HHS Public Access

Author manuscript

Community Dent Oral Epidemiol. Author manuscript; available in PMC 2018 December 01.

Published in final edited form as:

Community Dent Oral Epidemiol. 2017 December ; 45(6): 506–511. doi:10.1111/cdoe.12313.

A Mediation Analysis Study: The Influence of Mothers' Dental Anxiety on Children's Dental Utilization among Low-Income African-Americans

Masahiro Heima,
Case Western Reserve University

Lisa Heaton,
University of Washington

Douglas Gunzler, and
Case Western Reserve University

Nathan Morris
Case Western Reserve University

Abstract

Objectives—The aim of this study was to test a hypothesized mediation model to explain associations between mothers' dental anxiety and children's dental utilization through the mothers' own dental utilization.

Methods—Two hundred and twenty three low-income African-American mothers with young children (age 31–59 months) completed a study questionnaire which assessed (i) mothers' dental anxiety; (ii) mothers' dental utilization (seeing a dentist at least once a year) and (iii) children's dental utilization (at least one non-study-related dental visit during the 36-month study period). The hypothesized mediation model consisted of these three elements with both a direct path from mothers' dental anxiety to children's dental utilization and an indirect path from mothers' dental anxiety to children's dental utilization through mothers' dental utilization. Mediation analysis with bootstrapping was conducted to test the hypothesized model.

Results—The mediation analysis indicated significant total effect of mothers' dental anxiety on children's dental utilization. The standardized total effect of mothers' anxiety on children's dental utilization was −0.164 (SE=0.084, p=0.050), and the standardized indirect effect of mothers' anxiety on children's dental utilization mediated by mothers' dental utilization was −0.072 (SE=0.039, p=0.068). The direct effect from mothers' anxiety to children's dental utilization was not statistically significant (p=0.313) after adjusting for the mothers' dental utilization.

Conclusions—In this low-income African-American sample, there was a trend for mothers' dental anxiety to be associated with children's dental utilization indirectly through mothers' own dental utilization, while the direct influence of mothers' dental anxiety on children's dental

Corresponding author: Masahiro Heima, Department of Pediatric Dentistry, School of Dental Medicine, Case Western Reserve University, 10900 Euclid Ave., Cleveland, Ohio 44106-4905 USA, Office: +1 216 368 1379, masahiro.heima@case.edu.
DR. MASAHIRO HEIMA (Orcid ID : 0000-0002-5884-7736)

utilization was not seen. This suggests that mothers' dental utilization might explain how mothers' dental anxiety impacts children's early dental utilization.

Keywords

Parents; Child; Poverty; African-American; Questionnaire; Dental Anxiety; Dental Health Services

Introduction

In the United States (U.S.), children from low-income families and those from some minority populations, such as African-Americans, have significantly more dental caries than more affluent and non-minority counterpart populations[1–5]. A recent review of the U.S. Medical Expenditures Panel Survey (MEPS) found children with Medicaid dental coverage had a very low rate of preventive dental visits (29.2%) in a two-year period (2010–2012)[6]. In this same study, Hispanic and non-Latino Black children were less likely to receive dental care compared to non-Hispanic White children (34.7% and 34.8% versus 47.3%, respectively). Yang and colleagues[7] found several factors associated with poor oral health and high levels of dental caries in U.S. children including identifying as "multi-racial" or "other race' (p. 498), low family income, low level of maternal education, and poor maternal health. Children from minority populations who also come from low-income families, then, clearly face several barriers to adequate dental care and, by extension, good oral health.

A systematic review by Fisher-Owens and colleagues, designed to develop a conceptual etiological model for children's dental caries, noted that children's dental caries is a multi-factorial disease with identified risk factors ranging from the individual microbiological factor, to parental psychological and behavioral factors, to community level factors[8]. Furthermore, Hooley at al. suggests that negative parental factors, such as dental anxiety, prevent their children from accessing regular dental care, while positive parental factors, such as dental utilization, positively impact children's dental utilization. Parents' behaviors, therefore, play an important role in children's dental caries development in addition to socio-demographic factors[9].

The American Academy of Pediatric Dentistry (AAPD) guidelines for the prevention of dental caries recommend that children should visit a dentist at the eruption of the first tooth or by the their first birthday[10, 11] and dentists should provide periodic comprehensive examinations, anticipatory guidance, and preventive dental services such as prophylaxis and topical fluoride treatment at these visits[12]. Previous reports indicated that caregivers' dental utilization is strongly and positively related to children's utilization, especially in low-income African-American population[13–16]. However, Kelly et al. reported that African-American caregivers of Medicaid-insured children had not utilized dental services for their children due to high levels of caregivers' dental anxiety[17].

Dental anxiety clearly acts as a barrier to adequate dental care[18–21]; approximately 75% of adults have some anxiety about going to the dentist and about 10–20% of adults indicate they have severe dental anxiety[22–24]. Furthermore, the prevalence of dental anxiety has not significantly changed in the U.S. from the 1960s to 2001[25].

We hypothesized that the dental anxiety of mothers who are primary caregivers may prevent their children's dental utilization directly and/or indirectly. However, understanding the pathway of the impact of mothers' dental anxiety and dental utilization on children's dental utilization is still limited[9]. Given the barriers to adequate oral care for low-income African-Americans in the U.S., the understanding of this pathway among this population is an urgent need.

The aim of this study was to test a hypothesized path model to explain a path between mothers' dental anxiety and children's dental utilization through the mothers' own dental utilization, using a mediation analysis.

Methods

Study Design

This secondary analysis utilized a database from a longitudinal birth cohort study that included dental anxiety and dental utilization information for both mothers (as the primary caregivers) and children. The Institutional Review Board of University Hospitals Case Medical Center reviewed and approved this study protocol.

Study Sample

The original cohort study, which investigated preterm birth and oral health, was conducted in Cleveland, Ohio, an urban city in the U.S.[26]. A total of 890 mothers who had a live birth from September 2007 through September 2010 were approached consecutively and recruited from two hospitals, University Hospitals Case Medical Center and MetroHealth Medical Center. Three hundred twenty four mothers did not participants or were not eligible according to inclusion and exclusion criteria. e.g. Mothers who had a history of mental illness and/or substance abuse listed in their medical records were not eligible. A total of 566 mothers consented to participate. The participants were asked to bring their children at the age of 8 months, 18–20 months, and 36 months to the research unit at one of the two hospitals. The mothers were asked to complete questionnaires including their own and their children's demographic information and oral health behavior, while their children received a toothbrush prophylaxis treatment, oral screening examination, fluoride varnish application and oral health instruction three times during the study. The total number of participants who visited the research sites for the original cohort study at 8, 18–20 and 36-month appointments were 410, 406, and 395, respectively.

We extracted a sample of low-income African-American mothers receiving Medicaid, who were primary caregivers attending the 36-month appointments, as our target population from the original study. Two hundred fifty-four mothers were eligible for this research at the time of recruitment. Data from 223 mothers and children were collected at the 36-month appointment (children's mean (s.d.) age = 39.57 (5.45) months, range = 31–59 months) and analyzed for this study. (Figure 1)

Measures

The questionnaire was written in English at approximately a 6th grade reading level. The questionnaire contained the Modified Dental Anxiety Scale (MDAS), questions about mothers' and children's dental utilization as well as mothers' demographic characteristics. The MDAS was used to measure mothers' dental anxiety with five questions regarding anticipation of a dental visit the next day; scores range from 5–20, with higher scores indicating greater anxiety[27, 28]. The MDAS is one of the most commonly used measurements of dental anxiety and it has been translated into many languages[29–34]. The internal consistency of the MDAS (alpha) was 0.7 in people with dental anxiety; the test-retest reliability was more than 0.8. The concurrent and discriminate validities are also high[28, 35].

Two dental utilization questions were modified from the National Health and Nutrition Examination Survey III (NHANES III). Question 1, "How often do you see a dentist or dental hygienist?" (At least once a year; every 2 years; less often than every 2 years; whenever needed, no regular schedule; other, or does not go anymore; never), was used to detect the frequency of mothers' dental utilization. This question was dichotomized into binary answers; whether the mother sees a dentist at least once a year or not. Question 2, "Has your child ever been seen by a dentist?" (yes/no), was used to detect whether the child had a dental visit during the study period. Mothers were instructed by the researcher in the original cohort study not to count the study visits as a dental visit.

Hypothesized model

A hypothesized model was developed based on previous research results. First, people with dental anxiety avoid dental visits even if they experience dental needs[18–21]. Second, caregivers' dental utilization is positively associated with their children's dental utilization[13–16]. Third, caregivers' dental anxiety is negatively associated with their children's dental utilization[36, 37].

The hypothesized model consisted of three variables: (I) mothers' dental anxiety level as an exposure, (II) mothers' dental utilization (seeing a dentist at least once per year) as a mediator, and (III) children's dental utilization (dental visit during the study period) as an outcome (Figure 2).

Statistical Analyses

After the analyses of participants' characteristics, student t-tests and chi-square tests were utilized to investigate the relationships among mothers' dental anxiety and mothers' and children's dental utilization.

To test both direct and indirect effects of mothers' dental anxiety on their children's dental utilization, a mediation analysis was performed[38]. The mediation analysis using a probit link for the binary endogenous variables (both mothers' and children's dental utilization) was conducted. The probit model can also be conceptualized as a threshold model similar in principal to tetrachoric correlation. Thus, the coefficient/effect size for the pathways between the mothers' and children's dental utilization can be interpreted as the effect of

latent continuous traits upon each other[39]. Model coefficients (standardized) were estimated by Weighted Least Squares Means and Variance adjusted with Monte Carlo simulation for numerical integration. Standard errors for the Standardized Indirect Effect and Standardized Direct Effect were calculated using the bootstrap approach. The goodness-of-fit test of this model was not indicated as the model was saturated. The mediation analysis for this study was done by using Mplus Version 7.2 (Muthén & Muthén, Los Angeles, Calif., USA).

Results

Demographic characteristics of the mothers who did not attend the 36-month appointment (n=31) including the average of mothers' age, education level (graduated from high school or not) and marital status (married, living with partner, or single) were compared with the characteristics of participants (n=223) whose data were analyzed, and found there were no significant differences of the characteristics between them: mothers' age (t=−1.00, df=252, p=0.316): education level (Pearson Chi-Square=1.25, df=1, p=0.263): marital status (Fisher's Exact test p=1.000). Mothers' mean age was 24.9 years (s.d.=4.8; range=17–40 years). Approximately four-fifths of mothers (83.0%) completed high school and 80.3% of mothers were single. The mean MDAS score was 14.51 (s.d.=5.6; range=5–25).

Mothers' dental anxiety was associated with decreased dental utilization in both mothers and children. Table 1 shows the differences in mothers' dental anxiety between dental utilization patterns: Mothers who saw a dentist at least once per year had significantly lower MDAS scores than mothers who saw a dentist less than once a year (t=3.01, df=208, p=0.002).

Table 2 shows the relationship between mothers' and children's dental utilization. Increased mothers' dental utilization was strongly associated with increased children's dental utilization. Mothers who saw a dentist at least once per year took their children to a dentist during the study period significantly more often than mothers who saw a dentist less than once a year (Pearson Chi-Square=7.15, df=1, p=0.008).

Mediation analysis

Table 3 shows the direct unstandardized effects between all variables and the standardized total, direct, and indirect effects of mothers' dental anxiety on children's dental utilization. The indirect effect was defined as the amount of the effect of one variable upon another which explained by intermediate variables (mothers' dental utilization)[40]. We have used standardized values for the decomposition of the effects so they can be interpreted on a correlation-like scale. The standardized estimated beta-coefficient of the total effect of mothers' dental anxiety on the children's dental visit during the study period was −0.164 (SE=0.084, p=0.050). The indirect effect of mothers' dental anxiety on children's dental utilization mediated by mother's dental utilization indicated a trend of the effect (standardized estimated beta-coefficient = −0.072, SE=0.039, p=0.068) and the mothers' dental anxiety did not show a significant direct effect on children's dental utilization (standardized estimated beta-coefficient = −0.092, SE=0.091, p=0.313).

Discussion

Results from this study suggest that children's early dental visits were associated with mothers' dental anxiety indirectly, which was mediated by mother's dental utilization, rather than a direct influence of mothers' dental anxiety. Parents' dental anxiety is known to be negatively associated with children's dental utilization[36, 37]. During childhood and even adolescence, child dental utilization relies primarily on parental/guardian decision-making and other dental care-seeking behaviors. This time of life is critical in terms of developing good oral health behaviors, such as visiting for regular, preventive dental care.

With regard to mothers' dental anxiety and their own dental utilization, there is extensive evidence in the literature that people who are afraid of dentists avoid regular dental visits[18–21]. This study also found that mothers with higher dental anxiety showed significantly less utilization of dental care than mothers with less dental anxiety.

The American Dental Association and American Academy of Pediatric Dentistry (AAPD) recommend that the first dental visit should be at the emergence of the first tooth or by the child's first birthday[10, 11]. Mothers in the original cohort study were provided with recommendations to seek an early preventive dental visit for their children. Only half of the children, however, had a dental visit during the 36-month study period. Given that maternal dental utilization is associated with child dental utilization, one way increase dental visits for young children may be to work with mothers to improve their own utilization of oral health services on a regular basis.[14–16].

Other factors than dental anxiety, of course, can help explain the link between mothers' and children's dental utilization. A concept of "dental home", which was introduced by AAPD, is a dentist who provide a continuous dental care by family-centered way[41]. A number of studies[42–44] have aimed to increase mothers' and pregnant women's association with a "dental home," under the assumption that mothers with a dental home would be more likely to take their children to a dentist. Given this argument, it is possible that some mothers may not have taken their children to a dentist due to a lack of a dental home.

Previous studies indicated that mothers who are afraid of receiving dental care tend to avoid taking their children to the dentist[36, 37]. In this study, mothers who did not take their children to a dentist reported higher levels of dental anxiety than mothers who took their children to the dentist (Table 1). However, after controlling for mothers' dental utilization, the phenomenon disappeared; mothers' dental anxiety influenced children's dental utilization, mediated by mothers' dental utilization.

Children in the original study received oral examinations, fluoride varnish applications, and recommendations for dental visits. Thus, the mothers were exposed to pediatric dentists when the children visited the research site for 8 and 18–20 month appointments before the data were collected that were used in this study. Those exposures could increase the mothers' behavior, taking their children to a dentist before the 36-month appointment for both fearful and nonfearful mothers. It has weakened the direct influence of mothers' dental anxiety on children's dental utilization. Nevertheless, this study showed a trend of indirect influence of mothers' dental anxiety on children's dental utilization.

Mothers' dental anxiety was associated indirectly with children's dental utilization: a mother's high dental anxiety may lead her to delay in taking her child to a dentist. This delay might lead to an increase in a child's dental caries incidence and subsequent invasive treatment, which might contribute to onset of the child's dental anxiety. Furthermore, previous surveys indicate that 50–85% of adults with dental anxiety reported their anxiety began in childhood[24, 45]. Although further investigations are needed, dental anxiety on the part of the parent may contribute to the child's dental anxiety due, in part, by this delay in receiving dental care[46, 47]. Increasing parents' dental utilization might help increase children's dental utilization, which in turn could prevent or reduce childhood dental caries as well as children's dental anxiety.

As a secondary data analysis, some limitations exist in the interpretation of these results. Participants were recruited from two hospitals in a city in a nonrandomized way. Thus, participants may have some volunteer biases such as higher education level; in fact, the high school graduation rate in the current sample was higher (83%) than the rate in this general Cleveland area (59.3%)[48]. Higher parental educational level increases both parents' and children's dental utilization[49]. Lastly, the data were from a self-reported and cross-sectional questionnaire. The responses might be influenced by recall and social desirability bias. It is impossible to eliminate these biases without interventions. More definitive conclusions require an intervention study.

Conclusion

Among low-income African-American mothers, there was a trend for mothers' dental anxiety to be associated indirectly with children's dental utilization through the mediating influence of the mothers' own dental utilization. We did not see a direct association with mothers' dental anxiety on children's dental utilization after controlling for mothers' own dental utilization. Increasing mothers' dental utilization might lead to children's greater use of dental services.

Acknowledgments

This research was supported by NIH NIDCR RO1DE07947-01 and Clinical and Translational Science Collaborative (CTSC) UL1TR 000439. The authors thank Dr. Jeffrey Albert and Dr. Suchitra Nelson who provided critical suggestions and comments during the writing of this article.

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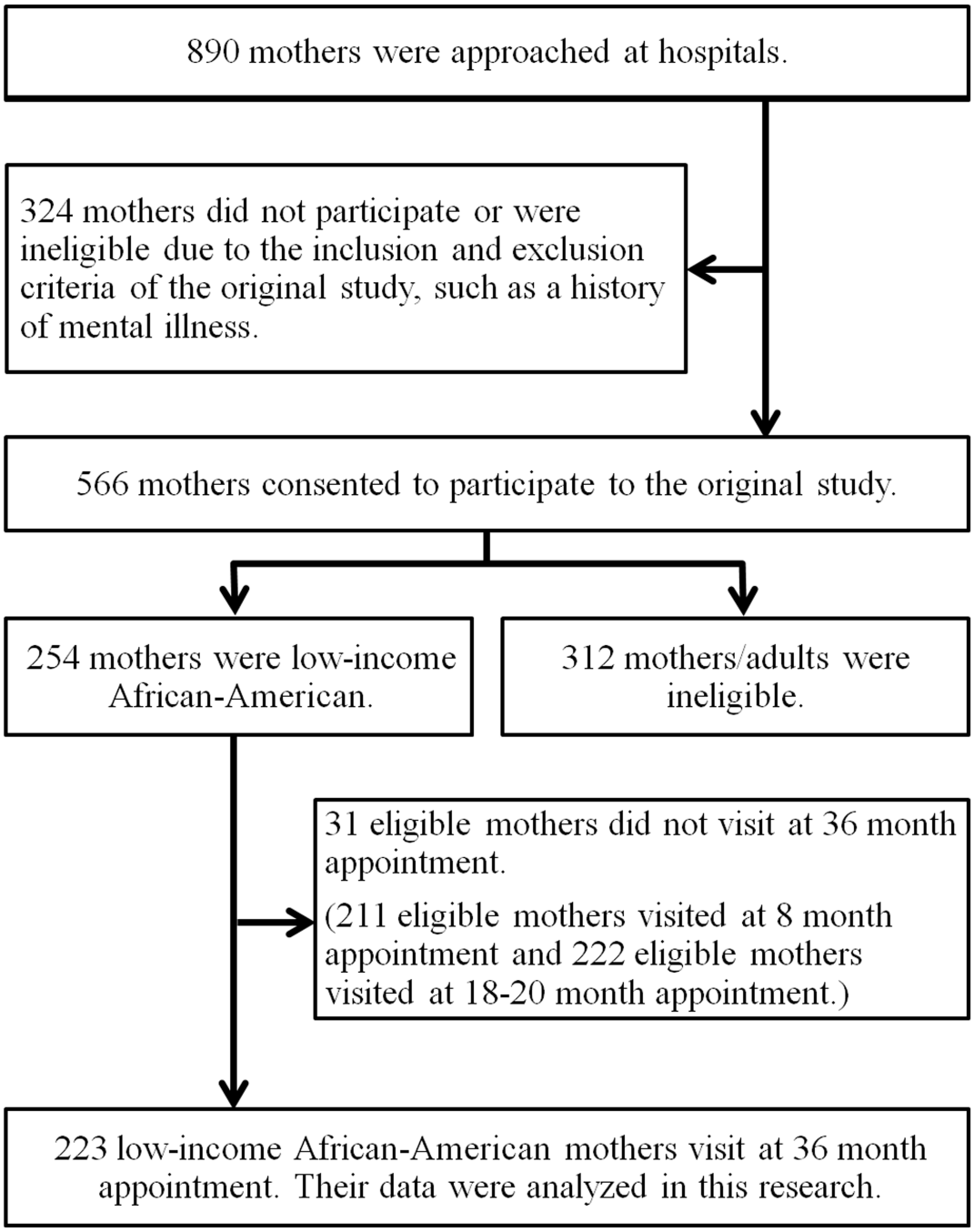

Figure 1.
Summary of participant recruitment and retention

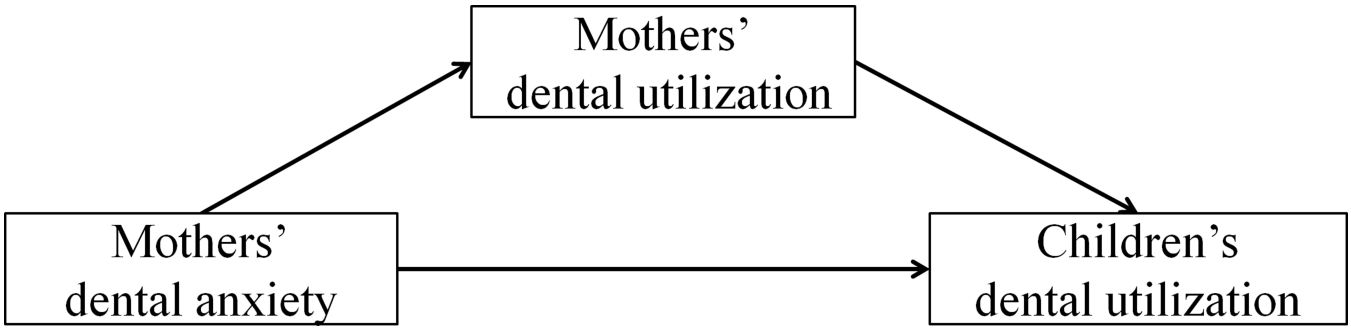

Figure 2.
The mediation model

Table 1

Comparisons of mothers' dental anxiety by differences in dental utilization

Dental utilization	Mean (SD) of mother's MDAS scores	Statistics
Mothers' dental utilization[i]		
Yes (n=93)	13.4 (5.1)	t=3.01, df=208 p=0.002
No (n=117)	15.7 (5.6)	
Children's dental utilization[ii]		
Yes (n=113)	13.8 (5.1)	t=1.94, df=208.8 p=0.054
No (n=107)	15.3 (6.0)	

[i]: seeing a dentist at least once a year, n=210, the number of missing data was 13.

[ii]: at least one dental visit during the study period, n=220, the number of missing data was 3.

Table 2

Relationship between mothers' and children's dental utilization

		Children's dental utilization[ii]	
		Yes	**No**
Mothers' dental utilization[i]	Yes	66 (55.9%)	52 (44.1)
	No	34 (37.0%)	58 (63.0%)
Pearson Chi-Square=7.15, df=1, p=0.008			

n=210, the number of missing data was 13.

i: seeing a dentist at least once a year

ii: at least one dental visit during the study period

Table 3

The results of the mediation analysis

Unstandardized Estimated β-coefficients	S.E.	P-Value (Two-Tailed)
Mothers' dental anxiety → Mothers' dental utilization		
−0.049	0.016	0.002
Mothers' dental utilization → Children's dental utilization		
0.264	0.107	0.013
Mothers' dental anxiety → Children's dental utilization		
−0.017	0.017	0.325
Standardized Estimated β-coefficients	**S.E.**	**P-Value (Two-Tailed)**
Total effects of mothers' dental anxiety on children's dental utilization		
−0.164	0.084	0.050
Indirect effect:		
Mothers' dental anxiety → Mothers' dental utilization → Children's dental utilization		
−0.072	0.039	0.068
Direct effect:		
Mothers' dental anxiety → Children's dental utilization		
−0.092	0.091	0.313

Mothers' dental anxiety: MDAS score
Mothers' dental utilization: seeing a dentist at least once a year
Children's dental utilization: at least one dental visit during the study period