Research

Dental Care Needs of Male versus Female Children Visiting a School-based Mobile Dental Facility in West Virginia

R. Constance Wiener, MA, DMD, PhD; Tiffany Summerlin, RDH, BSDH; Lee B. Smith, MD, JD; Daniel T. Carrier, DDS; Michael A. Wiener, DMD, MBA

Abstract

Purpose: Many school-aged children have not received dental care in West Virginia, despite mandated statewide requirements of a dental evaluation and dental treatment before entering school, and the provision of Medicaid/CHIP insurance coverage for children from families below the federal poverty level. An innovative mobile oral health program to educate children, provide preventive care, and bring technology to public schools was developed for West Virginia children in a need shortage area. It was unknown if the unmet dental needs challenge was greater for male or female children residing in that area. The purpose of this study was to determine whether there was a difference by sex in the number of attendees and the incidence of dental caries for children who visited a school-based mobile dental facility.

Methods: School-aged children who had not had a dental examination within the previous year were offered school-based examinations/assessments, preventive care, and oral health education via a mobile oral health program following parental/guardian consent. Data were collected concerning the number of current carious teeth in need of restoration. Descriptive statistics and chi square analyses were conducted to analyze the data.

Results: There were 429 students evaluated at the school-based mobile dental facility. Half (50.3%) were male. Referrals for additional necessary oral/medical care were made for 214 (50.1%) children; 45.9% of males and 53.3% of females (p= 0.287) had dental caries.

Conclusion: Results from this study indicate that sex was not a statistically significant factor in school-based mobile dental facility attendance nor in current dental caries incidence among school-aged children in an underserved area of West Virginia.

Keywords: dental care, dental caries, mobile dentistry, West Virginia, oral health disparities, dental public health, community interventions

This manuscript supports the NDHRA priority area, **Population level: Health services** (community interventions)

Submitted for publication: 5/8/19; accepted: 11/4/19

Introduction

Dental caries is a formidable. In the United States (US), an estimated 14% of children ages 2-8 years have untreated dental caries.[1] In children ages 6-11 years and in children 12-15 years, an estimated 19% have untreated dental caries.[1] The national trend, except for a small increase in young children from 1999-2004, has shown little change in pediatric dental caries incidence over the past 30 years.[1] Dental care trends over the past 30 years have focused upon innovative prevention techniques not available to previous generations. Toothpastes with bioavailable calcium, pit and fissure sealants, and alcohol-free fluoridated mouth rinses, in addition to community water fluoridation, and fluoridated toothpaste have resulted in many advances in limiting caries experiences.[2,3] Researchers are continuing to develop innovative products and techniques to manage the caries process and its risk factors. However, many children continue to have dental caries throughout the U.S.and West Virginia (WV) in particular.

Caries development is complex. A familiar dental caries theoretical model is the Keyes Triad.[4] It is a time-dependent biological model of dental caries in which the intersection of microflora, vulnerable host and teeth, and substrate/diet results in dental caries. Researchers Fisher-Owens, et al.

developed another dental caries model that included other factors encapsulating the triad. In that caries model, there were also child-level influences (such as health behavior practices, development, biologic and genetic endowments, sex, etc.), family-level influences (family function, culture, socioeconomic status, health behaviors of the family, etc.), and community-level influences (dental care system characteristics, physical environment, social capital, community oral health environment, governmental policies, etc.) considered in dental caries development.[5]

Genetic, dietary, and hormonal factors; lower salivary flow, earlier eruption patterns, and oral microbiome factors have been associated with a higher caries risk in females as compared with males in several studies.[6-9] Additionally, eco-socio-behavioral factors potentially affect caries experience by sex. Researchers have indicated that a gender gap of biologic and cultural influence, have placed women at a disadvantage in oral health.[10] In the U.S., there remains a cultural emphasis to sexualize young girls in their clothing, hair, makeup, and teeth.[11] Girls may need more dental care than boys, or may have parents/guardians who perceive that they need more dental care than boys, and therefore receive more dental care than boys; however, such research results have not been well established. Among the many eco-social-behavioral factors of family influences on caries (distance to care,[12] transportation, parent/guardian time away from work, dental fear, cost, convenience, lower income and other aspects of accessing care[12-15]), seeking dental care for one's children may be influenced by parental/guardian perceptions of the importance of need of dental care. The oral health status of daughters may be perceived as different from sons. Little research exists to support or document the relationship of perception of oral health status and caries.[16]

The issue of sex and dental caries is also controversial.[17] Some researchers have indicated girls have a higher caries risk in some studies.[15,18] Researchers, reporting National Health and Nutrition Examination Surveys (NHANES) 2011-2014 data, have indicated that U.S. caries experience for boys, ages 2-5 years, was at a level similar to girls, while in previous years it had been higher than girls.[1] From the same data, there were 17.6% of males and 15.5% of females, ages 5-19 years, with untreated dental caries.[19] Results were mixed in a WV and Pennsylvania (PA) 2002-2009 study where there were no differences in caries by sex in children, ages 1-5 years and 12-17 years, while females, ages 6-11 years, had fewer caries experiences.[20] Adult females in this study had similar affected teeth as males, but had more dental restorations; while males had more untreated caries ($p<.0001$).[20] Researchers have identified sex disparities in dental caries in many populations. Females more commonly have affected teeth in national and international studies, possibly due to earlier tooth eruption patterns, dietary differences, nature/composition of dentition or saliva, and dental utilization practices.[20]

It is important to know if such a disparity exists in an Appalachian sub-population. Given the limited resources for dental care in WV, such information would help plan where efforts should be concentrated for the best use of these resources. If there were greater dental caries incidence for either group, public health community initiatives could be developed for events known to be attended well by the parents/guardians of the children most in need. Dental public health personnel would be more likely to reach more boys and their families in Appalachia at children's football/baseball games, scouting events, etc.; and more likely to reach more girls and their families at softball games, tennis matches, ballet/other dance classes/recitals, girl scout events, etc., thereby maximizing limited resources.

Meeting oral healthcare need with innovative dental care systems

Guided by an idea that if children cannot be taken for dental care, perhaps dental care should be taken to them, healthcare professionals at Monongalia County Health Department in WV began a mobile dental program in 2018. Itinerant dentistry has been common in the history of the U.S. Traveling dentists were often necessary to meet dental needs of people in underserved areas due to a lack of providers in those areas.[21] Since the mid-1970's state dental boards, the American Dental Association, and other professional organizations have defined appropriate standards for mobile dental care and the strategy has proven effective to provide greater physical access to under-served individuals.[22] The Monongalia mobile dental program was established to visit public schools, and to provide oral evaluations/assessments and preventive dental care to children who had not had a dental examination within the previous year. Services included examination, oral health instruction, prophylaxis, topical fluoride application, pit and fissure sealants, radiographs and the encouragement to establish a dental home with local dental professionals.

Based upon the previous research cited regarding caries incidence and sex,[20] a greater effort has been made to access dental care for girls in Appalachia through targeted outreach programs. However, it is not known whether more boys would participate in a convenient, school-based mobile dental facility. The purpose of this study was to determine whether there was a difference in current dental caries incidence in school-aged girls and boys visiting a convenient, school-based mobile dental facility.

Methods

This was a cross-sectional secondary data analysis of existing dental chart data available from evaluations/assessments performed on school-aged children who visited Monongalia County Health Department's mobile dental facility from September 2018 to May 2019. The Monongalia County Health Department provided the data which were collected and managed using secure REDCap electronic data capture tools hosted at West Virginia University.[23,24] This study was approved by the West Virginia University Institutional Review Board (I1901439187A003).

The dental examinations/assessments were conducted by two dental care providers. Data were extracted from the clinical records. As these data were from clinical notes written by the two different providers, and the collection of the data was for clinical rather than research purposes, the two providers were not formally calibrated for conducting research. The records included information from written forms completed by parents/guardians. Child health information, age, sex, and insurance information was collected from the forms. Clinical notes included self-reports by the children (number of times per day they brushed, flossed, and any exposure to tobacco smoke in the home), and clinical evaluations/assessments (existing restorations, current dental caries, pit and fissure sealants present, pit and fissure sealants needed and placed at the mobile facility visit, and referrals.

Students, ages 5-18 years, throughout a five-county area of North-central WV public schools were invited to have dental evaluations/assessments, oral hygiene instructions, radiographs (as needed), prophylaxis, topical fluoride applications, and dental pit and fissure sealants placed (as needed) during normal school hours, if they had not had a dental examination within the previous year. Parents/guardians of all children in 66 schools were provided information about the service. The number of children who had received dental care within the previous year is not known; however, the state of West Virginia requires all pre-kindergarten, kindergarten, second-grade, seventh-grade, and twelfth-grade students to have a dental examination/assessment prior to the school year. The parents/guardians provided the information whether their child/children had a dental examination within the previous twelve months. Parents/guardians provided written consent for the treatment. If specific dental/medical needs were determined, letters indicating such needs were provided to parents/guardians. The parents/guardians were encouraged to seek a dental home for their child(ren) for follow-up care. Data were analyzed with SPSS software, version 26 (IBM: Armonk, NY). Analyses included descriptive statistics and Fisher exact Chi-square testing by sex.

Results

A total of 429 students (50.3% male, n=216) were seen by healthcare providers in the mobile dental facility. All the participants received oral hygiene instruction, oral evaluations/assessments, prophylaxis, and topical fluoride application. More than one-half (n=232, 54.1%) of the children did not have current dental caries teeth at the time of evaluation/assessment and 60.8% (n= 261) did not have any restorations. More than one-quarter (27.8%) had at least one existing dental pit and fissure sealant. One-half of the children (n=214, 50.1%) had a need for additional oral/medical health care and approximately one-third (n=147, 35.7%) were lacking any type of dental insurance coverage. Overall screening results are shown in Table I.

In the data analyses comparing male and female students regarding their current dental caries status, no significant differences were identified between the groups. There were 53.3% of the males (n=105) and 46.7% of the females (n=92) who had current dental caries (p=.287). Female students were more likely to need and have pit and fissure sealants placed during their mobile dental facility visit (n=111, 53.6%) than male students (n=74, 36.5%) (p=.045). Although not a focus of this study, older age was significant in analyses for current caries, a history of existing restorations, the existence of dental pit and fissure sealants, and the placement of dental pit and fissure sealants (Table II). In the analysis of insurance status and current caries, families with Medicaid/CHIP had children with more current dental caries (n=116, 52.3%) than families with other insurance or no insurance and with no insurance (n=17, 39.5%) (p=.019).

Discussion

West Virginia school-aged children who had not had a dental visit within the previous year and attended a mobile dental facility at their school were the focus of this study. No significant statistical difference was found in the two main aims of the study: the number of males/females presenting to the mobile dental facility; or, current dental caries incidence. Similarly, there were no statistical differences identified in having a history of restorations, existing dental pit and fissure sealants, needed referrals, self-care by brushing and flossing, between male and female students. However, there was a greater need and placement of dental pit and fissure sealants for female students (n= 111, 53.6%) compared to male students (n=74, 36.5%) (p=.045). A high level of caries was also present in the participants of this study, with 45.9% of children attending the mobile dental facility having current dental caries.

Table I. Sample characteristics and comparison by sex of children, ages 5-18 years

	Overall Sample	Males	Females	*p*-value[1]
Current dental caries				**.287**
Yes	197, 45.9%	105, 53.3%	92, 46.7%	
No	232, 54.1%	111, 47.8%	121, 52.2%	
Any restoration present				**.424**
Yes	165, 38.5%	89, 53.9%	76, 46.1%	
No	261, 60.8%	125, 47.9%	136, 52.1%	
Any dental sealant present				**.827**
Yes	115, 27.8%	57, 49.6%	58, 50.4%	
No	298, 72.2%	152, 51.0%	146, 49.0%	
Dental sealants provided				**.045**
Yes	241, 58.6%	74, 36.5%	111, 53.6%	
No	170, 41.4%	96, 46.4%	129, 63.5%	
Need for referral[2]				1.000
Yes	214, 50.1%	107, 50.0%	107, 50.0%	
No	213, 49.9%	107, 50.2%	106, 49.8%	
Tobacco use in the home				.589
Yes	96, 22.5%	49, 51.0%	47, 49.0%	
No	35, 8.2%	20, 57.1%	15, 42.9%	
Missing	296, 69.3%	146, 49.3%	150, 50.7%	
Daily use of floss				.451
Yes	20, 4.7%	10, 50.0%	10, 50.0%	
No	133, 31.4%	73, 54.9%	69, 45.1%	
Missing data	271, 63.9%	130, 48.0%	141, 52.0%	
Brushing twice daily				.197
Yes	69, 16.3%	33, 47.8%	36, 52.2%	
No	113, 26.7%	65, 67.5%	48, 42.5%	
Missing data	242, 57.1%	115, 47.5%	127, 52.5%	
Dental Insurance				.453
Medicaid/CHIP	222, 53.9%	107, 48.2%	115, 51.8%	
Other	43, 10.4%	25, 58.1%	18, 41.9%	
None	147, 35.7%	76, 51.7%	71, 48.3%	
Age categories (in years)				.638
≤5	38, 8.9%	18, 47.4%	20, 52.6%	
>5 to ≤11	220, 51.3%	107, 48.6%	113, 51.4%	
>11 to ≤19	171, 39.9%	91, 53.2%	80, 46.8%	

Note: All children attending the mobile dental facility received oral hygiene instructions, a prophylaxis, topical fluoride application, and any needed dental sealants as part of the services provided.

[1]Fisher exact Chi-square p-values between male/female and the presented variables.

[2] "Need for referral" included having a need for restorative care, orthodontic care, oral surgical care, or medical care.

A family preference to seek dental care more for girls than boys, was not evident in this study. Researchers showed Appalachian health beliefs/practices influence health seeking behavior and are deeply rooted in the culture. However, gender inequity in dental care in childhood was not evident as one of them in this study. There remains a need to identify and target the traditional beliefs that do influence oral health.[25] For example, in a qualitative study of young Appalachian adults receiving recommendations for oral health behavior, recommendations were viewed as "excessive."[26] It is important to understand the belief factors that are in play in families and cultures to improve oral health.

Although not a focus of the study, there were interesting results concerning insurance, for example, 53.9% of participant families had Medicaid/CHIP and 35.7% of participant families had no insurance. The presence of a financial safety net such as Medicaid/CHIP is considered a protective family factor against childhood caries. However, this was not evident in this population as families with Medicaid/CHIP had children with more current dental caries than families with other insurance or no insurance. In instituting the mobile dental facility, the Health Department made an effective public health effort in the provision of preventive dental care to students who previously did not have such access.

Similar studies

In a study of children ages 2 through 17 years, using the 2016 National Survey of Children's Health data, there were no significant differences in the number of carious teeth within the previous year, between males and females.[27] Similarly, in another study of U.S. children, ages 6 to 9 years, there was also no significant

Table II. Characteristics by children's age (5-18 years)

	≤ 5 years n, %	>5 to≤11 years n, %	>11 to ≤19 years n, %	*p*-value[1]
Current Dental Caries				**.041**
Yes	16, 8.1%	114, 57.9%	67, 34.0%	
No	22, 9.5%	106, 45.7%	104, 44.8%	
Any Restoration present				**.028**
Yes	cell size suppressed	cell size suppressed	cell size suppressed	
No	30, 11.5%	127, 48.7%	104, 39.8%	
Any Dental Sealant present				**.017**
Yes	34, 11.4%	150, 50.3%	114, 38.3%	
No	cell size suppressed	cell size suppressed	cell size suppressed	
Dental Sealants Provided				**<.005**
Yes	11, 4.6%	139, 57.9%	90, 37.5%	
No	26, 15.3%	70, 41.2%	74, 43.5%	
Need for referral[2]				**0.086**
Yes	16, 7.5%	121, 56.5%	77, 36.0%	
No	22, 10.3%	98, 46.0%	93, 43.7%	
Tobacco use in the home				**.776**
Yes	cell size suppressed	cell size suppressed	cell size suppressed	
No	cell size suppressed	cell size suppressed	cell size suppressed	
Missing	27, 9.2%	152, 51.5%	116, 39.3%	
Daily use of floss				**.003**
Yes	cell size suppressed	cell size suppressed	cell size suppressed	
No	cell size suppressed	cell size suppressed	cell size suppressed	
Missing data	28, 10.3%	144, 53.1%	99, 36.5%	
Brushing twice daily				**.008**
Yes	cell size suppressed	cell size suppressed	cell size suppressed	
No	cell size suppressed	cell size suppressed	cell size suppressed	
Missing data	27, 11.2%	124, 51.2%	91, 37.6%	
Dental Insurance				**.064**
Medicaid/CHIP	24, 10.8%	122, 55.0%	76, 34.2%	
Other	cell size suppressed	cell size suppressed	cell size suppressed	
None	12, 8,2%	66, 44.9%	69, 46.9%	

Note: All children attending the mobile dental facility received oral hygiene instructions, a prophylaxis, topical fluoride application, and any needed dental sealants as part of the services provided. Rows in which one cell was below 10 children were suppressed to protect identification.

[1] Fisher exact Chi-square p-values among ages and the presented variables.

[2] "Need for referral" included having a need for restorative care, orthodontic care, oral surgical care, or medical care.

difference between the sexes in the prevalence of untreated caries.[28] The researchers indicated that 21.80% of male children and 17.84% of female children had untreated caries.[28] Though no difference between sexes were noted the current study and the 2018 Lin, et al. study, there was a large difference in overall untreated caries between them.[28] A possible rationale is that the children attending the mobile dental facility were more likely to have a lower socio-economic status and resultant dental access issues than the participants in the Lin, et al. study.[28] Caries has been shown to be disproportionate in children with health inequities related to structural determinants, intermediary determinants and the nature of the health system.[29]

In a study of children, ages 5-15 years in the United Kingdom, no significant differences in untreated dental caries were found between males and females; however, deprivation was significantly associated with higher occurrences of caries experience.[30] The same pattern was noted in a comparative study using NHANES data in which children whose families had incomes below the poverty level were more likely to have dental caries.[30] This pattern has remained consistent over the 20 years of the study despite the expansion of Medicaid and other health insurance programs.[30]

Dental caries, on a public health level, is manageable with preventive professional dental care. Although the American Dental Association policy-makers reported that the majority of Medicaid-insured children live in close proximity to a Medicaid-participating dentist,[31] other researchers have indicated that such a result was an overestimate and access to dental care *remains* a public health issue.[32]

Strengths of this study were the large sample size, and availability of current information concerning caries and restorations present in children attending the mobile dental facility. As a secondary data analysis of existing dental charts, data were limited to the captured information available in the charts and from the self-reports of the parents/guardians concerning the child's health, and length of time since the last dental visit. This limitation is noted as there is a potential for parents/guardians without insurance coverage to seek free care, even if the child had a dental visit within the previous year. Neither examiner had any formal calibration, resulting in the possibility for the data to be skewed. Also, the number of students who were eligible, but did not keep their appointments, were not available from the secondary data source.

Future needs

Researchers continue to try to understand caries disparities to determine where and how limited resources should be applied. This study has generated relevant questions that need to be addressed. West Virginia children, from poor or near-poor households, have access to Medicaid and CHIP coverage, which includes free dental care. Remuneration to West Virginia dentists for Medicaid and CHIP is high and most West Virginia dentists participate and would welcome these children. West Virginia is adequately covered by dental office locations throughout the state. Most West Virginia homes are within a 20-30 minute drive to a dental office. The mobile dental facility was also conveniently located on the school campus, and care was free. And yet, attendance to the mobile dental clinic varied from generally good to poor attendance. Concerns about access to care due to location of providers and cost of service do not appear to be the reason for children not receiving needed care in West Virginia.

A Minnesota mobile dental service program was successful in increasing utilization and providing dental care for low-income school children over the fifteen-year period (2000-2015) of its existence.[33] Such programs need time to be developed, and to become sustainable. The concept is innovative and deserves long-term commitments to thrive. The school-based mobile dental clinic program described in the current study also needs time to develop and obtain long-term commitment to become self-funding and fiscally independent. A mechanism to encourage parents to follow through with the referrals made during the preventive school visits is needed. Public health outreach and parental incentives may be helpful in obtaining the needed care.

The public health vision of the future, is one where dental caries is largely controlled. A family's attribute of a protective sense of coherence (ability to manage tension; cope by finding solutions, identify and use resources from within and externally; and be health-promoting) and other psychosocial correlates are relevant factors in oral health-related behaviors, including greater tooth brushing frequency, and higher frequency of dental visits.[34] There is a need for a caries free community to be a common cause. Parents/guardians need to want good oral health for their children, for themselves, and their community. Future research is needed to address these important aspects to reach caries-free goals.

Conclusion

Results from this study indicate that sex was not a statistically significant factor in attending a school-based mobile dental facility nor in the current dental caries incidence among school-aged children in an underserved area of West Virginia.

Disclosures

Research reported in this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number U54GM104942-04. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Data

Study data were collected and managed using REDCap electronic data capture tools hosted at West Virginia University. De-identified data for this study are available upon request to Tiffany Summerlain: Tiffany.D.Summerlin@wv.gov

R. Constance Wiener, MA, DMD, PhD is an associate professor, Department of Dental Practice and Rural Health, School of Dentistry, West Virginia University, Morgantown, WV; ***Tiffany Summerlin, RDH, BSDH*** is the program coordinator, Monongalia County Health Department, Morgantown, WV; ***Lee B. Smith, MD, JD*** is the Monongalia County Health Officer and Monongalia County Health Department Executive Director, Morgantown, WV; ***Daniel T. Carrier, DDS*** is the Monongalia County

Health Department Director, Dentistry and Smile Express, Morgantown, WV; ***Michael A. Wiener, DMD, MBA*** is the Smile Express dentist, Monongalia County Health Department, Morgantown, WV.

Corresponding author: R. Constance Wiener, MA, DMD; rweiner2@hsc.wvu.edu

References

1. Dye BA, Mitnik GL, Iafolla TJ, Vargas CM. Trends in dental caries in children and adolescents according to poverty status in the United States from 1999 through 2004 and from 2011 through 2014. JADA. 2017 Aug 1;148(8):550-65.
2. Twetman S, Axelsson S, Dahlgren H, et al. Caries-preventive effect of fluoride toothpaste: a systematic review. Acta Odontol Scand. 2003 61(6):347–55.
3. Zero D. Dentifrices, mouthwashes, and remineralization/caries arrestment strategies. BMC Oral Health. 2006 Jun 6(Supplement 1):S9.
4. Keyes PH. Recent advances in dental caries research. Int Dent J. 1962 12:443-464.
5. Fisher-Owens SA, Gansky SA, Platt LJ, et al. Influences on children's oral health: a conceptual model. Pediatrics. 2007 Sep 1;120(3):e510-20.
6. Lukacs JR, Largaespada LL. Explaining sex differences in dental caries prevalence: saliva, hormones, and "life-history" etiologies. Am J Hum Bio. 2006 Jul;18:540–55.
7. Vieira AR, Marazita ML, Goldstein-McHenry T. Genome-wide scan finds suggestive caries loci. J Dent Res. 2008 May;87(5):435–39.
8. Ferraro M, Vieira AR. Explaining gender differences in caries: A multifactorial approach to a multifactorial disease. Int J Dent [Internet]. 2010 [cited 2020 Apr 14]. Available from: http://downloads.hindawi.com/journals/ijd/2010/649643.pdf
9. Ortiz S, Herrman E, Lyashenko C, et al. Sex-specific differences in the salivary microbiome of caries-active children. J Oral Microbiol. 2019 Aug;11(1):1653124.
10. Martinez-Mier EA, Zandona AF. The impact of gender on caries prevalence and risk assessment. Dent Clin North Am. 2013 Apr;57(2):301-15.
11. American Psychological Association. Report of the APA Task Force on the Sexualization of Girls [Internet]. Washington, DC: American Psychological Association. 2008 [cited 2020 April 14] Available from: http://www.apa.org/pi/women/programs/girls/report-full.pdfhttp://hdl.handle.net/11212/2201
12. Cao S, Gentili M, Griffin PM, et al. Disparities in preventive dental care among children in Georgia. Preventing chronic disease. 2017 Oct;14: E104.
13. Edelstein BL. Access to dental care for Head Start enrollees. J Public Health Dent. 2000 Sep;60: 221–29.
14. Siegal MD, Marx ML, Cole SL. Parent or caregiver, staff, and dentist perspectives on access to dental care issues for head start children in Ohio. Am J Public Health. 2005 Aug;95(8):1352-9.
15. Ismail AI, Sohn W, Lim S, Willem JM. Predictors of dental caries progression in primary teeth. J Dent Res. 2009 Mar;88(3):270-5.
16. Weyant RJ, Manz M, Corby P, et al. Factors associated with parents' and adolescents' perceptions of oral health and need for dental treatment. Community Dent Oral Epidemiol. 2007 Oct;35(5):321-30.
17. Martinez-Mier EA, Zandona AF. The impact of gender on caries prevalence and risk assessment. Dent Clin North Am. 2013 Apr;57(2):301-15.
18. Ditmyer M, Dounis G, Mobley C, Schwarz E. Inequalities of caries experience in Nevada youth expressed by DMFT index vs. significant caries index over time. BMC Oral Health. 2011 Dec;11(1):12.
19. Centers for Disease Control and Prevention. Untreated dental caries, by selected characteristics: United States, selected years 1988-1994 through 2011-2014 [Internet]. Atlanta (GA): Centers for Disease Control and Prevention; 2017 [cited 2020 Apr 14]. Available from: https://www.cdc.gov/nchs/data/hus/2017/060.pdf
20. Shaffer JR, Leslie EJ, Feingold E, et al. Caries experience differs between females and males across age groups in Northern Appalachia. Int J Dent. 2015;2015: 938213.
21. Stucki-McCormick, SU. Byrne RP. Ethical decision making in dentistry. 1st ed. Shelton (CT): People's Medical Publishing House; 2013. Chapter 16, The itinerant practice in dentistry; p.134-40.
22. Dawkins E, Michimi A, Ellis-Griffith G, et al. Dental caries among children visiting a mobile dental clinic in South Central Kentucky: a pooled cross-sectional study. BMC Oral Health. 2013 Dec 1;13(1):19.

23. Harris PA, Taylor R, Thielke R, Payne J, et al. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. Journal Biomed inform. 2009 Apr 1;42(2):377-81.

24. Harris PA, Taylor R, Minor BL, et al. The REDCap consortium: Building an international community of software platform partners. Journal Biomed inform. 2019 Jul 1;95:103208.

25. Denham SA, Meyer MG, Toborg MA, Mande MJ. Providing health education to Appalachia populations. Holist Nurs Pract. 2004 Nov 1;18(6):293-301.

26. Savage MW, Scott AM, Aalboe JA, et al. Oral health beliefs and behavior among young adults in Appalachian Kentucky. J Appl Commun Res. 2018 Jan 2;46(1):113-34.

27. Lebrun-Harris LA, Canto MT, Vodicka P. Preventive oral health care use and oral health status among US children: 2016 National Survey of Children's Health. J Am Dent Assoc. 2019 Apr;150(4):246-58.

28. Lin M, Zhang X, Holt JB, et al. Multilevel model to estimate county-level untreated dental caries among US children aged 6–9 years using the National Health and Nutrition Examination Survey. Prev Med. 2018 Jun;111:291-8.

29. Masood M, Mnatzaganian G, Baker SR. Inequalities in dental caries in children within the UK: Have there been changes over time?. Community Dent Oral Epidemiol. 2019 Feb;47(1):71-7.

30. Slade GD, Sanders AE. Two decades of persisting income-disparities in dental caries among US children and adolescents. J Public Health Dent. 2018 Jun;78(3):187-91.

31. Garvin J. HPI shares new state-level approach to measuring access to dental care [Internet]. Chicago (IL): American Dental Association: 2020; [Jun 8 2017; cited 2020 Apr 14]. Available from: https://www.ada.org/en/publications/ada-news/2017-archive/june/hpi-shares-new-state-level-approach-to-measuring-access-to-dental-care

32. Serban N, Tomar SL. ADA Health Policy Institute's methodology overestimates spatial access to dental care for publicly insured children. J Public Health Dent. 2018 Sep;78(4):291-5.

33. Spetz J, Pourat N, Chen X, et al. Expansion of dental care for low-income children through a mobile services program. J Sch Health. 2019 Aug;89(8):619-28.

34. Silva AN, Alvares De Lima ST, Vettore MV. Protective psychosocial factors and dental caries in children and adolescents: a systematic review and meta-analysis. Int J Paediatr Dent. 2018 Sep;28(5):443-58.