

Home Safety and Low-Income Urban Housing Quality

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KEY WORDS

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ABBREVIATIONS

CPS—CARES Parent Study

HQS—Housing Quality Standards

HUD—Housing and Urban Development

MSC—Mobile Safety Center

SIS—Safety in Seconds

All authors participated sufficiently in the work to take public responsibility for appropriate portions of its content. Dr Gielen served as principal investigator on the study and contributed to the conception, design, acquisition of data, analysis and interpretation; drafting and revising the article; and final approval of the version to be published. Dr Shields served as coinvestigator on the study and contributed to the conception, design, acquisition of data, analysis and interpretation; drafting and revising the article; and final approval of the version to be published. Ms McDonald served as coinvestigator on the study and contributed to the conception, design, acquisition of data, analysis and interpretation; drafting and revising the article; and final approval of the version to be published. Dr Frattaroli served as coinvestigator on the study and contributed to the conception, design, acquisition of data, analysis and interpretation; drafting and revising the article; and final approval of the version to be published. Dr Bishai served as coinvestigator on the study and contributed to the conception, design, acquisition of data, analysis and interpretation; drafting and revising the article; and final approval of the version to be published. Ms Ma served as data analyst on the study and contributed to the analysis and interpretation of the data; drafting and revising the article; and final approval of the version to be published.

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WHAT'S KNOWN ON THIS SUBJECT: The effect of substandard housing on children's risk of diseases such as asthma has been studied; little is known about how it affects child injury risk. Pediatricians actively promote injury prevention but typically without regard to housing quality.



WHAT THIS STUDY ADDS: Low-income children are likely living in substandard homes, which is significantly associated with not having working smoke alarms and safe hot water temperatures. Pediatricians can use these results to inform anticipatory guidance.

abstract



OBJECTIVES: Living in substandard housing may be one factor that increases the risk of fire and burn injuries in low-income urban environments. The purposes of this study are to (1) describe the frequency and characteristics of substandard housing in urban homes with young children and (2) explore the hypothesis that better housing quality is associated with a greater likelihood of having working smoke alarms and safe hot water temperatures.

METHODS: A total 246 caregivers of children ages 0 to 7 years were recruited from a pediatric emergency department and a well-child clinic. In-home observations were completed by using 46 items from the Housing and Urban Development's Housing Quality Standards.

RESULTS: Virtually all homes (99%) failed the housing quality measure. Items with the highest failure rates were those related to heating and cooling; walls, ceilings, and floors; and sanitation and safety domains. One working smoke alarm was observed in 82% of the homes, 42% had 1 on every level, and 62% had safe hot water temperatures. For every increase of 1 item in the number of housing quality items passed, the odds of having any working smoke alarm increased by 10%, the odds of having 1 on every level by 18%, and the odds of having safe hot water temperatures by 8%.

CONCLUSIONS: Many children may be at heightened risk for fire and scald burns by virtue of their home environment. Stronger collaboration between housing, health care, and injury prevention professionals is urgently needed to maximize opportunities to improve home safety. *Pediatrics* 2012;130:1053–1059

Children living in low income, urban environments are at increased risk for fire and scald burns in their homes.^{1,2} Programs, including those conducted in pediatric health care, that encourage parents to reduce home injury hazards have been evaluated with mixed results.^{3,4} Thus, there remains a gap in understanding how to best enhance home safety to reduce child injuries, including fires and burns.

For low income, urban communities, addressing substandard housing may hold promise.⁵ According to the Centers for Disease Control and Prevention, "Childhood lead poisoning, injuries, respiratory diseases such as asthma, and quality of life issues have been linked to the more than 6 million substandard housing units nationwide."⁶ The evidence on home injury risk and housing quality is limited. Studies have used different outcomes (eg, fatalities or hazards such as no working smoke alarm), as well as different indicators of housing quality such as an interviewer assessment of a home needing repair,⁷ a home that lacks indoor plumbing,⁸ or census tract variables such as housing code violations,⁹ vacancy rates,¹⁰ or age of housing stock.¹¹ Only 1 study, conducted >15 years ago, used a standard government assessment; the authors found that substandard housing was associated with more injury hazards, including no working smoke alarms and unsafe hot water temperatures.¹²

With this suggestive evidence that housing quality is associated with child home injury risk and the availability of a newer standardized tool to measure housing quality, it is timely to further explore these relationships. The aims of this article are to (1) describe the frequency and characteristics of substandard housing in homes with young children and (2) explore the hypothesis that better housing quality is associated with

a greater likelihood of having working smoke alarms and safe hot water temperatures.

METHODS

Sample

The data for this analysis come from 246 parents with children 0 to 7 years old who participated in 1 of 2 studies conducted in East Baltimore, Safety in Seconds (SIS)¹³ and the CARES Parent Study (CPS).¹⁴

The authors of the SIS study evaluated the effects of a computer-tailored report on safety behaviors of parents. From September 2004 to December 2005, 901 parents from the Johns Hopkins Pediatric Emergency Department participated in a randomized controlled trial. Intervention parents received a 4-page tailored report on smoke alarms, poison storage, and car seats. Control parents received a 4-page generic report on health issues. Parents completed follow-up telephone surveys at 2 weeks ($n = 759$) and 4 months ($n = 719$). Home observations of smoke alarms and hot water temperatures were conducted on a random sample of 100 families (50 intervention and 50 control), who form the sample for the present analysis. The parents were 98% African American; 11% had more than a high school education; 68% earned \leq \$5000 per capita per year; 23% were \geq 30 years old; and 24% were married or in a couple relationship.

The CPS evaluated the impact of a mobile safety center (MSC), a 40-foot vehicle outfitted like a home environment that contains interactive educational exhibits and provides education and low-cost safety products. From July 2005 to May 2006, 296 parents were enrolled at a community health center. The interventions included either a prescribed or optional MSC visit as part of a well-child care visit; the

control group was given a schedule of MSC community locations. Follow-up interviews and home observations of smoke alarms and hot water temperatures were completed between 2 weeks and 4 months after enrollment with 146 families, who form the second sample used in the present analysis. The parents in this sample were 97% African American; 18% had more than a high school education; 71% earned \leq \$5000 per capita per year; 22% were \geq 30 years of age; and 25% were married or in a couple relationship.

Measures

Housing Quality

The national Housing Choice Voucher Program is the primary form of federal housing assistance in the United States ("Section 8" housing). Vouchers are used to pay for homes deemed to be "decent, safe, and sanitary" according to the US Department of Housing and Urban Development's (HUD) Housing Quality Standards (HQS).¹⁵ Housing Choice Voucher Program homes are required to pass HQS inspections annually. The 120 HQS items focus mostly on structural elements of housing and some neighborhood features. Trained housing inspectors complete the assessment.

In the 1990s, HUD conducted pilot tests to explore whether a subset of 64 items would be a valid assessment and whether the resident could reliably complete the assessment. More than 4000 residents in 3 states completed surveys by using this subset of items. High rates of agreement were found between inspector and resident completed assessments (>80%) and in test-retest reliability (>80%).^{16,17}

Because the shorter survey performed well, it was used in both the SIS and CPS studies. For the present analysis, we retained 46 items that focused specifically on structural elements of the home environment. Items were

dropped because they focused on neighborhood features ($n = 8$) or had missing data ($n = 4$)*; 6 items were combined with another item as required by the scoring instructions.

These 46 items cover 6 housing domains: kitchens and bathrooms (11 items); electrical wiring (5 items); heating and cooling (4 items); walls, ceilings, and floors (7 items); sanitation and safety (11 items); and outside the home (8 items). Consistent with the HUD requirements, each item is scored as “pass” or “fail,” and the entire unit fails to meet the minimum housing quality standards if a single item fails.

Safety Behaviors

During the home observations in both the SIS and CPS studies, data collectors located and tested smoke alarms and tested the temperature of the hot water at the kitchen sink. Three dichotomous variables were created: any working smoke alarm (yes/no), working smoke alarms on all levels of the home (yes/no), and safe hot water temperature ($\leq 48.9^\circ\text{C}$) (yes/no). Having 1 working smoke alarm is also a measure in the sanitation and safety domain of the HQS; therefore, this item was dropped when we analyzed smoke alarm outcomes.

Sociodemographic Factors

Data were collected on child’s age and gender. Data on the respondent characteristics included the following: ethnicity, relationship to child, age, education, marital status, employment status, per capita annual income, and whether the home was rented or owned.

*Does the refrigerator keep food cold enough that it does not spoil? How many times did the heating break down for 6 hours or more? Was your home ever so cold for 24 hours or more that someone in your home was uncomfortable? Do you see any problems with the roof such as sagging, holes or missing roofing?

Data Analysis

For the first study aim, we present simple descriptive statistics on the housing quality results. For the second aim, we compare the number of housing quality items passed to the presence of working smoke alarms and safe hot water temperatures by using logistic regression, adjusting for the study sample and significant sociodemographic covariates.

RESULTS

Sample

The children were 2.5 years old on average; they were roughly equally divided between boys and girls (Table 1). Respondents were mostly African American (98%), child’s mother (93%), 20 to 29 years old (61%), and unmarried (76%). One-half (50%) were employed, 15% had more than high school education, and

69% earned $\leq \$5000$ per capita per year. Data on whether the home was rented or owned were missing for 57 participants (23%); for the remainder of the sample ($n = 173$), 92% were living in rental property.

Rates and Characteristics of Substandard Housing

Table 2 presents housing quality domain data, including the mean number of items failed, mean item failure rate, and frequency distribution of items failed. Any failed item results in failing the entire assessment. For the total sample, the mean number of items failed was 8.2 out of the total 46 items, an 18% mean item failure rate. However, only 2 homes failed no items, meaning that 99% of the homes in this sample failed the housing quality assessment.

The data in Table 2 also demonstrate that the domain with the highest item failure rate was domain 4 (walls, ceilings, and floors) with the mean number of items failed 2.2 out of 7 (31%). Domain 3 (heating and cooling) and domain 5 (sanitation and safety) had average item failure rates of 22% and 20%, respectively. The domain with the lowest mean item failure rate was domain 6 (outside), for which 0.8 out of 8 items failed on average (10%). Domain 2 (electrical) and domain 6 (outside) had the highest proportion of homes with no failed items (53% and 50%, respectively), and domain 5 (sanitation and safety) had the lowest (11%).

The detailed listing of the housing quality items is presented in Table 3, along with the proportion of homes that passed each item. For ease of presentation, the 32 items with $\geq 80\%$ passing are listed in the Appendix. The 14 items with passing rates below 80% (Table 3) came from all 6 domains. The 4 items with the lowest proportion of homes passing included having a heating system that provides enough heat in every room (44%); no paint that is easy to chip or peel off

TABLE 1 Sociodemographic Characteristics of the Sample ($N = 246$) East Baltimore, Maryland

Variable	Mean	SD
Child age, mo	31	24
	Frequency	%
Child gender		
Boy	133	54
Girl	113	46
Respondent relationship to child		
Mother	229	93
Father	6	2
Other	11	4
Respondent age		
14–19 y	40	16
20–29 y	148	61
≥ 30 y	55	23
Respondent education		
Less than high school	71	29
High school graduate	138	56
More than high school	37	15
Respondent marital status		
Married	60	24
Single, divorced, widowed	186	76
Respondent employment		
None	121	50
Yes, full time	83	34
Yes, part time	39	16
Annual per capita income		
$\leq \$5000$	161	69
$> \$5000$	73	31

TABLE 2 Housing Quality Measures of 246 Homes in East Baltimore, Maryland

Domain	Total Number of Items	Average Number of Items Failed by Domain		Frequency and Percent of Homes That Failed by Number of Items Failed and by Domain		
		Mean Number of Items Failed	Mean Item Failure Rate, %	Number of Items Failed	Number of Homes That Failed	Cumulative Percent
Domain 1, kitchens and bathrooms	11	1.4	13	0	71	29
				1	77	60
				2	53	82
				3+	45	100
Domain 2, electrical	5	0.7	14	0	130	53
				1	70	81
				2+	46	100
Domain 3, heating and cooling	4	0.9	22	0	91	37
				1	105	80
				2+	50	100
Domain 4, walls, ceilings, floors	7	2.2	31	0	56	23
				1	58	46
				2	40	63
				3	27	74
				4	27	85
Domain 5, sanitation safety	11	2.2	20	5+	38	100
				0	28	11
				1	50	32
				2	70	60
				3	59	84
Domain 6, outside the home	8	0.8	10	4+	39	100
				0	122	50
				1	75	80
				2+	49	100
Total	46	8.2	18	0	2	1
				1–4	62	26
				5–9	98	66
				10–12	39	82
				≥13	45	100

(44%); no mold, mildew, or water damage on walls, floors, or ceilings (44%); and having a working smoke alarm on every level (42%). Fifty percent (50%) of respondents reported having seen a rat within the past week; 59% reported that all their windows had working locks.

Association Between Substandard Housing and Safety Behaviors

Table 4 shows that 82% of the sample had at least 1 working smoke alarm; 42% had 1 on every level; and 62% had safe hot water temperatures. Respondent age was associated with having working smoke alarms on every level, and respondent education was associated with having safe hot water temperatures in bivariate analyses (data not

shown); these variables were included in the logistic regressions. The adjusted logistic regression analyses revealed that for every increase of 1 in the number of housing quality items passed, the odds of having any working smoke alarm increased by 10%, the odds of having 1 on every level by 18%, and the odds of having safe hot water temperatures by 8%.

DISCUSSION

In this low income, urban sample of homes with young children, we found that 99% would be considered substandard. The most common problems were inadequate heating systems; peeling paint; walls, floors, or ceilings that

have mold, mildew, or water damage; evidence of rats; and windows without locks. The odds ratios were significant and substantial for the association between the number of housing quality items failed and not having safe hot water temperatures or working smoke alarms. These results, while intuitive, are important because they add to the literature demonstrating an association between substandard housing and pediatric health problems previously demonstrated for lead poisoning and asthma.^{5,6} Pediatricians caring for low income families can use these results to inform their injury prevention anticipatory guidance and consider having referral resources for housing needs available.

The authors of a recent systematic review of interventions to address injury-related structural deficiencies in housing noted the absence of research on improving the implementation of safety-related building and housing codes.¹⁸ To the extent that HUD standards reflect commonly accepted building codes, our data provide some of the first empirical evidence linking structural deficiencies to home injury prevention behaviors. We were limited to data on only 2 safety behaviors, but results suggest other injury hazards and safety behaviors should be investigated.

The study does not elucidate why families in poor quality housing would be less likely to have working smoke alarms and safe hot water temperatures, nor did we have specific hypotheses in this exploratory study. Poverty is a common risk factor for both substandard housing and lower rates of smoke alarms and safe hot water temperatures. Because our sample was predominantly low income, the independent effect of housing quality cannot be isolated. It is likely that a constellation of factors are associated with being able to implement safety behaviors and home modifications and that poor housing quality is a marker for some of these.

TABLE 3 Housing Quality Measures of 246 Homes in East Baltimore, Maryland, Percent of Homes Passing by Item and Domain for Items With <80% Passing

Domain	Housing Quality Item (Passing Response)	% Passing
Domain 1, kitchens and bathrooms	Do all stove burners work? (Yes)	78
Domain 2, electrical	Do all ceiling and wall mounted light fixtures work? (Yes)	78
	Ask parent: How many times have fuses blown or circuit breakers tripped in the last 3 mo? (None)	73
Domain 3, heating and cooling	Does the heating system provide enough heat in every room? (Yes)	44
Domain 4, walls, ceilings, and floors	Is there any paint that can be chipped or peeled by finger scraping? (No)	44
	Is there any area of peeling paint or broken plaster bigger than the size of this page? (No)	79
	Are there any floor problems such as boards, tiles, carpeting, or linoleum that are missing, curled, or loose? (No)	75
	Is there mildew, mold, or water damage on any wall, floor, or ceiling? (No)	44
	Is there any place where floor problems can cause you to trip? (Yes)	71
Domain 5, sanitation and safety	Ask parent: Did you see a rat anywhere in your building or outside around the grounds this week? (No)	50
	Ask parent: Have you seen any cockroaches in your home this week? (No)	77
	Do all windows have locks that work? (Yes)	59
	Is there a working smoke detector on each floor in your home? (Yes)	42
Domain 6, outside the home	Ask parent: Is there enough light for safety? (Yes)	79

Many of the homes in this study were rental properties. For smoke alarms, landlords are responsible for putting smoke alarms in the home, but residents are responsible for maintaining them, and our data could not distinguish between absent alarms, disabled alarms, or alarms with nonworking batteries. Landlords are also responsible for controlling the water temperature in rental properties, and we do not know whether the homes in our study had central or individual water heaters, which would determine whether the resident had access. We also do not know if the water heaters were of the newer type with

preset safe temperatures. However, although hot water temperature is generally correlated with the water heater setting, we have evidence that this is not always the case,¹⁹ and the 2009 International Residential Code for 1- and 2-family dwellings recommends thermostatic mixing valves that regulate the water temperature at the faucet.^{20,21}

The sample consists of parents enrolled in child safety intervention trials, and thus, is not representative of homes in any defined geographic area. We do not have further detail on the structural characteristics of the homes or actual home injuries, which would be

useful to collect in future studies. Nevertheless, the sample does reflect a large number of homes within low income, urban neighborhoods in East Baltimore.

An important strength of the study is the use of home observations. These data are the first to our knowledge to use a standardized housing quality assessment tool to describe housing characteristics in this level of detail. The results are important because they demonstrate that a large number of low income, urban children may be at heightened risk for not only the well-documented lead poisoning and asthma that can be traced to the home environment but also for fire and scald burns. Moreover, the inadequate smoke alarm coverage and unsafe hot water temperatures have implications for entire families.

Our findings suggest that there are other safety modifications to include in the HUD's standard housing quality assessments, especially for homes that are being inspected for occupancy by families with young children. High rates of homes with evidence of rats and cockroaches raises concern that there are also toxic chemicals in the home being used to kill them. The availability of lockable cabinets or other safe places to store such hazardous products should be included in housing quality assessments. Given the high failure rate for the heating and cooling domain, the presence of a working carbon monoxide alarm should be included for the protection of entire families.

CONCLUSIONS

Based on our findings and the availability of evidence-based solutions to many home injury risks, stronger collaboration between housing, health care, and injury prevention professionals is urgently needed to maximize the policy opportunities available to improve home safety.

TABLE 4 Relationship Between Housing Quality and Safety Behaviors Among 246 Residents in East Baltimore, Maryland, Distribution of Outcome Variables and Logistic Regression Analyses

Outcome Variable	Frequency (%)	Adjusted Odds Ratio ^a (95% Confidence Interval) for Number of HQ Items Passed	P
Working smoke alarm	202 (82)	1.10 (1.03–1.17)	.01
Working smoke alarm on every level	104 (42)	1.18 (1.1–1.27)	.00
Safe hot water temperature	152 (62)	1.08 (1.02–1.14)	.01

^a All models adjusted for the data set from which the sample was drawn; working smoke alarm on every level adjusted for respondent's age; safe hot water temperature adjusted for respondent education level.

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APPENDIX Housing Quality Measures of 246 Homes in East Baltimore, Maryland: Percent of Homes Passing by Item and Domain for Items With $\geq 80\%$ Passing

Domain	Housing Quality Item (Passing Response)	% Passing
Domain 1		
Kitchens and bathrooms	Does your kitchen have a working oven? (Yes)	96
	Does the tap water have a problem with color or bad odor? (No)	98
	Is there a working light fixture in the kitchen ceiling or wall? (Yes)	94
	How many working outlets are in the kitchen? (2 or more)	91
	Is there hot and cold running water at each kitchen/bath sink/tub? (Yes)	88
	Is there water leaking from any kitchen/bath sink, drain, or pipe? (No)	87
	Is any kitchen or bath sink, tub, or shower clogged? (No)	87
	Does the bathroom have a window that opens or a ventilation system that works? (Yes)	82
	Ask parent: How many times did the toilets not work for 6 h or more? (None)	80
	Ask parent: Has any bathroom floor been covered by water because of plumbing problems? (No)	80
Domain 2		
Electrical	Is all the building's wiring in your home enclosed in walls or metal coverings? (Yes)	88
	Do all electrical outlets and switches have cover plates? (Yes)	92
	Not counting the bathroom, does each room have at least 1 working outlet? (Yes)	98
Domain 3		
Heating and cooling	In cold weather do you ever need to use your oven to heat your home? (No)	86
	If your home comes with air conditioning, does it work correctly? (Yes)	96
	Can you adjust the heat when it is too hot or too cold? (Yes)	86
Domain 4		
Walls, ceilings, and floors	Are there any holes or large cracks where outdoor air or rain can come in? (No)	87
	Do you see any walls, ceilings, or floors with serious problems like sagging, leaning, buckling, or large holes? (No)	82
Domain 5		
Sanitation and safety	Ask parent: In your home, do you smell bad odors such as sewer, natural gas, etc? (No)	92
	Do all outside doors have locks that work? (Yes)	97
	Do all bedrooms have a window you can open? (Yes)	88
	Does any window have broken glass that can cut someone? (No)	95
	Ask parent: In the last 3 mo, has your mail been stolen or tampered with? (No)	97
	In case of fire, do you have a least 2 ways out of the home? (Yes)	93
Are secure handrails on all stairs and landings? (Yes)	89	
Domain 6		
Outside the home	Is the condition of any porch or balcony dangerous? (No)	96
	Are any outside handrails, steps, or stairs unsafe? (No)	89
	Is any sidewalk, driveway, or parking lot damaged in a way that could cause you to trip? (No)	91
	Are fences or gates in bad condition? (Yes)	90
	Do you see any walls with serious leaning, buckling, or large holes? (No)	94
	Does the garbage service pick up each week? (Yes)	98
	Ask parent: Do you have either covered dumpsters or covered cans for your garbage and trash? (Yes)	80