Dental Health: Current Research

Dental Caries and Treatment Needs in Adolescents Aged 15 to 19 Years Old and their Relationship with Dental Services: A Systematic Review

Reifur KD*, De Oliveira Piorunneck CM and Moyses SJ

Abstract

Objective: To systematically review the prevalence and the need for treatment of dental caries in adolescents. Materials and methods: References consulted: Cochrane Library, PubMed, Embase, SCOPUS, Web of Science, BVS-BIREME and Google scholar, in the period between July 2016 and September 2016. Titles and abstracts were evaluated according to criteria of inclusion and exclusion. The selected manuscripts had their methodological quality evaluated.

Results: From a total of 877 studies, 11 articles were included in the review after the application of the methodological filters. The cross-sectional study was the most used design in the articles. Brazil stands out as the country with more published studies on this subject. The prevalence ranged from 59% to 90.4%, whereas the DMFT index ranged from 1.4 to 7.1. Most of the studies presented differences between genders and locations. The need for caries treatment varied from 42.3% to 62.3%. Locations committed to the use of preventive measures in oral health presented better indicators or decreased chance of individuals having an untreated caries.

Conclusion: There is an evident and wide range in the average prevalence of caries among adolescents, although DMFT index averages have been declining over the past few years. Well-organized dental services guided by the preventive values of Evidence-Based Dentistry seem to contribute to reduce the damages caused to adolescents in their oral health and their subjective experiences of life.

Clinical Relevance: The Access to dental services proved to be important for the control of caries, with preventive actions or clinical repair of the damages.

Keywords

Adolescent; Dental caries; DMFT index; Dental care; Oral health services; Health care

Introduction

Even though dental caries has suffered a global decline in the last decades, especially in young populations, it continues to be one of the most prevalent oral diseases in the world, however, its occurrence differs between age groups [1]. Adolescence is a critical period between childhood and adulthood characterized by biological, social and psychological changes. The emotionally unstable behavior of adolescents, with mood swings that vary from positive to negative attitudes, may predispose them to neglect self-care activities, which consequently leads to an increase in the prevalence of dental caries [2].

Dental caries is a complex disease due to several factors that contribute to its installation and development. The access to and effective use of dental services is one of these factors. Hypothetically, one can be influenced in order to have a lower number of lesions that can lead to dental losses as there is great possibility of promotion, prevention, early diagnosis and immediate intervention, thus providing the individual with timely and appropriate restorative treatment [3]. The relationship between people's needs for oral care and the services provided must be emphasized. The progressive destruction of teeth and, unfortunately, their extraction is considered mutilation. It can lead to loss of opportunities for the individual and reduced self-esteem, as well as difficulties in personal and professional relationships, making it more difficult for young people to have a social life into their adulthood [4].

Based on this problematization, in which the importance of the adolescence period is contextualized and related with dental services, this systematic review is justified. This work aims to review scientific articles that investigate the prevalence and need for dental caries treatment in adolescents aged 15 to 19 years old and its relationship with the provision of dental services.

Methodology

In order to formulate a clear question focused on the problem and answered by literature research, an adaptation of the PICO(S)/PIO strategy for systematic reviews was performed [5,6]. The results revealed the following guiding question: "What does the current scientific evidence reveal on dental care services concerning to dental caries in adolescents?" In this review strategy, adolescents are presented as the population (P); the intervention (I) is the condition of interest in dental care services; the outcome (O) represents individuals having decayed, restored or missing teeth due to caries; (S) is the design of the observational study. In this context, the comparison (C) was not included.

The descriptors selected to cover this question were the following Medical Subject Headings (MeSH(s)): Dental Care, Dental Health Services, Delivery of Health Care, Dental Caries, DMF index, tooth decay, adolescent, and their respective translations into Portuguese, with possible equivalents in the Descriptors in Health Sciences (DeCS) in the databases where it was necessary to use descriptors in Portuguese (assistência odontológica, serviços de saúde bucal, assistência à saúde, cárie dentária, índice CPO, adolescente). The selection of descriptors and search strategies was carried out by one of the researchers and a librarian.

At first, the search was made in the Cochrane Library database in order to verify the existence of systematic reviews on this topic. As no results were found, the search was carried out in the following databases: PubMed, Embase, Scopus, Web of Science, Virtual Health Library (VHL) and Google Scholar, from July 2016 until September 2016.

*Corresponding author: Keity Dayane Reifur, Federal University of Paraná, Rua Padre Camargo, 280 - 5° andar, Alto da Gloria, Curitiba, Parana, Brazil, CEP 80060-240, Tel: +55 41 36656393, +55 41 33852112, +55 41 996607039; E-mail: keity.reifur@sjp.pr.gov.br, keityreifur@hotmail.com

The following search strategies were used in the databases.

Cochrane Library - ("Dental Care" OR "Dental Health Services" OR "Delivery of Health Care") AND ("dental caries" OR "DMF index" OR " tooth decay") AND (adolescent)

PubMed - ((("Dental Care/epidemiology"[Mesh] OR "Dental Care/statistics and numerical data"[Mesh] OR "Dental Care/utilization"[Mesh])) OR ("Dental Health Services/epidemiology"[Mesh] OR "Dental Health Services/statistics and numerical data"[Mesh] OR "Dental Health Services/utilization"[Mesh])) OR ("Delivery of Health Care/epidemiology"[Mesh] OR "Delivery of Health Care/statistics and numerical data"[Mesh] OR "Delivery of Health Care/utilization"[Mesh]) AND ("dental caries" OR "DMF index" OR " tooth decay") AND (adolescent) NOT (child)

Embase - ("Dental Care" OR "Dental Health Services" OR "Delivery of Health Care") AND ("dental caries" OR "DMF index" OR " tooth decay") AND (adolescent) NOT (child)

VHL - ("assistência odontológica" OR "serviços de saúde bucal" OR "assistência à saúde") AND ("cárie dentária" OR "Índice CPO" OR "DMF index") AND ("adolescente") NOT criança

Google Scholar - ("assistência odontológica" OR "serviços de saúde bucal" OR "assistência à saúde") AND ("cárie dentária" OR "índice CPO" OR "DMF index") AND ("adolescente") NOT criança

Scopus - TITLE-ABS ("Dental Care" OR "Dental Health Services" OR "Delivery of Health Care") AND ("dental caries" OR "DMF index" OR "tooth decay") AND (adolescent) NOT (child) AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "Portuguese") OR LIMIT-TO (LANGUAGE , "Spanish"))

Web of Science - ("Dental Care" OR "Dental Health Services" OR "Delivery of Health Care") AND ("dental caries" OR "DMF index" OR " tooth decay") AND (adolescent) NOT (child)

The titles and abstracts found were read and assessed by two researchers independently and subsequently compared by both. Abstracts of articles that presented divergences were analyzed once more until a consensus was reached.

The articles selected for full reading were those that fit the following inclusion criteria: observational study design; published as of 2005; study population in the age group 15 to 19 years; study population with no special medical condition; focus on the relationship between dental caries and dental care; and written in Portuguese, English or Spanish. Scientific articles with experimental design were excluded, as well as those concerning to clinical intervention; published before 2005; with a study population that included individuals outside the age group 15 to 19 years; and adolescents with any special condition. Articles that focused on other types of oral alterations, such as cancer, periodontal disease and orthodontic alterations were also excluded. Other articles excluded from the search were those that focused on dental care performed in school programs and collective actions, such as the application of fluoride; studies commonly called "gray literature" (unpublished theses, monographs and dissertations) and those written in other languages. In order to find possible articles that were not located by the adopted search strategies, the bibliographical references of the theses found in the cited databases were consulted.

The articles selected for full reading were re-evaluated according to inclusion and exclusion criteria. The articles selected for systematic review had their methodological quality assessed through an adaptation of the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement, adapted by Berra et al., consisting of nine items: A) Selection and research design: 1. Indicates the criteria for inclusion and exclusion of patients. 2. Specifies the sample selection method. 3. Specifies the research design clearly in the text. 4. Reports the number of potentially eligible patients, those initially selected and those who agreed to participate or respond. B) Method and data analysis: 5. Clearly defines the variables studied. 6. The samples assessed are equal to or greater than 30 individuals. 7. Specifies the statistical evidence used. C) Quality of results and discussion: 8. The results are clearly described, according to the objectives of the study. 9. The discussion considers practical implications of outcomes and potential benefits for patients [7].

In order to evaluate the quality of the selected articles, a point system was applied to each item, ranging from 0 to 18 points, as follows: Good (2 points), Regular (1 point) and Bad (0 points). The articles that obtained 1 to 6 points were considered of low quality, those that reached 7 to 12 points were considered of intermediate quality and those from 13 to 18 points were considered of high quality.

Results

In the elaboration of the systematic review, the search strategy generated a total of 872 studies. The reading of the references in the theses and dissertations generated five more articles, totaling 877. One hundred and sixty-three articles were excluded by duplication and 355 articles by the period in which they were published. Ten articles were excluded due to the language, 317 by the population or subject covered and eight studies were excluded for being classified as gray literature. Twenty-four articles were selected for full reading. After that, 13 more articles were excluded for dealing with population or subjects outside the scope of the review (Figure 1). Eleven scientific articles were selected for quality evaluation and to compose the systematic review (Table 1).

Most studies have a cross-sectional design - a total of ten articles. One article was classified as ecological with aggregated data. Brazil was the country with the largest number of studies, followed by Lithuania, Denmark and China (Table 2). Of all articles that presented population in the age group of 15 to 19 years, seven covered the 15-19 age group, two focused specifically on 18-year-old individuals, one focused on 15-year-old individuals and one article studied the age range 15 to 16 years (Table 2).

The most commonly used indicators for assessing dental caries were the prevalence, which ranged from 59.0% to 90.4% (Table 2) and the DMFT index, which counts decayed, missing and filled teeth in the permanent dentition [8]. The average DMFT index varied from 1.4 to 7.1 with differences between genders, races/ethnicities and urban or rural locations (Table 2).

The following indicators were also used, however, to a lesser extent: a) The Significant Caries Index (SCI), which ranged from 5.2 to 11.6 (Table 2) and concerns to the oral health condition in the caries polarization group. In other words, the third of the population with the highest caries levels is selected and the mean DMFT index for this subgroup is calculated [9]. (b) Index of decayed, missing and filled surfaces (DMFS), which counts the number of dental surfaces with caries, surfaces lost by decay and surfaces restored without caries in the permanent dentition [10]. c) Dental Care Index (DCI), which calculates the ratio "filled (restored) teeth/DMFT" and the need for treatment [11].
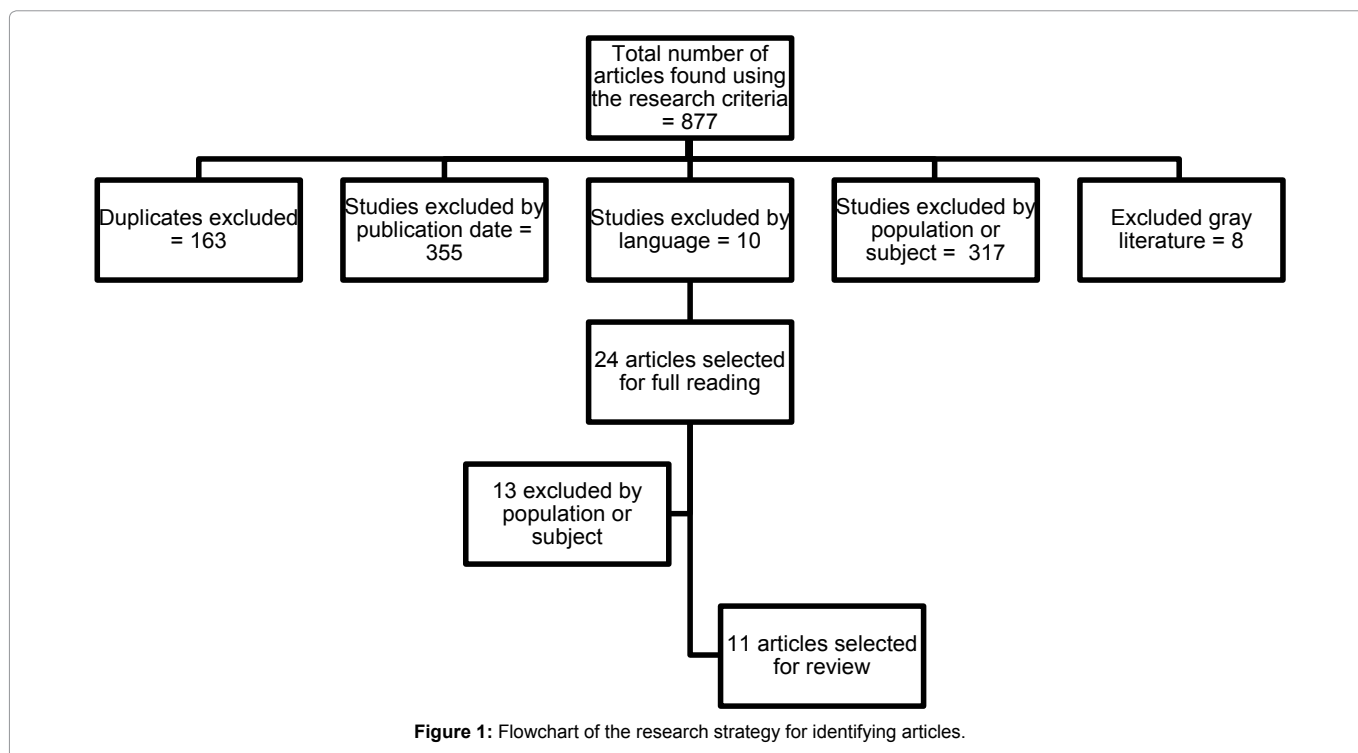
Figure 1: Flowchart of the research strategy for identifying articles.

Table 1: Quality assessment of the articles.

Year	Study first author	Selection and research design *				Methods and data analysis *			Results and Discussion*		Quality
		1	2	3	4	5	6	7	8	9	
2016	Zemaitiene et al. [21]	Regular	Good	Good	Good	Good	Good	Good	Good	Good	High
2015	Vazquez et al. [15]	Good	Good	Good	Good	Good	Good	Good	Good	Good	High
2013	Lu et al. [16]	Regular	Good	Regular	Good	Good	Good	Good	Good	Good	High
2012	Silveira et al. [12]	Regular	Good	Good	Good	Good	Good	Good	Good	Regular	High
2010	Ekstrand et al. [18]	Good	Good	Good	Good	Good	Good	Good	Good	Good	High
2009	Rebelo et al. [13]	Good	Bad	Good	Good	Good	Good	Good	Good	Good	High
2009	Barbato et al.[19]	Regular	Good	Bad	Good	Good	Good	Good	Good	Good	High
2007	Frias et al. [23]	Regular	Good	Bad	Regular	Good	Good	Good	Good	Good	High
2007	Celeste et al. [17]	Regular	Regular	Regular	Good	Good	Good	Good	Good	Good	High
2005	Gushi et al. [20]	Regular	Good	Good	Good	Good	Good	Good	Good	Good	High
2005	Brukiene et al. [14]	Regular	Regular	Bad	Regular	Good	Good	Good	Good	Good	High

*Description in text

Silveira et al., Rebelo et al. and Brukiene, Aleksejuniene and Balciuniene carried out studies that calculated the need for treatment among adolescents, which was obtained by adding the number of teeth with some type of need (restoration of one surface, restoration of two or more surfaces, crowns, facets, extractions, pulp treatment, remineralization of white spots and presence of sealant) [12-14]. The authors observed a variation from 42.3% to 62.3%, also with difference between genders (Table 2).

In what concerns to health services, it was found that adolescents who had visited the dentist recently showed the highest DMFT index, however, these individuals did not have regular maintenance visits (Table 2) [15-17].

Locations that were more committed to preventive approaches in their service presented improvements in the DMFT index or a decreased chance of individuals having an untreated caries (Table 2) [17,18].

Ekstrand et al. demonstrated that the stability of labor and economy, implementation of goals and preventive approaches in dental care services were decisive factors in obtaining better results in the caries experience in the cities (Table 2) [18].

The presence of fluoridation in the water supply was confirmed as a protection factor, since locations that adopted this measure presented higher percentages of caries-free individuals (Table 2) [18-20].

Discussion

Epidemiological studies on dental caries in individuals in the age group 15 to 19 years are scarce according to the systematic review; fact also reported by other authors [20,21]. Articles that identified the relationship among adolescents/caries/access to/use of dental care services are even rarer - only 11 from the 877 studies previously

Table 2: Publications on dental caries and oral health in adolescents from 15 to 19 years of age organized by author, year of publication, country, study design, indices* used, main results of the study.

Author	Year of publication	Country	Study design	Age Group	Indices	Main results
Zemaitiene et al. [21]	2016	Lithuania	Cross-sectional	18	Prevalence	The global prevalence of dental caries was 78.3%;
					DMFT	DMFT = 2.93, with differences between genders and between locations (urban and rural areas), higher DMFT for female gender and rural areas;
					SiC	SiC = 6.14;
					Care Index	Dental Care Index = 62.3%, more than 1/3 of all decayed teeth without treatment;
Vazquez et al. [15]	2015	Brazil	Cross-sectional	15 - 19	DMFT	DMFT = 2.10 and SiC = 5.24; DMFT was higher for female adolescents and it increased along with the age. DMFT decreased inversely with time since the last visit to the dentist.
					SiC	Individuals whose family had a relative in prison and individuals who lived with a higher number of people in the same house presented a higher number of decayed teeth.
Lu et al. [16]	2013	China	Cross-sectional	18	Prevalence	59% dental caries prevalence; DMFT = 1.4, in which filled teeth represented 80% of the dental caries experience;
					DMFT	Adolescents who had visited the dentist in last three years presented a higher DMFT, however, less than 20% of them had had regular visits.
						32.4% reported having snacks two or more times a day. Most of these individuals were females;
						67.9% reported brushing their teeth two or more times a day. Most of these individuals were females;
						Almost 80% reported no flossing.
SILVEIRA et al. [12]	2012	Brazil	Cross-sectional	15 - 19	DMFT	DMFT = 3.4;
					NDC	42.3% of the adolescents presented need for dental treatment.
EKSTRAND et al. [18]	2010	Denmark	Ecological	15	DMFS	Fluoride level in the water and mother education level had a significant influence on the variations in the mean DMFS index;
						Cities with an improvement in the mean DMFS index were more committed to offering prevention services to individuals, with systematic use of guidelines and supervised brushing;
						The stability of labor and economy, as well as the implementation of goals and preventive approaches in dental care services were major factors in the obtainment of better results in the experience of caries in the cities studied.
REBELO et al. [13]	2009	Brazil	Cross-sectional	15 - 19	Prevalence	87.4% dental caries prevalence;
					DMFT	DMFT = 4.65, D= 2.62 (73,1%), M=0,78 (39,7%) e F=1.24 (37,7%), no reported differences between genders;
					NDC	The main need for treatment was the restoration of a dental surface.
						Tooth surface restoration was the main cause of need for treatment.
BARBATO et al. [19]	2009	Brazil	Cross-sectional	15 - 19	Prevalence	38.9% prevalence of tooth loss, from which 92.71% were due to dental caries;
						Individuals with tooth losses that had the worst results: rural area residents, female gender, brown skin, 19 years of age, with school delays, public services user, and residents without fluoridated water.
FRIAS et al. [23]	2007	Brazil	Cross-sectional	15 - 19	Prevalence	65.3% prevalence of untreated caries in Brazil, with differences among macro-regions;
					DMFT	Risk factors: dark or brown skin, rural area resident. Protection factor: being a student.
CELESTE et al. [17]	2007	Brazil	Cross-sectional	15 - 19	Prevalence	Prevalence (DMFT>0) = 92.7%, DMFT = 7.1, D>O= 56,9%, M>0= 39,3% e F>O= 75,8%
					DMFT	Residents from the 21 cities with lowest rates of preventive measures showed 1.76 more chances of having untreated caries than residents from the 21 cities with the highest rates, in the adjusted model;
						Chances of untreated caries were higher in male individuals and in those who reported their last visit to the dentist was not a regular one.

GUSHI et al. [20]	2005	Brazil	Cross-sectional	15 - 19	Prevalence	90.4% dental caries prevalence;
					DMFT	DMFT = 6.44 (D= 22,2%, M=6,5% e F= 71,2%) with differences between genders; males presented more decayed and lost teeth whereas females more filled teeth
					SiC	SiC = 11.68; Higher percentage of caries-free adolescents in cities with fluoridated water.
BRUKIENE et al. [14]	2005	Lithuania	Cross-sectional	15 - 16	Frequency	7.7% of the participants had healthy teeth; The highest cause of need for treatment was primary caries;
					NDC	There were significant differences between genders regarding the type of treatment needed; females presented a higher need for secondary caries restoration whereas males needed primary caries restoration.

* DMFT index (Decayed, missing and filled teeth index); SiC (Significant caries index); DCI (Dental care index); DMFS (Decayed, missing, and filled surfaces); NDC (need for dental care).

selected for review. Brazil is one of the countries with the highest number of studies, which can be explained by the recent increase in publications on the epidemiology of oral health promoted by two large national surveys carried out in 2010 and 2013 that included the adolescents age group [15-20,21].

Most studies have a cross-sectional design. The predominance of this type of study can be attributed to its low cost, facility in data obtainment and execution compared to longitudinal studies, as well as its usefulness in prevalence estimation and assessment of the health needs of the population. Nevertheless, there is a certain limitation, if not completely incapacity, of this study design in determining the cause-and-effect relationship.

The decrease in caries disease among students between the 1970's and 1980's in developed countries was attributed in 65% to the improvement in socio-economic conditions whereas only 3% was attributed to the provision of dental care [22]. Since then, several studies have reported the relationship between caries disease and socio-economic determinants as well as dental care services. Such studies reported 14% relationship attributed to socio-economic variations and 11% to dental care service variations [17]. One should be cautious when making comparisons, as there are methodological and group age differences in the studies analyzed.

In what concerns to health services, adolescents that had gone to the dentist more recently presented a higher DMFT index even though these visits were not regular [22,23]. Moreover, locations that were more engaged in preventive measures focused on individuals either presented a better index or decreased the chance of individuals having untreated caries [17,18]. Oral services aimed at prevention were assessed as an important factor for the improvement of the prevalence of dental diseases, especially caries; in this case, the need for a re-evaluation of the current treatment standards and traditional medical assistance is emphasized. It was hypothesized that professionals have been restoring teeth instead of working on a preventive treatment and preservation [16-18]. Cities that presented instability in relation to workforce, number of patients covered and services funding were associated to a negative caries experience, what reinforces the need for quality dental care services as well as stable and sufficient workforce aimed at health promotion and prevention focused on early diagnosis and minimum intervention [18].

There are significant differences between genders in most studies [14,16,21,22]. The average DMFT index was higher for females, who have a higher impact from the filled teeth component, whereas males had a higher experience of untreated caries [15,17,21]. The hypothesis are that the higher frequency of the disease in females is associated with the biological factors of early eruption, hormonal variation, saliva composition and flow, and eating habits, and in males, with lack of self-care and lack of regular dental care services.

The situation is problematic concerning to the need for treatment and access to/use of services in this age group 15 to 19 years. The need for treatment was quite high. Regarding access to services, although not reporting that the increase in the offer of dental services necessarily decreased the inequalities in oral health, Davoglio et al. verified that the increase in access contributes to the decrease in tooth loss since there is a higher probability of decayed teeth receiving restoring treatment promptly [3]. Barbato and Peres state that in the prevalence of tooth loss, 92.7%of the cases were due to dental caries that were not prevented or treated [19].

The reviewed studies also emphasized the importance of having well-collected epidemiological data, with adequate standardization and methodology, in order for them to be used as tools for researches as well as for the planning, monitoring and assessment of the services. Thus, it would be possible to minimize conditions that are unfavorable to oral health [12,13,15,17,18,20,23].

Inequality gradients in the epidemiological profile of caries and in dental care assistance were observed within and among countries [12-21,23].

One should be cautious when making comparisons based on this review, as there were differences in the methodologies and samples of the studies reviewed. Nonetheless, the articles demonstrated a certain consistency as the same result was verified in different studies.

Conclusion

Based on the articles reviewed, the high prevalence of caries in adolescents stands out. Locations that presented a sustainable average decrease in prevalence were more engaged in preventive measures, had dental professionals with well-established goals and put emphasis in dental caries prevention. Fluoridation of the water supply was confirmed as a prevention factor. Furthermore, there is a need for more studies that correlate the access to services with the eventual improvement in oral health condition, which must focus on the control of the confusion variables in a way that the results might be more clearly attributed to the access to and dental assistance provided.

Compliance with Ethical Standard

Author Keity Dayane Reifur declares that she has no conflict of interest.

Author Cristiane Matsuo de Oliveira Piorunneck declares that she has no conflict of interest.

References

1. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C (2005) The global burden of oral diseases and risks to oral health. Bull World Health Organ 83: 661-669.

2. Granville-Garcia AF, Cavalcanti AL, Sobrinho JEL, Araujo JC, Menezes VA, et al. (2009) Importance of oral health: a study focused on teenagers from Vitória de Santo Antao -PE. Cad Saude Colet 17: 361–374.

3. Davoglio RS, Aerts DRG de C, Abegg C, Freddo SL, Monteiro L (2009) Factors associated with oral health habits and use of dental services by adolescents. Cad Saude Publica 25: 655-667.

4. Moreira TP, Nations MK, Alves M do SCF (2007) Inequality and damaged teeth: oral sequela e from living in poverty in the Dendê community, Fortaleza, Ceará, Brazil. Cad Saude Publica 23: 1383-1392.

5. Akobeng AK (2005) Principles of Evidence Based Medicine. Arch. Dis. Child 90: 837-840.

6. Galvao TF, Pereira MG (2014) Systematic reviews of the literature: steps for preparation. Epidemiol. Serv. Saúde 23: 183-184.

7. Berra S, Elorza-Ricart JM, Estrada M-D, Sanchez E (2008) I Aroot for the critical appraisal of epidemiological cross-sectional studies. Gac Sanit 22: 492-497.

8. Klein H, Palmer CE (1937) Dental caries in American Indian children. Public Health Bulletin, U.S. Govern. Print. Off, USA, 239: 1-54.

9. Bratthall D (2000) Introducing the Significant Caries Index together with a proposal for a new global oral health goal for 12-year-olds. Int. Dent. J 50: 378-84.

10. Klein H, Palmer CE, Knutson JW (1938) Studies on Dental Caries: I. Dental Status and Dental Needs of Elementary School Children. Public Heal. Reports 53: 751-65.

11. Walsh J (1970) International patterns of oral health care--the example of New Zealand. N. Z. Dent. J 66: 143-52.

12. Silveira MF, Nascimento JE, Haikal DS, Queiroz ÍO de A, Ottoni JLM, et al. (2012) Oral health among adolescents of Montes Claros, Minas Gerais, Brazil, Unimontes Científica 14: 99-110.

13. Rebelo MAB, Lopes MC, Vieira JMR, Parente RCP (2009) Dental caries and gingivitis among 15 to 19 year-old students in Manaus, AM, Brazil. Braz Oral Res 23: 248-254.

14. Brukiene V, Aleksejuniene J, Balciuniene I (2005) Dental Treatment Needs in Lithuanian Adolescents. Stomatol Balt Dent Maxillofac J 7: 11-15.

15. Vazquez F de L, Cortellazzi KL, Kaieda AK, Bulgareli JV, Mialhe FL, et al. (2015) Individual and contextual factors related to dental caries in underprivileged Brazilian adolescents. BMC Oral Health 15: 6.

16. Lu H-X, Wong MCM, Lo ECM, McGrath C (2013) Risk indicators of oral health status among young adults aged 18 years analyzed by negative binomial regression. BMC Oral Health 13: 40.

17. Celeste RK, Nadanovsky P, Leon AP de (2007) Association between preventive care provided in public dental services and caries prevalence. Rev Saude Publica 41: 830-838.

18. Ekstrand KR, Christiansen MEC, Qvist V, Ismail A (2010) Factors associated with inter-municipality differences in dental caries experience among Danish adolescents. An ecological study. Community Dent Oral Epidemiol 38: 29-42.

19. Barbato PR, Peres MA (2009) Tooth loss and associated factors in adolescents: a Brazilian population-based oral health survey. Rev Saude Publica 43: 13-25.

20. Gushi LL, Soares M da C, Forni TIB, Vieira V, Wada RS, et al. (2005) Dental caries in 15-to-19-year-old adolescents in São Paulo State, Brazil, 2002. Cad Saude Publica 21: 1383-1391.

21. Zemaitiene M, Grigalauskienė R, Vasiliauskienė I, Saldūnaitė K, Razmienė J, et al. (2016) Prevalence and severity of dental caries among 18-year-old Lithuanian adolescents. Medicina (B Aires) 52: 54-60.

22. Nadanovsky P, Sheiham A (1995) Relative contribution of dental services to the changes in caries levels of 12-year-old children in 18 industrialized countries in the 1970s and early 1980s. Community Dent Oral Epidemiol 23: 331-339.

23. Frias AC, Antunes JLF, Junqueira SR, Narvai PC (2007) Individual and contextual determinants of the prevalence of untreated caries in Brazil. Rev Panam Salud Pública 22: 279-285.

Author Affiliation   Top

Federal University of Parana, Rua Padre Camargo, 280 - 5° andar, Alto da Gloria, Curitiba, Parana, Brazil