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Associations Between Caregiver Health Literacy and Preschool Children's Secondhand Smoke Exposure

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Abstract

Objective Examine the associations between caregiver health literacy (HL) and smoking-related outcome expectancies, implementation of home/car smoking bans (H/CSBs), and child secondhand smoke exposure (SHSe). **Methods** Caregivers of Head Start children residing with a smoker(s) completed measures assessing HL, outcome expectancies, and H/CSB implementation. Biomarkers of child SHSe included home air nicotine monitors and child salivary cotinine. **Results** Caregivers with lower HL had higher levels of home air nicotine and child salivary cotinine in the full sample and among smokers. After controlling for child age and number of smokers in the home, lower HL was associated with higher endorsement of negative smoking expectancies in the full sample and in smokers. HL was not associated with H/CSB implementation across groups. **Conclusions** Caregiver HL is associated with child SHSe and is important in shaping smoking-related beliefs. HL is not directly related to adoption of SHSe-reduction behaviors such as H/CSBs.

Key words: children; disparities; tobacco use; parents.

More than 32 million children in the United States are exposed to secondhand smoke, placing them at increased risk for respiratory illnesses, middle ear disease, decreased lung function, and more severe and frequent asthma exacerbations (Centers for Disease Control & Prevention [CDC], 2010). The primary source of secondhand smoke exposure (SHSe) in children is the home with 18% residing with at least one smoker (CDC, 2010). Children aged 3–11 years are at the greatest risk for SHSe with approximately 40% of children having detectable levels of cotinine, a biomarker for nicotine (CDC, 2015a).

There are racial and socioeconomic disparities in SHSe with low-income, African-American children being at a disproportionally greater risk (CDC, 2010; King et al., 2009). Low-income children are 3 times more likely to be exposed to secondhand smoke in the home in comparison to children from middle- and high-income homes (CDC, 2010) and 7 out of every 10 African-American children are regularly exposed to secondhand smoke (CDC, 2015b). Contributors to these disparities include high rates of smoking among low-income minority adults (CDC, 2015c). Urban, low-income families are also more likely to reside in multigenerational and/or multiunit homes with multiple adults living together without private outdoor space contributing to increased child SHSe (Bleakley, Hennessy, Mallya, & Romer, 2014; Winickoff, Van Cleave, & Oreskovic, 2010). Given the disparities in SHSe among African-American, low-income children

and the resulting adverse health effects, it is important to identify potentially modifiable factors to improve health and eliminate this known health disparity.

The Institute of Medicine defines health literacy (HL) as "the degree to which individuals can obtain, process, and understand the basic health information and services they need to make appropriate health decisions" (HHS, 2000; Ratzan & Parker, 2000). HL may play an important role in smoking by limiting a person's ability to obtain, understand, and use information regarding SHSe. Low HL is common with approximately 14% of a nationally representative sample having difficulty engaging in basic literacy tasks such as reading and understanding information contained in simple text and documents (Kutner, Greenberg, Jin, & Paulsen, 2006). Though related to educational attainment, HL is distinct as it draws on reading grade levels that tend to be lower than the highest grade completed (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011) and can reflect greater unfamiliarity with health care services and terms despite overall literacy level (CDC, 2014). Low HL in adults is associated with decreased health-related knowledge and comprehension, poor health outcomes, increased hospitalizations, greater emergency department use, and lower preventative care utilization and has been hypothesized as a potential mediator of racial disparities in health (Berkman et al., 2011). Among caregivers, low HL is associated with poor child health outcomes, less general and disease-specific health knowledge, and decreased engagement in preventative health behaviors (DeWalt & Hink, 2009).

In smoking, low HL is associated with greater perceptions of positive smoking outcomes (e.g., smoking reduces boredom) and fewer negative smoking outcomes (e.g., smoking is harmful to health) in addition to decreased knowledge of smoking health risks and lower individual risk perceptions (Stewart et al., 2013). Of the few studies examining the relation between low HL and smoking status, some have found an association in certain populations such as the elderly (Sudore et al., 2006) and parents (Fredrickson et al., 1995), while other studies have not found an association (Arnold et al., 2001; Baker et al., 2007; Martin et al., 2012). Similarly, while one study found increased odds of quitting for every grade equivalent increase in reading skills (Martin et al., 2012), HL did not predict intention to reduce, limit, or quit smoking in another study (Stewart et al., 2013). Variations in the measurement of HL may contribute to these disparate findings. While there are still many questions about the association between HL and smoking there has been limited research examining the association between HL and SHSe, particularly among low-income urban families.

Short of quitting, one of the most effective interventions that caregivers can implement to reduce their child's SHSe is a complete home smoking ban (HSB), where no smoking is allowed in any parts of the home (Hill & Liang, 2008; Johansson, Hermansson, & Ludvigsson, 2004). Partial HSBs, which allow for smoking in designated areas of the home, have not been shown to be effective in reducing children's SHSe (Wakefield et al., 2000). Although HSBs are only adopted in 50% of all U.S. homes where both a child and smoker reside, rates of implementation are significantly lower in African-American homes, with only 33% of families implementing HSB (Mills, White, Pierce, & Messer, 2011). Limited awareness of the harmful effects of SHSe, African-American households, and lack of private outdoor space decreases the likelihood of implementing a complete HSB (Bleakley et al., 2014).

The family composition and smoking status predicts the presence of a HSB with 88% of nonsmokers and 27% of current smokers having a complete HSB (Winickoff et al., 2009). Families who have more than one smoker are much less likely to have a HSB (Bleakley et al., 2014). Thus, reducing SHSe in children through implementation of a HSB is a challenge because the primary caregiver may not be the smoker in the home nor be responsible for making house rules. For example, HSB implementation involves caregiver nonsmokers asking others not to smoke compared with caregiver smokers who have to focus on changing their own smoking behavior. This is much more complicated for low-income families living in urban environments who are faced with unique challenges to smoking outdoors including unsafe neighborhoods, outdoor pollution and exposure, limited private outdoor living space, and multiunit homes. In addition, they may face the added complexity of implementing HSBs in homes with multiple smoking adults. However, there is limited research on what factors predict disparities in the implementation of a HSB, particularly among low-income urban families of preschoolers.

Given that HL is associated with smoking outcome expectancies among smokers (Stewart et al., 2013), it is possible that HL plays a similar role in shaping beliefs around SHSe and subsequent child SHSe. Beliefs about the adverse health effects of child SHSe were associated with household rules around smoking in urban households with both a smoker and a child below 13 years (Hennessy, Bleakley, Mallya, & Romer, 2014). Specifically, caregivers who endorsed a no to low intention to implement a HSB were significantly less likely to believe that limiting child SHSe would result in fewer breathing problems, prevent ear infections, and limit emergency room visits in comparison to caregivers with high intention (Hennessy et al., 2014). Therefore, low HL may be associated with lower awareness of the harmful effects of SHSe, decreased likelihood to implement a HSB, and increased

child SHSe. However, these relations have not been examined, particularly among vulnerable populations such as low-income minority families.

The purpose of this study was to assess the association of HL among smoking and nonsmoking caregivers on smoking-related outcome expectancies, presence of a HSB, and objective measures of SHSe outcomes in urban, low-income children living with ≥ 1 smoker. Caregivers with low HL were hypothesized to perceive less harmful effects of SHSe, be less likely to have a HSB, and have higher rates of child SHSe as indicated by child salivary cotinine and home air nicotine levels in comparison to caregivers with high HL. Because previous research has demonstrated significant differences in the rates of HSB implementation in caregiver smokers versus nonsmokers (Winickoff et al., 2009), analyses were also conducted stratifying by caregiver smoking status.

Methods

Participants

Data for this study came from the baseline assessment of 336 families enrolled in a longitudinal randomized clinical trial from 2009 to 2013, which aimed to reduce child SHSe in preschool children enrolled in an urban Head Start system (Eakin et al., 2014). The enrolled sample had a similar gender, income, and age distribution to the 10,394 (88%) urban Head Start caregivers who completed a screening questionnaire; however, our enrolled sample was 91% African American compared with the 95% reported by Head Start. Subsequently, 350 caregivers consented to participate and 336 completed the baseline assessment. For this purpose of this study, only participants without any missing baseline data were examined. This excluded 4 participants who did not complete the baseline assessment, 55 who did not have HL data because the measure was added to the baseline assessment at a later date, 5 were missing cotinine data, and 4 were missing survey items (i.e., 2 on the outcomes expectancies measure, 1 for the HSB question, and 1 for the CSB question), resulting in a final sample size of 268. The excluded participants had significantly older children ($p = .01$), lower child salivary cotinine ($p = .001$), and lower air nicotine levels ($p = 001$) but did not differ from the final sample on number of smokers in the home, HL, presence of H/CSBs, and outcome expectancies.

Measures

Health Literacy

The Rapid Estimate of Adult Literacy in Medicine-Short Form (REALM-SF) is a 7-item instrument used to assess literacy, validated in an age, gender, education, and ethnically diverse sample (Arozullah et al., 2007). It has demonstrated good test–retest reliability and concurrent validity with other measures of HL (i.e., REALM, Test of Functional Health literacy in Adults (TOFHLA), and Wide Range Achievement Test (WRAT)-R; Arozullah et al., 2007). In a recent systematic review, the REALM-SF was noted to be one of the most commonly used measures of HL among caregivers presenting for pediatric healthcare (Morrison, Myrvik, Brousseau, Hoffman, & Stanley, 2013). The REALM-SF assesses one's ability to correctly pronounce a list of medical terms (e.g., antibiotics, jaundice) categorized into four grade levels (i.e., ≤ 3rd, 4th-6th, 7th-8th, and ≥ 9th grade). The total score was calculated based on the number of items read correctly with a range of 0–7. Higher scores indicate greater HL skill. The REALM-SF can be scored continuous, or a cutoff score of <7th–8th grade reading level can be used to categorize low HL. The alpha coefficient for the current sample was 0.81 indicating good reliability.

Smoking Status

Caregivers were asked to report whether or not they were a current smoker and the number of people who smoke in the home with the child.

Smoking-Related Outcome Expectancies

The Outcome Expectancies measure is a self-report survey assessing caregiver's thoughts on SHSe and H/CSBs. Developed for this study, the outcome expectancies measure is based upon other surveys assessing attitudes, beliefs, knowledge, social influences, and behaviors related to SHSe and HSBs (de Vries & Backbier, 1994; Yousey, 2006). Example items include "There is not good proof that children get sick easier if they are exposed to "smoke" and "Banning smoking in my home and car will lower the risk of my child developing asthma or having an asthma attack." It is composed of 26 items rated on a 5-point Likert scale from "strongly disagree" to "strongly agree"; 13 items were reverse scored. The total score ranges from 0 to 130, with higher scores indicating more positive expectations around limiting SHSe. The alpha coefficient for the current sample was 0.84 indicating good reliability. The Flesch-Kincaid grade reading level of the measure was 5.5.

Smoking Ban

Caregivers were asked to report the presence or absence of a home and/or a car smoking ban (H/CSB). HSBs have been shown to be associated with biomarkers of SHSe in a Head Start population (Yousey, 2006) and the degree of reported smoking among inner-city Black smokers (Okah et al., 2003). Responses were dichotomized such that household rules reflecting

a complete HSB (no smoking is allowed in my home with no exceptions) were given a score of 1 and those indicating a partial (smoking is sometimes allowed in my home) or absent (there are no rules about where people can smoke in my home) HSB received a 0. Caregivers who endorsed the additional CSB response option, "I do not travel in a car", were excluded from analyses that included CSB as an outcome. Scoring for the CSB was dichotomized to be consistent with the HSB (i.e., complete vs. partial/ absent).

Objective Measures of SHSe

Home air nicotine and child salivary cotinine were collected as indicators of SHSe (Apelberg et al., 2012). Air nicotine was monitored using passive sampling monitors (Hammond & Leaderer, 1987) that have been shown to be both reliable and valid (Leaderer & Hammond, 1991). Monitors were placed for 7 days in the location where the child slept and another room identified as a "major activity room" by the caregiver. The air monitor relies on passive diffusion of nicotine to the filter where it is trapped and the detection limit was 0.01 μg with a coefficient of variability of 0.11 (Hammond & Leaderer, 1987). Nicotine samples were analyzed at the Johns Hopkins Bloomberg School of Public Health. For quality control, a fixed random sampling procedure was used to collect a blank and duplicate sample for every 10 samples. A review of all field blank monitors recorded 0 mg and a comparison of the duplicate monitors showed greater than .95 correlations at all time points demonstrating high reliability. For analyses, the means of the two air nicotine monitors were calculated and log-transformed.

Salivary cotinine is a well-accepted measurement of SHSe in young children (Bernert, McGuffey, Morrison, & Pirkle, 2000). Samples were collected from the child with sorbettes using a standard protocol. Two salivary cotinine samples were collected from the child at baseline and again 7 days later to reduce variability in samples due to recent exposure (Matt et al., 2007). The samples were stored frozen, batched, and transported on ice to the Johns Hopkins University Center for Interdisciplinary Salivary Bioscience Research where they were tested. The samples were assayed for cotinine using a commercially available enzyme immunoassay without modification to the manufacturer's protocol (Salimetrics, State College, PA). The test used 20 ml of sample (10 μl saliva diluted in 90 μl of assay diluent), had a lower limit of sensitivity of .05 ng/ml, range of sensitivity from 0.05 to 200 ng/ml, and average intra- and interassay coefficients of variation of less than 10% and 15%, respectively. For analyses the mean of the four cotinine samples were averaged together and log-transformed due to nonnormal distribution.

Procedures

The Johns Hopkins University Institutional Review Board approved the study and written informed consent was provided by all participants. Prior to enrollment, Head Start staff asked all families to complete an eligibility screening questionnaire that assessed whether the child lived with a smoker, the presence of a H/CSB, and permission to contact to participate in a research study. Caregiver eligibility criteria for the trial included: (1) parent or legal guardian of a child between the ages of 6 months and 6 years enrolled in a Head Start program, (2) $\geq$1 smoker currently living in the home, and 3) English-speaking. Interested families were then contacted by phone by a research assistant (RA) who confirmed eligibility and scheduled two baseline home visits (i.e., prior to randomization). During the first baseline home visit, the RA obtained written informed consent, collected 2 salivary cotinine samples from the child, and attached air nicotine monitors to the family room and the child's bedroom to measure passive air nicotine in the home. The RA returned 7 days later to complete the second baseline visit and collect two additional salivary cotinine samples from the child, detach the air nicotine monitors, and complete an assessment survey which was read to the child's primary caregiver. Participants received $50 compensation for completing both home visits.

Data Analysis Plan

Descriptive analysis was used to describe the sociodemographic and household characteristics of sample. Statistical analyses were conducted for the overall group as well as stratified by caregiver smoking status. Paired samples t-tests and chi-square analyses compared caregiver smokers to nonsmokers on demographic variables and those that were significantly different were included as covariates. Spearman's rho correlation coefficients were conducted to assess associations among the variables of interest. To investigate the impact of caregiver HL on smoking outcome expectancies and child SHSe (i.e., home air nicotine and child salivary cotinine), multiple regression analyses were conducted. Logistic regression was utilized to examine the role of caregiver HL on the presence of H/CSB.

Results

The majority of participant caregivers were mothers, African-American, and low income (Table I). Most of the primary caregivers were smokers ($n = 185$, 69%) and more than half of the households had more than one smoker ($n = 135$, 52%), whereas less than one-quarter reported having a HSB. Most of the primary caregivers were smokers ($n = 185$, 69%) and more than half of the households had more than one smoker ($n = 135$, 52%), whereas less than one-quarter

Table I. Demographic Characteristics of Study Sample and Stratified by Caregiver Smoking Status

Variables	Full sample $n = 268$	Smokers $n = 185$	Nonsmokers $n = 83$	p-value
Caregiver age (yr), mean (SD)	32.11 (8.86)	32.28 (8.56)	31.72 (9.54)	.63
Child age (yr), mean (SD)	3.71 (0.82)	3.80 (0.80)	3.51 (0.85)	.01
Child gender – female, *n* (%)	134 (50.0)	96 (51.9)	38 (45.8)	.43
Child race – African-American, *n* (%)	245 (91.4)	166 (89.7)	79 (95.2)	.16
Relation to child, *n* (%)				.38
Mother	201 (75.0)	136 (73.5)	65 (78.3)	
Father	36 (13.5)	28 (15.2)	8 (9.7)	
Grandparent	17 (6.3)	13 (7.0)	4 (4.8)	
Legal guardian/ other	14 (5.2)	8 (4.3)	6 (7.2)	
Household income, *n* (%)				.68
<$10,000	85 (31.7)	62 (33.5)	23 (27.7)	
$10,000–$30,000	108 (40.3)	76 (41.1)	32 (38.5)	
>30,000	67 (25.0)	39 (21.1)	28 (33.8)	
Missing	8 (3.0)	8 (4.3)	—	
Caregiver education, *n* (%)				.23
<High school graduate	85 (31.7)	66 (35.7)	19 (22.9)	
High school graduate/ GED	90 (33.6)	57 (30.8)	33 (39.8)	
Some college/trade school	74 (27.6)	50 (27.0)	24 (28.9)	
4-Year college graduate	9 (3.4)	5 (2.7)	4 (4.8)	
Missing	10 (3.7)	7 (3.8)	3 (3.6)	
More than 1 smoker in home, *n* (%)	138 (51.5)	115 (62.2)	23 (27.7)	<.001
Number of people who smoke in the home, median (IQR)	1.0 (1.0, 2.0)	1.0 (1.0, 2.0)	1.0 (0, 1.0)	<.001
Home smoking ban, *n* (%)	60 (22.4)	35 (18.9)	25 (30.1)	.06
Car smoking ban, *n* (%)	75 (38.0)	39 (21.1)	36 (43.4)	< .001
No car	71 (26.5)	53 (28.6)	18 (21.7)	
REALM grade equivalents, *n* (%)				
≤3rd grade	4 (1.5)	1 (0.5)	3 (3.6)	.19
4th-6th grade	21 (7.8)	16 (8.6)	5 (6.0)	
7th-8th grade	90 (33.6)	65 (35.1)	25(30.1)	
High school	153 (57.1)	103 (55.7)	50 (60.2)	

reported having a HSB. Within our sample, caregiver smokers had significantly older children ($p = .01$) and had a greater number of smokers living in the home ($p < .001$) than nonsmoking caregivers and so were included as covariates in all analyses. Caregiver smokers were also less likely to have a CSB ($p < .001$) and there was a trend for fewer HSBs ($p = .06$). Children of caregiver smokers had higher salivary cotinine rates ($p = .001$) and higher levels of home air nicotine ($p = .02$). In addition, rates of low HL were similar for both caregiver smokers ($n = 17$, 9.1%) and nonsmokers ($n = 8$, 9.6%).

Bivariate Associations

On a bivariate level, lower caregiver HL was associated with lower outcome expectancies (i.e., less positive expectations around limiting SHSe; Table II; $p < .001$) and higher levels of both home air nicotine ($p = .004$) and child salivary cotinine ($p = .002$). When stratifying the sample by smoking status, lower HL in caregiver smokers was similarly correlated with lower outcome expectancies ($p < .001$) and higher levels of home air nicotine ($p = .03$) and child salivary cotinine ($p = .01$). The pattern of results was the same for caregiver nonsmokers, except that HL was not associated with salivary cotinine.

Relation Between HL and Smoking-Related Outcome Expectancies

After controlling for child age and number of smokers in the home, multiple regression analysis was used to test the association between caregiver HL on caregiver reported SHSe outcome expectancies (Table III). Caregiver HL was a significant predictor of outcome expectancies in the full sample, $p < .001$. However, when stratifying the group by smoking status, HL only predicted outcome expectancies in caregiver smokers, $p = .001$, but not in nonsmokers, $p = .07$.

Exploring the individual smoking-related outcome expectancy items (Table IV) indicated variability in the perceived harmful effects of SHSe by caregiver HL. Caregivers with low HL were more likely to doubt the harmful health effect of smoking and SHSe than those with high HL. For example, they were more likely to agree with the following negative beliefs: "Other pollution in my neighborhood is much worse for my child than exposure to smoker," "There is no good proof that children get sick easier if they are exposed to smoke," and "Allowing smoking in my home and car does not have any effect on my health." Similarly, caregivers with low HL were more likely to perceive H/CSBs as inconvenient and a hassle compared with caregivers with high HL. Only two-thirds

Table II. Median, Interquartile Range (IQR), and Spearman's Correlations Among Study Variables for the Full Sample and Stratified by Caregiver Smoking Status

	1.	2.	3.	Median (IQR)
Full Sample ($n = 268$)				
1. Health literacy	—	—	—	7.00 (6.00, 7.00)
2. Outcome expectancies	.30**	—	—	68.00 (60.00, 76.00)
3. Air nicotine	−.18**	−.14*	—	0.93 (0.17, 2.92)
4. Salivary cotinine	−.19**	−.18**	.62**	3.97 (1.67, 7.44)
Smokers ($n = 185$)				
1. Health literacy	—	—	—	7.00 (6.00, 7.00)
2. Outcome expectancies	.29**	—	—	67.00 (58.50, 75.00)
3. Air nicotine	−.16*	−.06	—	1.23 (0.24, 3.37)
4. Salivary cotinine	−.21**	−.13	.60**	4.64 (2.22, 7.69)
Nonsmokers ($n = 83$)				
1. Health literacy	—	—	—	7.00 (6.00, 7.00)
2. Outcome expectancies	.31**	—	—	69.00 (61.00, 78.00)
3. Air nicotine	−.26*	−.26*	—	0.45 (0.13, 1.59)
4. Salivary cotinine	−.14	−.27*	.64**	2.36 (1.15, 6.83)

Note. *$p < .05$, ** $p < .01$. Log transformed cotinine and nicotine values used in correlation analysis and raw values presented for median (IQR).

Table III. Summary of Regression Analyses Examining the Role of Caregiver Health Literacy on Smoking Beliefs and Exposure

Measure	Full sample ($n = 268$)	Smokers ($n = 185$)	Nonsmokers ($n = 83$)
Outcome expectancies			
R^2	0.08**	0.07**	0.13*
b (SE)	1.95 (0.50)**	2.26 (0.64)**	1.47 (0.80)
Air nicotine			
R^2	0.26**	0.26**	0.20**
b (SE)	−0.16 (0.06)*	−0.16 (0.08)*	−0.16 (0.10)
Salivary cotinine			
R^2	0.20**	0.22**	0.16**
b (SE)	−0.10 (0.04)**	−0.13 (0.04)**	−0.06 (0.07)

Note. Controlling for the number of people who smoke in the home and child age. *$p < .05$, **$p < .01$

(68%) of all respondents felt a H/CSB would positively reflect on their parenting; those with low HL were less likely to endorse this than those with high HL.

Relation Between HL and Implementation of Bans

Controlling for the covariates in a logistic regression analysis, caregiver HL was not significantly associated with reporting having a HSB (Table V; full sample OR: 1.13, 95% CI: 0.83, 1.54; smokers OR: 1.06, 95% CI: 0.70, 1.61; nonsmokers OR: 1.47, 95% CI: 0.81, 2.66) or a CSB (full sample OR: 0.91, 95% CI: 0.77, 1.08; smokers OR: 0.91, 95% CI: 0.72, 1.16; nonsmokers OR: 0.92, 95% CI: 0.71, 1.18).

Relation Between HL and Biomarkers of SHSe

Lower caregiver HL was associated with higher levels of child salivary cotinine in the full sample ($p = .01$) and in caregiver smokers ($p = .003$), but this relation was not supported among nonsmokers (Table III) after controlling for child age and number of smokers in the home. Similarly, lower caregiver HL was also associated with higher levels of home air nicotine in the full sample ($p = .01$) and in caregiver smokers ($p = .04$), but this relation was not significant in nonsmokers.

Discussion

This study examined the relation between HL and smoking-related outcome expectancies, child SHSe, and implementation of a H/CSB among low-income, urban caregivers of Head Start children living with at least one smoker. Overall, low caregiver HL predicted higher air nicotine in the home, higher levels of child salivary cotinine, and lower outcomes expectancies such as less perceived harmful effects of smoking and SHSe. When stratifying by caregiver smoking status, the same patterns held for caregiver smokers but not

Table IV. Percentage of Caregivers Who Agreed or Strongly Agreed With Negative and Positive Outcome Expectancy Items by Low and High Health Literacy Status

	Overall (%) $n = 268$	High HL (%) $n = 153$	Low HL (%) $n = 115$	
Negative outcome expectancies				
Other pollution in my neighborhood is much worse for my child than exposure to smoke.	44.8	35.2	57.4	**
It is unfair to ask adults to leave their own home to smoke.	30.6	30.1	31.3	
Family members would be mad at me if I asked people not to smoke in my home and car.	29.9	27.5	33.0	
There is no good proof that children get sick easier if they are exposed to smoke.	26.5	20.3	34.8	*
It is inconvenient for the smokers in my home to smoke outside.	26.5	18.3	37.4	**
People would think I was picky, uppity, or "putting on airs" if I banned smoking in my home and car.	24.2	24.8	24.3	
Letting people smoke in my house won't affect my child's health as long as my child isn't in the room.	17.2	13.7	21.7	
Asking people not to smoke in my home and car would make my life more stressful.	16.8	13.7	20.9	
It is not worth the hassle to make people smoke outside.	16.0	11.1	22.6	*
Allowing smoking in my home and car does not have any effect on my health.	16.0	9.8	24.3	**
If it is legal to smoke in your home than it must be safe.	14.6	11.1	19.1	
I am not convinced that smoke exposure is bad for people's health.	14.2	9.8	20.0	*
Banning smoking in my home and car will make it harder to socialize with friends.	10.8	9.1	13.0	
Positive outcome expectancies				
Banning smoking in my home and car will lower the risk of my child developing asthma or having an asthma attack.	93.7	94.8	92.2	
My child's doctor would support me if I ban smoking in my home and car.	92.2	94.1	89.6	
My family would support me if I ban smoking in my home and car.	88.1	91.5	83.5	
My home and car would be cleaner or wouldn't smell if I banned smoking in them.	86.9	86.3	87.8	
My friends would support me if I ban smoking in my home and car.	83.6	86.2	80.0	
Banning smoking in my home and car will lower the risk of me getting cancer.	83.2	82.4	84.3	
I would feel better about my ability to be a good parent if I banned smoking in my home and car.	81.0	81.7	80.0	
Banning smoking in my home and car will lower the risk of my child getting a cold.	78.4	79.1	77.4	
People would be proud and respect me if I banned smoking in my home and car.	73.5	75.8	70.4	
Banning smoking in my home and car will lower the risk of me having a heart attack.	72.8	74.5	70.4	
Banning smoking in my home and car will lower the risk of my child getting an ear infection.	68.7	69.3	67.8	
People would think I am a good parent if I banned smoking in my home and car.	68.3	73.2	61.7	*
If I banned smoking in my home and car, my child would be less likely to become a smoker.	67.2	68.6	65.2	

Note. Percentages reflect caregivers who either "agreed" or "strongly agreed" with the outcome expectancy item on a 5-point Likert scale. Health literacy was dichotomized using the cutoff score of <6 (i.e., equivalent to a 7th–8th grade reading level). Utilizing chi-square analyses, significant group differences by HL are indicated by *$p < .05$ and **$p < .01$.

Table V. Logistic Regression Analyses Predicting Implementation of a Car and Home Smoking Ban From Caregiver Health Literacy

Smoking ban	Full sample Odds ratio (95% CI)	Smokers Odds ratio (95% CI)	Nonsmokers Odds ratio (95% CI)
Home ban present	1.13 (0.83–1.54)	1.06 (0.70–1.61)	1.47 (0.81–2.66)
Car ban present	0.91 (0.77–1.08)	0.91 (0.72–1.16)	0.92 (0.71–1.18)

Note. Controlling for the number of people who smoke in the home and child age. Removed caregivers with no car from analyses predicting car smoking ban. *$p < .05$, ** $p < .01$.

nonsmokers. Caregiver HL did not predict implementation of a H/CSB in the overall or the stratified groups. Interestingly, caregiver HL did predict smoking expectancies and SHSe in caregiver smokers but this relation was not present in caregiver nonsmokers. Thus, the results partially support our hypothesis that HL is an important factor in child SHSe and in outcome expectancies about smoking among caregivers who smoke only.

Approximately 10% of the current sample had low HL, which is generally consistent with a nationally representative population (i.e., 14%) (Kutner et al., 2006) but better than what is typically found in other African-American (i.e., 24%) and low-income groups (i.e., 27%) (Kutner et al., 2006). One explanation for the difference in low HL rates is measurement variability. Although this study used the REALM-SF that assesses word pronunciation as a proxy for HL, the National Assessment of Adult Literacy study (Kutner et al., 2006) used task-based measures which included prose, document, and quantitative literacy and there are several other commonly used measures such as TOFHLA (Parker, Baker, Williams, & Nurss, 1995). When assessing HL in clinical or research settings, it is important to interpret the results within the context of the type of task(s) one is being asked to complete. Another possibility is that even though the current sample is composed of mostly low-income, African-American families, caregivers who enroll their children in Head Start programs may represent a group that is more knowledgeable about child development and health.

Though most caregivers endorsed positive benefits of limiting SHSe and implementing H/CSBs, a nontrivial proportion endorsed statements suggesting they did not perceive smoke exposure to be harmful. Caregivers with low HL were more likely than those with high HL to agree with statements, suggesting smoking may not have negative health effects and that H/CSBs are inconvenient. Caregiver smokers with low HL may underestimate the adverse outcomes associated with their own smoking behavior to both themselves and their child. This is consistent with previous research that has shown that HL plays an important role in making decisions about one's own health (Berkman et al., 2011) as well as decisions about their child (DeWalt & Hink, 2009). Particularly among caregivers who are engaged in unhealthy behaviors such as smoking, it is recommended that HL be evaluated as it may impact the caregiver's ability to understand the importance of reducing SHSe.

More than three-fourths of the caregivers in this study allowed smoking in their home, which is generally consistent with rates found in African-American households (i.e., 67%) but higher than the general population (i.e., 50%) (Mills et al., 2011). In comparison to previous research, passive air nicotine levels were generally consistent with other rates of children living in the home with a smoker; however, salivary cotinine levels were higher (Wilson, Kahn, Khoury, & Lanphear, 2007). Pediatric clinicians are in a unique position to address SHSe reduction due to regular multiple contacts throughout a child's development. It is critical to integrate counseling about the harmful effects of SHSe with families that have a caregiver who smoke to improve overall health of the entire family. One example is the Clinical Effort Against Secondhand Smoke Exposure (CEASE) module that is an evidence based intervention that teaches clinicians the 3 A's to addressing SHSe reduction (1. Ask, 2. Assist, and 3. Referral) that has been implemented and evaluated using clinician education (Hall, Hipple, Friebely, Ossip, & Winickoff), EHR prompts (Sharifi et al., 2014), and can be tailored for individual clinical practices (Winickoff et al., 2008).

Although HL did not predict implementation of a H/CSB, caregiver HL was found to be a significant predictor of child SHSe in caregiver smokers, but not in nonsmokers, after controlling for the number of smokers in the home and child age. With regard to caregiver smokers, it is possible that having adequate HL may not be sufficient for behavior change which would require them to find alternative locations to smoke. Most households included more than one smoker, which may present an additional challenge for both caregiver smokers and nonsmokers when implementing rules about smoking. Overall, the low HSB implementation rate suggests that even though most caregivers perceive benefits of HSBs, their outcome expectancies are not translating into behavior change. These results suggest that future research should seek to identify other modifiable factors that may be associated with implementation of H/CSBs.

There are limitations, which may have impacted the findings of this study. The cross-sectional design of the study limits our ability to make inferences about causality, and it is not clear if the relations remain steady over time. Many of the children within this study lived in homes with more than one smoker but we did not measure HL in other members of the household, and it is unknown if the primary caregiver participant was responsible for making rules about smoking in the home or car. We had to develop a measure of outcome expectances about SHSe since a validated measure was not available; however, this limits our ability to assess its validity and generalizability. It is also possible that other unmeasured variables such as environmental factors (Stewart et al., 2013) and caregiver depression (Friedman-Wheeler, Ahrens, Haaga, McIntosh, & Thorndike, 2007) may have impacted outcome expectancies, behaviors, and exposure. Social desirability may have also affected caregiver-report regarding implementation of a H/CSB and ratings of outcome expectations; HL may

moderate the influence of social desirability. Though, implementation of a H/CSB could not be verified, objective measures of home SHSe directly measured the level of air nicotine in the home. Caregivers with low HL may have also had some difficulty comprehending questions and terms despite the measures being administered orally by an RA. Future research should include longitudinal studies to identify causality between HL and SHSe as well as inclusion of all smokers in the home. Furthermore, interventions should assess the entire household unit for more effective behavior change.

Despite these limitations, these finding suggests that the impact of low caregiver HL on child SHSe should be considered in clinical practice. Utilizing simplified language, teach-back techniques, and supplementing verbal information with pictures and/or videos are important for conveying information about the adverse health effects of child SHSe to individuals with low HL (Sheridan et al., 2011). Additional strategies to promote comprehension in low HL individuals include prioritizing and isolating essential material and presenting numerical data in tabular format or with icon arrays (Sheridan et al., 2011). Indeed, interventions that use strategies appropriate for low HL caregivers have demonstrated greater comprehension of health education materials (Davis et al., 1996;, 1998), fewer medication dosing errors (Yin et al., 2008), and greater adherence to medication regimens (Yin et al., 2008). In addition to incorporating low HL strategies, future research should also examine cultural adaptations (e.g., intervention team, materials, messaging, and delivery), which address the beliefs, attitudes, and values of a particular group (Hawkins, Kreuter, Resnicow, Fishbein, & Dijkstra, 2008) as this has demonstrated increased intervention acceptability in a systematic review of minorities participating in a culturally adapted smoking intervention (Liu et al., 2013).

In summary, the results of this study suggest that caregiver HL is an important associated factor in child SHSe, especially among primary caregivers who are smokers. HL may play an important role in understanding education messages as well as reducing their child's SHSe. This study underscores the need to consider the influence of caregiver HL when providing education and counseling around child SHSe.

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