic dietary pattern was associated with caries (Prevalence ratio = 1.4)	Quantitative Food Frequency Questionnaire
Blostein et al. (2020) USA	4467	18 years or more	Cross sectional	Yes, NHANES	DMFT>0	Breads & fats, Sugar-sweetened beverages & sandwiches, Milk & cereal	Gender, age, head of household education indicator variable and ratio of family income to poverty, mean daily energy, BMI, average snacking occasions per day and average breakfast per day variables.	Poisson regression	<i>A posteriori</i> : PCA	Among individuals >30, a pattern high in sugar-sweetened beverages and sandwiches was associated with a higher prevalence and severity of caries, and a diet high in breads & fat was associated with higher severity. In those 18-30, no dietary pattern was associated to caries.	24-hour recall

Table 4. Risk of bias of the studies included in this review, evaluated with the Newcastle–Ottawa tool.

STUDY	SELECTION (MAX. 5*)				COMPARABILITY OF OUT COME GROUPS (MAX 2*)		OUTCOME (MAX. 3*)		TOTAL MAX. 10*
	1*	2*	3*	4**	5*	6*	7**	8*	
Burt, <i>et al.</i> 2006	*	*	-	**	*	*	**	*	9
Cinar, <i>et al.</i> 2011. (among Danish)	*	-	-	*	*	-	**	-	5
Cinar, <i>et al.</i> 2011	*	-	*	*	*	-	**	-	6
Perera, <i>et al.</i> 2012	*	*	*	**	*	*	**	*	10
Kaye <i>et al.</i> 2015 (a)	-	-	-	**	*	*	**	*	7
Monteagudo <i>et al.</i> 2015	*	-	-	**	-	-	**	*	6
Silva, <i>et al.</i> 2015	*	*	*	*	*	*	**	*	9
Blostein, <i>et al.</i> 2020	*	*	*	*	*	*	**	*	9
Sanders, <i>et al.</i> 2020	*	*	-	**	*	*	**	*	9

MAX.: Maximum.

(a) Note: It is a prospective study, but not a cohort study, as it does not compare between two groups that differ in the exposure.

95% CI: 1.01 – 1.28). They adjusted by family income and oral hygiene status, using backward selection of variables.

Cinar *et al.*,²⁵ studied Danish teenagers; they did not evaluate the relationship between some pattern and caries as outcome but included in the pattern dietary habits and caries. They found a healthy pattern which had high loads (out of a maximum of 1) for the variables “no dental caries experience” (0.695), BMI (non-obese versus obese) (0.538), non-smoking (0.428) and daily fruit consumption.

That reveals that those who do not have dental caries are also who are not obese, do not smoke and eat fruits daily. Two *a posteriori* studies did not find a relationship between any pattern and caries.^{26,27} First, Burt *et al.*,²⁶ extracted four liquid and four solid food factors. None of them was significantly associated with caries.

Likewise, Cinar *et al.*,²⁷ in their study among Turkish school children, as they did in the

other article included,²⁵ did not evaluate the relationship between some pattern and caries as outcome, instead, they included variables in the same pattern. The variables were oral health (DMFT), periodontal status, obesity and lifestyle factors (which included tooth brushing and daily consumption of milk). Non relationship was found between dental, periodontal health and obesity in this study, both in the non-adjusted model and the adjusted model by lifestyle factors.

Risk of bias evaluation

All included articles were evaluated with Newcastle Ottawa Scale (NOS) for cross sectional studies. One of them was a prospective study,¹⁹ but was not a cohort study as it did not compare between two groups differing in exposure. They followed up a unique group. We decided to use the same scale because its design is similar to repeating a measurement from a cross sectional study.

DISCUSSION

Based on the results, certain dietary patterns, such as “*sugar-sweetened beverages and sandwiches*,” “*obesogenic*,” and “*sweet*,” were found to be associated with dental caries.

In contrast, adherence to AHEI 2010 was associated with a lower risk of caries. Out of nine articles selected, in six of them we found a positive relationship between some pattern and dental caries. *A posteriori* was the most used methodology (six out of ten). Five of them use principal component analysis as the strategy for pattern extraction. Most of the studies were cross sectional. We did not find any article that had used RRR as this strategy to obtain dietary patterns. It should be noted that those studies had low risk of bias. Four of them got nine or ten stars (out of a maximum of ten).

One of the strengths of this review is that it associates dietary patterns (understood as a combination of foods) with the outcome of caries. This association has been limitedly studied compared to other health outcomes such as obesity, overweight and diabetes. Another strength of the study is that it focuses on the methodology used, including articles with *a priori* and *a posteriori* methods and differentiating between them.

As a weakness, it can be mentioned that clinical trials cannot be included in this review because there are ethical reasons that prevent assigning a group to have less healthy dietary patterns. Observational studies are an acceptable alternative in this case.

Characteristics of the studies

Several studies have derived dietary patterns through exploratory FA,²⁸⁻³¹ extracting the pat-

terns with PCA. The PCA is used when there are many variables, to reduce them to a smaller number of components or patterns. The patterns are non-correlated linear combinations of initial variables that maximize the explained variance.³² Thus, it allows us to measure the combined effects of different behaviors.²⁸⁻³³

In the Blostein study, the pattern “*High in sugar-sweetened beverages and sandwiches*” was associated with caries.²² In Brazil, the pattern associated with caries was the “*obesogenic*” pattern, which had higher loads for fast food; sugars and sweets; and milk and dairy products.²³ Finally, the “*sweet*” pattern was associated with caries with high loads for sweetened buns and pastries; chocolates and toffees; and fizzy drinks (soda) and sweetened fruit drinks.²⁴

Conversely, the DASH diet —characterized by a high consumption of vegetables, whole grains, and beans; and a limited consumption of foods that are high saturated fat, full-fat dairy products, tropical oils, and sugar-sweetened beverages— showed it was associated with less caries. Likewise, a high score of adherence to the Alternative Healthy Eating Index-2010 (AHEI 2010) was associated with a lower caries experience. AHEI 2010 is a diet with more vegetables, fruits, whole grains, nuts and legumes, long-chain omega-3 fats, and other polyunsaturated fatty acids.

Notably, among those articles that did not find any relationship with caries, there was no confounders adjustment. However, among those that did adjust, they did find a relationship. This could be explained because of the presence of negative confounding.

As it is described by Szklo *et al.*,³⁴ it is a pheno-

menon that leads to underestimation of the true strength of the association. It is possible that there exists negative confounding in those articles that did not adjust in the analysis and that could have led to an underestimation of the association.

The relationship between dietary patterns and some oral diseases has been studied previously. In a recent systematic review, it was found that healthy dietary patterns may be protective factors for periodontal disease.³⁵ They affirm that to reduce the global burden of periodontal diseases, a healthy dietary pattern could be relevant, additionally to standard care actions such as hygiene and periodontal therapy.

Although it is not possible to conclude causality yet, the existence of other articles that have reached analogous conclusions with other outcomes —such as hypertension,^{36,37} cardiometabolic risk,³⁸ and dysglycemic risk³⁹ or metabolic syndrome⁴⁰— contributes to give consistency to this results that suggest that some dietary patterns may be associated with dental caries.

Furthermore, it has been recently studied that the association of socioeconomic status and dental caries is partially mediated by dietary factors.⁴¹

Some articles included factors other than food in the patterns, such as healthy behaviors. Some built the patterns only based on foods from the diet. The incorporation of other variables may help to answer this research question better. It is remarkable that during this review, 91 full-text articles were excluded because of not building dietary patterns but groping foods in, for example, “sugary” or “snacks”.

That may reflect the tendency to focus on dietary sugars in dentistry since it is the best-known factor. The weakness of using sugary or snack foods as indicators is that their interactions with healthy ingredients are not considered. We believe that sugar “as a risk factor for caries” is extensively researched. This study focused on the overall diet.

Likewise, to understand this phenomenon better, it is necessary to find out what explains determined food choices among people. We did not find studies that included variables related to the reason for choosing certain foods or what the food purchasing decisions are. However, qualitative research in Sweden has found that numerous aspects are important for food choices, such as environmental benefits, nutrition, sensory characteristics, production practices and ingredients.⁴²

Seeking to get countries to take charge of this problem, the World Health Organization calls governments to action, implementing fiscal policies to promote healthy diets, such as taxes on less healthy foods and beverages and subsidies on foods and beverages that contribute to a healthy diet, considering the evidence that supports the taxes and subsidies are effective in dietary changes.⁴³

The policies implemented vary from country to country. There is more evidence regarding taxes on sugar-sweetened beverages than on food. Of the 85 WHO member states, 83 WHO Member States tax “soft drinks”. 37 countries include juices within the taxed products. Energy and sports drinks are included in 22 countries.⁴³

CONCLUSION

Finally, it is concluded that, although there is evidence that certain ways of combining foods in the diet may be associated with caries, new studies are needed whose designs allow us to conclude causality.

The results of the articles included reaffirm the relevance of studying eating styles to explain dental caries and not only certain ingredients in the diet.

CONFLICT OF INTERESTS

The authors declare that they have no conflicts of interest.

ETHICS APPROVAL

Not needed

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AUTHORS' CONTRIBUTIONS

Correa Ramírez A: Conducted the search, reviewed the abstracts and full text articles.

Espinoza Santander I: Reviewed the abstracts and full text articles, drafted and critically revised the manuscript.

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