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Patterns of Health Insurance Discontinuity and Children's Access to Health Care

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Abstract
Objectives This study classified patterns of discontinuous health insurance coverage, including change in coverage type and gaps in coverage, and described their associations with children's access to health care. *Methods* Using the 2011–2013 National Health Interview Survey data, we determined children's insurance coverage over the past year, and whether children had a usual source of care, had to delay getting care, or had unmet health care needs. Using multivariable logistic regression, we compared measures of access to care across insurance coverage patterns, classified as continuous private coverage; continuous public coverage; continuous lack of coverage; change in coverage type (public versus private) without gaps in coverage; and any gap in coverage. A subgroup analysis repeated this comparison for children with a caregiver-reported chronic physical illness. *Results* The analysis included 34,105 children, of whom 7% had a gap in coverage and 1% had a change in coverage type. On multivariable analysis, gaps in coverage were associated with increased likelihood of unmet health care needs, compared to continuous private (OR 6.9; 95% CI 5.9, 8.0) or continuous public coverage (OR 5.1; 95% CI 4.4, 6.0). Seamless changes in coverage were also associated with greater likelihood of unmet health care needs [OR vs. private: 3.8 (95% CI 2.3, 6.1); OR vs. public: 2.8 (95% CI 1.8, 4.6); all $p < 0.001$]. Results were similar for other study outcomes, and among children with chronic physical illness. *Conclusions for Practice* Both gaps in coverage and seamless changes between coverage types were associated with limited health care access for children.

Keywords Health insurance · Health care access · Unmet health care needs · Pediatric

Significance

What is already known on this subject? Discontinuity in health insurance coverage is considered to limit access to health care, but contemporary associations between changes in coverage and children's access to care have not been described, and distinct influences of gaps in coverage and changes between coverage types have not been assessed.

What this study adds? Distinguishing between recent gaps in coverage and seamless transitions between public and private health insurance, we demonstrate that both types of health insurance discontinuity are adversely associated with unmet health care needs in nationally-representative samples of all children and children with chronic physical illness.

Introduction

Continuity of health insurance coverage is recognized as a key principle of health care financing and a measure of the quality of health care provided to children in the United States (US) (Hudak et al. 2017; Strickland et al. 2015). Nevertheless, many children experience changes or gaps in insurance coverage that could compromise their access to primary and specialty care (Guevara et al. 2014; Orzol et al. 2015). Insurance discontinuity is an important dimension of children's "social complexity," and may reflect the consequences of job loss, income fluctuation, housing instability,

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and other stressful events in children's lives (Carroll et al. 2017; Schrager et al. 2016; Smits-Seemann et al. 2016; Torres et al. 2017). Yet, it remains unclear what the most useful definition of insurance discontinuity might be for clinical risk stratification, and what data are required to construct such a measure.

Previous studies have used conflicting definitions of insurance discontinuity (Guevara et al. 2014), with some studies addressing gaps in insurance coverage (Olson et al. 2005; Satchell and Pati 2005), other studies addressing change between public and private coverage (Buchmueller et al. 2014), and still other studies focusing on change in coverage within a single type (e.g., transitions between Medicaid and Children's Health Insurance Program [CHIP]) (Orzol et al. 2015). Apart from a recent study on adolescents (Parasuraman et al. 2018), contemporary evidence on insurance discontinuity and children's access to care is generally limited to data collected in the mid-2000s or earlier (Olson et al. 2005; Satchell and Pati 2005; Buchmueller et al. 2014). Therefore, the bulk of this literature does not reflect continuing improvements in children's insurance coverage and access to care achieved within the last decade (Larson et al. 2016; Ortega et al. 2018), nor address the disparity between faster improvements in insurance coverage for children, and relatively slower improvements in access to healthcare (Spencer et al. 2018).

In this study, we aim to refine the classification of insurance discontinuity and determine its association with access to care. To resolve inconsistent definitions of insurance coverage in past studies, we construct mutually exclusive categories of children with gaps in coverage (whether or not they experienced a change in coverage type), and children with seamless changes between types of insurance. Even in cases where changes in insurance type occur without gaps in coverage, there may be a resulting disruption to health care access, due to the need to update insurance information and potentially find a different provider who accepts the new coverage. Difficulties in finding a provider have been recently described for new enrollees in Medicaid managed care plans (McCullough and Dalstrom 2018), but may also apply to people gaining coverage through commercial plans.

Secondarily, we aim to characterize the association between insurance discontinuity and access to care for children with chronic illness, among whom continuity of coverage is especially important, as interruption of care may increase the risks of further disease progression or development of significant comorbidities (McManus et al. 2013; Okumura et al. 2013; Sable et al. 2011). Our primary hypothesis is that, relative to continuous coverage of a single type (either public or private), both gaps in coverage and seamless changes in coverage type will increase the likelihood of lacking a usual source of care, delaying getting care, and reporting unmet health care needs. Our secondary hypothesis is that the association between discontinuous coverage and limited health care access will be stronger among children with chronic physical conditions.

Methods

This study did not include patient or clinical data, and the Institutional Review Board at our institution deemed this study exempt from review as not human subjects research. De-identified data were obtained from the National Health Interview Survey (NHIS), a nationally representative cross-sectional in-person household interview survey (National Center for Health Statistics 2017a). The 2011–2013 survey data, collected after the passage of the ACA in 2010 and before its full implementation (including Medicaid expansion in participating states) in 2014, were used in the study. Data from more recent surveys (2014 onwards) were excluded due to discontinuation of the items measuring specific chronic conditions, as described below, and due to potential confounding by state-specific Medicaid expansion, which cannot be addressed in the analysis of the public-use NHIS files because these data files do not include respondents' state of residence.

The NHIS collects a roster of all persons in the household, and basic information on the household and each family living in the household. Among households with children, the NHIS randomly selects one "sample child" age 0–17 years for whom a knowledgeable caregiver completes a detailed questionnaire including questions about their health status, health care access and utilization, and additional socioeconomic data (National Center for Health Statistics 2017b). Households with a completed sample child questionnaire were evaluated for inclusion in the study. Children were excluded from the study if their insurance coverage over the past year could not be classified as described below, if they were missing data on the study outcomes, or if they were missing data on study covariates.

Insurance coverage at the time of the interview was classified as private; public (Medicaid, Medicare, CHIP, or any other state program); or none. Continuity, change, and gaps in children's health insurance were defined using questions about children's current insurance coverage and questions about changes or gaps in insurance coverage during the preceding 12 months. Questions on insurance coverage are summarized in Table 1. The following patterns of insurance coverage were coded over the 12 month period leading up to the interview: (1) continuous private coverage; (2) continuous public coverage; (3) continuous lack of insurance; (4) change between insurance types (public vs. private) with no interruption in coverage; and (5) interrupted coverage, with or without change in insurance type. This classification of children's insurance coverage is illustrated in Fig. 1.

Table 1 National Health Interview Survey questions used to ascertain insurance coverage

Question wording	Answer choices[a]	Coding for analysis[b]
Q1. What kind of health insurance coverage does your child have?	Private health insurance	Private coverage
	Medicare	Public coverage
	Medi-Gap	
	Medicaid	
	CHIP	
	State-sponsored plan	
	Military health care	Other coverage
	Indian Health Service	
	Other government program	
	Single service plan	
	No coverage of any type	No coverage
Q2. In the past 12 months, was there any time when your child did not have any health insurance coverage?[c]	Yes	Gap in coverage
	No	No gap in coverage
Q3. What type of health insurance did your child have before this period?[d]	Same as Q1	
Q4. Did your child have this type of health insurance for the past 12 months?[c]	Yes	No change in coverage
	No	Change in coverage
Q5. What other types of health insurance did your child have?[e]	Same as Q1	
Q6. How long has it been since your child last had health care coverage?[f]	6 months or less	Had coverage in past year
	> 6 months to 1 year	
	> 1 year to 3 years	Did not have coverage in past year
	> 3 years	
	Never	

CHIP Children's Health Insurance Program

[a]"Refused" and "don't know" answer choices not shown

[b]For the algorithm classifying children's insurance coverage over the past year, see Fig. 1

[c]Asked about children who currently had some kind of insurance coverage

[d]Asked about children who had a gap in coverage

[e]Asked about children who had a change in coverage

[f]Asked about children who were currently uninsured

Study outcomes included the following measures of access to health care during the preceding 12 months (i.e., the same period as when insurance coverage was assessed). Lack of access to a usual source of care was defined as having no place where the child usually goes when they are sick or when they need routine preventive care. Delay in getting care was defined as reporting any reason for delaying getting care in the past 12 months (e.g., cost, transportation difficulties, or waiting time). Unmet health care needs were defined as reporting needing medical care but not being able to afford it in the past 12 months. All outcomes were recoded into dichotomous variables for analysis.

Descriptive analysis used Wald tests to compare weighted proportions or means of study variables according to the pattern of insurance coverage. Multivariable logistic regression models for each study outcome included the following covariates: child's age, gender, race/ethnicity, place of birth, maternal education, and US Census region of current residence. Data on maternal education were obtained from the sample child questionnaire, and, except in a few cases with incomplete responses, were collected regardless of whether the child's mother was the caregiver answering this questionnaire.

As health care needs are influenced by health status, we also included children's caregiver-rated health; and whether the child was limited in participating in play activities (for ages < 5 years) or required assistance with personal care needs because of a physical, mental, or emotional problem (for ages > 3 years). Chronic physical illness was ascertained by questions about whether a health professional has ever told the respondent that the sample child had arthritis, asthma (if still present at the time of the interview), cerebral palsy, congenital heart disease (CHD), other heart condition, cystic fibrosis, diabetes, Down syndrome, muscular dystrophy, or sickle cell anemia (Zan and Scharff 2015). In the primary analysis, the presence of one or more chronic conditions was included as a covariate. In a sub-analysis of children with one or more of these conditions, the type of illness was subdivided as asthma

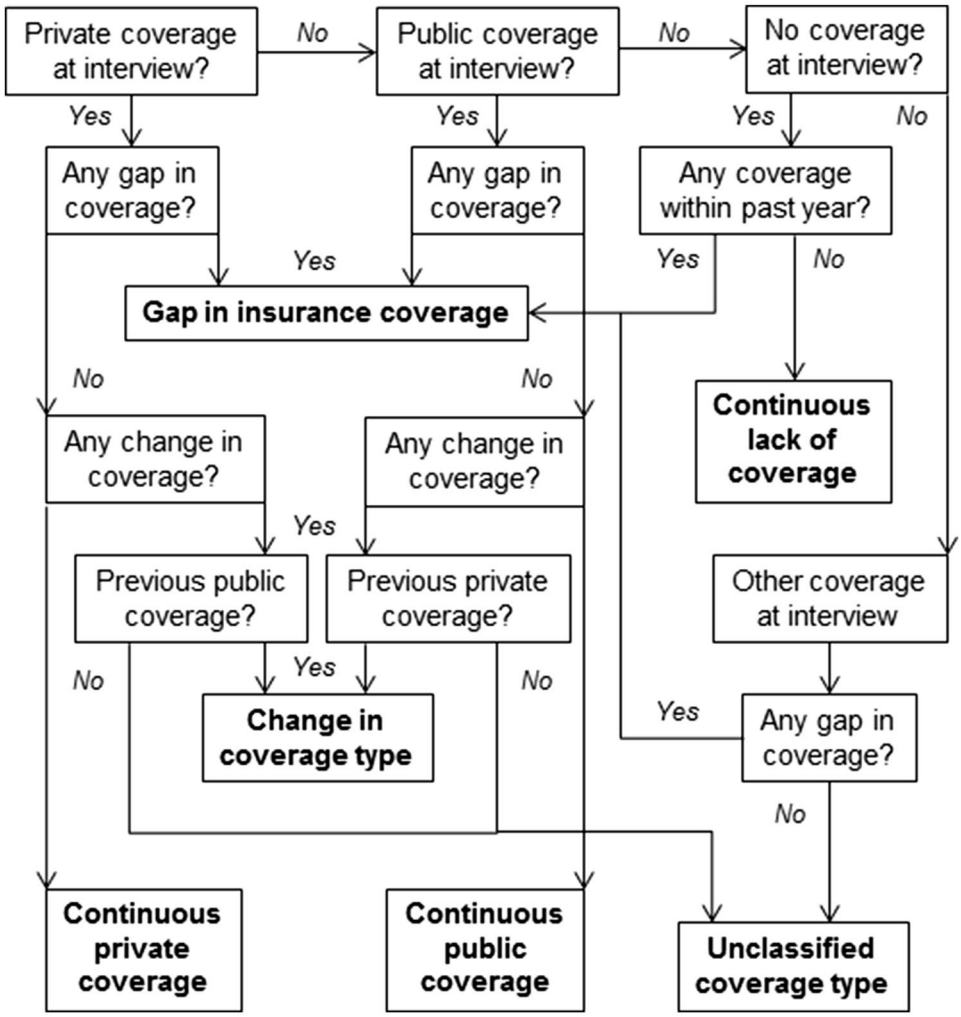

Fig. 1 Classification of insurance coverage type over the past year

alone, CHD or other heart condition alone, and other or multiple conditions.

All analyses were adjusted for the year of interview to reflect trends of improvements in access to care (Larson et al. 2016; Ortega et al. 2018). To account for unequal probabilities of sample selection and the complex sampling design, survey weights were applied and standard errors were adjusted in all analyses. The survey weights for the sample child in each household accounted for the child's probability of being selected out of all children in the household, and the household's probability for participating in the survey. Data analysis was performed using Stata/IC 14.2 (College Station, TX: StataCorp, LP), and $p < 0.05$ was considered statistically significant.

Results

We identified 38,985 completed sample child interviews during the study period. After excluding 1882 children whose insurance coverage was unclassifiable in the above scheme (e.g., children with continuous TRICARE coverage or children with continuous Indian Health Service coverage), 27 children missing data on study outcomes, and 2971 children missing data on study covariates, we reached a final analytic sample size of 34,105. Among children included in the analysis, 51% had continuous private coverage, 36% had continuous public coverage, and 6% were continuously uninsured over the past year. We

identified 201 (0.6%) children whose insurance coverage changed but who did not experience a gap in coverage; at the time of the interview, 64% of this group had private insurance compared to 36% with public insurance. More commonly, 2352 (7%) children experienced a gap in coverage, of whom 25% had private insurance at the time of the interview, 34% had public insurance, 40% had no insurance, and 1% had some other type of coverage (military health care, single service plan or a government plan other than Medicaid, Medicare, CHIP, or state programs). Among the 2352 children who experienced a gap in coverage, 237 (10%) also had a change in insurance type (public vs. private) within the past year. In the overall study sample, 1328 (4%) children had no usual source of care, 4126 (12%) children experienced a delay in care over the past year, and 3119 (9%) children had unmet health care needs over the past year.

Weighted proportions and means of study variables are compared according to insurance coverage pattern in Table 2. Lacking a usual place of care was more common among children who experienced a gap in coverage (11%) than among children with continuous coverage (2% for either public or private). Delays in care were most common among children with gaps in coverage (28%), compared to 7% in the continuous private coverage group and 14% among children with continuous public coverage. Unmet health care needs were also most common among children with gaps in coverage (29%) and children who were continuously uninsured (28%), and were higher for children with seamless changes in coverage type (18%) when compared to either continuous public coverage (8%) or continuous private coverage (5%). Demographically, children with interrupted insurance or a change between insurance types were more similar to children with continuous private coverage than to children who were continuously uninsured. Compared to children without any insurance coverage in the past year, children with changes or gaps in coverage were more likely to be non-Hispanic White, more likely to have a mother who completed college, and more likely to have been born in the US.

Multivariable logistic regression results are summarized in Table 3. The likelihood of lacking a usual source of care was higher among children who were continuously uninsured when compared to children with either continuous private insurance [odds ratio (OR) 12.5; 95% CI 9.8, 15.9; $p < 0.001$] or continuous public insurance (OR 12.8; 95% CI 5.5, 30.0; $p < 0.001$). The likelihood of lacking a usual source of care was also higher among children with gaps in coverage when compared to children with either continuous private insurance (OR 6.9; 95% CI 5.5, 8.8; $p < 0.001$) or public insurance (OR 6.9; 95% CI 5.3; 9.1; $p < 0.001$) and among children with seamless changes between coverage types, compared to continuous private (OR 2.4; 95% CI 1.1, 4.9; $p = 0.021$) or public insurance (OR 2.4; 95% CI 1.1, 4.9; $p = 0.021$). When examining delay of care, this outcome was most likely among children with gaps in coverage [OR vs. continuous private insurance: 4.3 (95% CI 3.7, 5.0; $p < 0.001$); OR vs. continuous public insurance: 2.5; 95% CI 2.2, 2.9; $p < 0.001$]. Delay of care was also more likely for children with change in insurance coverage, when compared to children who had continuous private insurance (OR 1.8; 95% CI 1.1, 3.0; $p = 0.029$). Considering unmet health care needs, this study outcome was most likely among children with gaps in coverage [OR vs. continuous private insurance: 6.9 (95% CI 5.9, 8.0; $p < 0.001$); OR vs. continuous public insurance: 5.1 (95% CI 4.4, 6.0; $p < 0.001$)], but the likelihood of this outcome was also elevated among children with change in the type of coverage [OR vs. continuous private insurance: 3.8 (95% CI 2.3, 6.1; $p < 0.001$); OR vs. continuous public insurance: 2.8 (95% CI 1.8, 4.6; $p < 0.001$)].

Results were similar among 3763 children with chronic physical illness, of whom 44% had continuous private coverage, 44% had continuous public coverage, 4% were continuously uninsured, 1% had a seamless change in coverage, and 7% had a gap in coverage. In multivariable analysis of this subgroup, gaps in coverage were associated with greater likelihood of lacking a usual source of care, delaying care, and having unmet health care needs, compared to either continuous private or public coverage (Table 4). As in the main analysis, seamless changes in coverage type were associated with greater likelihood of delaying care, compared to continuous private insurance; and were associated with greater likelihood of reporting unmet health care needs, compared to either type of continuous coverage. In this sub-analysis, adjusted ORs for change and gaps in coverage were generally larger than in the main analysis. In the main analysis, birth outside the US, residence in the South (compared to the Northeast), Hispanic ethnicity (compared to non-Hispanic White) and lower maternal educational attainment were associated with delaying care, whereas older age was associated with lacking a usual source of care and a higher likelihood of unmet health care needs. The presence of chronic conditions was associated with a greater likelihood of having a usual source of care, but also a greater likelihood of delaying care and reporting unmet health care needs.

Discussion

In the US, both lack of insurance coverage and gaps in coverage are considered to limit the quality of health care available to children (Strickland et al. 2015). Our study demonstrates that both gaps in coverage and change in coverage type are strongly associated with diminished access to health care. Specifically, having experienced recent gaps in insurance coverage (even if a child was currently insured) was associated with greater likelihood of lacking a usual

Table 2 Weighted proportions and means of study variables according to insurance coverage pattern (N = 34,105)

Characteristic	Insurance coverage pattern					P
	Continuous private (unweighted N = 17,484)	Continuous public (unweighted N = 12,129)	Continuously uninsured (unweighted N = 1939)	Change in coverage type (unweighted N = 201)	Gap in coverage (unweighted N = 2352)	
	Estimate (95% CI)	Estimate (95% CI)	Estimate (95% CI)	Estimate (95% CI)	Estimate (95% CI)	
Study outcomes						
No usual place of care	0.02 (0.01, 0.02)	0.02 (0.01, 0.02)	0.25 (0.22, 0.27)	0.04 (0.02, 0.07)	0.11 (0.09, 0.13)	< 0.001
Experienced a delay in care	0.07 (0.07, 0.08)	0.14 (0.13, 0.15)	0.23 (0.21, 0.26)	0.13 (0.08, 0.21)	0.28 (0.26, 0.30)	< 0.001
Unmet healthcare needs	0.05 (0.05, 0.06)	0.08 (0.07, 0.08)	0.28 (0.26, 0.31)	0.18 (0.12, 0.26)	0.29 (0.27, 0.31)	< 0.001
Study covariates						
Female	0.48 (0.47, 0.49)	0.49 (0.48, 0.51)	0.49 (0.46, 0.52)	0.47 (0.38, 0.56)	0.51 (0.49, 0.54)	0.145
Age (years)[a]	9 (9, 10)	8 (7, 8)	10 (9, 10)	8 (7, 9)	8 (8, 9)	< 0.001
Race/ethnicity						
Hispanic	0.13 (0.12, 0.13)	0.38 (0.36, 0.39)	0.52 (0.48, 0.55)	0.22 (0.16, 0.30)	0.30 (0.28, 0.32)	< 0.001
Non-Hispanic White	0.71 (0.70, 0.72)	0.35 (0.33, 0.36)	0.33 (0.29, 0.36)	0.61 (0.52, 0.69)	0.49 (0.46, 0.52)	< 0.001
Non-Hispanic Black	0.10 (0.09, 0.10)	0.23 (0.22, 0.24)	0.11 (0.09, 0.13)	0.11 (0.07, 0.17)	0.15 (0.13, 0.17)	< 0.001
Non-Hispanic Asian	0.06 (0.06, 0.07)	0.03 (0.03, 0.04)	0.05 (0.04, 0.06)	0.04 (0.02, 0.08)	0.04 (0.03, 0.06)	< 0.001
Other non-Hispanic	0.01 (0.01, 0.01)	0.01 (0.01, 0.02)	0.003 (0.001, 0.007)	0.02 (0.01, 0.09)	0.01 (0.01, 0.02)	< 0.001
Maternal education						
Less than high school	0.04 (0.04, 0.04)	0.31 (0.30, 0.32)	0.38 (0.35, 0.41)	0.12 (0.08, 0.19)	0.17 (0.15, 0.19)	< 0.001
High school	0.15 (0.15, 0.16)	0.30 (0.29, 0.31)	0.29 (0.26, 0.31)	0.19 (0.14, 0.26)	0.28 (0.25, 0.30)	< 0.001
Some college	0.17 (0.17, 0.18)	0.21 (0.20, 0.22)	0.16 (0.14, 0.19)	0.22 (0.15, 0.30)	0.24 (0.22, 0.27)	< 0.001
College degree	0.45 (0.44, 0.47)	0.17 (0.16, 0.18)	0.15 (0.13, 0.17)	0.38 (0.30, 0.48)	0.27 (0.24, 0.29)	< 0.001
Advanced degree	0.18 (0.17, 0.19)	0.02 (0.01, 0.02)	0.02 (0.01, 0.03)	0.08 (0.04, 0.14)	0.05 (0.04, 0.06)	< 0.001
US Census region						
Northeast	0.18 (0.17, 0.19)	0.16 (0.14, 0.17)	0.09 (0.06, 0.11)	0.13 (0.08, 0.20)	0.11 (0.10, 0.13)	< 0.001
Midwest	0.27 (0.26, 0.28)	0.20 (0.18, 0.21)	0.15 (0.12, 0.17)	0.34 (0.25, 0.44)	0.22 (0.19, 0.25)	< 0.001
South	0.33 (0.31, 0.34)	0.40 (0.38, 0.42)	0.46 (0.42, 0.50)	0.23 (0.17, 0.31)	0.41 (0.39, 0.44)	< 0.001
West	0.22 (0.21, 0.23)	0.24 (0.23, 0.26)	0.31 (0.28, 0.34)	0.30 (0.22, 0.39)	0.25 (0.23, 0.28)	< 0.001
Born in the US	0.97 (0.97, 0.97)	0.97 (0.96, 0.97)	0.79 (0.77, 0.81)	0.98 (0.92, 0.99)	0.95 (0.94, 0.96)	< 0.001
Health status						
Excellent	0.64 (0.64, 0.65)	0.49 (0.47, 0.50)	0.51 (0.48, 0.54)	0.56 (0.47, 0.65)	0.54 (0.52, 0.57)	< 0.001
Very good	0.25 (0.25, 0.26)	0.26 (0.25, 0.27)	0.25 (0.23, 0.28)	0.27 (0.19, 0.37)	0.27 (0.25, 0.29)	0.347
Good	0.09 (0.09, 0.10)	0.21 (0.20, 0.22)	0.20 (0.18, 0.22)	0.16 (0.10, 0.24)	0.15 (0.14, 0.17)	< 0.001
Fair or poor	0.01 (0.01, 0.01)	0.04 (0.03, 0.04)	0.04 (0.02, 0.05)	0.01 (0.001, 0.02)	0.03 (0.02, 0.05)	< 0.001
Year of interview[a]	2012 (2012, 2012)	2012 (2012, 2012)	2012 (2012, 2012)	2012 (2012, 2012)	2012 (2012, 2012)	0.271
Chronic physical illness	0.09 (0.09, 0.10)	0.13 (0.12, 0.14)	0.07 (0.06, 0.09)	0.14 (0.09, 0.21)	0.12 (0.10, 0.14)	< 0.001
Limited activity or need for assistance with personal care	0.01 (0.01, 0.01)	0.02 (0.02, 0.02)	0.003 (0.001, 0.007)	0.004 (0.001, 0.03)	0.01 (0.01, 0.02)	< 0.001

Reported values are weighted means or proportions

CHD congenital heart disease, *CI* confidence interval, *US* United States

Table 3 Multivariable logistic regression analysis of access to care (N = 34,105)

Covariate	Study outcomes					
	No usual place of care		Delay in care		Unmet healthcare needs	
	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P
Insurance coverage						
Continuous private	Ref	–	Ref	–	Ref	–
Continuous public	1.0 (0.8, 1.3)	0.999	1.7 (1.5, 1.9)	< 0.001	1.3 (1.2, 1.5)	< 0.001
Continuously uninsured	12.5 (9.8, 15.9)	< 0.001	3.0 (2.5, 3.5)	< 0.001	5.6 (4.7, 6.6)	< 0.001
Change in coverage types	2.4 (1.1, 4.9)	0.021	1.8 (1.1, 3.0)	0.029	3.8 (2.3, 6.1)	< 0.001
Gap in coverage	6.9 (5.5, 8.8)	< 0.001	4.3 (3.7, 5.0)	< 0.001	6.9 (5.9, 8.0)	< 0.001
Female	1.0 (0.9, 1.2)	0.792	1.1 (1.0, 1.2)	0.019	1.1 (1.0, 1.2)	0.011
Age (years)	1.1 (1.0, 1.1)	< 0.001	1.0 (1.0, 1.0)	0.826	1.1 (1.1, 1.1)	< 0.001
Race/ethnicity						
Hispanic	1.0 (0.8, 1.3)	0.792	1.4 (1.2, 1.5)	< 0.001	1.1 (1.0, 1.3)	0.077
Non-Hispanic White	Ref	–	Ref	–	Ref	–
Non-Hispanic Black	0.9 (0.7, 1.2)	0.584	1.1 (1.0, 1.3)	0.089	1.1 (0.9, 1.2)	0.438
Non-Hispanic Asian	1.3 (0.9, 1.7)	0.121	0.9 (0.8, 1.1)	0.483	0.6 (0.5, 0.8)	0.001
Other Non-Hispanic	1.4 (0.6, 3.2)	0.389	1.7 (1.1, 2.6)	0.017	1.2 (0.7, 1.9)	0.534
Maternal education						
Less than high school	Ref	–	Ref	–	Ref	–
High school	0.9 (0.8, 1.2)	0.653	0.9 (0.8, 1.0)	0.119	1.1 (0.9, 1.3)	0.195
Some college	0.6 (0.5, 0.8)	0.001	1.1 (0.9, 1.2)	0.310	1.5 (1.2, 1.7)	< 0.001
College degree	0.6 (0.5, 0.8)	< 0.001	1.0 (0.9, 1.1)	0.821	1.1 (0.9, 1.3)	0.372
Advanced degree	0.5 (0.4, 0.8)	0.001	0.9 (0.7, 1.1)	0.286	0.8 (0.6, 1.1)	0.147
US Census region						
Northeast	0.4 (0.3, 0.6)	< 0.001	0.7 (0.6, 0.9)	< 0.001	0.8 (0.7, 0.9)	0.004
Midwest	0.9 (0.7, 1.1)	0.381	1.0 (0.9, 1.1)	0.766	0.9 (0.8, 1.1)	0.445
South	Ref	–	Ref	–	Ref	–
West	1.1 (0.9, 1.3)	0.387	1.2 (1.1, 1.4)	< 0.001	1.3 (1.2, 1.5)	< 0.001
Born in the US	0.4 (0.3, 0.6)	< 0.001	0.8 (0.6, 1.0)	0.020	0.7 (0.6, 0.8)	< 0.001
Health status						
Excellent	Ref	–	Ref	–	Ref	–
Very good	1.1 (0.9, 1.4)	0.174	1.1 (1.0, 1.3)	0.016	1.2 (1.1, 1.4)	< 0.001
Good	0.9 (0.8, 1.2)	0.588	1.7 (0.5, 2.0)	< 0.001	1.7 (1.5, 1.9)	< 0.001
Poor	1.2 (0.7, 2.1)	0.540	2.1 (1.7, 2.8)	< 0.001	2.2 (1.6, 3.0)	< 0.001
Year of interview	1.1 (1.0, 1.2)	0.244	0.9 (0.8, 0.9)	< 0.001	0.9 (0.9, 1.0)	0.021
Chronic physical illness	0.6 (0.4, 0.8)	0.003	1.3 (1.2, 1.5)	< 0.001	1.4 (1.2, 1.7)	< 0.001
Limited activity or need for assistance with personal care	0.5 (0.1, 2.3)	0.380	1.7 (1.2, 2.3)	0.001	1.9 (1.3, 2.7)	< 0.001

CI confidence interval, *OR* odds ratio, *US* United States

source of care, having a delay in getting care, or having had unmet health care needs, compared to both continuous private coverage and continuous public coverage. Children with recent changes in coverage type who did not experience gaps in coverage also had a greater risk of unmet health care needs, compared to children with either continuous private or continuous public coverage. These findings were replicated in the subgroup of children with chronic physical illness. Our findings indicate that disruption of coverage, and even seamless change in coverage type, are more salient to children's health care access than the type of continuous insurance coverage; and that lower access to health care is a plausible mechanism by which discontinuous insurance coverage may adversely affect children's health.

Previous studies have described associations between gaps in coverage and reduced access to health care among both adults and children (Buchmueller et al. 2014; Burstin et al. 1998; Olson et al. 2005; Satchell and Pati 2005).

Table 4 Multivariable analysis of access to care among children with chronic physical illness (N = 3763)

Covariate	Study outcomes					
	No usual place of care		Delay in care		Unmet healthcare needs	
	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P
Insurance coverage patterns						
Continuous private	Ref	–	Ref	–	Ref	–
Continuous public	0.9 (0.3, 2.7)	0.902	1.6 (1.2, 2.1)	0.001	1.4 (1.0, 2.1)	0.047
Continuously uninsured	12.0 (4.5, 31.8)	< 0.001	2.6 (1.5, 4.4)	< 0.001	10.1 (6.0, 17.0)	< 0.001
Change in coverage types	[a]	–	3.4 (1.0, 11.1)	0.042	6.7 (2.1, 21.0)	0.001
Gap in coverage	11.9 (4.5, 31.4)	< 0.001	4.5 (3.0, 6.6)	< 0.001	6.3 (4.2, 9.7)	< 0.001
Female	1.1 (0.6, 2.1)	0.791	1.24 (1.0, 1.5)	0.049	1.2 (0.9, 1.5)	0.288
Age (years)	1.1 (1.0, 1.2)	0.004	1.0 (1.0, 1.0)	0.058	1.0 (1.0, 1.1)	0.003
Race/ethnicity						
Hispanic	1.5 (0.6, 3.5)	0.350	1.40 (1.0, 1.9)	0.030	1.2 (0.8, 1.6)	0.367
Non-Hispanic White	Ref	–	Ref	–	Ref	–
Non-Hispanic Black	1.1 (0.5, 2.6)	0.772	1.1 (0.8, 1.6)	0.453	1.1 (0.8, 1.6)	0.470
Non-Hispanic Asian	0.9 (0.1, 8.8)	0.960	1.1 (0.5, 2.3)	0.904	0.5 (0.2, 1.3)	0.157
Other Non-Hispanic	[b]	–	0.44 (0.13, 1.43)	0.172	0.35 (0.08, 1.49)	0.154
Maternal education						
Less than high school	Ref	–	Ref	–	Ref	–
High school	0.9 (0.4, 2.1)	0.747	1.0 (0.7, 1.5)	0.915	1.2 (0.8, 1.7)	0.445
Some college	0.4 (0.1, 1.3)	0.136	1.1 (0.8, 1.7)	0.569	1.1 (0.8, 1.6)	0.583
College degree	0.7 (0.3, 1.8)	0.440	1.3 (0.9, 1.9)	0.202	1.5 (1.0, 2.2)	0.074
Advanced degree	0.9 (0.2, 3.9)	0.844	0.5 (0.3, 0.9)	0.015	0.5 (0.2, 0.98)	0.044
US Census region						
Northeast	0.03 (0.01, 0.2)	< 0.001	0.6 (0.5, 0.9)	0.014	0.4 (0.3, 0.7)	< 0.001
Midwest	0.7 (0.3, 1.5)	0.335	0.9 (0.7, 1.2)	0.543	0.8 (0.6, 1.2)	0.333
South	Ref	–	Ref	–	Ref	–
West	1.2 (0.5, 2.5)	0.719	1.2 (0.9, 1.6)	0.201	1.4 (1.1, 1.9)	0.019
Born in the US	1.3 (0.2, 7.7)	0.807	0.5 (0.2, 0.9)	0.028	0.67 (0.4, 1.2)	0.202
Health status						
Excellent	Ref	–	Ref	–	Ref	–
Very good	1.6 (0.8, 3.2)	0.181	1.3 (1.0, 1.7)	0.100	1.1 (0.8, 1.6)	0.437
Good	0.8 (0.4, 1.6)	0.436	1.7 (1.3, 2.3)	< 0.001	1.3 (0.9, 1.8)	0.144
Poor	1.3 (0.4, 3.8)	0.632	2.2 (1.4, 3.4)	< 0.001	1.7 (1.1, 2.6)	0.017
Year of interview	1.3 (0.9, 1.9)	0.174	1.0 (0.9, 1.2)	0.899	0.98 (0.8, 1.2)	0.803
Type of chronic illness						
Asthma	Ref	–	Ref	–	Ref	–
CHD or other heart problem	2.51 (0.80, 7.87)	0.115	1.21 (0.82, 1.80)	0.337	1.02 (0.61, 1.71)	0.949
Other or multiple chronic illnesses	0.85 (0.34, 2.10)	0.723	1.34 (0.95, 1.90)	0.098	0.68 (0.42, 1.09)	0.107
Limited activity or need for assistance with personal care	[c]	–	1.17 (0.72, 1.91)	0.529	1.67 (0.92, 3.01)	0.091

CHD congenital heart disease, *CI* confidence interval, *OR* odds ratio, *US* United States

[a] 23 cases omitted and OR not shown due to perfect prediction

[b] 48 cases omitted and OR not shown due to perfect prediction

[c] 196 cases omitted and OR not shown due to perfect prediction

Among children in households surveyed using the NHIS during 1999–2001, gaps in coverage over the past year were associated with increased likelihood of lacking usual care, delaying care, and having unmet health care needs (Olson et al. 2005; Satchell and Pati 2005). In one study that distinguished between gaps in coverage and seamless changes in coverage type, children in households surveyed between 1996 and 2005 were less likely to have visited a primary care

physician if they had coverage for only part of a year or if they had a seamless change in coverage, compared to either public or private insurance (Buchmueller et al. 2014). In a more recent study of adolescents with special health care needs, gaps in coverage were not independently associated with access to care, although only 1% of this population had coverage gaps (Parasuraman et al. 2018). By comparison, our results from 2011 to 2013 NHIS data on children ages 0–17 suggest that the associations between insurance discontinuity and limited access to care have persisted, even as children's uninsured rate declined from 10.3% in 2001 to 6.5% in 2013 (Larson et al. 2016).

Despite improvement in the uninsured rate among children, our study reports similar levels of insurance discontinuity to the 1999–2001 NHIS, with 8% of children in 1999–2001 having had a recent gap in coverage (Satchell and Pati 2005), compared to 7% in our study. This comparison highlights the persistent challenge of assuring that children's health insurance coverage is continuous, and provides access to appropriate and ongoing health care (Hudak et al. 2017). Two recent studies has highlighted the relatively rapid improvement in insurance coverage among children and adolescents, including rapid gains made since the passage and implementation of the ACA (Larson et al. 2016; Spencer et al. 2018). However, these gains in insurance coverage may have also been accompanied by change in coverage type (e.g., increasing coverage by Medicaid) or even unintended effects on the likelihood of coverage gaps (e.g., loss of coverage purchased on the marketplace exchange after an increase in pricing). Furthermore, children's gains in access to care appear to have been slower and inconsistent across demographic subgroups. As documented in a study describing the experience of recent managed care Medicaid enrollees (McCullough and Dalstrom 2018), gaining insurance does not immediately translate to being able to access needed care, so policies which directly affect insurance coverage may have a weaker downstream effect on access to care and health outcomes (Leininger and Levy 2015).

In clinical settings, screening for history of insurance discontinuity and related socioeconomic determinants of health may aid in risk adjustment or referral for care coordination (Clark and Gurevich 2016; Schrager et al. 2016). Among measures of social complexity, insurance coverage is perhaps unique insofar as health care providers already track it routinely and uniformly, reducing the need to obtain external data on social determinants of health (Schrager et al. 2016), and reducing bias associated with underreporting of social determinants of health in the medical record (Torres et al. 2017). Data on insurance coverage are also routinely and consistently reported to disease- and procedure-specific multi-institutional registries (Knapp et al. 2016; Tumin et al. 2017b), supporting the study of insurance discontinuity as a risk factor in especially vulnerable and medically complex populations. However, data on insurance coverage stored in hospital records or included in clinical registries are generally better suited to determining changes in coverage type rather than gaps in coverage (Tumin et al. 2017a). During periods without coverage, children may be less likely to visit a health care provider, and their coverage status at that time is less likely to be recorded in clinical databases. Nevertheless, our study demonstrates that even seamless changes in coverage type are associated with limited access to health care. This finding supports further investigation of change in coverage type as a risk factor for adverse inpatient and surgical outcomes (Tumin et al. 2017a). Furthermore, additional research may reveal cost savings to payors of helping children maintain continuous coverage, if such coverage helps prevent clinical deterioration or the need for expensive emergency care. Regardless, our study shows the importance of evaluating the likelihood of coverage gaps as an outcome of public policy, as recently undertaken in a study evaluating the ACA dependent coverage provision (Chan et al. 2018).

As with previous reports using the NHIS, our study is limited by the cross-sectional reporting of insurance coverage, preventing us from examining effects of change in coverage over time. While discontinuous coverage over the past year was associated with decreased access to health care, longitudinal data analysis would be required to demonstrate a causal relationship between changes or gaps in coverage and decreased health care access (Barnett et al. 2017; Buchmueller et al. 2014). We also note that due to the small number of children in the group experiencing seamless changes in coverage, the precision of statistical estimates for this group was limited in our analysis. Our conclusions are further limited by the subjective and caregiver-reported nature of the health measures available. Respondents reported their child's overall health status and whether their child was limited in play and activity due to a chronic condition, but these reports could not be corroborated by biomarker data or a healthcare professional's evaluation. Furthermore, in our subgroup of children with specific chronic physical conditions, caregiver-reported data were the only available measure of disease type and severity. Lastly, we conducted an analysis of data collected before the full implementation of the ACA in 2014. Given that the NHIS does not release state identifiers in the public-use file, our analysis represents national estimates of the association between coverage gaps and children's access to care that are not confounded by state differences in 2014 and later Medicaid expansion. Despite these limitations, the NHIS data offer an important opportunity to contrast alternative measures of insurance coverage discontinuity in a large, nationally-representative sample of children.

In sum, our findings suggest that both gaps in coverage and seamless changes in coverage type are associated with limited access to health care, including among children

with chronic physical conditions who may require specific routine care to prevent disease progression or development of comorbidities. Further longitudinal data analysis could strengthen inference about the causal implications of insurance discontinuity for development of specific clinical risk factors that would culminate in adverse health outcomes. Other future research may consider how coverage gaps due to insurance discontinuity ultimately influence health outcomes, especially for medically complex patients with high rates of health care utilization and high risk of poor health outcomes. Our finding that changes in coverage type are associated with limited health care access supports leveraging existing electronic health records to include this measure in future clinical research. While the recent reauthorization of CHIP has been an important achievement, no data have yet shown that year-round insurance coverage for all children has been reached. Therefore, it remains important to track the continuity of children's coverage in response to further policy changes, and assess how gaps in coverage will affect clinical outcomes and health over the life course.

Compliance with Ethical Standards

Conflict of interest No potential conflicts of interests exist for any of the authors.

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