ORIGINAL ARTICLE

Association between dental caries activity, quality of life and obesity in Brazilian adolescents

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Objectives: The impact of oral conditions on quality of life in overweight/obesity needs to be elucidated. The aim of this study was to evaluate the association between dental caries activity, quality of life and obesity in Brazilian adolescents. **Materials and methods:** This study was conducted at public schools in Brazil, on a sample of 202 adolescents, 12 years of age. For anthropometric evaluation, the body mass index (BMI)-for-age was used. In oral examinations, the Decayed, Missing, Filled teeth (DMFT), significant caries (SiC) and dental caries activity (DCA) indices were used ($\kappa > 0.94$). The Child-Oral Impacts on Daily Performance (Child-OIDP) index was applied. The sample was divided into two groups: O (overweight/obese; $n = 101$) and N (normal weight; $n = 101$). For data analysis, chi-square, odds ratio (OR), Wilcoxon and Pearson correlation tests were used ($P < 0.05$). **Results:** The DMFT scores were 1.67 and 2.12 and the SiC scores were 3.85 and 4.26 for groups O and N, respectively. BMI-for-age was significantly related to DCA (OR = 0.579; $P < 0.000$) and to SiC (OR = 0.649; $P = 0.024$). There were differences between the groups in eating, cleaning mouth, emotional status, smiling, studying and the overall Child-OIDP ($P < 0.05$). Positive associations between the impacts on eating, cleaning mouth and smiling were found ($P < 0.05$). DMFT values showed significant correlation with the emotional status performance in group O and the DCA was positively correlated with performance at school in group O ($P < 0.05$). **Conclusion:** Obesity, dental caries and quality of life were not correlated. Adolescents with normal weight presented a low perception of the impact of oral conditions on quality of life; however, it seemed to affect psychological aspects in their daily performances. Providing adolescents with nutritional assistance may prevent obesity and dental caries, and improve their quality of life.

Key words: Adolescents, dental caries, obesity, overweight, quality of life

INTRODUCTION

Obesity can be defined as abnormal or excessive fat accumulation that may impair health and is ranked as the fifth risk factor for death worldwide[1]. The prevalence of overweight and obesity has increased all over the world, especially among children and adolescents. Studies have estimated that 170 million persons under the age of 18 years are overweight[2,3]. This condition is associated with premature mortality and long-term morbidity and may cause a reduction in quality of life and psychological damage to individuals[2,4].

Poor dietary habits, such as the consumption of high-sugar food and soft drinks, may contribute to the development of obesity among children and adolescents, in addition to playing an important role in dental caries[5]. The relationship between obesity and dental caries needs to be elucidated and the methods for diagnosing these conditions should be standardised because in the scientific literature some studies have described this relationship as being significant[6], whereas others have found no strong evidence for it[5,7,8].

Quality of life can be affected by both obesity and oral health conditions[4,9–11]. Socio-dental instruments have been used to assess this condition[12–14], but children's and adolescents' perceptions about oral impacts on quality of life differ from those of adults regarding the physical and emotional aspects at this stage of life[15].

The impact of oral conditions on quality of life in obese adolescents has been reported infrequently in the scientific literature and thus needs to be elucidated, as does the controversy about the relationship between dental caries and obesity in this population. This aim of this study was to evaluate the association between dental caries activity, quality of life and obesity in Brazilian adolescents.

METHODS

Study design and sample

This cross-sectional study was conducted at public schools in Dois Córregos, State of São Paulo, Brazil. The sample consisted of 202 adolescents, 12 years of age and of both genders, enrolled in five public schools, distributed in each region of the city. To calculate the sample size, data from the Brazilian Institute of Geography and Statistics and the National Survey of Oral Health SB Brazil 2010 were adopted[16,17]. Dental caries prevalence indicators were obtained from the above-mentioned oral health epidemiological survey, adopting the indices for the southeast of the country, a design effect of 1.4% and an error of 12%.

Anthropometric status

Anthropometric evaluation was performed using the body mass index (BMI)-for-age (kg/m²) percentiles, used by the World Health Organisation (WHO) as the instrument to measure growth and nutrition[18]. The BMI-for-age is dependent on gender- and age-specific weight-for-height charts for subjects 5–19 years of age. The BMI-for-age was used to divide the adolescents into two groups: overweight/obesity (BMI ≥ 85th percentile) and normal weight (3rd percentile ≥ BMI < 85th percentile).

Dental caries

Oral examinations were performed by two trained and calibrated examiners ($\kappa > 0.94$) with the assistance of two note-takers. Dental caries was evaluated using the Decayed, Missing, Filled teeth (DMFT) and significant caries (SiC) indices, in accordance with the WHO recommendations for epidemiological studies[19]. The variable 'Dental Caries Activity' (DCA) was used only for the permanent decayed teeth analysed.

Child-oral impacts on daily performances

Oral health-related quality of life was measured using the Child-Oral Impacts on Daily Performance (Child-OIDP) index, originally developed in English[12], and then translated into and validated in Portuguese[11]. This instrument was applied to the adolescents in two steps. The first step began with a self-administered questionnaire filled out by all children in their classroom. It contained all the most common oral problems that children are likely to perceive, including an open answer for problems unexpectedly perceived in the last 3 months. According to the developers, the purpose of this step was to focus children's attention on their oral health problems and to highlight the oral impact assessment in the second step. After this, the adolescents were individually interviewed, independently of their answers in the first step, to assess the oral impacts on daily life in the performance of eight daily activities. The activities investigated were: eating, speaking, cleaning mouth, sleeping, emotional status, smiling, studying and social contact. When the adolescents reported an impact on their performance of these daily activities, they answered questions about the severity and the frequency of this specific impact (score 0–3); overall calculation of the index included the multiplication of severity and frequency in each performance. A sum of the eight performance values was obtained, resulting in a number from 0 to 72, which was divided by 72 and then multiplied by 100, so that the Child-OIDP score ranged from 0 to 100.

Data analysis

Data were entered into Microsoft Excel 2010 spreadsheets (Microsoft Corporation, Redmond, WA, USA) and analysed using *STATISTICA* 10 statistical package (StatSoft Inc., Tulsa, OK, USA). The sample was divided into two groups, matched by gender and BMI-for-age [overweight/obese (group O), $n = 101$; and normal weight (group N), $n = 101$]. Data such as groups, caries activity and intensity of the oral impact on daily performance were dichotomised and analysed producing chi-square, odds ratio (OR) and 95% confidence interval. The data were tested for normality and homogeneity, and then the appropriate statistical test was chosen. The data did not show a normal distribution, and thus differences in mean prevalence values of performance and overall Child-OIDP between the groups were assessed using the Wilcoxon test. The Pearson linear correlation was applied to the performances, overall Child-OIDP and the BMI-for-age, DMFT and activity of dental caries. The level of significance adopted was $P < 0.05$.

Ethical aspects

The study protocol was approved by the Research Ethics Committee of the Bauru School of Dentistry (process number 109/2011) and complied with the norms of the Declaration of Helsinki at 2008. The adolescents' parents or guardians signed a term of free and informed consent before the examinations began.

RESULTS

The adolescents were evaluated and matched in two groups (group O, $n = 101$; and group N, $n = 101$) containing 56 girls and 45 boys in each. The mean BMI-for-age values in group O were 23.44 ± 3.74

Table 1 Prevalence of perceived oral problems, according to group, in 12-year-old Brazilian adolescents

List of commonoral problems	Overweight/ Obesegroup % (*n*)	Normal- weightgroup % (*n*)
Toothache	27.72 (28)	43.56 (44)
Sensitive tooth	51.49 (52)	61.39 (62)
Dental caries	31.68 (32)	36.63 (37)
Exfoliating primary teeth	25.74 (26)	28.71 (29)
Space between teeth	21.78 (22)	17.82 (18)
Broken permanent tooth	11.88 (12)	10.89 (11)
Tooth colour	33.66 (34)	48.51 (49)
Tooth shape or size	8.91 (9)	15.84 (16)
Position of teeth	44.55 (45)	37.62 (38)
Bleeding gums	24.75 (25)	34.65 (35)
Swollen gums	12.87 (13)	18.81 (19)
Tartar (calculus)	12.87 (13)	21.78 (22)
Wounds	22.77 (23)	15.84 (16)
Bad breath	38.61 (39)	40.59 (41)
Deformed mouth or face	2.97 (3)	1.98 (2)
Erupting permanent tooth	51.49 (52)	60.40 (61)
Missing permanent tooth	6.93 (7)	3.96 (4)

and 23.36 ± 3.63, for male adolescents and female adolescents, respectively, whilst in group N these values were 17.35 ± 0.98 and 17.37 ± 1.27.

In group O, 42.57% of the adolescents were caries free compared with 28.71% in group N. The mean DMFT score was 1.67 (D = 0.65; M = 0.00; F = 1.02) in group O and 2.12 (D = 1.03; M = 0.02; F = 1.07) in group N; the SiC score was 3.85 in group O and 4.26 in group N. A significant relationship was observed between BMI-for-age and DCA (OR = 0.579; 95% CI: 0.198–0.630; $P < 0.000$) and BMI-for-age and SiC (OR = 0.649; 95% CI: 1.093–4.010; $P = 0.024$).

The perceived oral problems were assessed in the first step of the Child-OIDP questionnaire (*Table 1*). In group O, the most common oral problems perceived were sensitivity and permanent tooth eruption (51.49% each), position of teeth (44.55%) and bad breath (38.61%). In group N they were tooth sensitiv-

ity (61.39%), permanent tooth eruption (60.40%); tooth colour (48.51%) and toothache (43.56%).

The performances that showed the highest prevalence of oral impact were eating (21.23), smiling (11.88) and emotional status (8.91) for group O, whereas in group N they were eating (27.39), cleaning mouth (18.26) and smiling (15.07) (*Table 2*). There were significant differences between the groups in eating, cleaning mouth, emotional status, smiling, studying and the Overall Child-OIDP.

The intensity of the impact was assessed by multiplying the frequency and the severity of each performance (*Table 3*). There were positive associations between the impacts on eating, cleaning mouth and smiling ($P < 0.05$).

The BMI-for-age, Child-OIDP and overall performance showed no evidence of significant correlations (all $P > 0.05$) (*Table 4*). The DMFT values showed significant correlation with the emotional status performance in group O ($P < 0.05$) (*Table 5*), and the DCA was positively correlated with study performance in the group O adolescents ($P < 0.05$) (*Table 6*).

DISCUSSION

This study was conducted in partnership with the City Health Department, and the adolescents who were diagnosed as being in need of dental treatment were referred to the health units and treated. A possible limitation of this study may be attributed to the self-perception of the individuals evaluated in understanding and responding to the questionnaire proposed, as their responses could overestimate the perceived oral problems. However, this point was noted by the authors of the instrument and was taken into consideration in the preparation of the questionnaire[12].

The adolescents in group N showed higher dental caries prevalence and DMFT values than those in group O. A significant relationship was shown

Table 2 Prevalence of oral impacts on daily performance, according to the Child-Oral Impacts on Daily Performance (Child-OIDP) score, in overweight/obese and normal-weight groups of 12-year-old Brazilian adolescents

Performances	Overweight/Obesegroup		Normal-weightgroup		*P*
	Mean $\pm$ SD	Range	Mean $\pm$ SD	Range	
Eating	21.23 ± 32.70	0–100.00	27.39 ± 29.50	0–100.00	0.000
Speaking	6.49 ± 19.89	0–100.00	6.27 ± 15.19	0–66.67	0.896
Cleaning mouth	10.23 ± 26.65	0–100.00	18.26 ± 26.41	0–100.00	0.002
Sleeping	4.07 ± 15.05	0–100.00	4.51 ± 14.42	0–66.67	0.056
Emotional status	8.91 ± 21.89	0–100.00	12.87 ± 24.43	0–100.00	0.009
Smiling	11.88 ± 28.12	0–100.00	15.07 ± 22.86	0–100.00	0.000
Studying	1.43 ± 10.38	0–100.00	1.10 ± 7.12	0–66.67	0.000
Social contact	7.48 ± 20.55	0–100.00	9.90 ± 21.48	0–100.00	0.265
Overall Child-OIDP	10.77 ± 14.56	0–68.06	13.61 ± 14.64	0–77.78	0.000

Wilcoxon test ($P < 0.05$).

Table 3 Prevalence, intensity and score of oral impacts, according to group, in 12-year-old Brazilian adolescents

Intensity of impact	Eating* % (n)	Speaking % (n)	Cleaning mouth* % (n)	Sleeping % (n)	Emotional status % (n)	Smiling* % (n)	Studying % (n)	Social contact % (n)
Very little								
Group O	4.95 (5)	2.97 (3)	1.98 (2)	1.98 (2)	2.97 (3)	1.98 (2)	0.00 (0)	3.96 (4)
Group N	11.88 (12)*	6.93 (7)	10.89 (11)*	4.95 (5)	5.94 (6)	7.92 (8)*	0.99 (1)	5.94 (6)
Little								
Group O	4.95 (5)	3.96 (4)	1.98 (2)	1.98 (2)	5.94 (6)	5.94 (6)	1.98 (2)	3.96 (4)
Group N	6.93 (7)	1.98 (2)	4.95 (5)	0.00 (0)	3.96 (4)	4.95 (5)	0.00 (0)	2.97 (3)
Moderate								
Group O	14.85 (15)	3.96 (4)	3.96 (4)	2.97 (3)	5.94 (6)	5.94 (6)	0.00 (0)	5.94 (6)
Group N	16.83 (17)	3.96 (4)	9.90 (10)*	0.00 (0)	5.94 (6)	13.86 (14)*	0.00 (0)	5.94 (6)
Severe								
Group O	5.94 (6)	0.99 (1)	2.97 (3)	1.98 (2)	2.97 (3)	0.00 (0)	0.00 (0)	0.99 (1)
Group N	9.90 (10)	0.99 (1)	6.93 (7)	2.97 (3)	2.97 (3)	2.97 (3)	0.00 (0)	0.99 (1)
Very severe								
Group O	9.90 (10)	2.97 (3)	5.94 (6)	0.99 (1)	2.97 (3)	7.92 (8)	0.99 (1)	2.97 (3)
Group N	11.98 (12)	0.99 (1)	5.94 (6)	1.98 (2)	5.94 (6)	4.95 (5)	0.99 (1)	4.95 (5)

Group O, overweight/obese; Group N, normal weight.
*Difference between reports from different groups was statistically significant. Chi-square ($P < 0.05$).

Table 4 Pearson linear correlation between body mass index (BMI)-for-age and performance and overall Child-Oral Impacts on Daily Performance (Child-OIDP) score, according to group, in 12-year-old Brazilian adolescents

Performance/Child-OIDPscore	BMI-for-age			
	Overweight/ Obesegroup		Normal-weightgroup	
	R	P	R	P
Eating	−0.09	0.327	−0.01	0.904
Speaking	−0.03	0.762	0.02	0.782
Cleaning mouth	−0.07	0.471	−0.01	0.889
Sleeping	−0.06	0.544	0.02	0.773
Emotional status	−0.14	0.148	−0.09	0.359
Smiling	−0.13	0.173	0.03	0.702
Studying	−0.03	0.718	−0.10	0.304
Social contact	−0.06	0.527	−0.05	0.585
Overall Child-OIDP	−0.14	0.162	0.01	0.918

Table 5 Pearson linear correlation between the decayed, missing, filled teeth (DMFT) index and performance and overall Child-Oral Impacts on Daily Performance (Child-OIDP) score, according to group, in 12-year-old Brazilian adolescents

Performance/Child-OIDP score	DMFT			
	Overweight/ Obesegroup		Normal-weightgroup	
	R	P	R	P
Eating	0.18	0.066	0.02	0.843
Speaking	0.03	0.756	0.11	0.262
Cleaning mouth	0.03	0.763	−0.18	0.060
Sleeping	0.00	0.997	0.00	0.965
Emotional status	0.20	0.047*	0.81	0.418
Smiling	0.00	0.961	−0.07	0.471
Studying	0.06	0.514	−0.08	0.420
Social contact	0.04	0.699	−0.59	0.552
Overall Child-OIDP	0.12	0.218	−0.06	0.499

*$P < 0.05$.

between BMI-for-age and DCA ($P < 0.000$). However, it was observed that a greater number of adolescents in group O had DMFT values close to the SiC index ($P = 0.0024$). A Chinese study showed no relationship between peripheral adiposity (BMI) and dental caries, but it found a significant relationship between central adiposity and caries[6]. Systematic reviews did not find sufficient scientific evidence of this relationship (obesity–dental caries), but the authors pointed out that there are some factors that must be considered, such as the criteria used for examinations, history of the use of fluoridated substances and access to oral health services[5,7]. The relationship between dental caries and obesity has been studied in Brazilian adolescents; however, no significant evidence of a relationship between the variables was found[20]. In this study, the adolescents lived in a

city without public water supply fluoridation and with poor oral health-education programmes. Access by the overweight/obese to industrialised food containing additional fluoride may have favoured the weight gain and could explain the lower DMFT values in this group[21–23].

In the first step of the Child-OIDP (*Table 1*), both groups indicated *tooth sensitivity* as the condition that most affected them, which has also been observed in a previous study of Brazilian adolescents[11], whereas in the Sudan, an underdeveloped African country, toothache and tooth sensitivity were the most reported/mentioned conditions[20]. *Permanent tooth eruption* was reported as the second most common condition affecting both groups; however, this condition is consistent with the age of the participants in this study, in the period of mixed dentition, and is

Table 6 Pearson linear correlation between dental caries activity (DCA) and performance and overall Child-Oral Impacts on Daily Performance (Child-OIDP) score, according to group, in 12 year-old Brazilian adolescents

Performance/Child-OIDP score	DCA			
	Overweight/Obesegroup		Normal-weightgroup	
	R	P	R	P
Eating	0.16	0.118	0.01	0.912
Speaking	−0.01	0.943	0.02	0.842
Cleaning mouth	0.42	0.676	−0.09	0.379
Sleeping	−0.01	0.895	−0.03	0.761
Emotional status	0.17	0.078	0.02	0.851
Smiling	0.95	0.340	−0.11	0.278
Studying	0.20	0.046*	−0.07	0.469
Social contact	0.07	0.490	0.03	0.760
Overall Child-OIDP	0.15	0.141	−0.05	0.586

*$P < 0.05$.

a transitory condition that tends to disappear[12]. Adolescents in group O also reported the *position of teeth* and *bad breath*, conditions more readily associated with social interaction[24], whereas in group N, *tooth colour* and *toothache* could be related to oral diseases, such as dental caries[20].

According to Castro *et al.*, *Eating* was the performance most affected when the Child-OIDP was used in Brazilian children[11,25], which was found in this study for both groups (*Table 2*). In overweight/obese adolescents, even *Smiling* and *Emotional status* were reported, showing the influence of oral conditions on psychological aspects[26,27]. Adolescents in group N reported *Cleaning mouth* and *Smiling* as the other most prevalent performances. Toothache and dental caries are important factors to consider when children and adolescents have difficulties with performing oral hygiene because these conditions demonstrate a strong association[28,29]; for example, the presence of dental caries may impact the performance of smiling[30].

Adolescents in group N had a worse perception of their oral health than did those in group O because there were positive associations with *Eating*, *Cleaning mouth* and *Smiling* (*Table 3*). The low perception of health-related quality of life in group O differs from that of other studies[31,32], in which overweight/obesity was associated with worse quality of life. However, in this study, group O adolescents had lower dental caries activity than did adolescents in group N, which, in turn, could explain the low perception in the Child-OIDP.

In this study, the BMI-for-age was not associated with the Child-OIDP scores and performances; however, the dental caries parameters were positively correlated with *Emotional status* (*Table 5*) and *Studying* (*Table 6*) performances in group O (*P < 0.05*).

Although the adolescents in group O demonstrated a low perception of the impact of oral conditions on their daily performance, the correlation with dental caries could show the real impact. Depression and low self-esteem are the psychological problems most commonly found in overweight and obesity[33], which may explain the results found in this study, with the adolescents in group O presenting a lower prevalence of dental caries and a lower perceived impact of the Child-OIDP, in addition to showing positive correlations between these factors.

The hypothesis tested was not accepted because 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. Moreover, quality of life was shown to have more impact on these individuals. Overweight/obese adolescents presented a low perception of the impact of oral conditions on their quality of life, but it appeared to affect the psychological aspects of their daily performance. Health promotion among adolescents is very important to improve their quality of life. In addition, they require care by a multidisciplinary team, with attention to proper nutrition. These measures could prevent diseases and health problems such as obesity and dental caries.

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Conflict of Interest

The authors declare that there are no conflicts of interest related to this study.

Authors' contributions

ARF carried out all work including data collection, data analysis and writing the paper. FDCA, AMFGT and JMY worked in data collection, analysis and assisted writing. ASP supervised the project and assisted writing. SHCSP initiated the idea of, supervised the project and edited writing.

REFERENCES

1. World Health Organization. *Obesity and Overweight*. Geneva: World Health Organization; 2013.

2. World Health Organization. *Population-Based Approaches To Chilhood Obesity Prevention*. Geneva: World Health Organization; 2012.

3. Lobstein T, Baur L, Uauy R. Obesity in children and young people: a crisis in public health. *Obes Rev* 2004 5(Suppl 1): 4–104.

4. Pratt KJ, Lazorick S, Lamson AL *et al.* Quality of life and BMI changes in youth participating in an integrated pediatric obesity treatment program. *Health Qual Life Outcomes* 2013 11: 116.

5. Silva AE, Menezes AM, Demarco FF *et al.* Obesity and dental caries: systematic review. *Rev Saude Publica* 2013 47: 799–812.

6. Peng SM, Wong HM, King NM *et al.* Association between dental caries and adiposity status (general, central, and peripheral adiposity) in 12-year-old children. *Caries Res* 2014 48: 32–38.

7. Hayden C, Bowler JO, Chambers S *et al.* Obesity and dental caries in children: a systematic review and meta-analysis. *Community Dent Oral Epidemiol* 2013 41: 289–308.

8. Elangovan A, Mungara J, Joseph E. Exploring the relation between body mass index, diet, and dental caries among 6-12-year-old children. *J Indian Soc Pedod Prev Dent* 2012 30: 293–300.

9. Tavares TB, Nunes SM, Santos MO. Obesidade e qualidade de vida: revisão de literatura. *Rev Med Minas Gerais* 2010 20: 359–366.

10. Tsiros MD, Olds T, Buckley JD *et al.* Health-related quality of life in obese children and adolescents. *Int J Obes* 2009 33: 387–400.

11. Castro RA, Cortes MI, Leao AT *et al.* Child-OIDP index in Brazil: cross-cultural adaptation and validation. *Health Qual Life Outcomes* 2008 6: 68.

12. Gherunpong S, Tsakos G, Sheiham A. Developing and evaluating an oral health-related quality of life index for children; the CHILD-OIDP. *Community Dent Health* 2004 21: 161–169.

13. Slade GD. Derivation and validation of a short-form oral health impact profile. *Community Dent Oral Epidemiol* 1997 25: 284–290.

14. Broder HL, Wilson-Genderson M. Reliability and convergent and discriminant validity of the Child Oral Health Impact Profile (COHIP Child's version). *Community Dent Oral Epidemiol* 2007 35(Suppl 1): 20–31.

15. Tesch FC, Oliveira BH, Leao A. Measuring the impact of oral health problems on children's quality of life: conceptual and methodological issues. *Cad Saude Publica* 2007 23: 2555–2564.

16. Brasil. *Censo Demográfico 2010*. Rio de Janeiro: Estatística Instituto Brasileiro de Geografia e Estatítica; 2010.

17. Brasil. *SB Brasil 2010. Pesquisa Nacional de Saúde Bucal: Resultados Principais*. Brasília: Ministério da Saúde; 2011. p. 92.

18. World Health Organization. *Child Growth Standarts. BMI-for-Age (5–19 Years)*. Geneva: World Health Organization; 2007.

19. World Health Organization. *Oral Health Surveys: Basic Methods*, 4th ed. Geneva: World Health Organization; 1997.

20. Sales-Peres SH, Goya S, Sant'Anna RM *et al.* Prevalence of overweight and obesity, and associated factors in adolescents, at the central west area of the state Sao Paulo (SP, Brazil). *Cien Saude Colet* 2010 15(Suppl 2): 3175–3184.

21. Buzalaf MA, de Almeida BS, Cardoso VE *et al.* Total and acid-soluble fluoride content of infant cereals, beverages and biscuits from Brazil. *Food Addit Contam* 2004 21: 210–215.

22. Buzalaf MA, Granjeiro JM, Cardoso VE *et al.* Fluorine content of several brands of chocolate bars and chocolate cookies found in Brazil. *Pesqui Odontol Bras* 2003 17: 223–227.

23. Munoz-Pareja M, Guallar-Castillon P, Mesas AE *et al.* Obesity-related eating behaviors are associated with higher food energy density and higher consumption of sugary and alcoholic beverages: a cross-sectional study. *PLoS One* 2013 8: e77137.

24. Mapengo MA, Marsicano JA, Garcia de Moura P *et al.* Dental caries in adolescents from public schools in Maputo, Mozambique. *Int Dent J* 2010 60: 273–281.

25. Castro Rde A, Portela MC, Leao AT *et al.* Oral health-related quality of life of 11- and 12-year-old public school children in Rio de Janeiro. *Community Dent Oral Epidemiol* 2011 39: 336–344.

26. Su CT, Wang JD, Lin CY. Child-rated versus parent-rated quality of life of community-based obese children across gender and grade. *Health Qual Life Outcomes* 2013 11: 206.

27. Drummond BK, Meldrum AM, Boyd D. Influence of dental care on children's oral health and wellbeing. *Br Dent J* 2013 214: E27.

28. Skrivele S, Care R, Berzina S *et al.* Caries and its risk factors in young children in five different countries. *Stomatologija* 2013 15: 39–46.

29. Gathecha G, Makokha A, Wanzala P *et al.* Dental caries and oral health practices among 12 year old children in Nairobi West and Mathira West Districts, Kenya. *Pan Afr Med J* 2012 12: 42.

30. Krisdapong S, Prasertsom P, Rattanarangsima K *et al.* Associations between perceived needs for dental treatment, oral health-related quality of life and oral diseases in school-aged Thai children. *Community Dent Oral Epidemiol* 2014 doi: 10.1111/cdoe.12092. [Epub ahead of print].

31. Jalali-Farahani S, Chin YS, Amiri P *et al.* Body mass index (BMI)-for-age and health-related quality of life (HRQOL) among high school students in Tehran. *Child Care Health Dev* 2013 doi: 10.1111/cch.12103. [Epub ahead of print].

32. Giel KE, Zipfel S, Schweizer R *et al.* Eating disorder pathology in adolescents participating in a lifestyle intervention for obesity: associations with weight change, general psychopathology and health-related quality of life. *Obes Facts* 2013 6: 307–316.

33. De Niet JE, Naiman DI. Psychosocial aspects of childhood obesity. *Minerva Pediatr* 2011 63: 491–505.

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