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Are parent involvement and school quality associated with adult smoking behaviors? Findings from an urban early childhood cohort☆

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A B S T R A C T

Although smoking prevention is a high priority, few studies have examined alterable family and school context factors in childhood that influence later smoking behaviors. The present study examined associations of parent involvement in and expectations for children's education, elementary school quality, and school mobility with lifetime smoking history in adulthood for a low-income, minority cohort. Participants from the Chicago Longitudinal Study (N = 1142) were interviewed at age 22–24 as part of a 20-year follow-up of a prospective early childhood cohort of economically disadvantaged families. The sample is 74% of the original cohort (N = 1539). Family surveys and school records measured parent involvement and expectations as well as school quality and mobility from 4th to 8th grades. At age 22–24 follow-up, 47% reported a smoking history, and 37% were current smokers. After controlling for family background and participant characteristics, parent involvement in school was associated with reduced odds of a smoking history (OR = 0.88; 95% CI = 0.78, 0.99). Magnet school attendance (a school quality indicator) was associated with lower odds of current (OR = 0.47; 95% CI = 0.28, 0.79) and daily smoking (OR = 0.40, 95% CI = 0.21, 0.74). More frequent school moves were consistently associated with increased odds of smoking (e.g., OR [currently] = 1.17; 95% CI = 1.07, 1.36). Results indicate that protective factors within the family and school context were consistently associated with smoking measures. Programs and practices that strengthen parent involvement and school support may contribute to prevention efforts.

1. Introduction

Despite Healthy People's 2020 priority on smoking cessation (U.S. Department of Health and Human Services, 2017), cigarette smoking is estimated to result in >480,000 deaths per year in the United States–approximately 1300 deaths per day (U.S. Department of Health and Human Services, 2016). Due primarily to its high prevalence among younger adults, whereby 27% of 20-to-49-year-olds smoke (Benjamin et al., 2017), the annual costs to society in health care expenditures and disease burden exceed $300 billion (Benjamin et al., 2017; O'Connell et al., 2009). Prevention strategies beginning early in life are increasingly recommended as highly cost-effective in improving health behaviors (O'Connell et al., 2009; Wellman et al., 2016).

While previous research has examined antecedents and protective factors in adolescence and early adulthood in hopes of delaying or decreasing the onset of smoking (Do et al., 2015; Englund et al., 2014), far less is known about the early social determinants of adult smoking behaviors within the context of families and schools. Research has demonstrated that males (Benjamin et al., 2017; Bronfenbrenner, 1979) and individuals who come from families of lower SES (Fan and Chen, 2001) or single-parent households (Forrester et al., 2007) are more likely to smoke, and that lower levels of education (Haertel et al., 1993; Han, 2014) are associated with higher risks. Parental smoking (Forrester et al., 2007; Haertel et al., 1993; Hayakawa et al., 2016) is also a consistent predictor of their child's later cigarette use, whereas monitoring and frequent parent-child communication reduce the likelihood of smoking (Hayakawa et al., 2016; Herbers et al., 2013). School context and achievement behaviors are further contributing factors, including exposure to peer and school staff smoking (Forrester et al., 2007; Haertel et al., 1993; Hayakawa et al., 2016; Higgins et al., 2015), low school achievement and performance (Hayakawa et al., 2016), and problem behaviors (Forrester et al., 2007; Hayakawa et al., 2016).

Three limitations in current knowledge are evident, however. The first and most salient is the narrow scope of measured predictors in prior studies. More comprehensive coverage of individual, family, and school factors is consistent with ecological, human capital, and risk-protection models of development (Hu et al., 2006; Jefferis et al., 2003; Jeynes, 2007). In the educational and developmental science literature, parental involvement in education is a consistent predictor of achievement and prosocial behavior (Juonala et al., 2016; Kyriakides

Abbreviations: CLS, Chicago Longitudinal; Study CPC, Child-Parent Center; AFDC, Aid to Families with Dependent Children

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et al., 2013), but is rarely examined as a smoking predictor, even though higher school performance and monitoring reduce smoking risk (Lanza and Vasilenko, 2015). Likewise, parents' expectations for children's educational success is a robust indicator of performance and adjustment that may carry over to later health behaviors (Juonala et al., 2016; Leatherdale and Manske, 2005), including reduced smoking risk as function of increased health conscientiousness.

Second, as a consistently positive predictor of school achievement and prosocial behavior, school quality–typically measured by aggregate performance outcomes and support for student achievement (Lerman et al., 1999; Ling et al., 2009)–has not been assessed as a contributor to adult smoking despite the importance of peer environments. Furthermore, as a detrimental influence, youth school mobility (Lovato et al., 2010; McLeer and DeHart, 2013) (especially if frequent) is a predictor of high school dropout and health compromising behaviors such as delinquency and crime (Ling et al., 2009; Munafo et al., 2004). Whether the influence of school mobility carries over to smoking as an independent contributor has not been investigated.

Finally, given the higher rates of smoking prevalence for low-income, minority populations (Bronfenbrenner, 1979), better identification of alterable correlates is needed to reduce disparities in smoking and health. Previous analyses in the Chicago Longitudinal Study (CLS), which prospectively tracks the health and well-being of a cohort of low-income black children, found that school quality and mobility mediated the relation between adversity in early childhood and health-compromising behavior in young adulthood (O'Connell et al., 2009; O'Loughlin et al., 2009); however, the direct contribution to smoking was not assessed.

In this study, we assessed the contributions of alterable educational and family context factors during elementary school on smoking behavior in young adulthood for the CLS cohort. Given the large discrepancy in smoking rates by gender, with males having higher rates (Otten et al., 2007; Ou et al., 2007), we also examined whether the influence of family and school support varies by gender. Three questions were addressed (U.S. Department of Health and Human Services, 2014a): Are the family factors of parent involvement in school and parental expectations for children's attainment associated with smoking behaviors at age 24, above and beyond family demographic and early school performance? (U.S. Department of Health and Human Services, 2014b), Do school quality, as measured by magnet school attendance, and school mobility contribute to smoking outcomes even after accounting for parent behaviors and demographic factors?, and (Benjamin et al., 2017) Are these associations similar for males and females? We hypothesized that parent involvement and expectations as well as school quality would be associated with lower rates of smoking. We expected that more frequent school mobility would heighten smoking risk. Finally, we predicted that these associations would be moderated by gender, with males evincing larger influences from family and school factors.

2. Methods

2.1. Sample and design

The CLS includes 1539 participants born in 1979–1980 (93% African American, 7% Hispanic) who grew up in high-poverty neighborhoods in Chicago and attended early childhood programs in the school district during preschool and/or kindergarten (1983–1986) (Reynolds, 2000; Reynolds and Ou, 2010). Representative of young children at risk of school underachievement and health compromising behavior, participants were followed prospectively into adulthood. In this report, the study sample was 1142 (74%) individuals who were interviewed as part of a 20-year follow-up between 2002 and 2004. Within the sample, 710 attended the Child-Parent Center (CPC) program beginning in preschool. The remaining 364 participants made up a demographically-matched comparison group who attended randomly selected schools that provided alternate early childhood programs.

Fully described elsewhere (Reynolds and Ou, 2010; Reynolds et al., 2001), and not a focus of the current study, the CPC program provides comprehensive child education and family services to economically disadvantaged children in high-poverty neighborhoods from preschool through 2nd or 3rd grade to promote long-term health and well-being. Analyses comparing background characteristics of the study sample to those who did not complete the adult interview (n = 397) indicated that non-respondents were more likely to be male, more likely to be economically disadvantaged (e.g., AFDC eligible, parent was a high school dropout), and have lower school readiness skills (Appendix A). These differences were investigated in robustness analyses.

2.2. Follow-up at age 22 to 24 years

Health and education data were collected as part of a larger interview on participant well-being at the 20-year follow-up. The interview included 120 items on life history and experiences, with an average completion time of 45 min. Most respondents completed by telephone (77%) through the University of Wisconsin Survey Research Center and the Public Opinion Laboratory at Northern Illinois University. Study approval was granted by IRBs at the Universities of Wisconsin and Minnesota.

2.3. Parental involvement and expectations

As measures of family support for children's education and development, two indicators were defined. Parental involvement in school activities was the number of years from 1st grade through 4th grade in which involvement was rated average or better by teachers and parents. In each of the four grades over this span, teachers assessed parent involvement in school on a 5-point scale from (U.S. Department of Health and Human Services, 2014a) “poor/not at all” to (Wellman et al., 2016) “excellent.” Values were coded dichotomously with a cut score of (Benjamin et al., 2017) “average/fair amount” or higher and summed. Parents self-reported their involvement in school activities when their child was in 2nd (7-point scale from “never” to “every day”) and 4th grades (3-point scale from “never” to “often”). Each response was dichotomized at the midpoint and summed with the teacher reports (total range of 0 to 6). Responses that were missing in any year were coded as not meeting the average/better threshold, though the entire study sample had at least one response from a teacher or parent. The validity of teacher ratings of parent involvement in school is well-documented (Juonala et al., 2016; Kyriakides et al., 2013; Reynolds et al., 2001), with a composite of teacher and parent ratings having stronger construct and predictive validity (Reynolds, 2000; Reynolds and Ou, 2010; Reynolds et al., 2001).

Parent expectations for children's educational attainment were the number of years of education that parents expected their children to attain in the future (range of 8 to 18). Measured in a survey of children's educational experiences between 4th and 6th grades, parents (usually the mother) were asked how far in school they expected their child would get. Responses ranged from grade 8 (U.S. Department of Health and Human Services, 2014a) to graduate degree (Jefferis et al., 2003) and were recoded to years of education (e.g., high school graduate = 12; 4-year degree = 16). Missing data were imputed with values from a similar item in 2nd grade. If also missing the latter, values were imputed with the same item in the 11th grade parent survey. Parent expectations for children's education are a strong correlate of student performance (Juonala et al., 2016).

2.4. School quality and mobility

Two indicators were defined. Elementary school quality was a dichotomous variable indicating whether participants attended a selective-enrollment magnet school for one or more years over 4th through 8th grades. Measured from year-by-year school records of enrollment in the Chicago Public Schools, magnet school attendance is a widely used indicator of school quality, reflecting participation in academically enriched learning environments (Lerman et al., 1999; Ling et al., 2009; Reynolds et al., 2001; Reynolds et al., 2007). More than 50% of CLS students in magnet schools performed at/above proficiency levels on district and state assessments, which is substantially higher than in neighborhood schools (20%) (Reynolds et al., 2001). Peer norms in magnet of schools of prosocial behavior and high expectations for performance also strengthen the climate for well-being (Reynolds et al., 2007). Previous studies indicate that enrollment in such schools is predictive of high school graduation, reduced delinquency, and lower risk of health-compromising behavior in adulthood (Lerman et al., 1999; Reynolds et al., 2001; Reynolds et al., 2009).

School mobility was defined as the number of times participants changed schools from 4th through 8th grades. This range was chosen to reflect elementary school transitions and school support that are independent of CPC school-age participation. Intra-year moves were not counted unless the participant remained in that same school the following year. As a measure of school support behavior, fewer moves enhance developmental continuity through stable instructional and academic expectations as well as maintenance of social and peer ties (Munafo et al., 2004). Meta-analyses document that mobility, especially if frequent, is associated with increased dropout (McLeer and DeHart, 2013) and health-compromising behaviors (Ling et al., 2009; Reynolds et al., 2009).

2.5. Smoking outcomes

As part of a checklist of health risk behaviors, participants were asked: "Have you ever: smoked tobacco (cigarettes, cigars)?" and then "If Yes: How often do you currently use it?" Response options ranged from (U.S. Department of Health and Human Services, 2014a) more than once a day to (Lanza and Vasilenko, 2015) never. Three dichotomous variables were defined.

Any smoking history was coded dichotomously such that an affirmative response (response options 1 to 5) to "Have you ever smoked" was coded as 1, and all other responses were coded as 0. Ten missing cases were coded 0.

Currently smoking was defined as a positive response to "How often do you currently use it?" at any level of frequency. Remaining individuals were coded 0.

Daily smoking was defined similarly to current smoking but the threshold was set to a frequency of "more than once a day" or "nearly every day." Others were coded 0. Other forms of tobacco use (e.g., spit) were not assessed, as cigarettes have been the major focus of research (Benjamin et al., 2017).

2.6. Child & family demographics and covariates

Family and child characteristics were measured from birth records, school records, parent report, and participant report through early school age (Reynolds et al., 2001; Reynolds et al., 2007; Reynolds et al., 2009). *Birth variables* included gender, race/ethnicity, birth weight, and if the mother was under 18 when she gave birth. *Early childhood characteristics*, measured primarily from birth to age 3, included: (a) family was eligible for Aid to Families with Dependent Children (AFDC) (Reynolds et al., 2009); (b) 4 or more children lived in the household; (c) mother did not complete high school; (d) mother was not employed; (e) child was in a single-parent household; and (f) any child welfare cases were reported. *School-age factors* included (a) participants' retrospective report of parental history of substance abuse; (b) percentage of families in poverty in school attendance area (60% or more); (c) eligibility for subsidized lunches; (d) school readiness skills at kindergarten entry as measured by the Iowa Tests of Basic Skills (ITBS); and (e) CPC participation (ages 3 to 4 and ages 6 to 8). Table 1 includes descriptive statistics for these variables.

Table 1
Descriptive statistics for model variables in CLS sample at follow up (age 24)[a].

Domain and variable	N, percent	M (SD)
Birth variables/characteristics		
Female	620, 54.3	–
African American	1075, 94.1	–
Birth weight (lbs.)/(% < 5.5 lbs)	137, (12.0)	6.79(1.26)
Mother under age 18 years at child's birth*	194, 17.0	–
Early childhood family demographics & behavior (ages 0–5)		
4 or more children in household*	201, 17.6	–
Mother did not complete school*	600 52.5	–
Participation in public aid (AFDC)*	698, 61.1	–
Mother not employed*	749, 65.6	–
Reside in single-parent household*	857, 75.0	
Child welfare services by age 3	41, 3.6	
Family risk index (0 to 8 indicators*)	–	4.51(2.22)
School-age and program experiences (ages 3 to 15)		
Percent low-income families in neighborhood/ (% > 60%)*[b]	871, (76.3)	66.22(6.44)
Eligible for subsidized school lunches (<185% poverty level)*	951, 83.3	
Parental substance abuse (retrospective report by age 15)[c]	154, 13.5	–
School readiness skills, age 5 (Iowa tests of basic skills)[d]	–	47.99(8.98)
CPC preschool participation, age 3 or 4	750, 65.7	–
CPC school-age participation, age 6 to 8	644, 56.4	–
Missing data imputation for family risk indicators	146, 12.8	
Completed survey in 2002 (year 1)**	566, 49.6	–
Family support and school quality (ages 7–14)		
Parent expectations for child's educational attainment (in years)	–	14.38(1.68)
Average or better parent involvement in school (grades 1 to 4)	–	1.46 (1.12)
Attended a magnet elementary school (grades 4 to 8)	122, 10.7	–
Number of school moves from grades 4 to 8	–	0.91 (0.92)

[a] $N = 1142$. CLS = Chicago longitudinal study. *included in family risk index. Among completed surveys, 77% were phone intervention, 12% mailed and completed, and 11% face-to- face interviews. **Study follow-up indicator. Proportions who completed survey in 2003 and 2004 were, respectively, 26.9% and 22.9%.

[b] Percent low-income families includes sample size (871) and mean percentage on right hand side (66.22).

[c] Parent substance abuse was assessed via a checklist completed by the participant; whether substance was tobacco or another drug was not specified. To adjust for recall bias, reports up to age 15 were included.

[d] The Iowa tests of basic skills (ITBS) is a widely used norm-referenced standardized test. Scores from the cognitive composite (vocabulary, math, word analysis, and listening) in the fall of kindergarten ranged from 28 to 83. The national norm was 48 (ITBS standard score).

2.7. Statistical analyses

Analyses were conducted using IBM SPSS Statistics, Version 24. Logistic regression analysis was used to estimate the associations with smoking outcomes of parent involvement, parent expectations, magnet school attendance, and school mobility. Log-odds ratios (OR) are reported for two sequential models, with the first including our four hypothesized correlates of smoking behaviors. The second model added all covariates and year of survey report (2002 or 2003). 95% confidence intervals were calculated, and intervals that did not include a value of 1.0 were interpreted. Corrections for potential attrition bias using

Table 2
Proportion of smoking behaviors by age 24 by sample attributes in the Chicago Longitudinal Study (CLS; $N = 1142$).

Attribute	Ever smoked	Current smoker	Daily smoker
	N, rate	N, rate	N, rate
Total sample	537, 47.0%	426, 37.3%	320, 28.0%
Females	214, 34.5%	159, 25.6%	123, 19.8%
Males	323, 61.9%	267, 51.1%	197, 37.7%
CPC participation, age 3–9	402. 46.3%	316, 36.4%	229, 26.4%
No CPC participation	135, 49.3%	110, 40.1%	91, 33.2%
Parent high school graduate	237, 43.7%	182, 33.6&	132, 24.4%
Parent high school dropout	300, 50.0%	244, 40.7%	188, 31.3%
High parent involvement	83, 39.3%	65, 30.8%	44, 20.8%
Lower parent involvement	454, 48.8%	361, 38.8%	286, 30.7%
Attended magnet school	42, 34.4%	23, 18.9%	14, 11.5%
Did not attend magnet	495, 48.5%	403, 39.5%	306, 30%
No school moves	190, 42.1%	147, 32.6%	105, 23.3%
One move	199, 45.9%	158, 36.4%	118, 27.2%
Two moves	99, 56.3%	80, 45.5%	62, 35.2%
Three moves*	44, 58.7%	36, 48.0%	31, 41.3%

Note. All data are from school records, except for parent involvement in school, which a composite of teacher and parent ratings (grades 1 to 4) and parents' high school attainment, which are from birth records supplemented with parent reports. As a measure of school quality, magnet school attendance was 4th through 7th grades. High parent involvement is a rating of 3 or more years of average or better involved compared a ratings of 0 to 2 years. *Those with 4 school moves are not shown (ns = 5, 5, 4 [of 6]; prevalence = 83.3%, 83.3%, and 66.7%).

propensity score analysis did not alter findings. Clustered standard errors were unnecessary, as intraclass correlations by original school site were below 0.01. Since a dummy code for multiple imputation of family demographics (12.8% had imputed values) did not evince an association in all models, it was excluded.

3. Results

Table 2 shows the proportion of the three smoking measures for the total sample and select subgroups. Smoking proportions for males were double that of females. For current smoking, the proportion was higher for males than for females. Participants who attended magnet elementary schools had lower proportions of current smoking as did those with higher levels (i.e., 3 or more vs. less) of parent involvement in school. The regression models assess these associations.

3.1. Any smoking history

3.1.1. Parent involvement in school and expectations

Table 3 shows the ORs, CIs, and model fit for the logistic regressions. As shown in the first column of unadjusted coefficients (Model 1), parental involvement in school was associated with reduced likelihood of smoking such that each 1-point increase reduced the odds by 12%. Parent expectations for attainment were unrelated to smoking. In the full model with all predictors and covariates, parent involvement in school was inversely associated with lifetime smoking history. Of the covariates, female gender (OR = 0.35; 95% CI = 0.27, 0.46), parent substance abuse history (OR = 2.5; 95% CI = 1.70, 3.70), and four or more children in the family (OR 1.53; 95% CI = 1.07, 2.19) were associated with smoking. This pattern was consistent across smoking models.

3.1.2. School quality and mobility

After controlling for baseline characteristics and parent involvement measures, each additional school move was associated with a 19% higher likelihood of smoking (OR = 1.19; 95% CI = 1.03, 1.38). Enrollment in magnet elementary schools was not associated with smoking history.

3.2. Current and daily smoking

3.2.1. Parent involvement in school and expectations

Neither family support indicator was associated with current smoking. Parent involvement was associated with lower odds of daily smoking, but only in unadjusted and baseline models (e.g., OR = 0.87; 95% CI = 0.76, 0.99; Appendix B).

3.2.2. School quality and mobility

Magnet school enrollment was found to reduce the odds of current smoking by more than half (OR = 0.47; 95% CI = 0.28, 0.79). It was further associated with a 60% reduction in odds of daily smoking. Likewise, the number of school moves was associated with higher likelihood of current smoking (OR = 1.17; 95% CI = 1.01, 1.36) and daily smoking (OR = 1.19; 95% CI = 1.02, 1.39), above and beyond magnet school enrollment.

Fig. 1 translates the strength of associations in Table 3 to percent reductions in smoking prevalence for commonly observed groups. Youth who were school stable, for example, had a 24% lower rate of lifetime smoking prevalence than those with 3 moves. Those attending magnet schools experienced a 48% lower rate of current smoking than those in neighborhood schools. Participants with high parental school involvement showed a 20% reduction in lifetime prevalence compared to the low involvement group.

3.3. Robustness

Four sets of robustness analyses were conducted. The first two models included family and school support factors separately (Appendix B). Composite family risk scores of the sum of SES indicators (see Table 1) assessed by ages 3 and 8 were included in an additional model (Appendix C). The pattern of findings was nearly identical. Second, to examine if attrition from the adult survey influenced findings, a propensity score measuring the probability of being in the recovery sample (predicted by variables in Table 1) was added. The linear, squared, and cubed propensity terms did not evince any effect. Finally, models that added adversity in the early home environment (e.g., frequent conflict) and another achievement wave yielded similar results (Appendix D). Together these alternate model specifications support robustness of findings.

3.4. Subgroup analyses

Subgroup analyses assessed whether associations with smoking behaviors were moderated by gender. For testing, variables were grand-mean centered to reduce multicollinearity. Although twice as many males as females were smokers, the pattern of associations was similar between groups (Appendix E). Following feedback from a reviewer of this article, we additionally tested whether associations were moderated by participation in CPC intervention. All program interactions did not contribute to the models, signifying that associations with smoking outcomes were equivalent between groups (Appendix F).

4. Discussion

Findings provide support for the association of three early life family and school context experiences in the development of smoking behaviors. Given that 37% of study participants were current smokers–10 points higher than the national rate for young adults (Bronfenbrenner, 1979)–these early life experiences highlight important avenues for reducing smoking prevalence among economically disadvantaged populations. Prevalence of smoking for participants with high levels of parent involvement, who enrolled in high-quality elementary schools, or who were school stable was at or below the national average. Given the many socioeconomic barriers to good health growing up, these links are especially noteworthy.

Table 3
Odds ratios for model of adult smoking behaviors from logistic regressions (N = 1142)[a].

	Ever smoked		Currently smoking		Daily smoking	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Gender (1 = female)		0.35		0.37		0.49
		[0.27, 0.46]		[0.28, 0.49]		[0.36, 0.65]
Race (1 = African American)		1.00		1.23		1.43
		[0.57, 1.75]		[0.69, 2.18]		[0.76, 2.69]
Birth weight (lbs.)		0.92		0.91		1.00
		[0.83, 1.02]		[0.82, 1.02]		[0.89, 1.12]
Mother under age 18 years		1.09		1.04		0.80
		[0.75, 1.59]		[0.71, 1.51]		[0.54, 1.21]
Eligible for participation in AFDC		0.95		0.82		0.89
		[0.65, 1.38]		[0.55, 1.20]		[0.59, 1.36]
4 or more children in household		1.53		1.77		1.72
		[1.07, 2.19]		[1.23, 2.54]		[1.18, 2.50]
Mother did not complete high school		1.15		1.21		1.30
		[0.86, 1.53]		[0.90, 1.62]		[0.96, 1.78]
Mother not employed		1.04		1.07		1.08
		[0.72, 1.50]		[0.73, 1.56]		[0.71, 1.62]
Single-parent household		0.73		0.99		1.24
		[0.53, 1.01]		[0.71, 1.38]		[0.86, 1.77]
Child welfare case recorded		0.94		0.78		0.96
		[0.47, 1.87]		[0.39, 1.58]		[0.46, 1.99]
Parental substance abuse		2.51		1.73		1.70
		[1.70, 3.70]		[1.18, 2.52]		[1.15, 2.51]
Poverty in school attendance area > 60%		0.88		0.89		1.08
		[0.65, 1.19]		[0.65, 1.21]		[0.77, 1.51]
Eligible for subsidized school lunches		0.96		0.88		0.72
		[0.66, 1.39]		[0.60, 1.29]		[0.48, 1.07]
Iowa tests of basic skills		1.01		1.01		1.01
		[1.00, 1.03]		[0.99, 1.02]		[0.99, 1.03]
CPC preschool participation		1.07		1.05		0.95
		[0.79, 1.44]		[0.78, 1.43]		[0.69, 1.30]
CPC school-age participation		0.92		0.94		0.86
		[0.69, 1.22]		[0.71, 1.25]		[0.64, 1.17]
Parent expectations	0.98	1.05	0.95	1.02	0.95	1.01
	[0.92, 1.06]	[0.97, 1.14]	[0.89, 1.03]	[0.94, 1.11]	[0.88, 1.03]	[0.93, 1.10]
Parent involvement	0.88	0.88	0.90	0.91	0.86	0.88
	[0.79, 0.98]	[0.78, 0.99]	[0.80, 1.00]	[0.81, 1.04]	[0.76, 0.97]	[0.76, 1.00]
Magnet school attendance	0.63	0.75	0.40	0.47	0.35	0.40
	[0.42, 0.93]	[0.47, 1.18]	[0.25, 0.65]	[0.28, 0.79]	[0.20, 0.63]	[0.21, 0.74]
Number of school moves	1.23	1.19	1.21	1.17	1.25	1.19
	[1.07, 1.40]	[1.03, 1.38]	[1.06, 1.39]	[1.01, 1.36]	[1.08, 1.45]	[1.02, 1.39]
Constant	1.18	1.46	1.26	1.29	0.93	0.34
–2 Log likelihood	1551.44	1392.01	1470.34	1345.07	1310.55	1215.71
Nagelkerke pseudo-R^2	0.032	0.201	0.045	0.182	0.055	0.165

[a] Values in brackets represent 95% confidence intervals. Models 2, 4, and 6 additionally controlled for age 24 survey completion variables. Completing the survey in 2002 (as opposed to 2004) was associated with reduced odds of having a smoking history (OR = 0.41; 95% CI: 0.29, 0.57), being a current smoker (OR = 0.46; 95% CI: 0.33, 0.64), and being a daily smoker (OR = 0.39; 95% CI: 0.27, 0.55). Completing the survey in 2003 (as opposed to 2004) was not associated with odds of having a smoking history (OR = 0.86; 95% CI: 0.60, 1.24), being a current smoker (OR = 1.00; 95% CI: 0.71, 1.43), or being a daily smoker (OR = 0.79; 95% CI: 0.55, 1.13). The upper 95% CI for parent involvement in school (ever smoked) is slightly <1.0 (0.995).

Results extend the work of previous CLS studies (Ling et al., 2009; Reynolds et al., 2009; Reynolds et al., 2010) and others (Hayakawa et al., 2016; Herbers et al., 2013; Leatherdale and Manske, 2005) showing that parent involvement in school is independently associated with lower substance abuse, crime prevention, school achievement, and educational attainment (Juonala et al., 2016; Kyriakides et al., 2013). Our study is one of the first to show a direct linkage with smoking in adulthood. Prior CLS studies have documented either indirect effects or direct impacts on education outcomes (Reynolds et al., 2009; Reynolds et al., 2010). School involvement and engagement is a protective factor in which parents are modeling prosocial behavior and interest in education that supports child learning. It also reflects the interaction between families and schools that creates a positive learning environment for well-being (Hu et al., 2006; Lanza and Vasilenko, 2015; Reynolds et al., 2017).

Our findings that school quality and frequent mobility in elementary school were consistently associated with smoking behaviors in the expected direction are new, and extend previous research that high-quality schooling can promote broader health and social behaviors (Ling et al., 2009; O'Connell et al., 2009; O'Loughlin et al., 2009). Meta-analyses, for example, indicate that multiple school moves substantially increase the risk of school dropout (McLeer and DeHart, 2013). Other studies show that school moves are associated with increased substance abuse, mental health problems, and arrests (Munafo et al., 2004; Rutter and Rutter, 1993; Topitzes et al., 2009). In previous CLS studies, school quality and mobility contributed directly and indirectly to broader health-compromising behaviors (O'Connell et al., 2009; O'Loughlin et al., 2009). School mobility, especially if frequent, disrupts peer and social ties that are detrimental to learning and developmental continuity (Lovato et al., 2010; Munafo et al., 2004). In contrast, attending higher quality schools is a commonly-found protective factor against risky health behaviors (Lerman et al., 1999; Reynolds et al., 2007) as

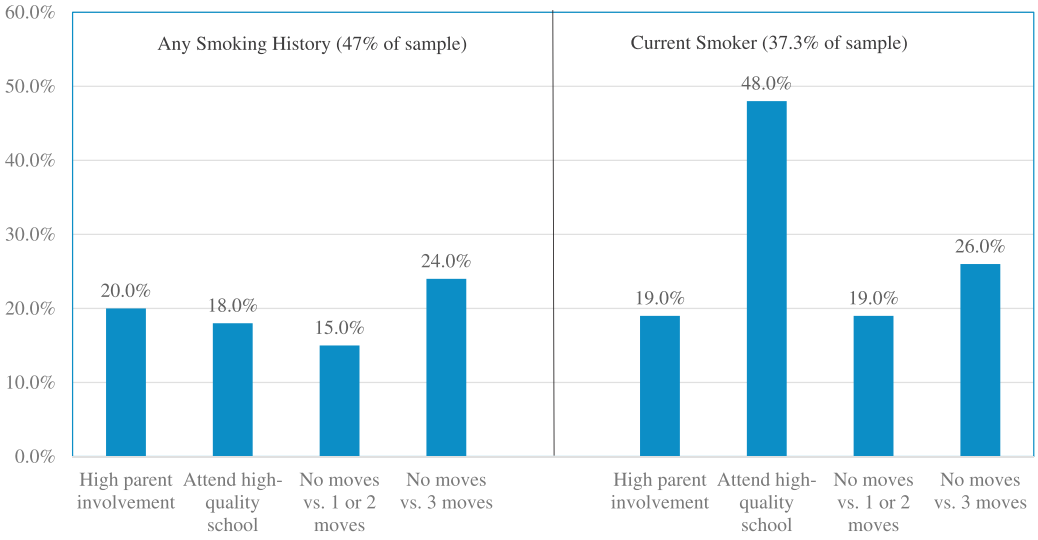

Fig. 1. Percent reduction in smoking prevalence in proportions associated with three model variables. Values are calculated from marginal means in percentage points adjusted for model variables as shown in Table 3. Marginal differences were significant at the 0.05 level. High parent involvement is 3 years of average/better involvement versus none (low). Moves are compared to the 3-move and 1 or 2-move groups. Group proportions were as follows for any smoking history: High vs. low parent involvement (40.4% vs 50.6%), high quality school vs. none (34.4% vs. 41.7%), no moves vs. 3 moves (42.1% vs. 55.6%), and no moves vs. 1 or 2 moves (42.1% vs. 49.8%). For current smoking they were: High vs. low parent involvement (31.7% vs. 38.9%), high quality school vs. none (18.9% vs. 36.6%), no moves vs. 3 moves (32.6% vs. 44.3%), and no moves vs. 1 or 2 moves (32.6 vs 40.0).

such schools have stronger learning climates in support of school achievement and prosocial behavior (Jeynes, 2007; Lovato et al., 2010; Reynolds et al., 2007).

Prevention and health-promotion strategies that enhance parent involvement, family socialization, and school quality are home visitation and parenting skills programs (Community Preventive Services Task Force, 2015; Leatherdale and Manske, 2005), comprehensive preschool and school-age interventions (Topitzes et al., 2010), social skills trainings (Community Preventive Services Task Force, 2015), school improvement and reform efforts that bolster instructional and family support (U.S. Department of Health and Human Services, 2014a; U.S. Department of Health and Human Services, 2014b), youth mentoring, and dropout prevention programs (U.S. Department of Health and Human Services, 2014a). Place-based initiatives and community partnerships also strengthen support for parents and reduce barriers to involvement (e.g., full-day preschool, workshops) (United Nations Development Programme, 2014). Greater availability and implementation of these programs and practices may strengthen behaviors that lead to smoking prevention.

We found no evidence that parent expectations for children's educational attainment was associated with smoking. This suggests that the consistent linkage between expectations and children's educational success (Juonala et al., 2016; Reynolds et al., 2010) may not carry over to health-compromising behaviors. There are three explanations to these findings. First, there was limited variability in expectations, which may have affected the strength of association. In addition, linearity may not hold—rather, a threshold may be necessary to impact health. Finally, the relation with smoking may be indirect or more complex, operating through parenting behaviors and parent-child relationships such as parental involvement (Ling et al., 2009; Reynolds et al., 2010; Vuolo and Staff, 2013). Further investigation along these lines is warranted.

Although our findings of substantially higher rates of smoking for males are consistent with prior studies (Otten et al., 2007; Ou et al., 2007), the associations of hypothesized predictors were similar for both groups. This is consistent with twin research showing the same genetic and environmental factors contribute to smoking for males and females (Wellman et al., 2016; Winsper et al., 2016; Youn et al., 2015). Future studies are warranted that assess a wider range of individual and environmental factors (Vuolo and Staff, 2013), including later school achievement, educational attainment, peer affiliation, and delinquency. We also found that observed associations were not influenced by CPC intervention (Appendix F) and were robust across tested models (Appendices B–E), suggesting generalizability to other similar contexts.

4.1. Limitations

We note three limitations. First, as an observational study of multiple influences on smoking, our findings are correlational and not causal. Although unmeasured variables cannot be ruled out, the model included a comprehensive set of known predictors, including birth variables, socioeconomic status, neighborhood poverty, early achievement, and parental health behaviors. The associations of family and school support indicators also controlled for each other's influence. Robustness analyses suggested a consistent pattern of associations but further corroboration is warranted. Second, parents' smoking history, a consistent predictor in prior studies, was proxied by participants' report of parental substance abuse history. Although the latter was an important influence, it may not have captured all of the contribution of parent tobacco use. Finally, the sample grew up in high-poverty contexts and thus results may not generalize to other contexts or more advantaged populations in which levels of school quality and stability would be higher. However, the purpose of the study was to identify early and alterable factors that contribute to smoking prevention for populations at risk.

5. Conclusion

In a long-term study of early risk and protective factors for an urban cohort experiencing health disparities, alterable family and school experiences were associated with reduced smoking prevalence. School-based programs and policies that strengthen parent involvement and school support in early childhood may promote health behaviors that reduce disease burden in adulthood and increase cost savings.

5.1. What's known on this subject

While poverty and a variety of individual and family factors influence smoking, early childhood factors known to promote achievement and prosocial behavior have rarely been assessed. Parent involvement in education and school quality are particularly promising for populations at risk.

5.2. What this study adds

In a prospective longitudinal cohort of children at risk, the alterable protective factors of parent involvement in school, school quality, and lower mobility were associated with lower rates of smoking after the influence of common predictors were taken into account.

Contributors' statement page

Dr. Reynolds conceptualized and designed the study, interpreted the data, drafted the manuscript, revised the manuscript, and approved the manuscript as submitted. Ms. Magro analyzed and interpreted data, helped draft and revise the manuscript, and approved the manuscript as submitted. Dr. Ou helped conceptualize and design the study, revised and reviewed the manuscript, and approved the manuscript as submitted. Ms. Eales analyzed and interpreted data, contributed to the revisions, and approved the manuscript as submitted. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Declaration of Competing Interest

The authors have no conflicts of interest relevant to this article to report. All funding is through NIHCD, with any opinions or recommendations expressed those of the authors exclusively. No financial conflicts of interest either to report.

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Appendix A. Supplementary data

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