Community Dental Health (2021) **38,** 76–82
Received 20 March 2020; Accepted 21 August 2020

doi:10.1922/CDH_00065Garcia-Pola07

Promoting oral health among 6-year old children: The impact of social environment and feeding behavior.

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Objective: To determine the prevalence of dental caries and identify key associated factors, including eating habits, body mass index, and the presence of dental plaque in immigrant and indigenous children. ***Basic research design***: Observational study with immigrant and native child populations (aged 6 years) with logistic regression analysis. ***Setting***: Oral Public Health Service in the Asturias region of Spain. ***Participants***: The presence of dental caries (World Health Organization) and oral hygiene (O'Leary index) were determined in 166 children. Information on eating habits was collected through a survey on food consumption (European Food Safety Authority). ***Result***: Children from immigrant families had more decayed and filled teeth index (2.59 vs. 0.21; Crude OR: 7.99 [95% CI 3.620-17.636]). In univariate analysis, protective factors were daily intake of milk and fruits ($p < 0.001$). In multivariate analysis, the presence of caries was associated with immigrant status, consumption of sugary foods, and being overweight, (OR: 13.179 [4.668-37.208]). ***Conclusion***: Public Institutions must take into account our results to help reduce caries in immigrant children.

Keywords*: health education, overweight, oral hygiene, caries, feeding, immigrant*

Introduction

Among the proposed targets for oral health 2020 from the World Dental Federation, World Health Organization (WHO) and International Association for Dental Research, the integration of oral health programs stands out with the purpose of increasing the proportion of 6-year-old children who are caries-free, by tackling the risk factors for the disease (Hobdell *et al*., 2003).

Dental caries has a multifactorial origin, resulting from long-term interactions among oral acidogenic microbiota, a substrate susceptible to metabolization and inherent host factors. Other variables in the development of dental caries include the presence of visible plaque, family, community factors and socioeconomic factors, and food products high in sugar (Fisher-Owens *et al*., 2007). Access to fluoride and regular dental visits serve as protective factors (Tinanoff *et al*., 2019).

Dental caries in deciduous teeth shares risk factors with other conditions associated with excessive sugar consumption, such as cardiovascular diseases, diabetes, and obesity (Tinanoff *et al*., 2019). Recent systematic reviews confirm the difficulty of associating overweight with the presence of dental caries in 6-year-old children based on their multifactorial nature (Alshihri *et al*., 2019). This is inconsistent with another systematic review (Paisi *et al*., 2019), which shows an odds ratio (OR) of 2.44 (Manohar *et al*., 2019).

Dental caries is associated with immigration in some populations with higher disease levels seen in some immigrant children and adults (Christensen *et al*., 2010; Cruz *et al*., 2009). The greater caries seen in immigrant populations might be due to sociodemographic, socioeconomic, or cultural factors, perhaps mediated by specific behaviors such as reduced oral hygiene, cariogenic diets (Schneider *et al*., 2013), and low dental service use (Tapias-Ledesma *et al*., 2011).

Despite the overall improvement in the dental caries experience of Spanish children in the last few years, disease indicators seem to show an upturn (Bravo *et al*., 2016), explained in some cases by disease in immigrant children, with high levels of caries in immigrant compared to indigenous children nationally (51.5% vs. 31.5%) (Bravo *et al*., 2016) and internationally (Masereijan *et al*., 2008; Truin *et al*., 2005).

This study aimed to determine the prevalence of dental caries and identify key associated factors, including eating habits, body mass index, and the presence of dental plaque in immigrant and indigenous children.

Methods

This cross-sectional analytic study was conducted following the Strengthening the Reporting of Observational Studies in Epidemiology criteria (Vandenbrouke *et al*., 2014).

The sample comprised children who made a dental visit to the Oral Health Plan of the Basic and Special Zone in Sanitary Departament IV SESPA (Health Service in Asturias Principality) in the year after their sixth birthday. The sample size was estimated applying a margin of error of 10%, level of confidence of 95%, and a participation rate of 50%. The Oral Health Unit at the Health Center sees approximately 225 6-year-olds per year, that is, 900 children during a four-year period. Based on data provided by the National Statistical Institute (Instituto Nacional de Estadística de España, 2018),

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the proportion of children who had immigrant status was estimated to be 10%. The sample size calculation indicated that 92 immigrant children would be required, and these were selected consecutively based on their first dental visit at SESPA'S Oral Health Plan. A similarly-sized sample of indigenous children recruited consecutively over four years.

The inclusion criteria were as follows: 1) age of 6 years ± 3 months, at the time of inclusion; 2) absence of developmental enamel defects (enamel hypoplasia, amelogenesis imperfecta) and acquired hypoplastic defects (derived from metabolic disturbances, infections and drugs); 3) consent by legal guardians to join the study and voluntarily completing questionnaires about children's eating habits. Children were considered to have the status of immigrant if they were registered as "immigrants" in the healthcare database and had less than 2 years of continuous residence in Spain (Instituto Nacional de Estadística de España, 2018; Malmusi *et al*., 2007). Children were deemed native Spaniards if they were Spanish citizens and had been living in Spain continuously for ≥2 years.

The exclusion criteria were as follows: 1) children who were aged younger or older than six years at the time of study; and 2) the presence dental morphological defects or food intolerance. The study was conducted by the Oral Health Unit at the Health Center. The children were invited to attend for a dental examination and to participate in preventive activities included in the SESPA Oral Health Plan in a personalized letter.

The clinical examination was conducted by a single investigator, who instructed and counseled the children and families about the procedures, study's purpose, and how to complete the survey and addressed any linguistic difficulties that appeared. Clinical examinations used dental mirrors, blunt-tipped dental probes, and dental tweezers, other disposable materials and equipment of the Oral Health Unit at the Health Center. The diagnosis of caries was based on the WHO (1997) diagnostic criteria for community programs and expressed using the dft index (primary teeth with caries and filling). Oral hygiene was recorded using the O´Leary (1972) index. Oral hygiene scores were classified as good (O´Leary index ≤15%), not so good (O´Leary index between 16% and 49%) and deficient (O´Leary index ≥50%).

To gather information on food habits, legal guardians completed a bespoke questionnaire about the frequency of consumption of various food types derived from the European Food Safety Authority's (Table 1) (Schröeder *et al*., 2004). Guardians answered questions about consumption of meat, fish, vegetables, legumes, rice and pasta, egg, fruit, bread, milk and dairy products, sugary foods, snacks and sweets, and sugar-sweetened juices and drinks (Vioque *et al*., 2013) on seven point frequency scales of: never or < 1 portion/month, 1–3 portions/month, 1 portion/week, 2–3 portions/week, 4–6 portions/week, 1 portion /day, and > 1 portion per day.

Data on each child's height and weight were obtained from the clinical history from the *Oficina Médica Informatizada* records of SESPA. Children's BMI was classified in three categories according to the WHO's growth pattern for children aged 5 to 10 years (WHO, 2007): normal, overweight (85th percentile), and obese (95th percentile).

Descriptive analysis of the data was conducted using SPSS 22 (SPSS, Chicago, IL, USA).

To determine predictors of dental caries, the dependent variable was the presence of dental caries (dft index ≥1). The independent variables were immigrant status, gender, oral hygiene (good or deficient), previous dental visits (none vs. once or more), and food habits. Food habits were dichotomised according to the Mediterranean diet recommendations (Schröeder *et al*., 2004) as follows: consumption of milk, fruit, vegetables, bread and pasta, or rice ≥1 time per day versus less; consumption of fish, meat, eggs, and legumes 4 times a week or more versus less. Consumption of sugary foods, snacks and candies, and sugary drinks were also dichotomized: 4 times a week versus less than 4 times weekly. Initial

Table 1. Definitions of the main food groups.

Main food groups	Meat	Beef, pork, lamb, rabbit, turkey, chicken, sausages, hamburguers, bacon.
	Fish	White fish (hake, cod), oily fish (sardine, anchovy, tuna), octopus, mussels.
	Vegetables	Artichoke, eggplant, collard greens, courgette, onion, couliflower, spinachs, green beans, tomato, pepper.
	Legumes	Beans, lentils, chickpeas.
	Fruit	Apple, pear, banana, seasonal fruit.
	Dairy products	Whole milk, skim milk, condensed milk, soy milk, whole milk yogurt, skimmed milk yogurt, cottage cheese, milkshakes, custard, ice-cream.
	Bread	White bread, wholegrain bread.
	Rice and Pasta	Macaroni, spaguetti, canelloni, tagliarini, fettuccini, noodles, fusillini, lasagna, ravioli, spiral pasta, tortellini, gnocchi, bows.
	Eggs	Boiled, poached, scrambled, omelet, baked, fried, beaten
Sugary foods		Breakfast cereals, processed baked goods, chocolate, jam, sugar, cakes, biscuits, honey, breakfast bars, doughnuts, muffin.
Sugary drinks		Sugar-sweetened drinks, sweetened milk, fresh juice, bottled juice, acidic beverage, soft drink, milkshake.
Snacks and Sweets		Candy, chips, crisps, dried fruit, gummy, fruit jellies.

The quantity and size of the portion were specified depending on the food type, in its common unit of measure (slices, piece of fruit) or domestic measures (glasses, plates, containers).

bivariate analyses used Student's t-tests and the Pearson chi-square tests, with p≤0.05 taken to indicate statistical significance. Multinomial logistic regression models were used to identify predictors of the presence of caries in children in immigrants and native children, estimating the crude and adjusted odds ratios (ORs) among covariates identified as significant in the bivariate analyses.

All legal guardians were informed about the target of this study before providing written informed consent. The study was approved by the Regional Clinical Research Ethics Committee of Asturias Principality (nº, 73/10).

Results

Twelve children were excluded from the immigrant status and six from the native group because of incomplete questionnaires. The final sample comprised 166 children, 80 (48.2%) immigrant and 86 (51.8%) natives. There were 85 boys and 81 girls. Most immigrant children were South American (n=52), followed by African (n=12), European (n=12) and Asian (n=4) children. The main sociodemographic features and caries and hygiene scores are presented in Table 2.

The number of caries-free children was 115 (69.3%), with 39 (48.8%) immigrants and 76 (88.4%) natives. The number of teeth with caries ranged from 0 to 13 in immigrant children and from 0 to 5 in natives. The mean number of teeth with caries was higher in immigrant than native children (2.59 vs. 0.21, p=0.001, t test), with migrants from other European countries having the highest scores (3.33).

Table 3 summarizes the food habits of immigrants and native children. Children of immigrant status ate legumes more often, whereas native children ate fish, fruit, milk dairy products, bread, sugary foods and drinks more often.

In the whole sample, bivariate analyses associated the presence of caries with being overweight (p<0.001, OR: 9.954 [3.854-25.709]). Furthermore, the presence of caries was associated with meat consumption ≤3 times per week (p=0.040; OR: 2.245 [1.024-4.922]) and consumption of sugary drinks (p=0.001), snacks (p=0.037) or sugary foods (p=0.030) > 4 times per week. The absence of plaque (p<0.001) played a protective role, and daily consumption of milk products (p=<0.001 OR:1.922 [1.298-2.845]) and fruit (p=0.010; OR: 2.587 [1181-5.782]) only played a protective role in the natives.

The logistic regression model for predictors of the presence of dental caries experience (dft ≥1) is presented in Table 4. The presence of caries was predicted by immigrant status and in the multinomial analysis, adjustment for OH, sugary food consumption and being overweight increased the likelihood of caries in immigrant children (OR=13 [4.668-37.208]).

Discussion

In this study, dental caries was more common among 6 year old children of immigrant status than among native Spanish children. Other predictive risk factors included consumption sugary foods and being overweight.

The prevalence of caries in this sample was similar to the one registered in Spain in 2015, by Bravo et al. (2016) in which the prevalence of caries in deciduous teeth was 31.3% (95% CI: 25.2–37.4) (Bravo *et al*., 2016). The proportion of Spanish children in that study was 87%, while 13% were from other ethnic groups.

The prevalence of caries in this study varied from 51.2% among children of immigrant status to 11.6% among native Spaniards, with mean dft varying from 0.21 in Spanish children to 3.33 among children from other European countries. These differences confirm the recorded data from previous studies, whether as a migratory phenomenon inside a country (Qiu *et al*., 2018) or because of the effect of immigration toward other countries, as described in American (Pierce *et al*, 2019), Asian (Hashizum *et al*., 2012), or European populations. In several studies conducted in European countries such as France (Enjary *et al*., 2018), the Netherlands (Duijster *et al*., 2014), Italy (Ferro *et al*., 2010), Greece (Mantonanaki *et al*., 2017), Norway (Wigen *et al*., 2010), Switzerland (Baggio *et al*., 2015), Sweden (Jacobsson *et al*., 2011), and Spain (Almerich *et al*., 2006), higher caries levels in deciduous teeth were found in immigrant children compared to natives. We present a prevalence of 11.6% in native children, as opposed to previous data presented from 2004 (29.5%) (Almerich *et al*., 2006) and from 2005 (32.05%) (Paredes *et al*., 2006). However, we found that, among the immigrants who came to our country in the last decade, the figure is much higher than native children (51.2%). Our figures are very similar to those indicated in the study of Bravo et al., (51.5%) (Bravo *et al*., 2016),

Table 2. Clinical and demographic features of 166 6-year-old children.

	dft Index	*Oral Hygiene*			*Dental Visit*	
	Mean (Range) CI	*Good %*	*Not so good %*	*Deficient %*	*1 visit %*	*≥2 visits %*
Immigrant (n=80)	2.59 (0-13) 1.83-3.35	58.8	26.2	15.0	36.2	63.8
Native (n=86)	0.21 (0-5) 0.06-0.36	84.9	9.3	5.8	26.7	73.3
Total	1.36 (0-13)	72.9	16.9	10.2	31.3	68.7

CI: Confidence intervals

Table 3. Distribution of eating habits in children 166 children aged 6 years.

Variable	*Immigrant* *n = 80* *%*	*Native* *n = 86* *%*	*p-value (Chi sq.)* *immigrants vs native*	*p-value (Chi sq.)* *caries vs no caries*
Gender			0.331	
Hygiene			**0.001**	**<0.001**
<15%	58.8	84.9		
16%-49%	26.2	9.3		
≥50%	15	5.8		
Visits			0.187	0.273
1 visit	36.2	26.7		
2 visits	63.8	73.3		
Weight			**0.005**	**<0.001**
Normal	76.2	90.7		
Overweight	21.2	4.7		
Obese	2.5	4.7		
Meat			0.459	**0.040**
≤3 days a week	82.5	77.9		
> 4 days a week	17.5	22.1		
Fish			**0.001**	0.215
≤3 days a week	96.2	79.1		
> 4 days a week	3.9	20.9		
Eggs			0.306	0.697
≤3 days a week	80.0	73.3		
> 4 days a week	20.0	26.7		
Rice/Pasta			0.130	0.671
<7 days a week	80.0	69.8		
7 days a week	20.0	30.2		
Vegetables			0.272	0.905
≤3 days a week	83.8	89.5		
> 4 days a week	16.2	10.5		
Legumes			**<0.001**	0.717
≤3 days a week	67.5	91.9		
> 4 days a week	32.5	8.1		
Fruit			**<0.001**	**0.010**
<1 a day	96.2	55.8		
≥1 a day	3.8	44.2		
Milk			**<0.001**	**<0.001**
<1 a day	72.5	14.0		
≥1 a day	27.5	86.0		
Bread			**<0.001**	0.155
<1 a day	67.5	19.8		
≥1 a day	32.5	80.2		
Sugary foods			**<0.001**	**0.030**
≤3 days a week	35.0	4.7		
>4 days a week	65.0	95.3		
Snacks/Sweets			0.645	**0.037**
≤3 days a week	51.2	47.7		
> 4 days a week	48.8	52.3		
Sugar-sweetened juice			**0.001**	**0.001**
≤ 3 days a week	60.0	33.7		
> 4 days a week	40.0	53.6		

and between 47.23% (Paredes *et al.*, 2006), and 64.1% (Almerich *et al*., 2006). Probably caries level among immigrant children is related to where they come from.

We highlight some differences between immigrant and native children in the frequency of consumption of milk and dairy products (hard cheese), apples, and fiber-rich foods that might be considered protective, as they have cariostatic properties by increasing salivary flow and containing calcium, phosphates, and casein (Moynihan 2002; Moynihan 2005; Touger-Decker and Van Loveren 2003). Thus, in the case of dairy products and fruits, children in the native group with lower caries scores than immigrant children consumed these products more frequently. These data are similar to those obtained

Table 4. Logistic regression analysis for predictors of dental caries experience in 166 6 year old children.

Model	*R^2 (Cox)*	*OR*	*[CI]*
Unadjusted Immigrant-caries (crude)	0.186	7.990	[3.620-17.636)]
Adjusted immigrant for OH	0.278	6.176	[2.648-14.408]
Adjusted immigrant for OH and sugary foods[a]	0.350	13.046	[4.984-34.196]
Adjusted immigrant for OH and sugary foods plus overweight	0.390	13.179	[4.668-37.208]

[a]: sugary foods >4 days a week. OH: oral health. p-value

in previous studies, in which the consumption of non-sugary milk and dairy products in children of the same age as in our sample was associated with a lower caries incidence (Llena and Fomer 2008; Marshall 2003), while sweetened milk may be cariogenic (El Batawi and Kakhruddin 2017). Moreover, milk was determined to be a protective factor, observing a higher prevalence of caries in children allergic to cow's milk protein or with milk intolerance (Moimaz *et al*., 2018).

In certain samples, immigrant children tend to eat more sweets compared to natives (Stecksén-Blicks *et al*., 2014). However, the consumption of sugary foods or drinks was more frequent among native children in our study. Despite this, the prevalence of caries was lower than for immigrant children. Moreover, in the case of immigrant children, the risk of caries substantially increased with the consumption of these food products. As previously described (Skafida and Chambers 2018), the risk of caries in children aged <5 years with these habits is reduced if oral hygiene is adequate.

Other factors associated with the presence of caries in immigrants and natives were overweight and obesity. This finding is inconsistent, present in some studies (Alshihri *et al*., 2019) but absent in others (Dikshit *et al*., 2018). There was an influence of economic factors, with some children from low-income countries (Manohar *et al*., 2019) or families (Chen *et al*., 2018). In contrast, some authors considered an association with high income (Elger *et al*., 2019).

Overweight is a condition that increases the risk of caries, especially if it is related to the excessive consumption of sweets (De Melo *et al*., 2019) and sugary foods or drinks (Schneider *et al*., 2013). However, in the immigrant children in our sample, these three habits, consumption of sugary foods or drinks and snacks, did not increase the risk of developing caries among overweight individuals. This is probably a consequence of other factors.

This study has some limitations, such as the inherent characteristics of cross-sectional surveys, making it difficult to establish causal relationships, and the sample losing power to detect subtle differences in multivariate analyses.

Conclusion

In this study we identify important predictors for caries development and possible targets for prevention. Therefore, given the prevalence of caries found in immigrant children and the existence of differences in eating habits that may have an influence on their oral health, compromising their oral health in the future, we raise the need to stimulate public health to redirect these habits, promoting protective behaviors such as consuming fruit and milk, and avoiding cariogenic foods to the greatest extent. Public institutions must take into account our results to help reduce caries in immigrant children.

Conflict of interest

The authors have no conflicts of interest to declare.

Funding statement

This research did not receive any grant.

References

Almerich, J.M. and Montiel, J.M. (2006): Oral health survey of the child population in the Valencia Region of Spain (2004). *Medicina Oral Patología Oral y Cirugía Bucal* **1**, 11, E369-381.

Alshihri, A.A., Rogers, H.J., Alqahtani, M.A. and Aldossary, M.S. (2019): Association between Dental Caries and Obesity in Children and Young People: A Narrative Review. *International Journal of Dentistry* **2**, 9105759.

Baggio, S., Abarca, M., Bodenmann, P., Gehri, M. and Madrid, C. (2015): *BMC Oral Health* **22**, 82.

Bravo, M., Almerich, J.M., Ausina, V., Vilés, P., Blanco, J.M., Canorea, E., Casals, E., Gómez, G., Hita, C., Llodra, J.C., Monge, M., Montiel, J.M., Palmer, P.J. and Sainz, C. (2016): Encuesta de Salud Oral en España 2015. *Revista del Ilustre Consejo General de Colegios de Odontólogos y Estomatólogos de España* **21** (Suppl 1), 8-48.

Chen, D., Zhi, Q., Zhou, Y., Tao, Y., Wu, L. and Lin, H. (2018): *Caries Research* **52**, 230-245.

Christensen, L.B., Twetman, S. and Sundby, A. (2010): Oral health in children and adolescents with different socio-cultural and socio-economic backgrounds. *Acta Odontologica Scandinavica* **68**, 34-42.

Cruz, G.D., Chen, Y., Salazar, C.R. and Le Geros, R.Z. (2009): The association of immigration and acculturation attributes with oral health among immigrants in New York City. *American Journal of Public Health* **99** Suppl 2, S474-480.

De Melo, M.M.D.C., De Souza, W.V. and De Goes, P.S.A. (2019): Increase in dental caries and change in the socioeconomic profile of families in a child cohort of the primary health care in Northeast Brazil. *BMC Oral Health* **14**, 183.

Dikshit, P., Limbu, S. and Bhattarai, R. (2018): Relationship of Body Mass Index with Dental Caries among Children attending Pediatric Dental Department in an Institute. *Journal of the Nepal Medical Association* **56**, 582-586.

Duijster, D., Verrips, G.H. and Van Loveren, C. (2014): The role of family functioning in childhood dental caries. *Community Dentistry and Oral Epidemiology* **42**, 193-205.

El Batawi, H.Y. and Fakhruddin, K.S. (2017): Impact of preventive care orientation on caries status among preschool children. *European Journal of Dentistry* **11**, 475-479.

Elger, W., Kiess, W., Körner, A., Schrock, A., Vogel, M. and Hirsch, C. (2019): Influence of overweight/obesity, socioeconomic status, and oral hygiene on caries in primary dentition. *Journal of Investigative and Clinical Dentistry* **10**, e12394.

Enjary, C., Tubert-Jeannin, S., Manevy, R., Roger-Leroi, V. and Riordan, P.J. (2006): Dental status and measures of deprivation in Clermont-Ferrand, France. *Community Dentistry and Oral Epidemiology* **34**, 363-371.

Ferro, R., Cecchin, C., Besostri, A., Olivieri, A., Stellini, E. and Mazzoleni, S. (2010): Social differences in tooth decay occurrence in a sample of children aged 3 to 5 in north-east Italy. *Community Dental Health* **27**, 163-166.

Fisher-Owens, S.A., Gansky, S.A., Platt, L.J., Weintraub, J.A., Soobader, M.J., Bramlett, M.D. and Newacheck, P.W. (2007): Influences on children's oral health: a conceptual model. *Pediatrics* **120**, e510-520.

Hashizume, L.N., Shinada, K. and Kawaguchi, Y. (2011): Factors associated with prevalence of dental caries in Brazilian schoolchildren residing in Japan. *Journal of Oral Science* **53**, 307-312.

Hobdell, M., Petersen, P.E., Clarkson, J. and Johnson, N. (2003): Global goals for oral health 2020. https://www.ncbi.nlm.nih.gov/pubmed/14560802 *International Dental Journal* **53**, 285-288.

Instituto Nacional de Estadística (2018): España en cifras. https://www.ine.es/prodyser/espa_cifras/2018/files/assets/common/.../publication.pdf.. Instituto Nacional de Estadística [last accessed 15.01.2018]. http://www.ine.es/prodyser/espa_cifras/2017/index.html#10

Jacobsson, B., Koch, G., Magnusson, T. and Hugoson, A. (2011): Oral health in young individuals with foreign and Swedish backgrounds--a ten-year perspective. *European Archives of Paediatric Dentistry* **12**, 151-158.

Llena, C. and Forner, L. (2008): Dietary habits in a child population in relation to caries experience. *Caries Research* **42**, 387-393.

Malmusí, D., Jansà, J.M. and Del Vallado, L. (2007): Recomendaciones para la investigación e información en salud sobre definiciones y variables para el estudio de la población inmigrante de origen extranjero. *Revista Española de Salud Pública* **81**, 399-409.

Manohar, N., Hayen, A., Fahey, P. and Aurora, A. (2019): Obesity and dental caries in early childhood: A systematic review and meta-analyses. *Obesity Reviews* **13**.

Mantonanaki, M., Hatzichristos, T., Koletsi-Kounari, H. and Papaioannou, W. (2017): Socio-demographic and area-related factors associated with the prevalence of caries among preschool children in Greece. *Community Dental Health* **34**, 112-117.

Marshall, T.A., Levy, S.M., Broffitt, B., Warren, J.J, Eichenberger-Gilmore, J.M., Burns, T.L. and Stumbo, P.J. (2003): Dental caries and beverage consumption in young children. *Pediatrics* **112**: e184-191.

Maserejian, N.N., Trachtenberg, F., Hayes, C. and Tavares, M. (2008): Oral health disparities in children of immigrants: dental caries experience at enrollment and during follow-up in the New England Children's Amalgam Trial. *Journal of Public Health Dentistry* **68**, 14-21.

Moimaz, S.A.S, Amaral, M.A, Garbin, C.A.S., Saliba, T.A. and Saliba, O. (2018): Caries in children with lactose intolerance and cow's milk protein allergy. *Brazilian Oral Research* **32**, e91.

Moynihan, P.J. (2002): Dietary advice in dental practice. *British Dental Journal* **193**, 563-568.

Moynihan, P.J. (2005): The role of diet and nutrition in the etiology and prevention of oral diseases. Bull. World Health Organization **83**, 694-699.

O'Leary, T.J., Drake, R.B. and Naylor, J.E. (1972): The plaque control record. *Journal of Periodontology* **43**, 38.

Paisi, M., Kay, E., Bennett, C., Kaimi, I., Witton, R., Nelder, R. and Lapthorne, D. (2019): Body mass index and dental caries in young people: a systematic review. *BMC Pediatrics* **23**, 19, 122.

Paredes, V., Paredes Cencillo, C. and Mir Plana, B. (2006): Prevalencia de la caries dental en el niño inmigrante: estudio comparativo con el niño autóctono. *Anales de Pediatría* (Barc) **65**, 337-341.

Qiu, R., Li, Y., Malla, M., Yao, J., Mo, D., Dhakal, N. and Huang, H. (2018): Impact of parental migration on oral health outcomes of left-behind school-aged children in Luchuan, southern China. *BMC Oral Health* **11**, 207.

Schneider, S., Jerusalem, M., Mente, J. and De Bock, F. (2013): Sweets consumption of preschool children-extent, context, and consumption patterns. *Clinical Oral Investigations* **17**, 1301-1309.

Schröder, H., Marrugat, J., Vila, J., Covas, M.I. and Elosua, R. (2004): Adherence to the traditional Mediterranean diet is inversely associated with body mass index and obesity in a Spanish population. *Journal of Nutrition* **134**, 3355-3361.

Skafida, V. and Chambers, S. (2018): Positive association between sugar consumption and dental decay prevalence independent of oral hygiene in pre-school children: a longitudinal prospective study. *Journal of Public Health* **1**, e275-e283.

Stecksén-Blicks, C., Hasslöf, P., Kieri, C. and Widman, K. (2014): Caries and background factors in Swedish 4-year-old children with special reference to immigrant status. *Acta Odontologica Scandinavica* **72**, 852-858.

Tapias-Ledesma, M.A., Garrido, P.C. and Peña, M.E., Hernánez-Barrera, V., de Miguel, A.G., Jiménez-Garcia, R. (2011): Use of dental care and prevalence of caries among immigrant and Spanish-born children. *Journal of Dentistry for Children* (Chic) **78**, 36-42.

Tinanoff, N., Baez, R.J., Diaz, C., Donly, KJ, Feldens, C.A., McGrath, C., Phantumvanit, P., Pitts, N.B., Seow, W.K., Sharkov, N., Songpaisan, Y. and Twetman, S. (2019): Early childhood caries epidemiology, aetiology, risk assessment, societal burden, management, education, and policy: Global perspective. *International Journal of Paediatric Dentistry* **29**, 238-248.

Touger-Decker, R. and Van Loveren, C. (2003): Sugars and dental caries. *American Journal of Clinical Nutrition* **78**, 881S-892S.

Truin, G.J., Van Rijkom, H.M., Mulder, J. and van't Hof, M.A. (2005): Caries trends 1996-2002 among 6- and 12-year-old children and erosive wear prevalence among 12-year-old children in The Hague. *Caries Research* **39**, 2-8.

Vandenbroucke, J.P., Von Elm, E., Altman, D.G., Gøtzsche, P.C., Mulrow, C.D., Pocock, S.J., Poole, C., Schlesselman, J.J. and Egger, M. (2014): STROBE Initiative. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. *International Journal of Surgery* **12**, 1500-1524.

Vioque, J., Navarrete-Muñoz, E.M., Gimenez-Monzó, D., García de la Hera, M., Granado, F., Young, I.S., Ramón, R., Ballester, F., Murcia, M., Rebagliato, M. and Iñiguez, C.; INMA-Valencia Cohort Study. (2013): Reproducibility and validity of a food frequency questionnaire among pregnant women in a Mediterranean area. *Nutrition Journal* **12**, 26.

Wigen, T.I. and Wang, N.J. (2010): Caries and background factors in Norwegian and immigrant 5-year-old children. *Community Dentistry and Oral Epidemiology* **38**, 19-28.

WHO, World Health Organization (1997): Oral health surveys, basic methods. 4ª ed, p66. Geneva: World Health Organization.

WHO, World Health Organization (2007): BMI-for-age (5-19 years). Copenhagen: Growth reference. WHO. bmi-for-age. [accessed 15. 01. 2018]. https://www.who.int/growthref/who2007_bmi_for_age/en/