## ORIGINAL ARTICLE

JA Weatherwax
KK Bray
KB Williams
CC Gadbury-Amyot

**Authors' affiliations:**

*JA Weatherwax*, University of Missouri-Kansas City, Kansas City, MO, USA
*KK Bray*, Division of Dental Hygiene, University of Missouri-Kansas City School of Dentistry, Kansas City, MO, USA
*KB Williams*, Department of Biomedical and Health Informatics, University of Missouri-Kansas City School of Medicine, Kansas City, MO, USA
*CC Gadbury-Amyot*, University of Missouri-Kansas City School of Dentistry, Kansas City, MO, USA

**Correspondence to:**

*C. C. Gadbury-Amyot*
University of Missouri-Kansas City School of Dentistry
650 E. 25th Street
Kansas City
MO 64108, USA
Tel.: (816) 235-2054
Fax: (816) 235-2157
E-mail: amyotc@umkc.edu

# Exploration of the relationship between parent/guardian sociodemographics, intention, and knowledge and the oral health status of their children/wards enrolled in a Central Florida Head Start Program

**Abstract:** *Objective:* The purpose of this study was to identify possible relationships between parent/guardian sociodemographics, intention, knowledge, and the oral health status of their child/ward. Intention includes three factors as defined in the Theory of Planned Behavior: attitudes, subjective norms and perceived control, and oral health status was measured by decayed, missing and filled teeth (dmft) scores. *Methods:* A convenience sample of parent/guardian with child/ward with age of three to five (*n* = 181 dyads) enrolled in a Head Start program in the state of Florida participated. A cross-sectional observational study comprised of two components, parent/guardian questionnaire and an oral health status form for recording dmft scores of participating child/ward was employed. *Results:* Parent/guardian race/ethnicity and years of education were significantly related to dmft of child/ward. The highest rates of severe early childhood caries (ECC) were found in child/ward whose parent/guardian is Hispanic and parent/guardian with less than a high school education. Multivariate regression analysis found that increased education level of parent/guardian was significantly associated with lower dmft in this population. No significant relationship was found between parent/guardian self-reported intention (attitudes, subjective norms and perceived control), knowledge and dmft scores of the child/ward. *Conclusion:* Researchers have called for greater attention to the impact of parental influences in the aetiology of ECC. Results from this study were consistent with current studies where parent/guardian race/ethnicity and educational level served as predictors of oral health status of children. In this study population, parent/guardian intention and knowledge were not shown to significantly impact the oral health status of their child/ward.

**Key words:** dental care for children; dental caries; Head Start programs; healthcare disparities; parents; socio-economic factors; Theory of Planned Behavior

## Introduction

Early childhood caries (ECC) remain the single most common chronic childhood disease in the United States with U.S. health surveillance

documenting a decline in the dental health of preschoolers 2–5 year olds from 1999 to 2004 compared with the previous decade (1, 2). It is estimated that eighty percent of decay in children ages 2–5 remains untreated in families of low socio-economic status (3). For those children who qualify for assistance (e.g. state Medicaid programs), peak utilization is shown to occur after the preschool period and after dental treatment needs and symptoms have progressed in severity (4). Severe ECC is described as aggressive and very destructive to primary dentition leading to pain, lowered concentration when learning and premature loss of primary teeth, which can be the forerunner to malocclusion (1, 5, 6).

The oral health status of parent/guardian may typify the importance or value they place on good oral health. The parent/guardian who feels they have little control over dental caries prevention may lack motivation to model good oral health habits. Moreover, their personal fear of dental pain may affect whether the child/ward receives regular care (7, 8). Other factors shown to play a role in the multidimensional aetiology of dental caries include family socio-economic level, race/ethnicity, educational levels of the parent/guardian, diet and environment (7, 9–14).

Socio-economic status and environment of family and community can impact health as a whole. Finlayson et al. examined maternal influences on tooth brushing habits of children ages 1–5 and concluded that several cognitive behaviours and psychosocial factors were directly associated with brushing habits (15). Social determinants of ECC have been cited as maternal health beliefs and, behaviours, material oral health fatalism, lack of knowledge of the child's oral hygiene needs, age of child and parenting stress. In contrast, higher education and income had protective benefits against ECC (15, 16). The impact of parent/guardian knowledge and attitudes on preschool oral health is further verified by research conducted by Schroth et al., which found that caregivers of preschool children with ECC were more likely to believe that caries could not affect a child's health (17).

Race and ethnicity play a role in the aetiology of early childhood caries. The report '*Oral Health in America: a Report of the Surgeon General*' states that those with poor oral health are disproportionately from racial/ethnic minority groups, which is also confounded by socio-economic status (SES) (most notably income and educational attainment). (1, 18–22) This suggests that health disparities be considered in light of both SES factors and race/ethnic groups.

Impacting the oral health status of children requires evaluating the parent/guardian to gain a better understanding of the factors affecting the child's oral health. One theoretical model that has been used to help understand health behaviours is the Theory of Planned Behavior (TPB) (23). Ajzen posits that a person's behaviour is determined by their *intention* to perform the selected behaviour. (Fig. 1) Intention is impacted by three factors; attitudes, subjective norms and perceived control. The TPB has been applied to a range of health-related behaviours, including oral health. Research suggests that negative parental attitudes towards oral health and limited
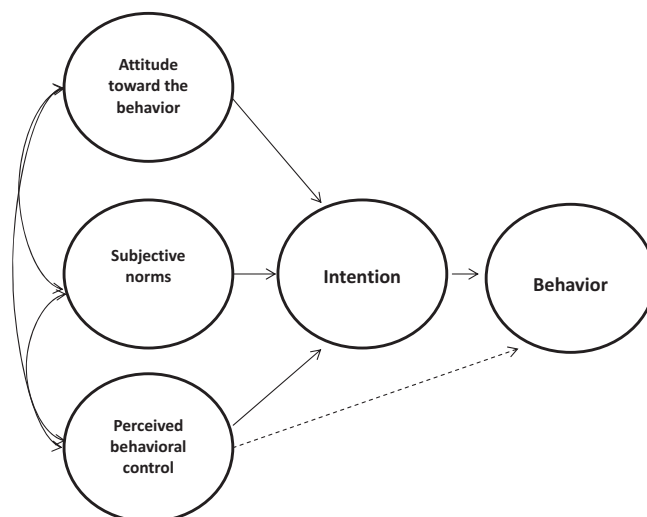


Fig. 1. Theory of Planned Behavior (23)

perceived control are a risk indicator for caries experience in their offspring (15, 17, 24–26). Theory-based behaviour change interventions identify appropriate targets for these interventions.

Therefore, the purpose of this study was to explore the relationship between parent/guardian sociodemographics, intention, and knowledge and oral health status of their child/ward. Questions examined include: (i) Is there a relationship between parent/guardian sociodemographics and dmft scores of their child/ward in a Head Start Program, (ii) Is there a relationship between parent/guardian intention (attitude, subjective norms and perceived control) and knowledge and dmft scores of their child/ward in a Head Start Program.

## Methods

The study employed a cross-sectional, observational design to collect prevalence data on children's oral health. Additionally, a parent/guardian questionnaire was designed to capture demographic characteristics, as well as constructs of the Theory of Planned Behavior (attitude, subjective norms and perceived control), parent/guardian knowledge of ECC along with perceived importance of primary dentition. In the context of the current study, attitude is defined as the value parents/guardians place on oral health. Subjective norms are defined as the parents/guardians perception that most people who are important to him/her believe oral health is important, and therefore, the parent/guardians take actions to ensure their child's/wards oral health. Finally, perceived control is defined as the parent/guardian belief that they have the ability to impact the oral health of their child/ward. (23) Response scales for items include Likert-type, dichotomous and categorical scales. Content validity was determined through the analysis of the instrument by three faculty members with collectively over 80 years of experience in dentistry and dental education, along with expertise in survey research. A pilot study with ten

Table 1. **Proposed case definition of early childhood caries and severe childhood Caries (27)**

| Age (Months) | Early childhood caries | Severe early childhood caries |
|---|---|---|
| <12 | 1 or more dmf surfaces+ | 1 or more smooth dmf surfaces* |
| 12–23 | 1 or more dmf surfaces+ | 1 or more smooth dmf surfaces* |
| 24–35 | 1 or more dmf surfaces+ | 1 or more smooth dmf surfaces* |
| 36–47 | 1 or more dmf surfaces+ | 1 or more cavitated, filled or missing (due to caries) smooth surfaces in primary maxillary anterior teeth OR dmf score of $\geq 4$ |
| 48–59 | 1 or more dmf surfaces+ | 1 or more cavitated, filled or missing (due to caries) smooth surfaces in primary maxillary anterior teeth OR dmf score of $\geq 5$ |
| 60–71 | 1 or more dmf surfaces+ | 1 or more cavitated, filled or missing (due to caries) smooth surfaces in primary maxillary anterior teeth OR dmf score of $\geq 6$ |

*Any carious lesion, non-cavitated ($d_1$) or cavitated ($d_2$), missing due to caries (m) or filled surface (f). Includes primary teeth only.

participants was conducted to assure readability and understanding of the survey items. The original instrument was written in English making it necessary to translate to Spanish. A primary dental provider fluent in Spanish and English translated the instrument to Spanish, and a separate primary dental provider also fluent in both languages translated the Spanish version back to English. Based on findings from the pilot study, the questionnaire was revised to ensure the ideas in the survey were maintained in the back translation. The dmft charting classifies the oral health status of each child/ward as having ECC or severe ECC based on guidelines defined during a workshop sponsored by the National Institute of Dental and Craniofacial Research, Health Resources and Service Administration, and the Health Care Financing Administration (Table 1) (27).

A convenience sample of parents/guardians with children/wards with age of three to five ($n$ = 181) enrolled in Volusia County, Mid Florida Community Services, Inc. Head Start program were surveyed in the Fall 2011. At the time of data collection, there were a total of 399 children enrolled. Institutional Review Board approval (SS11-95e) was obtained from the University of Missouri-Kansas City, and no incentives were offered to participating parents/guardians.

Head Start was conceptualized and implemented in the mid-1960s in the United States as a strategy for combating the inequalities found in disadvantaged groups. Head Start was designed to provide preschool children of low-income families with a comprehensive program to meet their emotional, social, health, nutritional and psychological needs. In the late 1970s, Head Start began bilingual and bicultural programs in 21 states in an effort to be culturally responsive to the communities served. (28) One of the many health services provided is oral

health with the recognition that good oral health is essential to a child's growth and development. As specifically stated in policy 45 CFR 1304.20 Child health and developmental services: 'Obtain from a health care professional a determination as to whether the child is up to date on a schedule of age appropriate preventive and primary health care which includes medical, *dental* and mental health. ……For children who are not up to date on an age-appropriate schedule of well child care, grantee and delegate agencies must assist parents in making the necessary arrangements to bring the child up to date'(29).

A single Oral Health Coordinator, employed by the Head Start Program, fluent in English and Spanish ensured standardization of procedures. Monthly educational meetings provided the context for the Oral Health Coordinator to recruit participants for the study. Once consent was obtained, this individual administered the parent/guardian survey, provided in both English and Spanish. A single, licensed dentist as part of the Head Start Program provided dental examinations to each child/ward.

Data were entered into the SPSS statistical program, and internal consistency estimates of reliability were computed on domain-specific items to confirm development of subscales. Preliminary bivariate analyses (ANOVA for parametric data, Kruskal–Wallis and chi-square for ordinal and nominal data, respectively) were conducted to explore the relationship of sample characteristics and oral health status of children. Multicollinearity was assessed among the predictors, and all VIF values determined to be <2. ECC scores were then regressed on those predictors identified in the bivariate analyses. Backwards elimination was used with removal criteria set at $P$ = 0.1 to determine the most meaningful model for predicting dmft while controlling for other potential predictor variables.

## Results

The total number of parent/child dyads participating in the study was 181. Demographic characteristics of parents and corresponding child caries assessment are documented in Table 2. Of the 181 dyads, Hispanics accounted for the largest percentage of participants (46%), which is comparable to all children enrolled at the time of data collection where 183/399 or 45.6% were reported as Hispanic. Fifty-four percent (54%) of participating parents reported being single; forty-three percent (43%) reported not having finished high school; and fifty percent (50%) were below the national poverty level, reporting an annual household income of <$10 000.

In answering the first research question, is there a relationship between parent/guardian sociodemographics and dmft scores of their child/ward, preliminary bivariate analyses were conducted to explore the relationship of parent/guardian characteristics and oral health status of children enrolled in the Head Start Program as measured by dmft scores. Bivariate analyses showed parent/guardian race/ethnicity and years of education as the only sociodemographic variables significantly related to dmft ($P$ = 0.044 and 0.0001, respectively). Decayed, missing or filled primary teeth scores (dmft) were highest in

**Table 2.** Characteristics of parents with children enrolled in a central florida head start program and corresponding child caries assessment

| | | Caries Classification* | | |
| --- | --- | --- | --- | --- |
| | N | No caries | Early childhood caries | Severe early childhood caries |
| Race/Ethnicity[†] (%) | | | | |
| Hispanic | 83 (46) | 29 (35) | 14 (17) | 40 (48) |
| Black | 56 (31) | 27 (48) | 7 (13) | 22 (39) |
| White | 27 (15) | 13 (48) | 8 (30) | 6 (22) |
| Other | 15 (8) | 8 (53) | 0 | 7 (47) |
| Marital status[‡] (%) | | | | |
| Single | 96 (54) | 44 (46) | 16 (17) | 36 (38) |
| Married | 62 (35) | 22 (35) | 7 (11) | 33 (53) |
| Separated/ divorced/ widowed | 20 (11) | 11 (55) | 6 (30) | 3 (15) |
| Years of education[§] (%) | | | | |
| 8th grade or less | 50 (28) | 11 (22) | 8 (16) | 31 (62) |
| Some high school | 28 (15) | 12 (43) | 5 (18) | 11 (39) |
| High school graduation | 49 (27) | 23 (47) | 9 (22) | 17 (35) |
| Some college or college graduate | 51 (28) | 31 (61) | 6 (12) | 14 (27) |
| Annual household income[¶] (%) | | | | |
| <$10 000 | 91 (50) | 36 (40) | 18 (20) | 37 (41) |
| $11 000–20 000 | 63 (35) | 31 (49) | 6 (10) | 26 (41) |
| $21 000–40 000 | 14 (8) | 8 (57) | 3 (21) | 3 (21) |
| Knowledge (TPB)[**] | | | | |
| Mean (SD) | 9.5 (3.2) | 9.9 (3.2) | 9.8 (3.5) | 9.0 (2.6) |
| Attitude Score (TPB)[††] | | | | |
| Mean (SD) | 1.9 (1.4) | 2.1 (1.4) | 2.1 (1.3) | 1.6 (1.3) |
| Perceived Control (TPB)[‡‡] | | | | |
| Mean (SD) | 1.6 (0.7) | 1.7 (0.6) | 1.7 (0.5) | 1.5 (0.8) |

Percentages may not total 100% due to non-responders.
TBP, Theory of Planned Behavior.
*Early and severe childhood caries as defined by Drury (Table 3).
[†]$P = 0.044$; [‡]$P = 0.06$; [§]$P = 0.010$; [¶]$P = 0.468$; [**]$P = 0.154$; [††]$P = 0.093$; [‡‡]$P = 0.230$.

**Table 3.** Regression model: relationship dmft scores to education category and attitudes

| Outcome dmft | β | SE | P |
| --- | --- | --- | --- |
| Constant | 4.78 | 0.55 | 0.0001 |
| Education category | | | |
| 8th grade or less (referent) | – | – | – |
| Some high school | −1.58 | 0.73 | 0.032 |
| High school grad | −2.10 | 0.62 | 0.001 |
| Some college | −2.71 | 0.61 | 0.0001 |
| Attitudes | −0.31 | 0.18 | 0.077 |

β, Beta.
SE, Standard error.

children/wards whose parents/guardians are Hispanic (Table 2). Similarly, children/wards of parents/guardians with less than a high school education presented with the highest dmft scores for severe ECC (62%).

Next, internal consistency estimates of reliability (Cronbach's alpha) were computed on domain-specific items to confirm development of subscales. Subjective norm was the only domain assessed using a single item. The subscales of attitude, perceived control and knowledge were confirmed. Reliability estimates computed for subscales of attitude, perceived control and knowledge towards care of deciduous teeth were 0.74, 0.67, and 0.69, respectively, confirming internal consistency of these measures. In answering the second research question, is there a relationship between parent/guardian intention (attitude, subjective norms and perceived control) and knowledge, and dmft scores of their child/ward, preliminary bivariate analyses were conducted. Attitudes and perceived control were

significantly related to dmft ($P < 0.05$). However, when multiple regression modelling was performed controlling for other covariates, neither attitudes nor perceived control were retained in the final model at a significance level of ≤0.05.

Multiple regression modelling was performed to determine the most meaningful model for predicting dmft as a function of predictor variables (race/ethnicity, education, attitude and perceived control). Education was dummy-coded to allow for examination of potential nonlinearity in the association of education with dmft. The backward elimination approach was used, with removal criteria set at $P > 0.10$. In the resulting model, only parent/guardian level of education and attitudes were retained, explaining 10% of variance in dmft scores, $R^2 = 0.11$, F (4177) = 6.3. Results show that, compared with the lowest educational category (8th grade or less), there was a predicted decrease in dmft score of −1.6 for children with parents/guardians reporting some high school education, −2.1 for children of parents/guardians who graduated from high school and −2.7 for children of parents/guardians with some college. While not statistically significant at the 0.05 level, parental attitudes were retained in the model. All other predictors were excluded in the final model. Model parameters are displayed in Table 3.

## Discussion

With conditions worsening in the oral health of U.S. preschoolers, it is imperative that there be an exploration of strategies to reverse this trend. (2) This study of a Head Start population provides a starting point as it establishes a baseline of oral health conditions and begins to explore predictive factors of early childhood caries in this setting. Researchers have called for greater attention to the impact of parental influences (e.g. education, race/ethnicity, income) in the aetiology of early childhood caries (ECC). Over the course of the past decade, a body of research has begun to establish the impact of parental education level on the oral conditions of children (10–12, 20). In each case, researchers found a connection between ECC and maternal low levels of education. These findings are consistent with results of the current study where parent/guardian level of formal education was found to be a significant predictor of ECC total.

Race/ethnicity is consistently reported as a predictor of children at high risk for oral disease and disproportionately

represented when it comes to early childhood caries (1, 3, 5, 10, 11, 13, 16). Guarnizo-Herreno and Wehby conducted a study measuring racial/ethnic inequalities in US children's dental health using data from the 2007 National study of Children's Health. The study found Hispanic children having the poorest dental health, followed by Black then White children, which is consistent with the current study (Table 2). However, as stated earlier, health disparity must be considered in terms of not only race/ethnicity but also SES.

Low income has been reported in several studies as having an influence on the oral health status of children (1, 10, 11, 13, 21, 22). A recent systematic review conducted by Hooleya et al., explored multiple determinants of ECC, and low income was identified as having an impact on the prevalence of dental caries. While this was not a significant factor in the current study, lack of significance in this population of Head Start children may be attributable to the homogeneous nature of the population in that only 8% of the study participants reported income ≥\$21 000.

Additional parent/guardian influences explored in this study included parent/guardian intention (attitude, subjective norms and perceived control) and knowledge. While bivariate analyses confirmed a significant relationship between parent/guardian attitudes and perceived control, subsequent predictive modelling did not retain these variables. Confirmatory analyses to determine estimates of reliability of domain-specific items did not confirm subjective norms as a scale. This would indicate the need for revision of the survey for future research in attempting to capture the domain of subjective norms as part of the Theory of Planned Behavior constructs. It is possible that knowledge did not emerge in this study as a predictor of dmft because the study was conducted in a Head Start population where there is an emphasis on parental knowledge of health. The emphasis that good oral health is essential to a child's growth and development could have resulted in limited variability among the parent/guardian participants. Policy 45 CFR 1304.20 Child health and developmental services goes on to say: '…..that by providing pregnant women with oral health care it is not only critical for women's oral health but also the future oral health of their children' (28). In 2008, Milgrom et al. explored strategies to empower Head Start to improve access to oral health and suggested that parent education and action needs to begin ahead of the Head Start years for children (4). Therefore, educational programming during a mother's pregnancy should begin with providing the evidence of how a combination of home and professional activities can arrest tooth decay. Reinforcing the importance of daily brushing with fluoridated toothpaste, reducing consumption of soda and sugary drinks, and application of fluoride varnish three times per year would go far in increasing parent/guardian knowledge and decreasing the incidence of caries in Head Start children/wards.

This warrants further research to explore the impact of educational programming and professional oral health interventions in Head Start programs on overall parent/guardian knowledge and child/ward oral health compared with parents/guardians who are not part of Head Start programs.

Milgrom et al. further suggest that conventional approaches to provide traditional treatment for children who need care is not working (4). Citing dental workforce shortages and unwillingness of most dentists to see children enrolled in Medicaid programs, it can be postulated that using trained individuals, such as dental hygienists with an expanded scope of practice, could be the answer to addressing the issue of early childhood caries in Head Start programs. Using portable equipment that would allow the dental hygienist to provide preventative and simple restorative procedures would help Head Start in meeting their objectives. The dental hygienist could serve as the liaison between Head Start and the dental community for those instances where more comprehensive restorative care is required. Working in an interdisciplinary fashion, the dental hygienist would be able to interface with nurses, physicians, social workers, psychologists and a variety of other healthcare providers to bring the expertise of all to bear on the treatment and care of Head Start program participants. In addition, the dental hygienist could assist Head Start with educational programming for pregnant clients so that knowledge on oral health can begin early and be reinforced during appointments so as to begin good oral healthcare practices early.

The dental hygiene model outlined above within the Head Start programs is further supported through research conducted by Guarnizo-Herreno et al., who found neighbourhood safety to be the most relevant neighbourhood characteristic for observed disparities restricting visits to a dental provider and potentially reducing the number of providers available (13). Head Start Programs provide a safe environment where mothers and children are nurtured and cared for. With dental hygienists providing services and educational programming onsite at Head Start centers, there is the potential of helping reduce the observed disparities thereby expanding rather than restricting dental visits.

Limitations to this study include the use of a convenience sample and the self-reporting nature of the questionnaire. Parents/guardians may provide answers reflecting how they wish to be perceived versus answers that represent the true nature of the situation. An additional limitation is the small, homogeneous population selected for this study.

## Conclusion

In conclusion, results from this study were consistent with current research where parent/guardian race/ethnicity and educational level served as predictors of the oral health status of children. In this study, knowledge did not emerge as a determinant of the oral health status of the child. Head Start is a unique program governed by specific policies and procedures which could have negated the impact of knowledge due to their strong emphasis on women's oral health during pregnancy (Policy 45 CFR 1304.20). Further research into the implementation of strategies set forth in this study and their impact on children's oral health and impact in helping Head Start meet oral health goals are needed.

# Clinical relevance

### Scientific rationale for the study

Disparity in access to oral healthcare continues to plague the United States. Particularly, troublesome is the worsening condition of preschoolers over the past two decades. Head Start is a federal programme designed to provide preschool children of low-income families with comprehensive services including oral health.

### Principal findings

Exploration of oral health conditions and contributing parental/guardian factors found race/ethnicity and education significantly impact child/ward oral health status.

### Practical implications

Practice acts that allow dental hygienists direct access to children in existing social structures such as Head Start Programs would be a reasonable strategy.

## Acknowledgements

## References

1 U.S. Department of Health and Human Services. *Oral Health in America: A Report of the Surgeon General*. Rockville, MD: U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health; 2000.

2 Dye BA, Tan S, Smith V *et al*. Trends in oral health status: United States, 1988–1994 and 1999–2004. *Vital Health Stat*, 11 (248) 2007.

3 Warren JJ, Weber-Gasparoni K, Marshall TA *et al*. Factors associated with dental caries experience in 1-year-old children. *J Public Health Dent* 2008; **68**: 70–75.

4 Milgrom P, Weinstein P, Huebner C, Graves J, Tut O. Empowering Head Start to improve access to good oral health for children from low income families. *Matern Child Health J* 2011; **15**: 876 –882.

5 Nunn ME, Braunstein NS, Krall Kaye EA, Dietrich T, Garcia RI, Henshaw MM. Healthy eating index is a predictor of early childhood caries. *J Dent Res* 2009; **88**: 361–366.

6 Hoffding J, Kisling E. Premature loss of primary teeth: part 1, its overall effect on occlusion and space in the permanent dentition. *J Dent Child* 1978; **45**: 279–283.

7 Fisher-Owens SA, Gansky SA, Platt LJ *et al*. Influences on children's oral health: a conceptual model. *Pediatrics* 2007; **120**: 510–520.

8 Talekar BS, Rozier RG, Slade GD, Ennett ST. Parental perceptions of their preschool-aged children's oral health. *J Am Dent Assoc* 2005; **136**: 364–372.

9 Dye BA, Shenkin JD, Ogden CL, Marshall TA, Levy SM, Kanellis MJ. The relationship between healthful eating practices and dental caries in children aged 2–5 years in the United States 1998–1994. *J Am Dent Assoc* 2004; **135**: 55–60.

10 Hooleya MSH, Boganin C, Satur J, Kilpatrick N. Parental influence and the development of dental caries in childen aged 0–6 years: a systematic review of the literature. *J Dent Educ* 2012; **40**: 873–885.

11 Psoter WJ, Pendrys DG, Morse DE, Zhang H, Mayne ST. Associations of ethnicity/race and socioeconomic status with early childhood caries patterns. *J Public Health Dent* 2006; **66**: 23–29.

12 Traebert J, Guimaraes Ldo A, Durante E and Serratine A. Low maternal schooling and severity of dental caries in Brazillian preschool children. *Oral Health Prev Dent* 2009; **7**: 39–45.

13 Guarnizo-Herreno CC. Explaining Racial/ethnic Disparities in children's dental health: a decomposition analysis. *Am J Public Health* 2012; **102**: 859–866.

14 Piovesan C, Mendes FM, Ferreira FV, Guedes RS, Ardenghi TM. Socioeconomic inequalities in the distribution of dental caries in Brazillian preschool children. *J Public Health Dent* 2010; **70**: 319–326.

15 Finlayson TL, Siefert K, Ismail AI, Sohn W. Maternal self-efficacy and 1 to 5-year-old children's brushing habits. *Community Dent Oral Epidemiol* 2007; **35**: 272–281.

16 Finlayson TL, Siefert K, Ismail AI, Sohn W. Psychosocial factors and early childhood caries among low-income African-American children in Detroit. *Community Dent Oral Epidemiol* 2007; **35**: 439–448.

17 Schroth RJ, Brothwell DJ, Moffatt ME. Caregiver knowledge and attitudes of preschool oral health and early childhood caries (ECC). *Int J Circumpol Heal* 2007; **66**: 153–167.

18 Braveman PA, Cubbin C, Egerter S *et al*. Socioeconomic status in health research: one size does not fill all. *J Am Med Assoc* 2005; **294**: 2879–2888.

19 Braveman PA, An J, Williams DR, Egerter S. Race and socioeconomic factors affect opportunities for better health. Robert Wood Johnson Foundation, 2009. Available at: https://folio.iupui.edu/handle/10244/659 (accessed 19 July 2013).

20 Schroth R. Determinants of early childhood caries (ECC) in a rural Manitoba community: a pilot study. *Pediatr Dent* 2005; **27**: 114–120.

21 Wigen TI, Espedlid I, Skaare AB, Wang NJ. Family characteristics and caries experience in preschool children. A longitudinal study from pregnancy to 5 years of age. *Community Dent Oral Epidemiol* 2011; **39**: 311–317.

22 Werneck R, Lawrence HP, Kulkarni GV, Locker D. Early childhood caries and access to dental care among children of portuguese-speaking immigrants in the city of Toronto. *J Can Dent Assoc* 2008; **74**: 805.

23 Ajzen I. The theory of planned behavior. *Organ Behav Hum Dec* 1991; **50**: 179–211.

24 Adeniyi AA, Ogunbodede OE, Jeboda OS, Morenike Folayan O. Do maternal factors influence the dental health status of Nigerian pre-school children? *Int J Paediatr Dent* 2009; **19**: 448–454.

25 Skeie MS, Espelid I, Riordan PJ, Klock KS. Caries increment in children aged 3–5 years in relation to parents' dental attitudes: Oslo, Norway 2002 to 2004. *Community Dent Oral Epidemiol* 2008; **36**: 441–450.

26 Astrom AN, Kiwanuka SN. Examining intention to control preschool children's sugar snacking: a study of carers in Uganda. *Int J Paediatr Dent* 2006; **16**: 10–18.

27 Drury TF, Horowitz AM, Ismail AI, Maertens MP, Rozier RG, Selwitz RH. Diagnosing and reporting early childhood caries for research purposes. *J Public Health Dent* 1999; **59**: 192–197.

28 U.S. Department of Health and Human Services. *History*. Washington, DC: Administration for Children and Families Office of Health Start. Available at: http://eclkc.ohs.acf.hhs.gov/hslc/hs/about/history (accessed 7 July 2013).

29 U.S. Department of Health and Human Services. *Head Start Policy & Regulation*. Washington, DC: Head Start and Office of the Administration for Children and Families Early Childhood Learning & Knowledge Center. Available at: http://eclkc.ohs.acf.hhs.gov/hslc/standards/Head%20Start%20Requirements/1304/1304.20%20Child%20health%20and%20developmental%20services.htm (accessed 12 July 2013).