Prevalence of dental caries and dental care utilization in preschool urban children enrolled in a comparative-effectiveness study

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Abstract

Aim—To assess dental caries prevalence and dental care utilization in pre-school children enrolled in urban childcare centres that participated in a comparative-effectiveness study.

Study design—Cross-sectional study.

Methods—Caries prevalence was determined in a cohort of children 12-60 months of age. Eligible children were randomized into two groups: group one received a traditional visual/tactile oral examination and group two received a Teledentistry examination. Questionnaires were administered to the children's parents/guardians to gather demographics and information about using dental and medical services.

Results—Of 234 children examined, approximately 28% had caries experience. The mean dfs score was 1.56 with a range of 0 to 34 carious surfaces. The mean dfs score for the children examined by means of Teledentistry was 1.75 and for the children examined by means of the traditional visual/tactile method mean dfs was 1.40; the means between the two groups were not significantly different. Twenty-six children showed evidence of being treated for dental caries. According to the parents, 31.5% of the children had never had a dental check-up before, only 3% of the children were lacking dental insurance and majority of the parents (92%) did not perceive accessing dental care for the children as a problem.

Statistics—The Wilcoxon Mann-Whitney test and the Kruskal-Wallis test were used to assess statistical differences among groups of children.

Conclusions—The data show that 28% of the children had caries and, of these, 61% had never been treated for caries, thus indicating that continued efforts are needed to improve oral health care utilization by inner-city preschool children.

Introduction

Dental caries remains the most common chronic childhood disease in the US despite the fact that it can be prevented. Data from the 1988-1994 National Health and Nutritional Examination Survey (NHANES III, 1988-1994) show that the prevalence of dental caries in

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the primary dentition of 2 to 5 year old US children was 24% [CDC, 2005]. More recent NHANES data released in 2007 by the Centres for the Disease Control and Prevention (CDC) show that the prevalence of caries in the primary dentition of US children is on the rise. Almost 28% of 2 to 5 year old US children were classified as having caries experience in the primary dentition [Dye et al., 2007]. Dental care continues to be the most unmet health need among US children, especially among poor and minority children [Newacheck et al., 2000]. More than 70% of carious surfaces in the primary dentition of the 2 to 5 year old US children remain untreated as presented in the 1999-2004 NHANES analysis [Dye et al., 2007].

Early childhood caries (ECC), as defined by the American Academy of Paediatric Dentistry (AAPD), is the presence of one or more decayed, missing, or filled tooth surfaces in a child 71 months of age or less [AAPD, 2004]. ECC has been related to failure to thrive, decreased capability to study, increased risk of caries development in the permanent dentition and an increase in the possibility of enamel defects on the successors of carious primary teeth [Acs et al, 1999; Gray et al., 1991; Broadbent et al., 2005]. Studies are warranted to examine different modalities that may reduce or eliminate barriers to optimal oral health and that improve oral health care utilization by US preschool children. In our previous studies, we evaluated the sensitivity and specificity of Teledentistry examinations vs. visual/tactile examinations and the feasibility of using this technology for dental screening of preschool children. We also assessed caries prevalence by means of Teledentistry screening in preschool children. [Kopycka-Kedzierawski et al., 2007; Kopycka-Kedzierawski et.al, 2008]. The sensitivity of the Teledentistry examinations was 100% and specificity was 81% versus traditional oral dental exams. The kappa statistic between traditional oral dental examinations and Teledentistry examinations was 61, suggesting a good agreement between the two examination modalities. The mean dfs scores for the Teledentistry images and the visual examinations were not statistically different, indicating that Teledentistry would be a useful tool for dental screening of young children in childcare centres for early signs of caries activity, especially ECC.

The purpose of this study was to assess dental caries prevalence and dental care utilization in 12 to 60 month old pre-school children enrolled in urban childcare in Rochester, New York who participated in a comparative-effectiveness study.

Materials and Methods

Study Population

A study sample of 234 preschool children, 12-60 months of age, was drawn from a cohort of nearly 600 total children that were available in 2008-2009 and attended urban childcare located in the northeast quadrant of the City of Rochester, NY. The selection of the six childcare was based on their participation in Health-e-Access, a Telemedicine project, conducted by the Department of Paediatrics, University of Rochester, School of Medicine and Dentistry.

Our sample size was limited to the children whose parents agreed to participate in the study, provided informed consent and completed the questionnaire. The majority of study participants were African-American and Hispanic children; only a few children were Caucasian or children of mixed race/ethnicity. Children enrolled in our study lived in the most impoverished areas of the City of Rochester, often referred to as the "inner-city''. We powered the study based on whether or not each child had any utilization of dental services from baseline to the twelfth month of follow-up. A two tailed chi-square test for proportion was used to detect a 20% difference with 80% power and a $p \leq .05$ level of significance. The proportion that gave the largest sample size showed that 98 children per group were needed.

After taking into account an estimated 30% attrition rate, 128 children per group were needed.

Informed Consent

The University of Rochester Medical Center Research Subject Review Board (RSRB) approved the study prior to its initiation. Informed consent was obtained from parents of participating children prior to the study. Children older than one-year of age and younger than six years of age, regardless of gender, ethnic origin or race, were eligible to participate in the study. There were no other exclusionary criteria.

Randomization procedures

After the parent or guardian signed the consent form, each child was randomly assigned to the control (clinical) or the experimental (Teledentistry) arm. A computerized uniform random number generator was utilized to allocate children to the clinical or Teledentistry arm.

Examination Procedures

The clinical oral exams were performed at the six childcare facilities selected for the study by a calibrated paediatric dentist. All examinations were conducted in an assigned examination room. Examinations were scheduled to fit each childcare centre's routine, usually after breakfast during playtime. Fiber optic lights, plane mirrors, and No 23 piano-wire explorers were used to conduct the clinical examinations. The explorer was used only to clean the tooth surface as necessary and was not used to probe the tooth or tooth surfaces. Radiographs were not used. As such, inter-proximal caries was assessed based on clinical examinations and Teledentistry intraoral images.

Teledentistry exams were performed at the six childcare facilities selected for the study. A trained Telehealth Assistant (TA) conducted these examinations in the Telemedicine examination room. The Dr. Camscope intraoral camera (Sometech Inc, Seoul, South Korea) was used to image the oral hard tissues. Six images of the labial/buccal and occlusal surfaces of each child's teeth were recorded, including two anterior and 4 posterior views. Additional views of the posterior buccal/facial surfaces and anterior/posterior lingual surfaces were obtained, as necessary. The images of the children's teeth were entered into the secure web database immediately after each screening was completed. The Teledentistry dental examiner at EDC had password secure access to the images stored in the database. A dedicated computer at the remote site (EDC) with the appropriate software program was used to view the images. A general dentist who was calibrated in the same manner as the clinical caries examiner, i.e., by the gold standard caries examiner, scored the Teledentistry images. To assess reliability of the clinical exams and Teledentistry exams, kappa was calculated. The intra-observer agreement was assessed based on clinically re-examining a selected subsample (5%) of children and a blinded re-reading of a randomly selected subsample (5%) of the stored images. Both examiner's reliability scores were excellent (kappa statistic was 93% and 87% respectively). The imaging protocol and the intraoral camera specifications have been described elsewhere [Kopycka-Kedzierawski and Billings, 2006]. The Telehealth Assistants underwent training to learn the proper technique for obtaining intraoral images. They practiced on a typodont first and subsequently on adult volunteers until they became proficient in obtaining intraoral images. A PowerPoint demonstration module was presented to the TAs to display healthy dentition, first signs of ECC and severe Early Childhood Caries. The Telehealth Assistants provided educational counselling to the parents of children in both the experimental and control arm along with providing referrals to parents of all participating children. Referrals were generated immediately in both arms of the study; i.e. in the control group after completion of the

examination and the experimental group after completion of the Teledentistry examination. The TAs were also responsible for providing colour printouts of teeth with untreated caries to parents in the experimental arm.

Caries Measurement

Decayed and filled surfaces (dfs) were recorded on individualized pre-labelled caries exam forms. The most recent definition of ECC was used for this study [AAPD, 2004]. ECC was defined as the presence of a white spot lesion(s) and or cavitated lesion(s) on any primary tooth.

Questionnaires

The purpose of the questionnaires used in this study was to gather demographic information from the parents/guardians of participating children and to obtain information about dental and medical utilization patterns. The following components were included in the questionnaire: demographics, including age, gender, race, ethnicity, education, employment, occupation, residence area (postal zip code) and family income; dental and medical use survey, including past 12 months dental and emergency room care utilization, difficulties in obtaining needed dental care, parents readiness to change with regard to dental care for their child or children, emergency dental and medical care utilization, and parent' self perceived dental treatment needs.

Data Analysis

Mean caries scores were calculated based on age, gender and ethnicity and the examination modality. Questionnaires were analyzed using descriptive statistics. Bivariate analyses were conducted using the Fisher's exact test. The Wilcoxon Mann-Whitney test and the Kruskal-Wallis test were used to assess statistical differences (p was set at .05). Data were managed and processed by means of SAS statistical package, version 9.2 (SAS Institute Inc, Cary, NC).

Results

Of 234 children examined, 66 (approximately 28%) had caries experience in the primary dentition. The mean dfs score for all the children was 1.56 (SD=4.15) with a range of 0 to 34 carious surfaces. The mean dfs score for the children examined by means of Teledentistry (n=108) was 1.75 (SD=4.25) and for the children examined by means of the traditional visual/tactile method (n=126), the mean dfs was 1.40 (SD=4.07); the means between the two groups were not significantly different (Wilcoxon Mann- Whitney test, p>.05). Approximately 27% of the children were classified as having caries experience by means of the visual/tactile exams and 29% of the children were classified as having caries experience by means of Teledentistry exams.

Overall, African-American children (n=153) had the highest mean dfs score of 1.86, followed by Hispanic children (n=42, dfs=1.64), Caucasian children (n=19, dfs=0.53) and children of mixed race/ethnicity (n=20, dfs= 0.15); the means among the different ethnic groups were not statistically significant, (Kruskal-Wallis test, p-value>.05). Females had a higher mean dfs score (n=121, dfs=1.97, SD=5.20) than males (n=113, dfs=1.13, SD=2.54); the means between girls and boys were not significantly different, (Wilcoxon Mann-Whitney test, p>.05).

As would be expected, children 5 years of age were found to have the highest mean caries scores followed by children 4 years of age, 3 years of age, 2 years of age and 1 year of age (Table 1). Differences based on age were statistically significant (Kruskal-Wallis test, p-

value <. 0001). Twenty-six children (approximately 39%) out of sixty-six children with caries experience showed evidence of being treated for caries.

Results of the questionnaires are presented in Table 2 and 3. The majority of respondents were females (93%). Seventy six percent of respondents identified themselves as African-Americans, 21% as Whites and 3% as Native Americans. Twenty seven percent were found to be Hispanic and 73% not Hispanic. Based on the bivariate analyses, conducted using the Fisher's exact test, more parents in the clinical arm identified themselves as Hispanic than parents in the Teledentistry arm, (p=. 03, Fisher's exact test). Self reported oral health status of parents in the clinical arm was statistically significantly different from parents in the Teledentistry arm, (p=. 04, Fisher's exact test). As presented in Table 2, the remaining variables, as reported by parents in the Teledentistry and clinical arms, were not significantly different. Approximately 64% of respondents were currently employed. Only 15% of the parents were married, 74% were single, 9% were divorced or separated and 2% identified themselves as "other". Seventy percent of respondents stated that their yearly family income was less than $20,000, suggesting that the majority of children who were enrolled in the study live in an economically disadvantaged home environment. About 45% of adults stated in the questionnaire that they had not had a routine dental visit in the past 12 months. Interestingly, 88.6% of the respondents had dental insurance and of these, 53% reported that they currently need dental work.

Parents/guardians also answered questions about their children's dental status, current and past dental utilization and future dental appointments. According to the parental responses 97% of the children had dental insurance; 68% had Medicaid, 12% had Child Health Plus and 17% of the children had other types of dental insurance. Medicaid is a US government insurance program for children under the age of 19 who are eligible for Medicaid coverage, based on the family's income. There is no cost or monthly insurance premium to the parents. Child Health Plus is a State insurance program for children under the age of 19 whose family income exceeds the eligibility level for Medicaid. Depending on family income, there may be a small monthly insurance premium.

About 36% of the children had not had a dental visit in the past 12 months and 39% of the children had not had a routine check-up in the last 12 months. Although a majority of parents (92%) did not perceive accessing dental care for their children as a problem, almost 32% of the children had never visited a dentist. Variables that were significantly associated with having caries experience in the primary dentition were: having a problem to get care for your child (p=. 003); timing of the last dental check-up (p=. 04) and any dental work needed for a child (p=. 004), as presented in Table 3.

Discussion

Several risk factors have been identified for ECC, including dietary factors, excessive bottle use, poor oral hygiene, previous caries experience, microbiologic factors, socioeconomic status, psychosocial factors, sociocultural factors and utilization factors [Broadbent et al, 2005; Tinanoff and Reisine, 2009]. In our study, approximately 28% of the children had caries experience in the primary dentition; these results are consistent with the NHANES 1999-2004 data on caries prevalence among 2 to 5 year old children, as almost 28% of 2 to 5 year old US children were classified as having caries experience in the primary dentition [Dye et al., 2007].

Tomar and Reeves examined the improvement in US children's oral health and dental public health infrastructure since the Healthy People 2010 Oral Health Objectives were issued [Tomar and Reeves, 2009]. According to their report, progress toward improving oral health

in the US during the last decade has been mixed. Although the oral health status of most US children improved in the last ten years, the prevalence of dental caries in the primary dentition of US preschool children increased greatly [Dye et al., 2007; Tomar and Reeves, 2009]. Furthermore, the use of preventive dental services by low-income children stayed far below the 2010 target; it was estimated that only about 31% of low income children and adolescents received any preventive dental services in 2004. Data from the parental questionnaires suggest that approximately 32% of the preschool children enrolled in this study had never visited a dentist. Almost 40% of the parents stated in the questionnaire that their children did not have a routine dental visit in the past 12 months and about 36% of the parents stated that their children did not have a dental appointment in the last 12 months. Although the majority of the parents did not report difficulties in accessing dental care for their children, more than 60% of the children with caries did not receive needed dental treatment. Rochester is considered fortunate in the availability of dental resources for inner-city children. Eastman Dental Center (EDC) Division of Pediatric Dentistry has a centrally located paediatric clinic located at EDC and the Division of Community Dentistry has one school based clinic as well as three mobile clinics (Smilemobiles) that travel to several inner-city elementary schools during the school year. The Community Dentistry clinics are mostly staffed by paediatric dentists and dentistry residents. Yet urban preschool children enrolled in this study had a high proportion of untreated caries in the primary dentition. Based on the questionnaires, about 45% parents of enrolled children had not had a routine dental visit in the past 12 months and about 47% stated that their children needed dental work. About 44% of parents stated that their child's dental status was excellent and 33% of parents believed that it was very good. These facts are consistent with our clinical data, as approximately 28% of children had caries experience in the primary dentition. Seventy percent of the respondents stated that their yearly family income was less than $20,000. Based on the US census, 42.8% of families in the northeast area of the city of Rochester live below the federal poverty level (zip codes 14605 and 14621) [US census, 2010]. The national average of families living below the federal poverty level is 9.2%. Rochester ranks 12th per capita in child poverty nationwide, and has the 2nd highest per capita poverty rate among all 720 school districts in New York State.

Our cross-sectional data suggest that new strategies are needed to improve utilization of dental services among young, poor, inner-city children. As the children in this study will be re-examined 6 and 12 months after baseline, we plan to perform explanatory analyses to measure the relationship of utilization of dental services by preschool children and their families with socioeconomic and demographic factors, utilization of medical services and perceived and actual need for dental treatment. At baseline examinations the Telehealth Assistants provided educational counselling to the parents of all participating children along with providing referrals for dental care as necessary or appropriate.

Two examination modalities were used in this study to assess caries prevalence and mean caries scores in the primary dentition of preschool, urban children: visual/tactile clinical examinations and Teledentistry examinations. Our results indicate that both examination methods were comparable in caries diagnosis for both caries severity and caries prevalence, suggesting that screening young children for dental caries by means of Teledentistry is as good as visual/tactile examinations. In a previous study, we evaluated the sensitivity and specificity of Teledentistry examinations vs. visual/tactile examinations [Kopycka-Kedzierawski et al., 2007]. The sensitivity of the Teledentistry examinations was 100% and specificity was 81%.

Teledentistry screenings may serve as an alternative screening modality in urban and rural areas where dental access is limited. Parents of children who were enrolled in the experimental (Teledentistry) arm received colour printouts of their children's carious teeth

with the referral form; our premise is that colour printouts will serve as a motivational instrument for parents of children examined by Teledentistry and will change parents' readiness to take their child to the dentist. The follow-up examinations are currently being conducted to assess the full extent of Teledentistry screening' capability to enhance dental care utilization, especially in families with evidence of limited oral health care utilization. Subsequently, we will examine the cost-effectiveness of Teledentistry for its utility as a potential screening tool by means of a cost-effectiveness analysis.

Conclusions

1. The data show that 28% of the children had caries and, of these, 61% had never been treated for caries, thus indicating that continued efforts are needed to improve oral health care utilization by inner-city preschool children.

Acknowledgments

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Table 1

Decayed and filled surfaces (dfs) for 234 children enrolled in the study by age

Age	N	Mean dfs	Std Dev	Min	Max	95%LCL	95%UCL
1year olds	37	.03	.16	0	1	-.03	.08
2year olds	67	.70	2.03	0	11	.21	1.20
3year olds	52	1.25	3.36	0	20	.31	2.19
4year olds	70	3.21	6.23	0	34	1.73	4.70
5year olds	8	3.50	4.04	0	12	.13	6.87

Kruskal-Wallis test, p<.0001

Table 2

Parents/guardians' demographics and dental/medical status from the baseline questionnaire.

Parents/Guardians			Clinical vs. Teledentistry Group. Bivariate comparisons using Fisher's exact test
Mean Age	27.6 years of age (SD=6.28) Min-Max 16-50		NS
Mean # of children	2.35 (SD= 1.41) Min–Max 1-11		NS
Gender	7% Male 93% Female		NS
Race#/Ethnicity[*] 21% White#	76% A-American# 73%Not Hispanic[*] 3% American/Indian#	27%Hispanic[*] [*]p=03	#-NS
Work Status	64% Currently employed 36% Currently unemployed		NS
Education	5% Middle school 41% High School 22% more than High School 29% College level 3% Post graduate level		NS
Marital status	15% Married 74% Single 9% Separated or Divorced 2% Other		NS
Income	70% $0-19.999 21% $20,000-29,999 9% $30,000-50,000+		NS
Dental insurance	61.1% Medicaid 27.5% Other 11.4% No dental Insurance		NS
Medical insurance	63.1% Medicaid 31.6% Other 5.3% No medical Insurance		NS
Emergency room visit in the last 12 months	14% Yes 86% No		NS
Routine dental visit in the past 12 months	55% Yes 45% No		NS
Do you currently need any dental work?	53% Yes		NS

Parents/Guardians		Clinical vs. Teledentistry Group. Bivariate comparisons using Fisher's exact test
	47% No	
Your dental health status [*]	13% Excellent	P=.04
	22.5% Very good	
	45% Good	
	13% Fair	
	6.5% Poor	
Residency status	90% City of Rochester	NS
	9% Suburbs of Rochester	
	1% Other	

Fisher's exact test: NS-non significant in bivariate comparison with Teledentistry and clinical exam group;

[*] statistically significant in bivariate comparison with Teledentistry and clinical exam group, p<.05

Table 3

Children's demographics and dental/medical status from the baseline questionnaire.

Children		Bivariate comparisons with dfs variable using Fisher's exact test
Dental insurance	68% Medicaid 12% Child Health Plus 17% other 3% None	NS
Medical insurance	66% Medicaid 14% Child Health Plus 19% Other 1% None	NS
Emergency room visit in the last 12 months	23% Yes 77% No	NS
Dental appointment in the last 12 months	64% Yes 36% No	NS
Routine dental visit in the past 12 months	61% Yes 39% No	NS
Are you thinking of taking your child to see a dentist in the next 6 months?	88% yes 12% No	NS
Did you make an appointment for your child to see a dentist in the next 6 months?	52% Yes 48% No	NS
In the last year how much of a problem was it to get care for your child that you or your dentist believed was necessary?[*]	3% A big problem 5% A small problem 92% Not a problem	P=.003
Last dental check-up of your child [*]	64% Past 12 months 4% 1-2 years ago 0.5% More than 2 years ago 31.5% Never	P=.04
Does your child currently need any dental work?[*]	12% Yes 88% No	P=.004
Your child's dental health status	44% Excellent, 33% Very Good, 21% Good, 1.4% fair, 1.5% Poor	NS

Fisher's exact test: NS-non significant in bivariate comparison with dfs;

*
statistically significant in bivariate comparison with dfs in p<.05