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# Food consumption, body mass index and risk for oral health in adolescents

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**KEYWORDS**
Adolescents;
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**Abstract**
*Objective:* The food intake has great influence on the oral health of adolescents, being relevant to analyze the type of food consumed by adolescents and their relationship with the DMFT index (decayed, missing and filled), the plaque index (PI) and the body mass index (BMI).
*Design:* Epidemiological study conducted in public schools of the 3rd cycle of basic education, central Portugal.
*Instruments:* The sociodemographic and dietary habits and frequency characterization was obtained through a self-administered questionnaire completed by adolescents and validated for the population under study. The DMFT index was evaluated according to WHO criteria, oral hygiene was evaluated based on the plaque index and BMI through weight and height in adolescents.
*Participants:* Random sample by clusters (schools) with 661 adolescents, 84.1% female and 15.9% male.
*Results:* Adolescents with mean age 13.22 years (± 1.139). The mean DMFT was 2.23 (± 2.484), the prevalence of PI was 96.4%, and ≥ 5 BMI <85. Adolescents with a higher DMFT index consume more cariogenic foods (r = 0.160; *P* = .000). Adolescents with a higher BMI consume less cariogenic foods (r = -0.1343; *P* = .001). The value of t reveals that the consumption of cariogenic foods explains 1.8% of the variance of the BMI and 2.6% DMFT.
*Conclusion:* The cariogenic foods are presented as a risk factor for dental caries. The results suggest that it is important to develop up actions for health education.


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## Introduction

Studies of dietary habits and nutritional status in Mediterranean countries emphasize the significant change in the diet of the population.[1] These changes show up most clearly in children and young people, because of their greater vulnerability to advertising and a more permissive attitude of parents towards consumption of cariogenic foods. This may contribute in the future for these children and adolescents have a greater number of chronic diseases and a reduced quality of life.[1] Today, we know that certain risk factors are determined from a very early age and eating habits established during childhood and school age persist over time and influence the subsequent habits.[2]

The American Dietetic Association (ADA) notes that nutrition is an integral component of oral health and different components of the diet are related to same.[3] The knowledge and the identification of the actions of anticariogenic, cariogenic[3] and cariostatic foods will develop more appropriate interventions to modify risky dietary habits.

It is essential, according to the ADA,[3] differentiate anticariogenic, cariogenic and cariostatic foods.[3] The anticariogenic are foods which can raise the pH of the saliva to an alkaline level, to promote and protect the enamel remineralization (dairy products, particularly cheese).[4]

The cariostatic foods are not metabolized by microorganisms of the plate and do not cause a fall in pH of the saliva to values lower than 5.5 in less than 30 minutes. Among them are the protein foods like eggs, meat, fish and most vegetables.

The cariogenic foods contain carbohydrates fermentable by microorganisms (sweets, sodas and "fast food"). They are characterized by being rich in mono and disaccharides and easily soluble in saliva, then slowly removed from the oral cavity. They can cause a decrease in pH of the saliva to values lower than or equal to 5.5 and demineralization when in contact with the microorganisms of the mouth. The chemical composition, physical form, particle size, solubility, adhesion and food texture are also important factors in determining the cariogenicity thereof.[5]

The relationship between eating habits, oral health and obesity in adolescents is something that has now been evaluated and discussed.

However, existing documentation is weak and contradictory, some studies show that there is no kind of association between the factors mentioned, while others have a specific association.[6-8] In this context emerged the present study to examine the relationship between consumption of cariogenic foods, oral health (DMFT and IP) and body mass index (BMI) in adolescents.

## Material and methods

Epidemiological study from a cluster-based random sample in 8 schools in central Portugal, with a total of 16 schools from the 3rd cycle of basic education (3.º CEB).

The study was authorized by the General Directorate for Innovation and Curriculum Development and the Ethics Committee of the School of Health of Viseu.

All 1115 adolescents from the selected schools were invited to participate in the study, 950 of these responded to the instrument of data collection, with some incomplete issues. However, only those who were encompassed voluntarily wanted to participate and presented the consent form signed by parents/guardians, and whose instruments: Food Frequency Questionnaire and Healthy Habits (FFQ)[9] Frequency Questionnaire Food acidogenic (QFA3C2) and Assessment Sheet for Oral Health[10,11] were properly completed by adolescents and researchers who performed physical examination (observation of mouth and anthropometric measurements), in a total of 661 adolescents. Despite the high rate of non-responses have performed a preliminary study which observed that there is no variability in responses, which does not compromise the present study.[12]

Food anticariogenic, Cariostatic Agents and cariogenic (QFA3C2) based on Regulatory Circular number 09/19 of DSE July[11] to assess the type of food and the frequency of food intake: the Food Frequency Questionnaire was applied. Foods were grouped based on the classification of ADA,[5] anticariogenic, cariogenic and cariostatic, translating its consumption in Low intake — one day/week, moderate drinking — two to three days/week, High intake — every day of the week.

The sum of the price of anticariogenic and cariostatic foods ranged between 9 and 27 points, indicating that the higher the score the higher the frequency of consumption and the sum of consumption of cariogenic foods to vary between 10 and 30 points, with the same meaning.

The values of Cronbach's alpha for all the items was reasonable ($\alpha = 0.79$). The internal consistency of anticariogenic and cariostatic foods was 0.62 and 0.78 of cariogenic, a reasonable consistency.

The criteria for diagnosis and intervention methodologies have been standardized in view the reliability and comparability of data with national and international studies.[13] The registration of the DMFT index was calculated based on procedures recommended by WHO.[10] The plaque index (PI) was obtained by the objective examination of the oral cavity, have been used in the evaluation, the developer plate (erythrosine solution of 2%) and examined the six predefined teeth, according to the criteria classification of Greene & Vermillion and DGS.[15,16]

This step, prior to fieldwork, aimed: to ensure uniformity in evaluation of DMFT indices and IP; understand and apply the criteria adopted; minimize errors and differences between observers and between observations; reduce intra and inter-observer variations. The calibration consisted of a theoretical and practical training, supervised by an expert in the area of community oral health for five periods. The theoretical training, one of the periods, lasting four hours, aimed at the discussion of the concepts and diagnostic criteria to be used in the study. Practical training held in two days, in four distinct periods, ran a school for the 3rd CEB. The first period was a visual display of clinical cases by the expert, followed by the execution of a set of observations and reobservations the oral structures (DMTF and IP) and respective filling the oral health assessment form. During the process, the differences identified, the criteria of doubtful diagnosis, coding and registration errors were the subject of reflection and discussion.

In each period of practical exercise 10 adolescents age groups 12, 13, 14 and 15 years were observed for three

teams consist of observer/evaluator and recorder, having also performed double observations and 10% of participants in calibration.[9] Observations made by the teams during the calibration, we obtained a value of intra-observer agreement for the Kappa index DMFT and IP, respectively, of 93.0% and 92.0% and inter-observer agreement for the DMFT index and plaque index of 86.0% and 85.5%, which represents a very good reliability for the validity of the data collected on the prevalence of dental caries and plaque index.

Registration BMI was obtained by evaluating the ratio between weight (kg) and height ($m^2$) (Quetelet index). To determine BMI percentiles, adapted to the age and sex of the teens, we used the cutoffs according to the references of the National Center for Health Statistics, Centers for Disease Control and Prevention, which recommends the following classification: Underweight (< 5) normal weight (≥ 5 and < 85), overweight (≥ 85 and < 95) and obesity (≥ 95).[17]

The processing and analysis of data was performed using the Statistical Package for Social Sciences (SPSS) version 20.0.

Techniques of descriptive statistics (frequency distributions and statistical measures) and inferential statistical techniques (chi-square, Kruskal-Wallis and Student t tests) were used in this study.

## Results

Teenagers aged between 11 and 17 years, with an average 13.22 years (SD = 1.139). The majority (71.9%) comes from the countryside. Values similar to those of the total sample are observed in boys and girls, 75.1% and 69.4%, without significant differences ($\chi^2 = 2.642$; $P = .104$).

Referring to the school situation, 43.1% attend the 7th grade, 30.7% and 26.2% 8th to 9th grade. The percentage values are identical in both genders ($\chi^2 = 0.339$; $P = .844$).

Parents/guardians, 71.4% live in rural areas, have as the 2nd cycle qualifications 30.0%, the 1st cycle 24.7%, secondary and higher education 23.9%, and the 3rd cycle 21.4%.

Most are employed (87.1%), 7.0% are unemployed and 2.8% retired, with no differences between genders ($\chi^2 = 2.373$; $P = .499$).

### DMFT index and plaque index (PI)

Girls have on average higher DMFT scores than boys ($P < .05$), inferring that women have worse oral health. IP in the differences between boys and girls are not significant ($P > .05$).

### Anthropometric profile of adolescents

The weight of adolescents is similar (Table 1) in both genders, with no significant differences ($P > .05$). The boys are on average taller than girls (Table 1), with significant differences ($P < .05$). The girls have a higher BMI than boys ($P < .05$) (Table 1).

### Eating habits of teens

Most teenagers think they have a healthy diet (67.9%), 14.7% fairly healthy, unhealthy 11.2% and 3% consider they have a very unhealthy diet. The perception of adolescents about the quality of your food does not differ in relation to gender ($\chi^2 = 3.030$; $P = .553$).

Most teens eat 5/6 meals a day (57.6%), 31.6% between 3/4 and only 7.3% eat 7 or more. The values obtained for boys and girls are identical ($\chi^2 = 7.562$; $P = .056$).

### Consumption anticariogenic, cariogenic and cariostatic foods

Teenagers relate mostly with a moderate anticariogenic food intake (50.3%) and cariostatic (57.5%). Regarding the consumption of cariogenic foods most eat them moderately (75.9%), 18.5% high intake and 5.6% manifest a low intake. The boys consume less cariogenic foods when compared to the girls (22.9% vs 15.1%) ($\chi^2 = 6.403$; $P = .041$).

The adolescents in urban and environment consume more cariostatic anticariogenic food and less cariogenic foods. The differences are not significant ($P > .05$).

**Table 1** Anthropometric profile of adolescents

| | Min | Max | $\overline{X}$ | Dp | CV (%) | Average | t Student |
|---|---|---|---|---|---|---|---|
| *Weight (kg)* | | | | | | | |
| Male | 28.0 | 100.0 | 53.35 | 12.013 | 22.52 | 53.0 | t = 0.274 |
| Female | 30.5 | 82.5 | 53.29 | 9.854 | 18.49 | 52.0 | *P* = .790 |
| Total | 28.0 | 100.0 | 53.32 | 10.842 | 20.34 | 52.5 | |
| *Height (cm)* | | | | | | | |
| Male | 135.0 | 183.0 | 159.31 | 9.197 | 5.77 | 159.1 | t = 3.740 |
| Female | 137.3 | 173.1 | 156.55 | 6.081 | 3.88 | 157.1 | *P* = .000 |
| Total | 135.0 | 183.0 | 158.11 | 7.670 | 4.85 | 157.5 | |
| *Body mass index - IMC (%)* | | | | | | | |
| Male | 13.8 | 36.6 | 20.88 | 3.647 | 17.47 | 20.40 | t = −2.121 |
| Female | 15.0 | 33.7 | 21.50 | 3.440 | 16.00 | 20.81 | *P* = .034 |
| Total | 13.8 | 36.6 | 21.23 | 3.543 | 16.69 | 20.66 | |

**Table 2** Employment status of parents and consumption of anticariogenic, cariogenic and cariostatic food

| Employment situation of the father | Anticariogenic/cariostatic food | | Cariongenic food | |
|---|---|---|---|---|
| | Average weight | Average | Average weight | Average |
| Employed | 272.83 | 19 | 261.10 | 15 |
| Unemployed | 247.08 | 17 | 295.23 | 16.5 |
| Retired | 340.67 | 20 | 347.09 | 20 |
| Emigrant | 234.92 | 17 | 340.50 | 18 |
| Kruskal-Wallis test | H = 6.690; *P* = .082 | | H = 12.787; *P* = .005 | |
| **Employment situation of the mother** | **Anticariogenic/cariostatic food** | | **Cariongenic food** | |
| | Average weight | Average | Average weight | Average |
| Employed | 277.04 | 19 | 273.82 | 16 |
| Unemployed | 274.05 | 18 | 275.96 | 16 |
| Retired | 258.00 | 17 | 296.94 | 16 |
| Emigrant | 334.50 | 20 | 376.17 | 18 |
| Kruskal-Wallis test | H = 0.568; *P* = .904 | | H = 1.417; *P* = .702 | |

The analysis of the frequency and type of food teenagers according to age revealed that older people consume more cariogenic foods. The Kruskal-Wallis test confirms that the differences are significant in the consumption of cariogenic foods (H = 6.650; *P* = .034) and not significant in the consumption of food and anticariogenic cariostatic (H = 0.438; *P* = .803).

Food consumption in family socioeconomic context regarding the employment status of father and mother, reveals significant differences only in the consumption of cariogenic foods (*P* = .005), and there is less consumption in adolescents with employed parents. Teenagers who have retired parents consume cariogenic food more often (Table 2).

The consumption anticariogenic/cariogenic and cariostatic food proved to be independent of employment status of the mother (*P* > .05) (Table 2).

## Discussion

Considering the WHO classification, which uses as reference levels of dental caries (DMFT) at age 12, the result of this study (2:23) is similar to that found in the municipality of Satão (2.32),[18] but still absent advocated for the European Region in 2020 (1.50) and the result (1.48) found in Portugal (2005/2006), the National Study of the Prevalence of Oral Diseases[11] value. The result is also less favorable than that of some European countries in 2005, namely, Spain 1.33 Sweden 1.0, Denmark 0.8, Germany and the UK and 0.7 in 2010, 0.9 Belgium and Denmark, it appears the result is less favorable.[19,20] In this context, in order to improve results, the promoter of oral health initiatives are of great acuity, the family and school environment. The role of health professionals, especially those working in primary care is of paramount importance because the bet must be made in terms of identification, promotion and prevention rather than in terms of treatment, so pediatricians, nurses, hygienists and dentists should take every opportunity they have with teens to make of this screening and education about healthy lifestyles. The health education should be part of education that children and adolescents should receive to promote healthy styles. Prevent risk behaviors and promote healthy choices among adolescents can produce positive health outcomes, not only during adolescence, but also during the adult life.[17]

*Body mass index*. Among adolescents there is 31.4% overweight / obesity. This percentage is similar to that found in Europe, where overweight and obesity affect 20% to 35% of children,[21] higher than the 9.1% found in a study of adolescents from public schools Peaks in Brazil,[22] and 17.1% obtained in the study in Portugal.[23] The girls have a higher BMI (*P* < .05).

*Eating habits*. The percentage of adolescents who consider their healthy eating habits is significantly higher than in other studies.[24,25]

Most teens eat 5/6 meals a day, values similar to those found in studies conducted in Portugal.[25,26] This dietary pattern, in terms of meals, is in accordance with the criteria of the General Directorate of Health.[13]

*Food consumption and BMI and DMFT relationship*. Teenagers younger than 12 years consume less often cariogenic foods than those who are younger than 15 years. These results corroborate those of other investigators,[26,27] whose studies mention the group of 15 years as the largest consumers of sweets and chocolates and younger (11 years) as less frequent users.

The consumption of such foods was associated inversely with BMI and positively with the DMFT, ie, adolescents who consume less often foods with cariogenic effect have a higher BMI (*P* = .000), and more often they ingest food with cariogenic effect have a higher amount of DMF (*P* = .000). The value of t shows that consumption of cariogenic foods

### What we know about the theme

The relationship between eating habits, oral health, body mass index and nutritional status in adolescents is something that has now been evaluated and discussed. However there is no reference to studies in this specific population.

### What we get out the study

The study shows que younger teens who live in urban areas, Whose father is employed, have a higher BMI and consumes less cariogenic food frequency. Older adolescents, more often Do consumes cariogenic foods, have higher index of DMF and hence worse oral health.

explains 2.6% and 2.8% of the variance in BMI and DMFT. In France,[28] in 2005, a cross-sectional study in a random sample of 835 adolescents, 12 years of age, obtained a mean BMI of 18.9 and DMFT 1:47, also, having found a significant association between DMFT and consumption of cariogenic foods, but not with BMI. In Portugal study included 181 adolescents aged 12 years, held in Vila Nova de Paiva, there was no significant difference in the association between DMFT and the four levels of BMI.[8]

The results show that adolescents who consume more frequently cariogenic foods have higher index of DMF and hence worse oral health.

Evidence of the effect of consumption of cariogenic association with the level of oral health in the adolescent population, allows food to sustain the importance of developing appropriate programs and interventions that contribute to modifying eating habits risk.

The association between oral health, body mass index, nutritional status and food consumption should be studied in other age groups so that they can make other inferences.

## Conflicts of interest

The authors declare that there are no conflicts of interest.

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