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Effects of the State Children's Health Insurance Program on Access to Dental Care and Use of Dental Services

Hua Wang, Edward C. Norton, and R. Gary Rozier

Objective. To provide national estimates of implementation effects of the State Children's Health Insurance Program (SCHIP) on dental care access and use for low-income children.

Data Source. The 1997–2002 National Health Interview Survey.

Study Design. The study design is based on variation in the timing of SCHIP implementation across states and among children observed before and after implementation. Two analyses were conducted. The first estimated the total effect of SCHIP implementation on unmet need for dental care due to cost in the past year and dental services use for low-income children (family income below state SCHIP eligibility thresholds) using county and time fixed effects models. The second analysis estimated differences in dental care access and use among low-income children with SCHIP or Medicaid coverage and their uninsured counterparts, using instrumental variables methods to control for selection bias. Both analyses controlled for child and family characteristics.

Principal Findings. When SCHIP had been implemented for more than 1 year, the probability of unmet dental care needs for low-income children was lowered by 4 percentage points. Compared with their uninsured counterparts, those who had SCHIP or Medicaid coverage were less likely to report unmet dental need by 8 percentage points (standard error: 2.3), and more likely to have visited a dentist within 6 or 12 months by 17 (standard error: 3.7) and 23 (standard error: 3.6) percentage points, respectively. SCHIP program type had no differential effects.

Conclusions. Consistent results from two analytical approaches provide evidence that SCHIP implementation significantly reduced financial barriers for dental care for low-income children in the U.S. Low-income children enrolled in SCHIP or Medicaid had substantially increased use of dental care than the uninsured.

Key Words. SCHIP, dental care, health insurance, low-income children

Lack of dental insurance is one of the main barriers affecting access to dental services (U.S. Department of Health and Human Services 2000). In the late 1980s and early 1990s, the U.S. government gradually increased eligibility for public health insurance for low-income children, mainly under the Medicaid

program. However, before the recent establishment of the State Children's Health Insurance Program (SCHIP) in 1997, some low-income children lacked health insurance because their family incomes were too high to be eligible for Medicaid but not high enough to afford private health insurance for medical care, let alone dental insurance. Congress created the SCHIP program to further expand public health insurance coverage to uninsured low-income children.

SCHIP has the potential to become a major dental insurer for low-income children. The SCHIP legislation authorized states to expand eligibility for public insurance for uninsured children younger than 19 years of age in families with incomes up to 200 percent of the federal poverty level (FPL), or 50 percentage points above the Medicaid threshold in effect in March 1997, whichever was greater. States had three options for SCHIP program design: expand Medicaid, establish a separate health insurance program, or a combination of the two. States that expanded Medicaid were required to provide full Medicaid benefits (including dental benefits) for SCHIP enrollees. The dental benefits provided in separate SCHIP programs were usually more generous than private dental plans. Although dental benefits are optional for separate SCHIP programs, by 2000 all states except Delaware, Colorado, and Florida offered dental benefits (Kenney, McFeeters, and Yee 2005).

The SCHIP program is also designed to help enroll children eligible for Medicaid through mandated coordination between the two programs in outreach and enrollment. For example, SCHIP applicants must first be screened for Medicaid eligibility, and if found to be eligible for Medicaid, their enrollment facilitated. As a result, Medicaid enrollment—which historically has been low (U.S. Government Accountability Office 2000; Remler and Glied 2003)—has increased since SCHIP implementation (Rosenbach et al. 2003). This effect of SCHIP on Medicaid enrollment is called the *spillover effect*. Therefore, both SCHIP- and Medicaid-eligible children who had not previously enrolled in Medicaid may have obtained public dental coverage because of implementation of SCHIP.

By expanding public health insurance, SCHIP is expected to improve low-income children's access to and use of dental care. However, having

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Address correspondence to Hua Wang, Ph.D., Department of Policy Analysis and Management, School of Human Ecology, Cornell University, 432A Martha Van Rensselaer Hall, Cornell University, Ithaca, NY 14853. Edward C. Norton, Ph.D., and R. Gary Rozier, D.D.S., are with the Health Policy and Administration, School of Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC.

public dental insurance does not guarantee access to dental care (Mofidi, Rozier, and King 2002; Mofidi et al. 2002). Medicaid enrollees, who are entitled to comprehensive dental services, often have poor access to dental care, primarily because of a shortage of participating dental providers. One reason for the low level of dentists' participation is low reimbursement rates. A few states used SCHIP to experiment with financing public dental care (Almeida, Hill, and Kenney 2001). For example, North Carolina contracted with Blue Cross Blue Shield to process dental claims. Not only does the program appear more like private insurance to participating dentists, but fees paid to providers were substantially more than for Medicaid. As a result, North Carolina children enrolled in SCHIP were found to have improved dental care access relative to those enrolled in Medicaid (Slifkin, Silberman, and Freeman 2004; Brickhouse, Rozier, and Slade 2006).

SCHIP has increased eligibility for public dental coverage and stimulated the reform of dental care delivery systems. In addition, through its spillover effect, it has helped Medicaid-eligible children enroll in Medicaid and obtain dental insurance. Yet the extent to which SCHIP has improved access to dental care and use of dental services among low-income children is largely unknown, especially at the national level.

A few state-specific studies have looked at separate SCHIP programs only. They find that compared with the pre-enrollment period, newly enrolled SCHIP children were less likely to report experiencing access difficulties and more likely to have seen a dentist within the past 12 months (Lave et al. 1998; Mofidi, Rozier, and King 2002; Mofidi et al. 2002; Damiano et al. 2003; Fox et al. 2003; Szilagyi et al. 2004). One recent national-level study of SCHIP-eligible children with chronic health conditions found that SCHIP expansions decreased the probability of having unmet need for dental care (Davidoff, Kenney, and Dubay 2005). It also found the same effect for children eligible for Medicaid, which indicates SCHIP implementation may have a spillover effect.

Our study analyzes how SCHIP affects dental care access and use at the national level for two subpopulations. The first is low-income children. We investigate the overall effect of SCHIP implementation on outcomes of interest for all low-income children, only some of whom actually enrolled in SCHIP or Medicaid as a result of SCHIP implementation. To examine effects of public program on outcomes of interest for enrolled children, in the second subpopulation we include children who are enrollees of public insurance programs, mainly SCHIP and Medicaid.

We use the same data set, which contains multiple years of national cross-sectional data, but different analytical approaches for the two

subpopulations. To identify the effect of SCHIP implementation for low-income children, we compare outcomes of interest pre- versus post-SCHIP implementation using variation in SCHIP availability to children within and across states. We estimate the effect of public health insurance enrollment on dental care access and use, using instrumental variables methods to correct for selection bias due to voluntary program enrollment.

METHODS

Data Source and Study Population

This study includes children from the Sample Child Files of the National Health Interview Survey (NHIS) from 1997 to 2002. The NHIS, conducted by the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS), has continuously collected a variety of health-related information including health insurance, access to and use of health services from nationally representative samples of the U.S. civilian noninstitutionalized population since 1957 (NCHS 2000). The Sample Child Files of NHIS contain information for one child from each family. Each year the Sample Child File consists of about 13,000 children younger than 18 years of age.

We restrict the sample to children with family incomes below state SCHIP eligibility limits. They are likely to be eligible for SCHIP or Medicaid and therefore likely to be affected by SCHIP implementation. We exclude children younger than 2 years of age, whose dental care access and use information are not collected in the survey. We do not use pre-1997 data because the NHIS questionnaire was redesigned in 1997 and many variables are not comparable afterwards. Observations ($N = 7{,}664$) with missing values for variables used in this study are excluded. The final analysis sample consists of 21,295 low-income children aged 2–17 years.

Measurement of Key Variables

The dependent variables are dichotomous measures of unmet dental care need in the past 12 months and dental visit in the past 6 or 12 months based on the following two questions: "During the past 12 months, was there any time when [sample child] needed dental care (including check-ups) but didn't get it because you couldn't afford it?" and "About how long (less than 6 months, 6–12 months, more than one year, or never) has it been since [sample child] last saw or talked to a dentist?"

The independent variables of primary interest in the first analysis are two binary variables for program availability. They represent at the time of the interview whether SCHIP has been available to a child in the state where the he or she resides for 1–11 and 12 months or longer. The comparison category is the pre-SCHIP implementation period. We calculate the availability variables based on the month and year of SCHIP implementation in a child's state of residence (Rosenbach et al. 2003) and the month and year of the interview for the child. (Access to geographic identifiers in NHIS was provided by NCHS.)

A binary variable indicating public health insurance is the independent variable of primary interest in the second analysis. We define enrollment in SCHIP, Medicaid, or other state or government programs for low-income children as public coverage. We group coverage other than the public coverage into an "other coverage" variable, whose main source is private health insurance. The comparison category is the uninsured.

Information about family income comes from the 1997 to 2002 Imputed Family Income/Personal Earnings Files. These files include five sets of multiple imputed values for missing data on family income and personal earnings each year (Schenker et al. 2005). We ran our analysis five times to get five sets of results, each time using one of the five sets of imputed values. We calculated the average point estimates and the variance following the procedures suggested by NCHS (Schenker et al. 2005). Exact imputed income was used for about 22 percent of the sample and categorical imputed income below $20,000 for 5.6 percent of the sample.

Conceptual Framework

We expect to detect positive effects of SCHIP for all low-income children, on average, because previous studies have shown that SCHIP has increased public coverage among eligible children, and insured children are expected to have improved dental care access and use (Lo Sasso and Buchmueller 2004).

Two factors may affect how and to what extent SCHIP may have improved dental care access and utilization. The first factor is age. Older children generally use more dental care services than younger children (Macek et al. 2005). Older low-income children are also more likely to be eligible for SCHIP than their younger counterparts because of the universal eligibility limit for all age groups under SCHIP and lower eligibility thresholds for older children in Medicaid. Thus, we expect to find that SCHIP has a greater effect

among older, low-income children than among younger children, particularly if spillover effects do not dominate.

Second, the type of SCHIP program also may play a role in its effects. For example, if separate programs are more likely than Medicaid expansion programs to reform the dental care delivery system in order to attract more dental providers, children enrolled in separate programs should have fewer access barriers and greater use. However, by the end of our study period only a few states had taken notable steps to focus specifically on children's access to dental care under SCHIP, so we may not find significant differential effects by types of SCHIP program.

Economic theory suggests that because health insurance lowers the relative cost of health care, it increases demand. Regarding SCHIP's effects for public program enrollees, we hypothesize that children who were enrolled in SCHIP, Medicaid or other public health insurance programs would have fewer financial difficulties in accessing dental care and use more dental services compared with their uninsured counterparts. Age and program type may influence these results in a similar way as discussed for low-income children in general.

Analysis 1: Effect of SCHIP Program Availability on Access to and Use of Dental Services

Because states started their SCHIP programs at different times between 1997 and 2000, considerable variation exists in the timing of program implementation across states. In other words, there is considerable variation in SCHIP program-availability to children across states. The variation is likely to be exogenous for two reasons. First, because all states and the District of Columbia started their SCHIP programs within 3 years of the legislation, it seems likely that all of them had decided to participate in the SCHIP program from its enactment. The variation in implementation time may be due to administrative matters rather than the specific health needs of the state. Second, although almost all states have included dental coverage as an important component of SCHIP, they generally did not pay particularly close attention to dental issues during SCHIP program development (Almeida, Hill, and Kenney 2001). Therefore, the timing of program implementation in a state is unlikely to be related to the status of children's access to or use of dental services. We therefore assume that SCHIP availability within and across states is exogenous and use its variation to identify the effect of SCHIP implementation on dental access and use in county and time fixed-effects models.

Dental care access and use are predicted as a function of program availability, controlling for county and time fixed-effects in addition to child and family characteristics as displayed in the following equation:

$$Outcomes_{ict} = \alpha_0 + \alpha_1 SCHIPlong_{ict} + \alpha_2 SCHIPshort_{ict} + \alpha_3 County_c + \alpha_4 Time_t + \alpha_5 X_{ict} + \varepsilon_{ict}$$

where $Outcomes_{ict}$ represents three dependent variables of whether a child had unmet need for dental care during the past 12 months, and whether the child had a dental visit in the past 6 or 12 months. The index i is for an individual child, c for the county of the child's residence, and t for time.

The model allows the influence of SCHIP availability to vary with time since SCHIP implementation by using two measures of length of program availability at the child-level: SCHIP having been available for 12 months or longer ($SCHIPlong_{ict}$) and for 1–11 months ($SCHIPshort_{ict}$). Using length of program availability fits the dependent variables, which represent dental care experience in the preceding 6 or 12 months, and takes into account the time needed by a new SCHIP program to become fully effective in outreach and services delivery.

Control variables include annual county-level unemployment rates, county and time dummies, and child and family characteristics. Many county-level characteristics that significantly influence dental care access and use, such as the number of dentists per capita, vary considerably. In addition to annual county-level unemployment rates, we include a full set of county dummies ($County_c$, $n = 158$) to account for unobserved time-invariant, county-level characteristics. The other set of dummy variables ($Time_t$, $n = 23$) for each quarter of each year captures the quarterly national trend in the dependent variables. Child and family level (X_{ict}) control variables include age, sex, race, U.S. born or not, self-reported general health status, family income, number of family members, and the highest education level of parents.

Although the dependent variables are dichotomous, linear probability models are estimated for ease of computation and interpretation. Results are adjusted for the NHIS survey design of stratified multistage sampling using *Stata 9* (Stata Corp, College Station, TX). As discussed earlier, because older children use more dental services and are more likely than younger children to be eligible for SCHIP than Medicaid, we conduct separate analyses for children aged 2–5 years and those aged 6–17 years in this and the following analysis.

Analysis 2: Effect of Public Insurance on Access to and Use of Dental Services

The first analysis estimates the overall effect of SCHIP implementation for all low-income children. It would be ideal to identify children who gained public insurance as a result of SCHIP implementation and examine the change in their dental care access and use after enrollment. However, we cannot identify these children in the data. In this analysis, we estimate the effects of public coverage (mainly SCHIP and Medicaid enrollment), obtained due to SCHIP implementation or not, on access to and use of dental services. By doing so, we include all SCHIP enrollees and capture the likely spillover effect of SCHIP outreach on Medicaid enrollment. As discussed later, because of the instruments selected for the public coverage variable, the estimates from this analysis are likely for the ideal subpopulation—children who gained public coverage as a result of SCHIP implementation.

In this analysis we employ the instrumental variables method to deal with potential selection bias associated with voluntary public program enrollment. If parents know their children have dental disease, they may be more likely to enroll their children into public health insurance programs and once enrolled, use more dental services. Poor oral health status before enrollment, which is not collected in the NHIS and cannot be controlled for in the analysis, may independently increase use of dental services and bias the effect of public coverage.

This study uses six instrumental variables for public insurance. The first four instruments represent key features of state SCHIP implementation. They include two SCHIP availability variables (less than or more than 12 months), lower limits of state SCHIP income eligibility (state Medicaid eligibility thresholds, percent FPL), and length of waiting periods before enrollment (months). The other two instruments, which measure family level affordability and availability of private insurance, indicate whether a child is likely to meet another critical SCHIP eligibility criterion—only those with no existing private coverage may be eligible for SCHIP. The two instruments denote whether any family member receives Food Stamps and whether health insurance was offered to a child's parents through the workplace. Because the instruments represent eligibility for SCHIP and features of state SCHIP implementation, the estimates from the instrumental variables method are likely obtained from those who gained public coverage as a result of SCHIP implementation (Imbens and Angrist 1994; Heckman 1997).

Specification tests show the six instrumental variables to be valid and strong instruments. *F*-tests show the instrumental variables are jointly highly

correlated with public coverage and other coverage (F-statistic >500, P-value $<.001$). The R^2 is .30 and .36 for public and other coverage, respectively (see Table 1). Hausman tests for the exclusion criteria suggest that the instruments are exogenous, i.e., they can be excluded from the main equation. Eligibility for Food Stamps and offer of health insurance through the workplace were used as key instruments for public and private health insurance in a recent study on children's access to and utilization of health care and they were also verified to be valid and strong instruments (Selden and Hudson 2006). Finally, Hausman tests on endogeneity of public and private insurance suggest that insurance is endogenous to all the dental care access and use variables, which justify our use of instrumental variables methods.

We used two-stage least squares (2SLS) regressions for the instrumental variables estimation. In the first stage enrollment in a public insurance program ($Public_{ict}$) and insurance other than public ($Other_{ict}$) are regressed on the instrumental variables ($Instrument_{ict}$) and the same set of control variables as used in the first analysis.

$$Public_{ict} = \alpha_0 + \alpha_1 Instruments_{ict} + \alpha_2 County_c + \alpha_3 Time_t + \alpha_4 X_{ict} + \varepsilon_{ict}$$

$$Other_{ict} = \alpha_0 + \alpha_1 Instruments_{ict} + \alpha_2 County_c + \alpha_3 Time_t + \alpha_4 X_{ict} + \varepsilon_{ict}$$

Then we use results from the first-stage regression to predict public coverage and other insurance. In the second stage we regress dental care access and use variables on the predicted public and other insurance ($\hat{Public}_{ict}$, $\hat{Other}_{ict}$) and the same control variables as in the first stage.

$$Outcomes_{ict} = \alpha_0 + \alpha_1 \hat{Public}_{ict} + \alpha_2 \hat{Other}_{ict} + \alpha_3 County_c + \alpha_4 Time_t + \alpha_5 X_{ict} + \varepsilon_{ict}$$

The predicted public insurance is the independent variable of primary interest in the second stage regression. Its coefficient indicates the difference in outcomes between children who were enrolled in public insurance programs and their uninsured counterparts.

RESULTS

Descriptive Results

Compared with low-income children aged 2–5, 6–17-years-old low-income children use more dental services, have more unmet dental care need, and are less likely to have public coverage (see Table 2). The proportion who had visited a dentist within 12 months is 70 percent among older children versus

Table 1: Regression Results of the First Stage of Instrumental Variables Analysis

	Ages 2–17		*Ages 2–5*		*Ages 6–17*	
	Public Coverage	*Other Coverage*	*Public Coverage*	*Other Coverage*	*Public Coverage*	*Other Coverage*
SCHIP available ≥ 12 months	0.023 (0.021)	0.000 (0.021)	− 0.011 (0.039)	− 0.006 (0.039)	0.033 (0.022)	0.009 (0.021)
SCHIP available 1–11 months	0.002 (0.014)	− 0.002 (0.015)	− 0.033 (0.027)	− 0.023 (0.029)	0.013 (0.015)	0.009 (0.017)
Waiting periods	− 0.007**(0.002)	0.004*(0.002)	− 0.007*(0.004)	0.005 (0.003)	− 0.008**(0.002)	0.004^{+} (0.002)
Lower eligibility limit	0.000**(0.000)	0.000** (0.000)	0.000^{+} (0.000)	0.000 (0.000)	0.000** (0.000)	0.000** (0.000)
Any Food Stamp recipient	0.409** (0.010)	− 0.227** (0.009)	0.388** (0.015)	− 0.198** (0.015)	0.418** (0.012)	− 0.241** (0.011)
Insurance offer from employer	− 0.168** (0.007)	0.402** (0.007)	− 0.213** (0.014)	0.409** (0.013)	− 0.150** (0.008)	0.401** (0.008)
Sample size	21,239	21,295	6,089	6,109	15,150	15,186
R^2	0.30	0.36	0.34	0.39	0.29	0.35

Notes: Public coverage indicates health coverage from SCHIP, Medicaid, or other state and government programs. Other coverage indicates health insurance other than the public categories. The main source of other coverage is mainly private insurance.

Regressions control for age, gender, race/ethnicity, U.S. born or not, family size, general health status, highest education level of parents, family income above $20,000 or not, county annual unemployment rate, county and time fixed effects. Results are adjusted for the survey weights and survey design.

Robust standard errors in parentheses;

$^{+}$Significant at 10%,

*Significant at 5%,

**Significant at 1%.

Table 2: Weighted Means of Key Variables in the Younger, Older, and All Low-Income Children, and Higher Income Children

	≤ SCHIP Thresholds			> SCHIP Thresholds
	Ages 2–17	Ages 2–5	Ages 6–17	Ages 2–17
Dental care				
Unmet dental care need	0.10	0.06	0.12	0.04
Last visit ≤ 6 months	0.43	0.32	0.47	0.63
Last visit ≤ 12 months	0.63	0.45	0.70	0.79
Health insurance				
Public insurance	0.30	0.37	0.27	0.04
SCHIP	0.04	0.04	0.05	0.01
Medicaid	0.23	0.31	0.20	0.02
Private	0.48	0.42	0.51	0.89
Uninsured	0.22	0.20	0.22	0.06
Sociodemographic				
Age (years)	9.13	3.49	11.34	9.84
Male	0.52	0.52	0.52	0.51
Race				
Non-Hispanic white	0.51	0.49	0.52	0.80
Non-Hispanic black	0.17	0.17	0.17	0.09
Hispanic	0.27	0.29	0.26	0.07
Other race	0.06	0.06	0.06	0.02
U.S. born	0.92	0.95	0.90	0.97
Family size	4.15	4.03	4.19	3.89
Any Food Stamp recipient	0.18	0.22	0.17	0.01
Insurance offer through work	0.63	0.60	0.64	0.91
Parents' highest education				
No high school	0.19	0.20	0.19	0.03
High school	0.69	0.68	0.70	0.53
College	0.12	0.12	0.12	0.44
Family income > $20,000	0.56	0.52	0.58	0.99
Health status				
Excellent	0.46	0.51	0.45	0.62
Very good	0.31	0.29	0.31	0.27
Good	0.20	0.18	0.21	0.09
Fair or poor	0.03	0.02	0.03	0.01
Program type				
SCHIP available: ≥ 12 month	0.58	0.58	0.58	0.60
SCHIP available: 1–11 month	0.18	0.18	0.18	0.17
SCHIP not available	0.24	0.24	0.24	0.23
Waiting period (months)	1.62	1.63	1.61	1.50
SCHIP eligibility (% FPL)	197	201	195	186
Medicaid eligibility (% FPL)	119	142	109	112
Sample size	21,295	6,109	15,186	37,128

Source: NHIS Sample Child Files 1997–2002. M-SCHIP, S-SCHIP, and C-SCHIP state represent a state that implements Medicaid expansion, separate, and combined SCHIP programs, respectively.

SCHIP, State Children's Health Insurance Program; NHIS, National Health Interview Survey; FPL, federal poverty level.

45 percent for younger children. The percentage of younger, low-income children reporting unmet need for dental care (6 percent) is half that of older ones (12 percent). About 37 percent younger low-income children have public coverage versus 27 percent among older low-income children. The descriptive findings further justify our separate analyses for younger and older subgroups.

Large disparities were found in the dental care access and use measures as well as sociodemographic variables between low-income children in our sample and those from families with incomes above state eligibility thresholds. For example, low-income children were much less likely to have visited a dentist in the past 6 months (43 percent) compared with higher-income children (63 percent). All subgroups of children are similar with respect to variables representing state SCHIP program features.

Simple time trends show that the dependent variables changed slightly after SCHIP implementation (not displayed). The proportion of all children with unmet need for dental care decreased from 9.7 percent in 1997 to 8.8 percent in 2002 and the proportion of all children who had contacted a dentist in the past six months increased from 41 percent in 1997 to 45 percent in 2002.

Regression Results (1): Effect of SCHIP Availability on Dental Care Access and Use

SCHIP availability was associated with a sizable and statistically significant decrease in the likelihood of experiencing unmet need for dental care due to cost among low-income children (see Table 3). Compared with those whose state of residence had not implemented SCHIP, low-income children residing in a state that had implemented SCHIP for more than one year were less likely to report having unmet dental care need due to cost in the past 12 months by 4.0 percentage points, about 40 percent of the average level of the sample (10 percent). However, SCHIP implementation did not affect dental visits in the past 6 or 12 months.

Results confirm the hypothesis that the longer the SCHIP program has been available, the greater the effect on dental care access and use. The likelihood of having had unmet dental care need did not decrease significantly when the program was available for less than one year but declined significantly when the program was available for more than 1 year. Results also support the hypothesis that SCHIP affects access to dental care for older low-income children more than their younger counterparts. The likelihood of having an unmet dental care need 1 year post-SCHIP implementation

Table 3: Effect of SCHIP Availability Compared with No SCHIP Availability on Unmet Dental Care Need and Time of Last Dental Visit: All, Younger, and Older Low-Income Children

	≤ SCHIP Thresholds		
	Ages 2–17	*Ages 2–5*	*Ages 6–17*
Unmet dental care need			
SCHIP available: ≥ 12 month	−0.040** (0.014)	−0.005 (0.018)	−0.058** (0.021)
SCHIP available: 1–11 month	−0.016 (0.013)	0.009 (0.016)	−0.027 (0.017)
Last visit ≤ 6 months			
SCHIP available: ≥ 12 month	0.032 (0.026)	0.066 (0.040)	0.015 (0.026)
SCHIP available: 1–11 month	0.012 (0.021)	−0.021 (0.031)	0.025 (0.024)
Last visit ≤ 12 months			
SCHIP available: ≥ 12 month	0.026 (0.022)	0.017 (0.039)	0.027 (0.026)
SCHIP available: 1–11 month	−0.009 (0.019)	−0.040 (0.030)	0.009 (0.021)
Sample size	21,295	6,109	15,186

Notes: Linear probability regressions control for age, gender, race/ethnicity, U.S. born or not, family size, general health status, highest education level of parents, family income above $20,000 or not, county annual unemployment rate, county and time fixed effects. Results are adjusted for the survey weights and survey design.

Robust standard errors in parentheses;

**Significant at 1%.

dropped by 5.8 percentage points for school-aged, low-income children, but was small and insignificant among younger, low-income children.

Regression Results (2): Effect of Public Insurance on Access to and Use of Dental Services

Results from the 2SLS regression analysis show that low-income children who had public coverage (mainly SCHIP or Medicaid) had considerably better access to dental care and use of dental services compared with their uninsured counterparts (see Table 4). They were less likely to have unmet need for dental care due to cost than the uninsured by 7.9 percentage points. They were more likely to have had their last dental visit within the past 6 months by 16.6 percentage points and have had the last visit within 12 months by 22.6 percentage points than those without health insurance.

In most cases, estimates from ordinary least square (OLS) regressions (not correcting for endogeneity bias of insurance) are smaller than those from the 2SLS (see Table 4). Exceptions are found for unmet need for dental care. The estimate from OLS is 3.1 percentage points larger than the result based on

Table 4: Effect of Public Coverage (Mainly SCHIP and Medicaid) Compared with the Uninsured on Unmet Dental Care Need and Time of Last Dental Visit: All, Younger, and Older Low-Income Children

	≤ *SCHIP Thresholds*		
	Ages 2–17	*Ages 2–5*	*Ages 6–17*
Unmet dental care need			
2SLS	−0.079** (0.023)	−0.124** (0.033)	−0.061* (0.030)
OLS	−0.110** (0.007)	−0.074** (0.011)	−0.126** (0.009)
Last visit ≤ 6 months			
2SLS	0.166** (0.037)	0.122 (0.067)	0.201** (0.041)
OLS	0.158** (0.009)	0.111** (0.017)	0.176** (0.012)
Last visit ≤ 12 months			
2SLS	0.226** (0.036)	0.261** (0.064)	0.234** (0.039)
OLS	0.180** (0.010)	0.132** (0.017)	0.198** (0.012)
Sample size	21,239	6,089	15,150

Notes: 2SLS and OLS regressions control for age, gender, race/ethnicity, U.S. born or not, family size, general health status, highest education level of parents, family income above $20,000 or not, county annual unemployment rate, county and time fixed effects. Results are adjusted for the survey weights and survey design.

Instruments for public (SCHIP, Medicaid, and other state and government programs) and other (mainly private) coverage include indicators of SCHIP available for less or more than one year, waiting periods, and SCHIP lower income eligibility thresholds (Medicaid income eligibility limits), indicators for whether any family member receives Food Stamps, and whether any parent has an offer of health insurance through work place.

Robust standard errors in parentheses;

*Significant at 5%,

**Significant at 1%.

2SLS, two-stage least squares regression; OLS, ordinary least squares regression; SCHIP, State Children's Health Insurance Program.

2SLS for the whole sample. The difference is even larger (6.5 percentage points) for children aged 6–17.

Not quite consistent with our expectations, only the effect of public insurance on the probability of having a dental visit within 6 months is greater for school-aged, low-income children than for preschool-aged children (20.1 versus 12.2 percentage points). The effect of public coverage on the likelihood of having visited a dentist in the past 12 months was similar between the two age groups (23.4 versus 26.1 percentage points), but was two times greater for preschool-aged than school-aged low-income children on reducing unmet dental care need (12.4 versus 6.1 percentage points).

Several sensitivity analyses show that our results are robust. We changed the cutoff threshold for the low-income sample to below 300 percent FPL, 250

percent FPL, 200 percent FPL, between 50 and 250 percent FPL or between 100 and 200 percent FPL. Estimates based on the different groups are consistent with the original results for children whose family incomes were less than state specific SCHIP eligibility thresholds. We split the school-aged children into subsamples of children aged 6–11 and 12–17 years. Results from these two age groups are similar to the results for the combined group, and both are larger than the estimates for the younger children. Finally, we investigated whether different types of SCHIP programs would have differential effects for younger low-income children. Probably because of the same issues discussed before, we did not see consistent differences in the effects of program type for younger children.

DISCUSSION

This study makes several important policy contributions. First, SCHIP implementation significantly lowered the chances of experiencing a financial barrier to needed dental care for children from a low-income family. The effects of SCHIP program availability on the likelihood of visiting a dental professional are small and not statistically significant for low-income children overall. But children who were enrolled in SCHIP or Medicaid were much more likely to report having had a dental visit in the past 6 or 12 months compared with their uninsured counterparts. The results on dental visits appear incompatible at first. However, the significant reduction in unmet dental need may be due to unmet need reflecting perceptions about needed care rather than actual clinical need or amount of care received.

Second, the magnitude of the estimated public programs' effect for insured children is large and within the upper range of the results from the literature. The large effects may be in part due to the fact that by using instruments that are highly relevant to SCHIP implementation, the 2SLS captures more children newly enrolled in SCHIP or Medicaid as a result of SCHIP implementation. These children were previously uninsured or underinsured for dental services and thus were likely to use more dental care services right after they obtained dental coverage than continuously insured children (Manning et al. 1985).

Third, although we hypothesized that the SCHIP effects would vary by types of SCHIP program, we did not find consistent differences. Two factors provide plausible explanations. Differences within a specific program type among the states may be greater than any average differences across type.

Table 5: Simulated Differences in Dental Care Access and Use between Children from Low and High Income Families

		Mean (Low-Income Children) – Mean (High-Income Children)		
	If Public Coverage Increased to:	*With Effects of Public Coverage Estimated from 2SLS (%)*	*With Effects of Public Coverage Twice as Big as That Estimated from 2SLS (%)*	*Current Differences in the Analysis Sample (%)*
Unmet dental care need	50%	4.8	3.2	6.4
Last visit $\leq$ 6 months	50%	− 16.9	− 13.7	− 20.3
Last visit $\leq$ 12 months	50%	− 11.9	− 7.4	− 16.4

Note: The method used in the simulation is the following: Changes in dental access and use are the multiples of the estimated effects of public coverage from 2SLS and the hypothesized 20% increase of public coverage (e.g., $-.079 \times .2 = -.0158$ for unmet dental care need). The changes are then added to the sample means to obtain the new levels of dental access and use among low-income children when the public coverage was expanded from 30% to 50% (.1–.0158 = .0842 for unmet dental care need). The figures in column 3 are the differences between the new levels of dental access and use among low-income children and that of the high-income children (.0842–.036 = .048 for unmet dental care need). In column 4 we double the estimated effects of public coverage from 2SLS.

2SLS, two-stage least squares regressions.

Because large effects of separate SCHIP programs have been found in some state-level analyses, it is likely that these states implemented a much different and more successful program than other states that implemented separate programs. A second possible reason is measurement error in program type. Some states have changed their type of program since initial implementation. This study did not track changes in program type and used the type of program recorded as of 2001.

We conducted a simulation analysis to predict the differences in dental care access and use between low-income and high-income children if public health insurance were further expanded to cover all uninsured low-income children (Table 5). A fourth policy contribution is our conclusion that improving public insurance programs' effectiveness on dental care access and use may be more important than simply increasing public coverage. Even if the government managed to increase public health insurance from the current 30 to 50 percent to cover almost all uninsured children (22 percent) in the analysis sample, the income gap in dental care access and use would remain large. For example, the difference in the proportion of children with unmet dental care need would decline only moderately from 6.4 to 4.8 percentage

points when public coverage increased to 50 percent among low-income children. To further reduce the gap, the effectiveness of public health insurance programs must improve. We show that if public programs became twice as effective as the level estimated from 2SLS in the second analysis, the income gap would reduce substantially with the same increase in public coverage. The gap in the likelihood of having the last dental visit in the past year would shrink by more than half from 16.4 to 7.4 percentage points.

The analytical approaches in this study make important contributions to the methodology of SCHIP evaluation and to an understanding of SCHIP's effect. Although the estimates of effects are conservative, our approach of using SCHIP program availability avoids the difficulty of imputing program eligibility and the complexity of dealing with the potential endogeneity of program eligibility. In the second analysis where we cannot avoid endogeneity, the instrumental variables approach adjusts for endogeneity of coverage and identifies effects for a group of children who were more likely to have gained public coverage due to SCHIP. Both analyses take into account the possible spillover effect of SCHIP on Medicaid enrollment by estimating the total effect of SCHIP, which was not considered in most previous studies. By estimating the overall effect of SCHIP, we avoid problems associated with lack of reliable SCHIP enrollment data because of under- or misreporting.

This study has several limitations. In the first analysis the overall effect of SCHIP depended on two factors—the extent of public coverage expansion and the effects of public program enrollment on dental care access and use. However, we cannot tell which factor is most responsible for the estimated overall effect. In the second analysis we found that public health insurance improved dental care access and use. This finding suggests that the small effect of SCHIP implementation on dental care use found in the first analysis was due more to either low enrollment during the beginning years of SCHIP or to the program's relatively small scale.

Another limitation is that we estimated SCHIP's effect for all low-income children, not just for those who were eligible. We used this approach primarily because of concerns about data limitations and incorporating the spillover effect. It is a conservative approach. Any effect found in this study should be smaller than in the eligible population alone. Likewise, another limitation is that we estimated the effects for children with public coverage, but not for children specifically enrolled in SCHIP. However, because a higher proportion of older low-income children are eligible for SCHIP, whereas a higher proportion of younger low-income children are eligible for Medicaid,

the effect of SCHIP implementation may be reflected by our separate estimates for the older and younger subsamples.

This study provides one of the first national estimates of the total effects of the SCHIP program on low-income children's dental care access and use. Our conclusions that SCHIP did make a difference in improving dental care access and use for low-income children are consistent with other studies and evaluation reports on SCHIP (Shulman, Kell, and Rosenbach 2004; Wooldridge et al. 2005) and will inform policy debates on Medicaid and SCHIP policies.

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