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Adolescents Validly Report Their Exposure to Secondhand Smoke

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Abstract

Objective—This study examined the validity of child-reported exposure to secondhand smoke (SHS) and investigated factors, such as child's age, that might affect accuracy of recall.

Study Design and Setting—Participants were drawn from a nonprobability sample of 380 families who completed baseline assessment as part of a randomized trial of a SHS reduction intervention conducted in an urban setting in Southern California. Parents and children (aged 8-13 years) retrospectively reported child's exposure to SHS using timeline follow-back methodology; reports were compared to child's urine cotinine.

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Results—Validity coefficients for parents and children were comparable ($r = 0.58$ vs. $r = 0.53$) but parents recalled three times more exposure than children (2.2 vs. 0.8 cigarettes per day; $p < 0.001$). Regression models predicting cotinine indicated that including child in addition to parent reports resulted in better prediction than either alone.

Conclusion—When there is a choice, parent reports are preferable over child reports due to decreased underreporting. However, child-reported SHS exposure had adequate validity ($r > 0.50$) and might be appropriate in some situations. Researchers might consider collecting both parent and child reports, since each made a unique contribution to the prediction of cotinine.

Keywords

Bias; Cotinine; Passive smoking; Psychometrics; Questionnaires; Validity of results

What is new?

- Both parents and their children aged 8 to 13 validly measured child's exposure to secondhand smoke ($r > 0.50$).
- Parents reported nearly three times more secondhand smoke exposure than children.
- The reports of children and parents appear to measure different aspects of exposure as both were significant but independent predictors of cotinine level.
- Recall was better when exposure was greater and occurred indoors.
- Validity was not affected by parent or child age, parent education, or child gender.

Introduction

Tobacco remains the leading cause of death in the U.S., including smoking and exposure to secondhand smoke (SHS) [1,2]. Although there has been a notable decline in SHS exposure among children in the past decade, 20–25% of children and adolescents live in a household with at least one smoker [3]. Based on serum cotinine measures, approximately 60% of children were exposed to SHS in the year 2000 [3]. Effective interventions to decrease exposure to SHS require valid measures of exposure to secondhand smoke.

While the validity of parent-reported secondhand smoke exposure of the child has been well-examined [4–8], the validity of child self-reported exposure to SHS has received limited attention [9–12]. The purpose of the present investigation was to determine the validity of child self-reported exposure to SHS and to compare it to parent proxy reports of child exposure. Validation was conducted by correlating reports to child urine cotinine and by examining the amount of exposure recalled by parent vs. child. The hypothesized effect that child and parental characteristics, such as child age [12], parental education [13], and level of SHS exposure [12], had on each validity coefficient was also investigated. The validation study was part of a randomized controlled trial, Project Sirocco (R01 grant #HL066307), which investigated the efficacy of behavioral counseling to decrease pre- and adolescents' exposure to SHS.

Methods

All procedures were approved by the San Diego State University (SDSU) Institutional Review Board.

Participants

Families were eligible to participate in Project Sirocco if they had a child 8 to 13 years of age who lived at home with at least one smoker, and who had a reported exposure of 2 or more

cigarettes per day or urine cotinine (a metabolite of nicotine) of 2.0 ng/mL or more. Low-income families were recruited as a nonprobability sample throughout San Diego County, California. The present investigation focused on 388 families who completed the baseline interview. One caregiver (84% were the biological mother) was selected as the “target parent” for the majority of study measures and for all contacts with research personnel. The “target child” was selected based on age. If more than one child in the home qualified, the one with the birth date closest to the date of the baseline interview was selected. Participants were compensated for completing the baseline interview (\$10 for the child and \$10 for each parent).

Measures

Both the target parent and child completed separate interviews at the baseline assessment visit. Parent and child were typically interviewed sequentially, with the parent interviewed first, and about an hour elapsing between administration of the parent and child interviews. The interviews included demographics and the child's SHS exposure over the past 7 days.

Reported exposure used a timeline follow-back (TLFB) method that has previously been applied to health behavior assessment [14]. The TLFB interview resulted in several indices of SHS exposure for calendar Days 1 through 7, where Day 1 was seven days prior to the interview and Day 7 was one day prior to the interview. The TLFB interview assessed, for each day, the number of cigarettes to which the child was exposed indoors and outdoors at home, in a car, and other locations that were due to smoking by the target parent, other parent, or by other smokers. Exposure to any part of a cigarette was counted as one cigarette. Parents and children separately completed the TLFB measure.

Urine was collected from the child on the day of the baseline interview. The sample was analyzed for cotinine at the SDSU Chemistry Laboratory, using isotope-dilution liquid chromatography-tandem mass spectrometry with a limit of detection (LOD) of approximately 20 parts per trillion (0.02 ng/mL) and limit of quantitation (LOQ) of 100 parts per trillion (0.10 ng/mL). Values falling below the LOQ were recoded to 0.06 ng/mL, which is the midpoint between the LOQ and LOD. The reliability correlation for blinded split-half urine samples was 0.99 ($p < 0.001$).

Scoring and coding—Based on the TLFB, per-day indoor only and indoor plus outdoor 7-day and 3-day average SHS exposure (number of cigarettes per day) was determined for both parent and child reports. The 3-day daily average was based on only the most recent 3 days (Days 5, 6, and 7). The half-life of cotinine is approximately 19 hours [15], so the 3-day TLFB measure was expected to more closely share the time frame being captured by the cotinine measure. To compare validity by parent and child characteristic and exposure level, independent variables were dichotomized (see Table 2).

Analysis

Statistical analyses were conducted using SPSS Version 14, STATA Version 9.2, and an alpha level of 0.05 (two-tailed). All distributions were highly positively skewed and nonparametric analyses were used. Outliers were identified using regression diagnostics. Validity analyses were repeated with and without the outliers. Evidence of criterion-related validity [16] was determined by correlating reported exposure (cigarettes/day) against child cotinine level (ng/mL). Medians and means (excluding outliers) are reported.

In order to examine differences in the median amount of SHS exposure, the Wilcoxon Signed Rank Test (WSRT) was computed. To examine whether SHS exposure differed by day of recall, the Friedman test was performed. To examine validity of child and parent reports, the Spearman rank order correlation was computed between TLFB scores and cotinine. These

validity coefficients for parents and children were then compared using a test of correlated correlations suitable for rank order data [17]. To test for factors that may influence validity correlations, an r-to-z transformation and z-test for comparing between-group correlations were used. To determine whether including both parent and child reports resulted in significantly better prediction of cotinine than either of the reports alone, regression to predict child urine cotinine level was performed. Because the assumptions for multiple linear regression were not met, quantile regression [18] was used for this analysis.

Results

Eight outliers were identified. Although analyses were calculated with and without outliers, unless otherwise noted, all results are presented excluding outliers ($N = 380$), resulting in more conservative validity coefficients.

Participant Characteristics

Families were mostly non-white with children on average aged 10.3 years ($SD = 1.6$) and parents aged 36.5 years ($SD = 8.1$) (see Table 1).

Average Daily Exposure of the Child

Parents reported significantly greater ($p < 0.001$) indoor exposure of the child than the child reported (see Figure 1) on each of Days 1 through 7. Median daily exposure was zero cigarettes per day on each of Days 1 through 7 for both parents and children. While mean daily SHS exposure of the child as reported by parents (without outliers) varied between 2.1 and 2.4 cigarettes per day, the exposure as reported by the child was about a third of that, varying from 0.7 to 0.9 cigarettes per day.

Trends in Recall across Days 1 through 7

For children, the Friedman test indicated that there was a significant difference in mean ranks of indoor SHS exposure across Days 1 through 7 ($p = 0.008$). Examining Figure 1 indicates that the amount of SHS exposure recalled tended to be lower in the days farthest away from the interview (i.e., Days 1 and 2). For parents, there was no difference in mean ranks of SHS exposure across Days 1 through 7 ($p = 0.990$).

Average 3-Day vs. 7-Day Exposure of the Child

Children reported significantly greater ($p = 0.029$) SHS exposure based on the 3-day as compared to the 7-day average (0.84 vs. 0.77 cigs/day; see Table 1); parent reports did not differ significantly for 3 vs. 7 days (2.29 vs. 2.23 cigs/day; $p = 0.257$).

3-Day vs. 7-Day Validity Correlations

For parents, the validity correlations were 0.57 (0.58 including outliers) for the 3-day averages and 0.58 (0.59) for the 7-day averages (see Table 2). For children, the validity correlations were 0.51 (0.52 including outliers) for the 3-day averages and 0.53 (0.55) for the 7-day averages. There were no significant differences in validity between parent and child for 7-day indoor SHS exposure, although the parent 3-day validity was marginally significantly greater than child 3-day validity ($p = 0.079$) (see Table 2).

Indoor vs. Total Exposure Validity Correlations

The validity of 7-day parent-reported total (indoor plus outdoor) exposure was 0.50; whereas the validity based on indoor-only exposure was 0.58; similarly for children the validity correlations were 0.40 vs. 0.53 (data not shown).

Factors Affecting Validity Correlations

Higher levels of reported exposure were associated with significantly greater correlations between 7-day averages and cotinine for both parents and child ($p < 0.01$; see Table 2). There was no difference in validity by age for parents or children or for educational level for parents or gender for children (see Table 2).

Regression to Predict Cotinine Level

The quantile regression indicated that parent-reported exposure was the stronger predictor of cotinine level ($t = 15.82$; $p < 0.001$) but that child-reported exposure also contributed independently and significantly to the prediction ($t = 9.72$; $p < 0.001$) (data not shown). Pseudo R for parent report alone was 0.35; for child report alone was 0.30; and for both reports it was 0.37.

Discussion

This is one of the few published examinations of validity of child-reported SHS exposure [9–12]. Results indicated that parent-reported validities were non-significantly greater than child-reported validities. Consistent with previous research using retrospective measures of SHS exposure by parents [6,8] the validities were large, ranging from 0.51 to 0.58. However, the amount of reported exposure differed significantly between parents and children, with parents recalling nearly three times the amount of SHS exposure as children. Factors such as child's age or gender and parental age or education had no effect on validity of the retrospective recalls. However, the amount of reported exposure did: higher exposure levels were associated with significantly higher validity correlations for both parents and children. Indoor exposure was more validly recalled than outdoor plus indoor exposure for both children and parents. Finally, including both parent and child recall of exposure resulted in slightly better prediction of cotinine level than including either alone.

Previous Research on Validity of Child Reports

There is limited research comparing the validity of child and parent reports of child's exposure to SHS [10–12]. In an early report [10] researchers compared child vs. parent smoking status of the parent (yes-no) by child age. Compared to those aged 10–13 years, younger children aged 9 years were three times more likely to disagree with parent self-reported smoking status. Wong et al. [11] examined whether asthmatic children aged 7–14 years could accurately assess their exposure to SHS while living with a smoking parent. Parents reported about twice as much household smoking than children with a median of 6.3 hours per week compared to 3.5 hours per week for children although they reported comparable validity coefficients. Lee and colleagues [12] analyzed the agreement between adolescents aged 13 to 17 years and their parents on SHS exposure ($N = 304$). Child, parent, and combined child and parent report of parental smoking indoors (yes vs. no) were compared to child's saliva cotinine (detectable vs. nondetectable). Kappa values suggested moderate validity at 0.44 for child and parent reports but sensitivity was enhanced when combining exposure information from both child and parent. Agreement between child reports and cotinine levels was lower among younger adolescents (aged 13 through 15 years), and no differences in validity were found between male and female children. These results indicate that child age affected validity and that child combined with parent reports resulted in stronger prediction of cotinine level.

Parent vs. Child Reports of SHS Exposure

In the present research child reports were as valid as parent reports and there were no differences in validity by child age. That there were no differences in validity due to child age may be because the TLFB is a semi-structured interview rather than a standardized set of survey

questions. When administering the TLFB measure the interviewer can easily word the questions so that the 8 to 13 year-old can understand what is being asked. The relatively attenuated age range in this sample also might have contributed to finding no significant effect due to age.

Retrospective recalls often suffer from inaccurate recall, resulting in an *underreporting* of incidental as compared to planned health-related behaviors [19,20]. Parents recalled on average their children being exposed to 2.2 cigarettes per day, while children recalled being exposed to nearly three times less, or 0.8 cigarettes per day. Child's reported exposure also appeared to be influenced by how distant in the past was their recall, with a more recent recall window resulting in greater exposure reported.

Amount of Exposure

The amount of SHS to which children were exposed (according to parent report) affected validity of recall, with significantly higher validity coefficients among those more highly exposed. Over 70% of those in the low exposure group reported zero exposure—no SHS exposure of the child in the past week. These zero exposure values, however, were paired with cotinine values which varied widely (from 0.06 to 49 ng/mL), thus attenuating the validity coefficient in the low exposed group. Unlike self-reports, cotinine is very precise and reflects recent exposure from all locations, all occasions, and all sources, including sources that may not be detectable by sight or smell, such as environmental contamination [7,21]. Thus, there would be attenuated correspondence at the low end of exposure and cotinine values.

3-Day vs. 7-Day Averages

It was expected that validities based on 3-day averages would be higher than those based on 7-day averages due to proximity to cotinine collection which has a half life of about 19 hours [15]. However, the 3-day validity correlations were found to be essentially identical. However, children reported significantly more SHS exposure based on the 3-day as compared to the 7-day average. These results suggest that 3-day averages, especially for children, may result in greater, and thus, more accurate recall.

Indoor-Only Exposure

As expected, indoor-only SHS exposure averages were significantly lower than total (indoor plus outdoor) SHS exposure (i.e. 3.2 vs. 2.2 cigarettes per day among parents). When absolute numbers of SHS exposure for risk assessments are needed, then the independent contributions of indoor vs. outdoor SHS exposure should be examined. However, cotinine-based validity correlations were greater for indoor-only exposure. This may be because indoor-only exposure is easier to recall and because exposures outdoors contribute less to cotinine level than indoor exposures. The latter interpretation is supported by post hoc validation of outside-only SHS exposure in which validities were negligible ($r = -0.03$ to $+0.03$, $p > 0.10$; data not shown).

Limitations

This study examined validity of child reports among children aged 8 to 13 years of age. It is unknown whether these findings generalize to older or younger children. While interviewers requested private individual interviews, the participating child was present during 34% of parent interviews and 57% of child interviews were conducted with a parent present. However, based on interviewer ratings, less than 4% of parent interviews and just over 11% of child interviews were influenced by other persons (i.e. the parent changed their answers based on interaction with others). These results suggest that there was limited effect of others, either parent or child, on the survey responses.

Recommendations

Parent reports of child exposure had nonsignificantly greater validities than child self-reports and resulted in significantly greater reported levels of exposure. Based on the assumption that SHS exposure is typically underreported, this suggests that parent reports are preferred to child reports. However, child reported SHS exposure had adequate validity ($r > 0.50$) and when relative changes are needed, may be adequate for research purposes. Researchers might consider collecting both parent and child reports as each made a unique contribution to the prediction of cotinine level; a recommendation that is supported by previous research [9–10].

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Figure 1. Mean Daily Indoor SHS Exposure of the Child According to Parent and Child Reports (N = 380)

Note. The line suggests that, for children, recall of the amount of SHS exposure increases the closer the day of recall is to Day 8, the day of the retrospective interview. Based on the Friedman test this trend was significant ($p = 0.008$) for children but not for parents. Analyses were based on data that excluded outliers.

Table 1

Descriptive Statistics of Sample Characteristics (N = 380)

Parent	
	<u>Percent</u>
Target parent was the mother	84.0
Non-Hispanic white	26.6
Hispanic	41.5
Non-Hispanic African-American	23.7
Single parent	43.6
Mean (SD)	
Education (years)	11.85 (2.3)
Age (years)	36.55 (8.1)
Proxy-reported 3-day average (cigarettes/day)	2.29 (4.4)
Proxy-reported 7-day average (cigarettes/day)	2.23 (4.2)
Child	
	<u>Percent</u>
Target child was male	46.1
Non-Hispanic white	17.6
Hispanic	46.0
Non-Hispanic African-American	22.9
Mean (SD)	
Age (years)	10.29 (1.6)
Cotinine (ng/mL)	4.20 (7.2)
Self-reported 3-day average (cigarettes/day)	0.84 (2.0)
Self-reported 7-day average (cigarettes/day)	0.77 (1.8)

Note: Analyses were based on data that excluded outliers.

Table 2

Validity of Indoor SHS Exposure as Reported by Parent and Child (N = 380)

	Parent	Child	P
3-day average (cigarettes/day)	0.571	0.510	0.077 ^a
7-day average (cigarettes/day)	0.581	0.532	0.142 ^b
Parent 7-Day Average			
	High	Low	
Parent age (years) ^c	0.569	0.598	0.673
Parent education (years) ^d	0.574	0.605	0.690
Parent-reported indoor exposure ^e	0.434	0.190	0.009
Child 7-Day Average			
	High	Low	
Child age ^f	0.543	0.528	0.845
Parent-reported indoor exposure ^e	0.425	0.160	0.005
	Boy	Girl	
Child gender	0.522	0.532	0.894

Note: The numbers reported in columns 2 and 3 are validity correlation coefficients between reported exposure and child urine cotinine. The correlations were compared by subgroups, e.g. parent vs. child reported exposure. The correlations were statistically compared in column 4. Analyses were based on data that excluded outlying observations.

^aThe two-sided p-value between the difference in 3-day validities of parent and child reports.

^bThe two-sided p-value between the difference in 7-day validities of parent and child reports.

^cComparison of validities by parent age (36 years or older vs. 35 years or younger).

^dComparison of validities by parent education (12 years or more vs. 11 years or less).

^eComparison of validities by parent-reported exposure (0.44 or more vs. 0.43 or less). Based on parent's average 7-day report of child's indoor exposure; reported as cigarettes/day.

^fComparison of validities by child age; for boys, high is age 12+ years; for girls, age 11+ years.