Published in final edited form as:
J Pediatr. 2012 December ; 161(6): 1153–1159.e2. doi:10.1016/j.jpeds.2012.05.025.

Children's Dental Health, School Performance and Psychosocial Well-Being

Carol Cristina Guarnizo-Herreño, DDS, MPH and
Department of Health Management and Policy, College of Public Health, University of Iowa, Iowa City, IA, 52242, USA, Departamento de Salud Colectiva, Universidad Nacional de Colombia, Bogotá, Colombia

George L. Wehby, MPH, Ph.D. [Assistant Professor]
Dept. of Health Management and Policy, College of Public Health, University of Iowa, 105 River Street, N248 CPHB, Iowa City, IA 52242, Phone: 319-384-3814

George L. Wehby: george-wehby@uiowa.edu

Abstract

Objective—To assess the effects of dental health on school performance and psychosocial well-being in a nationally representative sample of children in the US.

Study design—We analyzed data from the 2007 National Survey of Children's Health for 40,752– 41,988 children. The effects of dental problems and maternal-rated dental health on school performance and psychosocial well-being outcomes were evaluated using regression models adjusting for demographic, socioeconomic, and health characteristics.

Results—Dental problems were significantly associated with reductions in school performance and psychosocial well-being. Children with dental problems were more likely to have problems at school (OR=1.52; 95% CI: 1.37–1.72) and to miss school (OR=1.42; 95% CI: 1.23–1.64) and were less likely to do all required homework (OR=0.76; 95% CI: 0.68–0.85). Dental problems were associated with shyness, unhappiness, feeling of worthlessness, and reduced friendliness. The effects of dental problems on unhappiness and feeling of worthlessness were largest for adolescents between 15 and 17 years.

Conclusion—Preventing and treating dental problems and improving dental health may benefit child academic achievement and cognitive and psychosocial development.

Keywords

dental health; oral health; caries; child health; child development; academic achievement; psychosocial well-being

Although there has been general improvement in children's dental health over recent decades, dental problems are still highly prevalent during childhood. In the United States (US), about 42% of children aged 2 to 11 years experienced caries between 1999 and 2004

Correspondence to: George L. Wehby, george-wehby@uiowa.edu.

The authors declare no conflicts of interest.

(1), and 42% of children and adolescents aged 6–19 years have had dental caries in their permanent teeth (2). The prevalence of dental caries in primary teeth of children between 2 and 4 years of age increased from 18% in 1988–1994 to 24% in 1999–2004 (3).

Dental health plays a key role in the overall health status and quality of life of both children and adults; dental health also may affect several domains of child development and growth. Good dental health enhances the child's ability to develop several physical and social functions such as feeding, breathing, speaking, smiling, and social adaptation. Consequences of dental diseases in children may include pain, discomfort, embarrassment, challenged cognitive development, reduced self-esteem, and impairments of daily life activities (4). Severe caries in young children is associated with underweight, poor growth, irritability, higher risk of hospitalization, disturbed sleeping, and diminished learning ability (5, 6).

The relationships between children's dental health and their educational performance and psychosocial status have been investigated. Jackson et al (7) analyzed 2008 data from North Carolina and found that poor oral health status was associated with increased parental report of low child school grades. In that study, low school performance was associated with school absence because of dental pain or infection and not with absences for routine dental care. A previous study using the same data source for 2005 reported that children who have both poor oral and general health had lower parent-rated school performance (8). However when separated, oral health and general health had smaller and insignificant associations with school performance than when combined. Two other studies of US and other populations evaluated the relationship between child oral health and school attendance and found considerable decrease in school hours with dental problems and visits to dental care providers (9, 10).

Several dental problems in children and adolescents also have been negatively associated with psychosocial well-being. Dental pain affects emotional stability of children and enrollment in social activities such as by preventing children from engaging in playing time (11–13). Malocclusion has been associated with reduction in perceived attractiveness by others and social acceptance (14). Traumatic dental injury especially in the anterior teeth has been associated with reduced children's sociability including avoiding to smile, not enjoying contact with other people, and anxiety about others' perceptions of them (15, 16).

Previous studies have not evaluated the potentially related schooling and psychosocial consequences of dental health problems simultaneously, using the same sample and analytical framework. Such an analysis allows for a more comprehensive assessment of several related developmental consequences of child dental problems.

In this study we evaluate the effects of child dental health on school performance and psychosocial well-being in a large nationally representative US sample of children aged 6–17 years controlling for several demographic, socioeconomic, and health confounding variables.

Methods

We employed the 2007 National Survey of Children's Health (NSCH), which is the most recent nationally representative survey of children's health in the US. The 2007 NSCH is a module of the State and Local Area Integrated Telephone Survey from the National Center for Health Statistics at the Centers for Disease Control and Prevention (CDC) (17). The NSCH randomly selected a sample of households with children less than 18 years of age in all 50 states and the District of Columbia. One index child was randomly selected for the interview from all children in each identified household. Data were obtained through phone

interviews with the parent or guardian who knew about the health and health care of the index child.

Because we sought to evaluate school performance, we included in the study sample only children between 6 and 17 years. This also is the age for which the NSCH included questions about psychosocial status. Of the total NSCH sample, 64,076 met inclusion criteria. Next, we limited the sample to children for whom their mothers were the respondents to the NSCH interview in order to reduce errors in self-reported maternal and child data. This reduced the eligible sample to 46,750 children. Because some observations have complete data on some but not all of the study variables, and because we include different dental health and outcome measures in multiple regressions, the final sample included in our study regressions ranges from 40,752 to 41,988 children. Children with complete data who were included in the study regressions had some differences from children with incomplete data on certain outcome and dental health measures and on some demographic and socioeconomic characteristics (Table I; available at www.jpeds.com). In order to evaluate the effects of missing data on our results, we re-estimated the main study regressions (described below) using two approaches: (1) a propensity score model to readjust sampling probability weights for excluding observations due to missing data; and (2) imputing outcome and continuous explanatory variables and adding as covariates binary 0/1 indicators for observations with missing data on categorical explanatory variables. We found similar dental effects in both of these approaches to those in the main models that exclude observations with missing data (additional information available upon request from the authors).

Outcome and Dental Health Measures

The main study outcomes were the child's school performance and psychosocial well-being, which we measured in several ways from the survey questions (18). We used three school performance measures: 1) having received school report of a problem that the child was having at school during the last year based on the following question: "During the past 12 months, how many times has [the child's] school contacted you or another adult in your household about any problems [he/she] is having with school?" (18), 2) homework completion based on a five-item scale question about how often the child completed his/her homework, and 3) health-related missed school days during the last year, which we evaluated both as any missed days and number of missed days. Four psychosocial well-being outcomes were included: 1) shyness, 2) sociability/friendliness, 3) feelings of worthlessness/inferiority, and 4) unhappiness, all measured from maternal report on five-item frequency scales of never, rarely, sometimes, usually, and always. Shyness was measured by the child being withdrawn and not involved with others. Sociability is measured by getting along well with other children. The two other psychosocial outcomes measured how often the child feels worthless or inferior, and is unhappy, sad, or depressed.

We used two separate measures for child dental health based on maternal report: 1) having specific dental health problems and 2) rating of dental health. The first measure is a binary indicator for the child having experienced at least one of the following conditions over the past 6 months: toothache, decayed teeth or cavities, and bleeding gums, as reported by the mother in response to specific questions about these conditions. The second measure is based on maternal rating of the child's dental health status over a five-item scale of excellent, very good, good, fair, or poor. We combined excellent and very good dental health into one binary indicator and fair and poor dental health into another indicator, and use "good" dental health as the reference category because of the low frequency of poor dental health (1.19%) and to avoid potential biases toward reporting extreme responses. Although parental report of their children's dental health is not an objective measure, it has been found to have a significant positive association with objective measures and is

considered a valid proxy indicator of child dental health (19–22). In addition, parents' perceptions are highly relevant because they influence their decisions about child dental health and dental care use. In our sample, the Spearman correlation coefficient for maternal-rated dental health and reporting dental problems was 0.33 ($p<0.001$). About 19% of mothers who rated their child's dental health as excellent/very good reported dental problems, compared with 42% and 65% of mothers who rated their child's dental health as good and fair/poor, respectively.

Empiric Model and Statistical Analysis

We evaluated the effects of the dental health measures on the schooling and psychosocial outcomes using multivariate regression models that adjust for several potential confounding variables. All models were weighted by the survey sampling probability weights in order to obtain population-based estimates. We estimated separate regressions for each outcome – three measures of school performance and four measures of psychosocial well-being – and dental health measure. Binary logistic regression was used for binary outcomes and ordered logistic regression is used for the ordinal outcome measures. We used Poisson regression for the number of missed school days. We estimated all models for the total sample and stratified by school-level age groups including 6–11 years (elementary-school), 12–14 years (middle-school), and 15–17 years (high-school) to evaluate if dental health effects vary over age.

All regression models adjusted for several theoretically relevant demographic, socioeconomic, and health variables that may be related to both dental health and the study outcomes. For example, maternal education likely affects awareness of good dental health practices but can also independently affect child schooling or psychosocial performance. We adjusted for the following demographic characteristics: child's age, sex, race/ethnicity, country of birth (US versus others), and birth order, numbers of children and adults in the household, and maternal age and marital status. The socioeconomic characteristics adjusted for included maternal, household poverty-level, and child's health insurance coverage. The models also adjusted for whether the child had been diagnosed with: a learning disability, attention deficit disorder (ADD) or attention deficit hyperactive disorder (ADHD), behavioral or conduct problems, autism or an autism spectrum disorder (ASD), developmental delay that affects child's ability to learn, speech problems, and hearing problems. Further, we also included state-level fixed-effects in order to account for differences in dental care availability and quality and children's dental health between states.

Results

Table II shows the distributions of study variables. Over a quarter of children have at least one dental problem. About 30% of children have problems in school, and 80% miss at least one school day per year for illness/injury. Frequent (sometimes/usually/always) unhappiness, feeling worthless/inferior, and shyness are relatively common at 19.25%, 18.4%, and 11.46%, respectively.

Effects of dental health on school performance

Table III reports the dental health effects on school performance for the total sample. We report odds ratios in Table III for the logistic regression models. Dental health problems have significant negative associations with all school performance measures. Children with dental problems are more likely to have problems at school (OR=1.52, 95% CI: 1.37–1.72: IE=7.8%, 95% CI: 5.4% – 10.3%), miss school (OR=1.42, 95%CI: 1.23–1.64; IE=5.4%, 95% CI: 3.3%-7.5%), and are less likely to do all required homework (OR=0.76, 95% CI: 0.68–0.85). On average, children with a dental problem miss almost one school day per year

more than other children. A similar effect is observed after adjusting for the child having preventive dental visits (incremental effect=0.63, p<0.01; additional information available upon request from the authors).

Similar results are observed with maternal-rated dental health status. Children with poor/fair dental health are more likely to have problems at school, and children with excellent/very good dental health are more likely to complete their homework and less likely to have problems at school.

Table IV reports the dental health effects on school performance stratified by age. These effects are overall consistent with those for the total sample. Maternal-rated dental health status has insignificant effects on school performance for children aged 15–17 years. In order to test for the significance of differences in dental health effects on school performance by age, we estimated a combined model for the total sample that included age-group indicators and their interactions with the dental health variables. We found no significant differences in these effects by age (additional information available upon request from the authors).

Effects of dental health on psychosocial well-being

Table III reports the dental health effects (odds ratios) on the psychosocial outcomes in the total sample. Dental health is positively associated with all psychosocial outcomes. Children with dental problems are more likely to feel worthless/inferior (OR=1.39; 95% CI: 1.24–1.55), shy (OR=1.34; 95% CI: 1.19–1.51), and unhappy/sad/depressed (OR=1.31; 95% CI: 1.18–1.45), and are less likely to be friendly (OR=0.86; 95% CI: 0.77–0.96). Similarly, very good/excellent dental health is associated with less shyness and more friendliness. In contrast, poor/fair dental health is associated with more shyness and feeling worthless/inferior and unhappy/sad/depressed.

Table IV reports the dental health effects on psychosocial well-being stratified by age. These effects are consistent with those in the total sample and are generally more pronounced for adolescents between 15 and 17 years of age. For example, increased feeling of worthlessness/inferiority is 1.2, 1.36 and 1.9 times as likely among children with dental problems for ages 6–11, 12–14 and 15–17 years, respectively. These differences were tested by estimating a combined model with age-group indicators and their interactions with the dental health variables and found to be significant. Other significant differences include larger association between maternal-rated dental health and unhappiness for children aged 12–14 and 15–17 compared with 6–11 years of age, and larger association between dental problems and feeling worthless and unhappy and reduced friendliness for children 15–17 compared with 6–11 years of age.

Discussion

We found that poorer child dental health is significantly associated with reduced school performance and psychosocial well-being. The results are consistent across several measures of dental health and outcomes. Our findings highlight the importance of preventing and treating child dental problems not only for the direct clinical and somatic benefits such as reducing dental pain and improving dental functioning but also for the likely extended benefits for child educational achievement and psychosocial development. This evidence supports the Healthy People 2020 goals for reducing child dental problems and increasing children’s access to preventive dental care through effective policies and public health interventions (23).

To ensure that the dental health effects are not reflecting those of general health, we re-estimated the study models adjusting for maternal-rated child health status and observed a virtually similar pattern of results for dental health effects (additional information available upon request from the authors). Therefore, our study documents a positive relationship between improved dental health alone and several school performance outcomes in contrast to previous research showing only a significant joint effect of dental and general health on school outcomes (8). In exploratory analyses, we evaluated the interactions between dental and general health but found no consistent patterns.

The large and consistent results obtained for psychosocial well-being highlight the importance of dental health for normal psychological growth and social development. The study finds larger associations between dental problems and psychosocial outcomes for adolescents. Given that poor dental health likely is acquired early in life, these results are consistent with accumulating adverse effects on psychosocial well-being over age. Therefore, early interventions to improve child dental health may have multiplicative benefits for psychosocial development throughout childhood and adolescence. The larger psychosocial effects during adolescence may also reflect the higher sensitivity of this period to health shocks that may disrupt social networking and affect self-perception of peer evaluations. Therefore, in addition to clinical treatments of dental problems, psychological interventions may be needed for attenuating the adverse effects of poor dental health on psychosocial well-being especially during adolescence.

The study findings should be interpreted considering caveats that have implications for future research. One limitation is that the study measures were maternal-reported observations and may be subject to bias. Future work that utilizes more objective measures based on dental examinations, school test grades, and professionally administered psychosocial assessments is needed for evaluating the sensitivity of results compared with self-reported data. Another related issue is that we were limited to using the general schooling measures available in the survey data and were unable to examine specific cognitive and behavioral schooling outcomes. However, to our knowledge, the NSCH provides the only nationally representative US data that enable investigating child dental health effects on a variety of schooling and psychosocial outcomes. Another caveat is that dental problems are measured over the past 6 months while missing school and problems at school are measured over the past 12 months. This limitation might be considered a measurement error in these two schooling outcomes, which may increase standard errors and reduce significance of the dental problem effects but should not bias the effects.

It is possible that psychosocial status has reverse effects on dental health, which would bias the results. For example, less happy children with low self-esteem may have poorer dietary and teeth brushing habits. One safeguard against such bias is that dental health was measured over the past 6 months before the interview while the psychosocial measures were limited to the past month. While we cannot completely exclude this potential bias especially for the psychosocial outcomes, we re-estimated the dental health effects on schooling outcomes adjusting for the psychosocial measures and found similar effects. The only exception was for the effects of maternal-rated dental health on having problems at school which became insignificant (additional information available upon request from the authors). Furthermore, we estimated another model that included interaction terms between dental health and psychosocial measures in order to evaluate whether dental health effects on schooling outcomes are modified by psychosocial status. We found some significant interactions consistent with this hypothesis. For example, the positive association between excellent/very good dental health and homework completion increased with increased friendliness (additional information available upon request from the authors).

Finally, while we adjusted for several confounding factors, it is still possible that there are other unobserved factors that bias the relationship between dental health and schooling and psychosocial outcomes. For example, maternal attention to child dental health such as time spent in enforcing early home preventive dental health practices (e.g., tooth brushing) may correlate with other investments in schooling and psychosocial development. Such factors may result in overestimating the adverse effects of poor dental health. The survey did not include any measure about dietary habits or oral hygiene. To evaluate the possibility of bias due to parental attention, we re-estimated the study models adjusting for the extent of parental attendance of activities and events in which the child participated (which is the only measure of parental involvement in the dataset) and found similar results (additional information available upon request from the authors). Also, the maternal demographic and socioeconomic characteristics may account for some of the bias due to unobserved parental attention. However, we cannot rule out the possibility of such bias.

Given the limitations in our study for causal inference, identifying the causal dental health effects and the pathways through which they occur in future work is important for developing cost-effective interventions to reduce adverse effects. Longitudinal data with repeated objective measures of dental health and schooling and psychosocial outcomes that allow for within-child comparisons over time are instrumental for estimating causal effects and identifying their pathways.

Acknowledgments

Data analysis was in part supported by NIH/NIDCR grants R01 DE020895 and R03 DE022094.

References

1. Edelstein BL, Chinn CH. Update on Disparities in Oral Health and Access to Dental Care for America’s Children. Academic Pediatrics. 2009; 9:415–9. [PubMed: 19945076]
2. Beltran-Aguilar ED, Barker LK, Canto MT, Dye BA, Gooch BF, Griffin SO, et al. Surveillance for dental caries, dental sealants, tooth retention, edentulism, and enamel fluorosis--United States, 1988–1994 and 1999–2002. MMWR Surveill Summ. 2005; 54:1–43. [PubMed: 16121123]
3. Tomar SL, Reeves AF. Changes in the Oral Health of US Children and Adolescents and Dental Public Health Infrastructure Since the Release of the Healthy People 2010 Objectives. Academic Pediatrics. 2009; 9:388–95. [PubMed: 19945073]
4. Jurgensen N, Petersen P. Oral health and the impact of socio-behavioural factors in a cross sectional survey of 12-year old school children in Laos. BMC Oral Health. 2009; 9:29. [PubMed: 19917089]
5. Sheiham A. Dental caries affects body weight, growth and quality of life in pre-school children. Br Dent J. 2006; 201:625–6. [PubMed: 17128231]
6. McGrath C, Broder H, Wilson-Genderson M. Assessing the impact of oral health on the life quality of children: implications for research and practice. Community Dent Oral Epidemiol. 2004; 32:81–5. [PubMed: 15061856]
7. Jackson SL, Vann WF Jr, Kotch JB, Pahel BT, Lee JY. Impact of Poor Oral Health on Children’s School Attendance and Performance. Am J Public Health. 2011; 101:1900–6. [PubMed: 21330579]
8. Blumenshine SL, Vann WF Jr, Gizlice Z, Lee JY. Children’s school performance: impact of general and oral health. J Public Health Dent. 2008; 68:82–7. [PubMed: 18221320]
9. Pongpichit B, Sheiham A, Pikhart H, Tsakos G. Time absent from school due to dental conditions and dental care in Thai schoolchildren. J Public Health Dent. 2008; 68:76–81. [PubMed: 18661602]
10. Gift HC, Reisine ST, Larach DC. The social impact of dental problems and visits. Am J Public Health. 1992; 82:1663–8. [PubMed: 1456343]
11. Goes PS, Watt RG, Hardy R, Sheiham A. Impacts of dental pain on daily activities of adolescents aged 14–15 years and their families. Acta Odontol Scand. 2008; 66:7–12. [PubMed: 18320412]

12. Shepherd MA, Nadanovsky P, Sheiham A. The prevalence and impact of dental pain in 8-year-old school children in Harrow, England. Br Dent J. 1999; 187:38–41. [PubMed: 10452189]
13. Ratnayake N, Ekanayake L. Prevalence and impact of oral pain in 8-year-old children in Sri Lanka. Int J Paediatr Dent. 2005; 15:105–12. [PubMed: 15790367]
14. Zhang M, McGrath C, Hagg U. The impact of malocclusion and its treatment on quality of life: a literature review. Int J Paediatr Dent. 2006; 16:381–7. [PubMed: 17014535]
15. Bendo CB, Paiva SM, Torres CS, Oliveira AC, Goursand D, Pordeus IA, et al. Association between treated/untreated traumatic dental injuries and impact on quality of life of Brazilian schoolchildren. Health Qual Life Outcomes. 2010; 8:114. [PubMed: 20920332]
16. Cortes MI, Marcenes W, Sheiham A. Impact of traumatic injuries to the permanent teeth on the oral health-related quality of life in 12–14-year-old children. Community Dent Oral Epidemiol. 2002; 30:193–8. [PubMed: 12000342]
17. Blumberg, SJ.; Foster, EB.; Frasier, AM.; Satorius, J.; Skalland, BJ.; Nysse-Carris, KL., et al. Vital and Health Statistics. Series 1: Program and Collection Procedures. Department of Health and Human Services; 2009. Design and Operation of the National Survey of Children's Health, 2007. Available at: ftp://ftp.cdc.gov/pub/health_statistics/nchs/slaits/nsch07/2_Methodology_Report/NSCH_Design_and_Operations_052109.pdf
18. Centers for Disease Control and Prevention (CDC). National Survey of Children's Health. 2011. Available online at http://www.cdc.gov/nchs/slaits/nsch.htm#2007nsch
19. Talekar BS, Rozier RG, Slade GD, Ennett ST. Parental perceptions of their preschool-aged children's oral health. J Am Dent Assoc. 2005; 136:364–72. quiz 81. [PubMed: 15819352]
20. Sohn W, Taichman LS, Ismail AI, Reisine S. Caregiver's perception of child's oral health status among low-income African Americans. Pediatr Dent. 2008; 30:480–7. [PubMed: 19186773]
21. Filstrup SL, Briskie D, da Fonseca M, Lawrence L, Wandera A, Inglehart MR. Early childhood caries and quality of life: child and parent perspectives. Pediatr Dent. 2003; 25:431–40. [PubMed: 14649606]
22. Weyant RJ, Manz M, Corby P, Rustveld L, Close J. Factors associated with parents' and adolescents' perceptions of oral health and need for dental treatment. Community Dent Oral Epidemiol. 2007; 35:321–30. [PubMed: 17822480]
23. Healthy People 2020. Washington, DC: Department of Health and Human Services; 2010. Available at: http://www.healthypeople.gov/2020

Table 1

Weighted Descriptive Statistics for Study Variables for Children with Complete Data and those with Missing Data

Variables	Percentage or mean (SD)		Significance level of the differences (p-value)
	Children excluded from the analysis with the lowest number of observations (5,998)	Children included in the analysis with the lowest number of observations (40,752)	
Dependent variables			
School performance			
Problems in school	26.96	30.96	p< 0.05
Children who missed at least one school day	69.29	79.27	p< 0.01
Number of school missed days	3.46 (9.01)	4.03 (6.20)	p< 0.01
Homework completion			NS
Never	1.53	1.12	
Rarely	2.44	1.98	
Sometimes	10.84	10.93	
Usually	23.04	23.12	
Always	62.14	62.85	
Psychosocial well-being			
Shy (Child is withdrawn, does not get involved with others)			p< 0.05
Never	67.88	70.42	
Rarely	17.46	18.59	
Sometimes	11.36	8.72	
Usually	1.51	1.19	
Always	1.79	1.08	
Inferior (Child feels worthless or inferior)			p< 0.05
Never	58.18	59.62	
Rarely	22.82	22.11	
Sometimes	16.22	15.44	
Usually	0.70	1.44	
Always	2.09	1.38	
Unhappy (Child is unhappy, sad or depressed)			NS
Never	49.37	49.96	
Rarely	29.70	31.05	
Sometimes	18.90	17.07	
Usually	1.12	1.15	
Always	0.90	0.77	
Friendly (Child gets along well with other children)			NS
Never	0.32	0.50	
Rarely	0.67	0.89	

Variables	Percentage or mean (SD)		Significance level of the differences (p-value)
	Children excluded from the analysis with the lowest number of observations (5,998)	Children included in the analysis with the lowest number of observations (40,752)	
Sometimes	10.22	8.30	
Usually	33.65	34.86	
Always	55.13	55.45	
Independent variables			
Dental Health			
Any dental problem	27.61	29.99	NS
Dental Health Rating			p< 0.01
Excellent/very good	60.98	68.39	
Good	27.28	21.75	
Fair/poor	11.72	9.86	
Demographic			
Child's age (6–17 years)	11.61 (3.39)	11.59 (3.45)	
Child's sex (female)	49.86	49.04	
Race/ethnicity			NS
White	54.90	58.58	
Black	14.25	14.61	
Hispanic	23.60	19.25	
Other	7.25	7.57	
Child born in the United States	90.62	95.21	p< 0.01
Birth position	2.38 (1.03)	2.30 (0.94)	p< 0.05
Number of kids in the household	2.38 (1.00)	2.30 (0.93)	p< 0.05
Number of adults in the household	2.08 (0.59)	2.04 (0.58)	NS
Mother's age	40.98 (7.13)	40.18 (7.02)	p< 0.01
Mother's married status (married)	71.99	71.26	
Socioeconomic			
Mother's education			p< 0.01
Less than high school	16.01	11.85	
High school graduate	27.23	25.38	
More than high school	56.76	62.78	
Poverty level of household (1–8)[a]	4.49 (2.63)	5.29 (2.63)	p< 0.01
Employment [b]	84.36	88.39	p< 0.01
Child's Health Care insurance coverage	85.70	90.99	p< 0.01
Health problems (ever diagnosed)			
Learning disability	13.02	12.68	NS
Attention Deficit Disorder or Attention Deficit Hyperactive Disorder	10.72	10.99	NS
Behavioral or conduct problems	5.90	5.21	NS

Variables	Percentage or mean (SD)		Significance level of the differences (p-value)
	Children excluded from the analysis with the lowest number of observations (5,998)	Children included in the analysis with the lowest number of observations (40,752)	
Autism Spectrum Disorder	2.39	1.88	NS
Developmental delay that affects child's ability to learn	6.31	5.58	NS
Stuttering, stammering or other speech problems	5.78	6.89	NS
Hearing problems	2.73	3.57*	NS

NS=not significant

[a]Poverty level represents ranges of the percentage of federal poverty line (FPL) as follows: 1(<100%), 2(100%–133%), 3(133%–150%), 4(150%–185%), 5(185%– 200%), 6(200%–300%), 7(300%–400%), 8(> 400%)

[b]Anyone in the household employed at least 50 weeks out of the past 52 weeks

Table II

Weighted Descriptive Statistics for Study Variables

	Percentage or mean (SD)			
Variables	**Total sample (N=46,750)**	**6–11 years (N=20,314)**	**12–14 years (N=12,079)**	**15–17 years (N=14,357)**
Dependent variables				
School performance				
Problems in school	30.54	30.22	32.18	29.45
Children who missed at least one school day	78.01	78.51	78.11	76.93
Number of school missed days	3.95 (6.63)	3.69 (4.75)	4.03 (6.68)	4.37 (9.15)
Homework completion				
Never	1.17	0.74	1.16	2.01
Rarely	2.04	0.95	2.12	4.05
Sometimes	10.92	6.23	13.11	17.61
Usually	23.11	18.31	28.50	26.68
Always	62.76	73.77	55.11	49.66
Psychosocial well-being				
Shy (Child is withdrawn, does not get involved with others)				
Never	70.09	74.04	67.70	65.01
Rarely	18.44	15.92	20.50	21.15
Sometimes	9.06	7.95	9.26	10.98
Usually	1.23	0.97	1.55	1.41
Always	1.17	1.12	0.99	1.45
Inferior (Child feels worthless or inferior)				
Never	59.43	62.55	55.78	57.23
Rarely	22.20	20.98	24.60	22.07
Sometimes	15.54	14.10	16.13	17.71
Usually	1.35	0.98	1.97	1.39
Always	1.47	1.39	1.51	1.59
Unhappy (Child is unhappy, sad or depressed)				
Never	49.89	53.10	48.35	45.33
Rarely	30.87	31.09	30.68	30.65
Sometimes	17.31	14.36	18.77	21.45
Usually	1.15	0.88	1.42	1.37
Always	0.79	0.57	0.78	1.21
Friendly (Child gets along well with other children)				
Never	0.47	0.54	0.65	0.16
Rarely	0.87	1.07	0.62	0.73
Sometimes	8.55	8.73	7.85	8.96
Usually	34.7	36.66	33.57	32.11

	Percentage or mean (SD)			
Variables	**Total sample (N=46,750)**	**6–11 years (N=20,314)**	**12–14 years (N=12,079)**	**15–17 years (N=14,357)**
Always	55.41	53.00	57.31	58.04
Independent variables				
Dental Health				
Any dental problem	29.68	33.75	26.23	25.49
Dental Health Rating				
Excellent/very good	67.41	64.44	67.57	72.94
Good	22.48	23.78	23.01	19.45
Fair/poor	10.11	11.79	9.42	7.61
Demographic				
Child's age (6–17 years)	11.59 (3.45)	8.50 (1.70)	13.03 (0.83)	16.02 (0.80)
Child's sex (female)	49.15	48.11	50.83	49.37
Race/ethnicity				
White	58.14	56.63	57.68	61.51
Black	14.57	13.68	15.67	15.11
Hispanic	19.76	20.94	19.93	17.32
Other	7.53	8.75	6.72	6.05
Child born in the United States	94.65	95.25	94.80	93.36
Birth position	2.31 (0.96)	2.64 (1.00)	2.22 (0.85)	1.77 (0.67)
Number of kids in the household	2.31 (0.94)	2.47 (0.90)	2.30 (0.93)	2.02 (0.94)
Number of adults in the household	2.05 (0.58)	2.00 (0.53)	2.05 (0.60)	2.13 (0.64)
Mother's age	40.27 (7.04)	37.48 (6.62)	41.50 (6.39)	44.34 (6.05)
Mother's married status (married)	71.35	71.92	71.19	70.41
Socioeconomic				
Mother's education				
Less than high school	12.35	12.52	12.67	11.70
High school graduate	25.60	24.05	25.62	28.53
More than high school	62.05	63.43	61.70	59.77
Poverty level of household (1–8)[a]	5.25 (2.64)	5.15 (2.69)	5.28 (2.62)	5.42 (2.57)
Employment [b]	87.90	87.17	88.32	88.85
Child's Health Care insurance coverage	90.30	90.41	90.59	89.79
Health problems (ever diagnosed)				
Learning disability	12.72	11.07	13.52	15.06
Attention Deficit Disorder or Attention Deficit Hyperactive Disorder	10.95	9.25	11.13	14.03
Behavioral or conduct problems	5.3	5.06	4.88	6.20

	Percentage or mean (SD)			
Variables	**Total sample (N=46,750)**	**6–11 years (N=20,314)**	**12–14 years (N=12,079)**	**15–17 years (N=14,357)**
Autism Spectrum Disorder	1.95	2.41	1.84	1.17
Developmental delay that affects child's ability to learn	5.67	6.36	4.89	5.18
Stuttering, stammering or other speech problems	6.74	8.57	5.91	4.1
Hearing problems	3.46	3.51	3.02	3.84

[a]Poverty level represents ranges of the percentage of federal poverty line (FPL) as follows: 1 (<100%), 2 (100%–133%), 3 (133%–150%), 4 (150%– 185%), 5 (185%– 200%), 6 (200%–300%), 7 (300%–400%), 8 (> 400%)

[b]Anyone in the household employed at least 50 weeks out of the past 52 weeks

Table III

Dental Health Effects on School Performance and Psychosocial Well-Being Combined by Age*

Outcome Variable	Any dental problem			Dental health rating				
				Excellent/very good			Fair/Poor	
	N	OR or IE	[CI] or (SE)	N	OR or IE	[CI] or (SE)	OR or IE	[CI] or (SE)
School performance								
Miss school days	41,655	1.42***	[1.23–1.64]	41,643	0.92	[0.78–1.07]	1.13	[0.84–1.51]
Number of missed school days	41,618	0.63***	(0.15)	41,606	-0.43**	(0.17)	0.42	(0.32)
Problem in school	40,764	1.52***	[1.34–1.72]	40,752	0.83**	[0.72–0.97]	1.32**	[1.03–1.69]
Homework completion	41,894	0.76***	[0.68–0.85]	41,882	1.29***	[1.13–1.48]	0.87	[0.68–1.12]
Psychosocial well-being								
Shyness	41,946	1.34***	[1.19–1.51]	41,934	0.71***	[0.62–0.81]	1.54***	[1.22–1.94]
Worthlessness	41,800	1.39***	[1.24–1.55]	41,789	0.77***	[0.67–0.87]	1.46***	[1.14–1.87]
Unhappiness	41,953	1.31***	[1.18–1.45]	41,941	0.77***	[0.68–0.88]	1.59***	[1.26–2.00]
Friendliness	41,988	0.86***	[0.77–0.96]	41,976	1.15**	[1.02–1.30]	0.84	[0.65–1.08]

The effects are obtained from the regressions that adjust for all covariates reported in Table II.

*** *p*-value < 0.01,

** *p*-value < 0.05,

* *p*-value < 0.1.

Table IV

Dental Health Effects on School Performance and Psychosocial Well-Being Stratified by Age Group

Outcome Variable	Any dental problem			Dental health rating				
				Excellent/very good			Fair/Poor	
	N	OR or IE	[CI] or (SE)	N	OR or IE	[CI] or (SE)	OR or IE	[CI] or (SE)
6–11 years								
Miss school days	18,242	1.43***	[1.17–1.75]	18,237	0.93	[0.75–1.17]	1.2	[0.84–1.72]
Number of missed school days	18,231	0.62***	(0.16)	18,226	−0.31*	(0.17)	0.73*	(0.39)
Problem in school	17,821	1.60***	[1.35–1.89]	17,816	0.81**	[0.66–0.98]	1.42**	[1.04–1.95]
Homework completion	18,297	0.74***	[0.62–0.87]	18,292	1.24**	[1.01–1.51]	0.9	[0.66–1.24]
Shyness	18,342	1.37***	[1.16–1.61]	18,337	0.73***	[0.61–0.87]	1.36*	[1.00–1.87]
Worthlessness	18,287	1.20**	[1.03–1.40]	18,283	0.84*	[0.70–1.02]	1.34*	[0.99–1.83]
Unhappiness	18,350	1.21***	[1.05–1.40]	18,345	0.96	[0.81–1.13]	1.49**	[1.09–2.03]
Friendliness	18,359	0.93	[0.80–1.07]	18,354	1.13	[0.95–1.34]	0.97	[0.72–1.31]
12–14 years								
Miss school days	10,705	1.57***	[1.19–2.08]	10,701	0.82	[0.62–1.09]	1.33	[0.75–2.35]
Number of missed school days	10,703	0.48	(0.32)	10,699	−0.44	(0.35)	0.53	(0.62)
Problem in school	10,484	1.69***	[1.32–2.16]	10,480	0.81	[0.62–1.05]	1.18	[0.75–1.87]
Homework completion	10,793	0.72***	[0.58–0.89]	10,789	1.5***	[1.22–1.85]	0.81	[0.51–1.28]
Shyness	10,798	1.13	[0.89–1.44]	10,794	0.74**	[0.57–0.97]	1.41	[0.88–2.26]
Worthlessness	10,758	1.36***	[1.09–1.70]	10,754	0.77**	[0.60–0.97]	1.79**	[1.12–2.85]
Unhappiness	10,794	1.2	[0.96–1.50]	10,790	0.69***	[0.55–0.87]	1.93***	[1.21–3.09]
Friendliness	10,805	0.80**	[0.64–0.98]	10,801	1.20	[0.95–1.51]	0.68	[0.42–1.09]
15–17 years								
Miss school days	12,708	1.36**	[1.04–1.78]	12,705	0.9	[0.67–1.21]	0.84	[0.43–1.65]
Number of missed school days	12,684	0.79**	(0.31)	12,681	−0.92**	(0.36)	−0.39	(0.62)
Problem in school	12,459	1.41**	[1.07–1.84]	12,456	0.85	[0.62–1.17]	1.35	[0.75–2.43]

J Pediatr. Author manuscript; available in PMC 2013 December 01.

Outcome Variable	Any dental problem			Dental health rating				
				Excellent/very good			Fair/Poor	
	N	OR or IE	[CI] or (SE)	N	OR or IE	[CI] or (SE)	OR or IE	[CI] or (SE)
Homework completion	12,804	0.77**	[0.62–0.94]	12,801	1.2	[0.92–1.56]	0.85	[0.47–1.51]
Shyness	12,806	1.62***	[1.29–2.04]	12,803	0.61***	[0.46–0.80]	2.32***	[1.51–3.55]
Worthlessness	12,755	1.90***	[1.55–2.35]	12,752	0.67***	[0.51–0.86]	1.50	[0.84–2.70]
Unhappiness	12,809	1.74***	[1.40–2.16]	12,806	0.57***	[0.43–0.76]	1.72**	[1.06–2.78]
Friendliness	12,824	0.75**	[0.60–0.94]	12,821	1.13	[0.87–1.47]	0.72	[0.39–1.33]

The effects are obtained from the regressions that adjust for all covariates reported in Table II.

*** *p*-value < 0.01,

** *p*-value < 0.05,

* *p*-value < 0.1.