



Published in final edited form as:

J Public Health Manag Pract. 2024 ; 30(6): E282–E296. doi:10.1097/PHH.0000000000002002.

Recent single-family home buyer knowledge, attitudes and behaviors related to lead and radon exposure prevention

Tim Dignam, PhD, MPH¹, W.D. Flanders, DSc, MD, MPH, MA², Antonio Neri, MD³, Michael Shayne Gallaway, PhD⁴

¹Office of Director, National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, Georgia

²Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, Georgia

³Division of Environmental Health Science and Practice, National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, Georgia

⁴Formerly of Division of Population Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia

Abstract

Context: Federal law requires property owners to disclose the presence of known lead-based paint and/or lead hazards to potential home buyers and renters in homes built before 1978.

Objective: Using 2015–2016 randomized survey data, we measured lead and radon knowledge, awareness, and exposure avoidance practices. Setting: Home buyers from 4 US states (Illinois, Minnesota, North Carolina, and Ohio). Participants: 477 recent, single-family pre-1978 dwelling home buyers.

Main Outcome Measure(s): Predictors of the home buyer decision to purchase the home during the entire home buying experience based on their understanding of health issues related to lead-based paint and radon exposure.

Results: Personal networks (22%) and real estate agents (21%) were the most common sources of health-related lead information. Many home buyers (77%) reported that their awareness of lead did not affect their purchasing decision, and 78% could not confirm that their homes were tested for lead. Respondents who understood lead-related health effects were 5.4 times more likely (95% CI, 1.7–17.5) to have their decision to buy a home affected when their real estate agent discussed lead-based paint issues. Many home buyers reported either they did not remember (37%) or did not sign (20%) the federal law requirement that property owners reveal known lead paint

corresponding author: tdignam@cdc.gov.

Disclaimer:

The findings, conclusions and views expressed in this manuscript are those of the authors and do not necessarily represent the views, policies or official position of the Centers for Disease Control and Prevention.

Conflict of Interest Declaration:

T Dignam, A Neri, and MS Gallaway declare they have no actual or potential competing financial interests. W.D. Flanders is a co-owner of Epidemiologic Research & Methods, LLC which provides consulting services for various clients.

Access to data:

Limited, de-identified survey data are available from the Centers for Disease Control and Prevention.

hazards to prospective buyers before a property is sold. Home buyers with awareness of health issues caused by radon were 1.7 times (95% CI, 1.4–2.1) more likely than those who understood lead-related health issues to have their decision to buy the home affected.

Conclusion: Real estate agents play an important role to increase awareness of potential lead-based paint health issues when people buy older homes. Home buyer knowledge, awareness, and practice of radon exposure prevention was greater compared to lead exposure prevention. More than half of home buyers did not sign or remember signing lead disclosure paperwork.

Introduction

The United States banned the manufacture and consumer use of lead-based paint in 1978. However, numerous homes were finished with paints containing lead pigments before enactment of that legislation. More than half of owner-occupied homes were built before 1980, and approximately 38% were built before 1970.¹ The most common sources of lead exposure are lead paint; lead-contaminated dust, soil, and water; and lead containing products.² However, deteriorating lead-based paint and lead dust is found in poorly maintained older housing, housing undergoing renovation or repainting without the use of lead safe work practices, and is the primary source of lead exposure among US children.^{3,4} No safe blood lead level has been identified.⁵ Potential lead exposures in older homes are exacerbated through construction, remodeling, and other procedures that circulate lead dust and expose old paint layers that might contain lead.⁶

In 1992, the US Congress passed the Residential Lead-Based Paint Hazard Reduction Act (known as Title X). Section 1018 of Title X requires the US Department of Housing and Urban Development (HUD) and the US Environmental Protection Agency (EPA) to promulgate a lead paint disclosure rule. The rule (adopted in 1996) requires that buyers and renters of residential dwellings built before 1978 be notified by the seller or landlord that exposure to lead could result from past use of lead-based paint at the property.^{7,8} Federal law requires home sales to include (1) an EPA, HUD, and Consumer Product Safety Commission-approved information brochure on identifying and controlling lead-based paint hazards (“Protect Your Family From Lead In Your Home”); (2) disclosure of any known information concerning the presence of lead-based paint and/or lead-based paint hazards in the home; (3) an attachment to the contract, or language inserted in the contract, that includes a lead warning statement and confirms that the seller has complied with all notification requirements; and (4) a 10-day period to conduct a paint inspection or risk assessment for lead-based paint hazards if so desired by the buyer or seller.⁸

Radon, another potential hazard in the home, is an odorless and colorless radioactive gas. Radon is the leading cause of lung cancer among nonsmokers and is responsible for approximately 21 000 lung cancer deaths annually.⁹ Lead and radon in homes can be mitigated and treated, but part of their danger is that they can go unnoticed by the residents. Home buyers who are more knowledgeable about potential risks from lead and radon in their homes might be more likely to test their homes for both.^{10,11}

To understand residential home buyers’ lead and radon knowledge, attitudes, and protection behaviors, we built upon the findings of Neri and colleagues.¹² Those researchers assessed

radon-related knowledge, attitudes, and behaviors among recent home buyers in 4 states: Illinois, Minnesota, North Carolina, and Ohio. The present study focused on survey questions about lead Title X requirements. These states have enacted policies that offer awareness and protection from lead and radon during the home-buying process. Illinois and Ohio have enacted laws to support Title X lead disclosure during the home buying process.^{13,14} Minnesota and North Carolina have worked to increase awareness and compliance of Title X through their lead poisoning prevention programs.^{15,16} For radon exposure prevention, all 4 states require that previously identified levels of radon be disclosed at the time of purchase. Illinois and Minnesota also mandate disclosures and education regarding radon.^{17,18} Ohio's residential property disclosure form lists lead-based paint and radon.¹⁹

The Flint, Michigan, water crisis was during the home buyer survey period, which occurred during July 2015 through January 2016.²⁰ We hypothesized that the lead contamination of drinking water in Flint and subsequent intense media coverage raised national awareness about the harmful effects of lead exposure. We investigated if this increased awareness of lead exposure might differ among home buyers before and after the dates of the Flint water crisis. To assess the potential effect of the Flint water crisis media coverage on participant's lead knowledge, attitudes, and behaviors, we compared data for pre- and post-Flint water crisis periods (before September 24, 2015, and on or after that date).

This study explores the associations between knowledge, attitudes, and behaviors specifically related to lead (and the relationship to radon); influence on home-buying decisions; sources of home buyer knowledge; and whether the purchased homes abided by the federal lead disclosure rule (as reported by home buyers).

Methods

Data collection

US states were eligible for inclusion in the study if they had cities with at least 750 single-family home sales the year before recruitment (ie, 2014). To assess radon attitudes among recent home buyers, states with differing radon policies were considered for inclusion. Ten states had existing radon notification policies that required buyers, sellers, and real estate agents involved in the purchase of single-family homes to receive an informational brochure about radon and sign an acknowledgment that the property had or had not been tested for radon, and 23 states had existing professional certification policies that required radon mitigation professionals to be licensed by a state agency.²¹

In brief, a 27-question, paper-based survey was administered to recent single-family home buyers in 4 states regarding their knowledge, attitudes, and protection practices about radon and lead. After considering eligibility criteria, 4 states were selected for the survey: Illinois, Minnesota, North Carolina, and Ohio. Between July 2015 and January 2016, 750 addresses from each state were randomly selected from publicly available lists of home sales. Total single-family home sales reported during this period were approximately 56 000 (Illinois), 29 500 (Minnesota), 48 500 (North Carolina), and 50 500 (Ohio). Respondents were sent materials that offered a \$15 incentive to reply either online or by returning a hardcopy of

a paper-based survey in the mail. Households that did not return the initial survey were contacted 2 more times, with the final time by signature-required receipt. The 27-question survey collected demographic information (ie, home buyer age, sex, race, ethnicity, and educational level) and answers to individual questions (ie, yes/no, multiple choice, open-ended, and Likert scale) regarding knowledge, attitudes, and practices about radon and lead. Additional details about the data collection methods have been previously described.¹²

Data management and analysis

Because the study focused on home buyers' eligible for lead disclosure law notification, we limited most of our analyses of responses to lead and radon questions to home buyers who bought homes built before 1978 ($n = 477$). In the full dataset ($N = 995$), we assessed the relationship of lead-content home buyer responses related to health issues and the home buying process by year the residence was built (pre-1978 vs. post-1977). Descriptive statistics and bivariable analyses were used on demographic and lead-based survey questions. We defined the "pre-Flint" period as home buyer surveys completed before September 24, 2015, and surveys completed on or after September 24, 2015, as "post-Flint." This date aligns with the release of Dr Hanna-Attisha and colleagues' study about increased blood lead levels among children in Flint, Michigan, resulting from switching the source for municipal water.²² To assess potential recall issues, we analyzed the time difference between the home purchase date and this survey interview date.

Our main variable of interest was measured with the question, "Did your understanding of the health issues related to lead-based paint affect your decisions at any point during the home buying process?". With this question, home buyers were given the prompt, "...for example, did you consider lead-based paint issues when looking for and deciding on which home to buy"? The question covered the entire home buying experience culminating with the purchase of the home that triggered the survey. We performed chi-square tests to assess the relationship of responses to the question. We conducted bivariable analyses to examine predictors of responses to whether home buyers reported signing lead disclosure paperwork during closing (ie, the federal lead disclosure rule).^{7,8}

Respondents were asked identical lead and radon questions related to health issues and the home buying process. To compare the identical lead and radon questions related to health issues around the home buying experience among persons who bought homes built pre-1978, we used chi-square tests, prevalence ratios, and 95% confidence intervals (CIs). To compare identical lead questions about health issues and the home buying process among home buyers who bought homes built pre-1978 and post-1977, we calculated prevalence ratios.

We conducted multivariable regression analyses to determine factors that predicted respondent answers to five lead-specific questions. Predictive models were finalized through backward elimination and assessed for multicollinearity with the variance inflation factor (VIF). The 5 questions for these models were (1) whether the home buyers' understanding of health issues related to lead-based paint affected their purchase, (2) whether real estate agents discussed lead-based paint with the home buyer, (3) whether the home had been tested for lead-based paint, (4) whether the home buyer signed lead-based paint disclosure

paperwork, and (5) whether the home buyer received any educational brochures about lead-based paint. Multiple regression analyses controlled for potential confounding from demographic factors (ie, sex, race, ethnicity, age, and education). Lead-radon joint models were assessed to explore associations between radon-specific and lead-specific questions. A test of proportions analyzed homes built pre-1978 to homes built post-1977 for radon- and lead-specific questions against the same 5 questions used for the multivariable regression models.

All analyses were completed using R software (R Foundation for Statistical Computing, Vienna, Austria) and SAS, version 9.3 (SAS Institute Inc., Cary, NC). Statistical significance was regarded as 2-sided, $P < .05$. We report odds ratios (OR) and 95% confidence intervals (CI). In the multivariable analyses, variables with a VIF ≥ 10 were removed from the models due to potential multicollinearity.

This study was reviewed and approved by the CDC Human Subjects Review Board (protocol No. 6491) and the US Office of Management and Budget (OMB No. 0920-1051). The 4 participating states deferred to the CDC Human Subjects Review Board approval.

Results

The overall survey (N = 995) response rate was 33%. Response rates varied significantly ($P < .001$) by state, with North Carolina and Minnesota having the highest response rates. Most responses (48%) resulted from the first mailing. Compared with 2015 census data, this respondent group had a higher proportion of non-Hispanic/Latino, White and younger persons with college degrees.

Demographics and housing information

The pre-1978 home buyers' analytic sample (n = 477) was 52% female, 87% non-Hispanic/Latino, and White persons (84%). More than half of respondents (57%) were aged 25 to 44 years and most had a college degree (65%). All but 3 of the 477 (99%) respondents were not first-time home buyers. For 44% (n = 208) of home buyers, this was their second home purchase. For 41% of respondents, this was their third, fourth, or fifth home purchase. Among respondents, 94% (n = 446) said their purchase did not involve special homeowner's association paperwork (eg, articles of incorporation, declaration, any recorded covenants and restrictions, bylaws, HOA seller disclosure/resale addendum, etc.). Most of the homes were purchased during summer or fall (64%). More respondents were from Minnesota (39%), with the fewest being from Ohio (17%; $P < .001$). Seventy one percent (71%) of respondents purchased their home after the Flint water crisis. Many homes purchased (68%) were built during 1940-1977 and 20% were built during 1920-1939.

Federal lead disclosure rule

Of persons who bought homes built before 1978, 42% reported signing (or seller signing) lead disclosure paperwork during closing, 20% reported not signing, and 37% were unsure (Table 1). Signing lead disclosure paperwork did not vary by state of purchase (Supplemental Table 1). Signing lead disclosure paperwork also did not vary by season of purchase, educational achievement, age of house, or other demographic information (results

not shown). Respondents who previously owned 5 or more homes were more likely to report they signed lead disclosure paperwork when compared with home buyers purchasing their first or second home (OR = 3.0; CI, 1.1-8.0; Table 2).

Knowledge and attitudes of health issues caused by lead and radon exposure

Nearly all home buyers purchasing homes built before 1978 (98%) reported knowledge of health issues caused by lead-based paint. Similar broad knowledge about health issues caused by radon (90%) were observed. Respondents who said they knew of health effects from lead exposure reported their sources of information were from family, friends, neighbors, and co-workers (22%); real estate agents (21%); or television/web sites (20%; Table 3). The most common “other” source of information were health care providers (n = 17). The three most common sources of information about health issues caused by radon were real estate agents (59%), home inspectors (57%), and family, friends, neighbors, and co-workers (38%). Although real estate agents were the most frequent source of knowledge for radon-aware respondents, only about half of these respondents (51%) confirmed that their real estate agent discussed lead-based paint with them (results not shown). Slightly more than half of respondents (n = 101, 21%) said their pre-1978 home was tested for lead or they were unsure of any lead tests conducted (n = 159, 33%). Home inspectors (30%) were the most frequent group to recommend lead-based paint testing among the 101 home buyers who tested their homes. Only 37% of respondents reported receiving lead-based paint educational brochures at inspection or closing. A greater percentage (44%) knew of contractors in the area who deal with lead (Table 3). Home buyers were asked to rank the factors that they would consider if they needed a contractor to fix a lead-based paint problem in the home they just purchased. The most important factors were contractor certification by a state or national organization (30%), referral from a trusted person or source (25%), provision of a cost estimate for testing or repairs (17%), and prior experience testing or fixing lead problems (17%; results not shown). The impact of the Flint water crisis media coverage was not significant in the final models.

Predictive factors for home purchase decision based on lead knowledge, attitudes, and practices

Twenty-two percent (n = 107) of pre-1978 home buyers stated that knowledge of lead-related issues affected their home buying decision. Among these respondents, 47% (n = 50) reported knowledge of lead-based paint helped them decide to take necessary action to repair and 46% (n = 49) reported knowledge that lead-based paint was present helped them decide. Seventy-seven percent (n = 368) of pre-1978 home buyers stated that knowledge of lead-related issues did not affect their home buying decision. Among these respondents, most (85%, n = 311) reported they had the knowledge that lead-based paint was present; however, this did not influence their home buying decision. In bivariable analyses, home buyers purchasing a home in any season except summer were more likely to state that their understanding of lead-based health issues affected their home purchase. Respondents from North Carolina (OR = 4.6; 95% CI, 1.7-12.6) and respondents whose home purchase involved homeowner association paperwork (OR = 4.5; 95% CI, 1.3-16.2) were more likely to state that their understanding of lead-based health issues affected their home purchase (Table 1). In unadjusted analyses, home buyers had 5.1 times the odds (95% CI,

2.0-13.1) to have their decision to buy a home affected when the real estate agent discussed lead-based paint during the home buying experience. Respondents who knew of available lead-abatement contractors had 2.1 times the odds (95% CI, 1.3-3.4) to state that their understanding of lead-based health issues affected their home purchase (Table 3). After adjustment for season and state of purchase, home buyers had 5.4 times the odds (95% CI, 1.7-17.5) to have their decision to buy the home affected when the real estate agent discussed lead-based paint during the home buying experience. Similarly, home buyers had 1.8 times the odds (95% CI, 1.2-2.7) to have their decision to buy the home affected when contractors who work on lead-based paint were available in the area (Table 4).

Comparison of lead and radon knowledge, attitudes, and practices among home buyers who bought homes built pre-1978

Home buyers were asked 5 identical questions each about lead and radon. Among the pre-1978 home buyers, 107 (22%) stated that knowledge of lead-related issues affected their home buying experience. However, significantly more (39%; $P < .001$) pre-1978 home buyers reported that their understanding of radon-related issues affected their purchase decision (Table 5). Home buyers with awareness of health issues caused by radon were 1.7 times (95% CI, 1.4-2.1) more likely than those who understood lead-related health issues to have their decision to buy the home affected. Real estate agents were 1.4 times (95% CI, 1.1-1.8) more likely to discuss radon issues compared to lead-related issues. Buyers and sellers were 1.5 times (95% CI, 1.2-1.8) more likely to sign radon disclosure paperwork compared to signing lead disclosure paperwork. Similar significant differences were observed for radon compared to lead for receipt of educational brochures and awareness of contractors who address remediation and repair issues (Table 5). Respondents who signed lead and radon paperwork were more likely (OR = 1.57; 95% CI, 1.01-2.46) than those who did not to report that they received radon- and lead-related educational brochures. Multivariable models showed no significant differences in knowledge, attitudes, and protective practices among lead and radon knowledgeable respondents.

Comparison of respondents purchasing homes built pre-1978 and post-1977, by 5 lead-content questions

Respondents who bought homes built pre-1978 were less likely (OR = 0.87; 95% CI, 0.69-1.09) than those who bought homes built post-1977 to have their decision to buy the home influenced by health issues caused by lead exposure. Respondents who bought homes pre-1978 were more likely (OR = 1.14; 95% CI, 0.98-1.32) than those who bought homes post-1978 to be aware of contractors who test for and fix lead-based paint issues. As anticipated, respondents who bought homes built pre-1978 were significantly more likely (OR = 1.32; 95% CI, 1.15-1.52) than those who bought homes built post-1977 to have their real estate agent discuss lead-based paint issues. Similarly, respondents who bought homes built pre-1978 were significantly more likely than those who bought homes built post-1977 to have signed lead disclosure paperwork (OR = 1.47; 95% CI, 1.23-1.75) and significantly more likely to receive educational lead brochures during inspection or closing (OR = 1.80; 95% CI, 1.45-2.23) (Supplemental Table 2).

Discussion

This is the first study we are aware of that examines lead exposure home buyer knowledge, attitudes, and behaviors associated with the purchase of pre-1978 homes. Our multistate study of recent pre-1978 home buyers shows that virtually all were aware of health issues associated with lead exposure. One explanation may be that virtually all respondents were not buying their first home and had more opportunity to learn about household lead exposure health issues. This knowledge is higher than reported in a previous study. In that report, among 282 homeowners in 3 greater Omaha, Nebraska, neighborhoods, 50% to 71% reported seeing or receiving information about lead poisoning.²³ We hypothesized that home buyer's knowledge of health issues caused by lead would be higher among home buyers purchasing after the Flint water crisis. However, in multivariable analysis, we did not observe any differences among home buyers based on awareness created by the media coverage.

More than half of our sample of recent pre-1978 home buyers reported not signing or being unsure of signing (or seller not signing) lead disclosure paperwork during closing. This identifies possible collaboration for agencies like EPA, HUD, and health departments to increase Title X compliance. A national survey of 1035 US residents conducted during 2020-2021 found that lead exposure risk was not an issue of high concern among the general US population.²⁴ This finding contextualizes the opportunity that exists to make home buyers aware of potential lead exposure risks. In our study, home buyers not signing lead disclosure paperwork was consistent across all respondent demographic and survey questions, except for one. Home buyers with five or more previous home purchases were more likely to report that documentation of the lead disclosure process occurred. We did not find any studies indicating that persons with previous home buyer experience are more aware of the lead disclosure rule.

For dwellings built before 1978, HUD makes available to real estate agents a seller's information disclosure attachment to the closing contract, or language inserted in the contract, that includes a lead warning statement and confirms that the seller has complied with all notification requirements.²⁵ This lead-based paint and/or lead-based paint hazards disclosure contains signature lines for the seller, buyer, and real estate agent. However, in our sample, more than half of recent home buyers did not sign or did not recall signing such a document. Timing of signing might be a potential reason some home buyers are not sure they signed lead disclosure paperwork. Weissman (2006) reports that a common way real estate agents avoid complying with Title X is by attaching the seller's property disclosure statement (containing the lead-based paint disclosures) to the contract after the contract is signed by all parties.²⁶ In this situation, the buyer is presented with the decision to buy the home before receiving the lead-based paint disclosures. Real estate agents perform the perfunctory requirements of ensuring lead disclosure paperwork is filled out and providing lead and radon educational material (often grouped in with other materials).

Our analysis focused on predictors of the home buyer decision to buy the home based on their understanding of health issues related to lead-based paint exposure. Only 22% said this knowledge affected their home buying decision, which was the outcome variable. We

identified two predictors affecting the home buyer decision to purchase the home: (1) a real estate agent who discussed lead-based paint during the home buying experience and (2) home buyer awareness of contractors in the area who work on lead-based paint.

Real estate agents are important partner in the home buying experience. They were the second most frequent source of home buyer information about health information related to lead exposure (and the most common for radon health information). During the time of this study, home buyers utilized real estate agents 88% of the time and they were considered a “very useful” source of information 79% of the time.²⁷ A 2013 study of homeowners noted from focus groups that real estate agents are trustworthy sources for carbon monoxide education.²⁸ A study by Phoenix and colleagues looked at the effects of educating licensed real estate agents about lead hazards.²⁹ The researchers found that after training, real estate agents were more likely to act with greater concern for the home buyer’s welfare regarding reduction of lead hazards. Real estate agents have an opportunity to encourage lead testing and potential remediation during the time of home sales. The Ohio Lead Advisory Council includes an appointed member from the Ohio Real Estate Trade Organization.³⁰ This provides opportunity for discussion related to transparency about lead information during real estate transactions (personal communication with John Belt, Ohio Bureau of Environmental Health and Radiation Protection, February 5, 2024).

We did not identify previous studies describing home buyer awareness of contractors influencing the decision to buy an older home. However, home buyers receiving Title X lead disclosure information have increased probability to perform lead testing.¹⁰

Respondents who bought homes built before 1978 consistently reported more awareness, knowledge, and practice of radon exposure prevention than of lead exposure prevention. These areas concerned 5 questions about (1) the home buying process, (2) real estate agent discussion about lead and radon, (3) signing disclosure paperwork at closing, (4) receipt of lead and radon brochures, and (5) knowledge of contractors who test and repair for lead and radon. The reason for increased radon knowledge, awareness, and practice compared with that for lead is unclear. At the time of the survey, Illinois and Minnesota had state radon notification policies and Illinois and Ohio had state-managed radon professional licensure requirements.²¹ Those policies and requirements might have contributed to increased radon awareness, knowledge, and practice in the study sample. Radon policies require buyers, sellers, and real estate agents involved in the purchase of single-family homes to receive radon informational brochures and sign an acknowledgement that the property had or had not been tested for radon. Radon professional certification policies require radon mitigation professionals to be licensed by a state agency. Another possible reason for increased home buyer attention to radon compared to lead is the fact that all 4 survey states are mostly located in EPA radon zones 1 and 2. Zone 1 has the highest potential for indoor radon exposure and zone 2 has moderate exposure potential.³¹ This fact might have the effect of increased awareness among real estate agents and home buyers. Cost may be another factor contributing to the difference. Residential lead testing and abatement cost is generally higher compared to residential radon testing and mitigation. Depending on the location and size of home, certified residential lead inspection can cost \$500 to \$2500.^{32,33} Home buyers can also expect to pay an additional \$20 to \$100 if they want their drinking water tested for

presence of lead by a certified laboratory.³⁴ The average cost for certified residential lead paint abatement work in Baltimore averages \$7,600.³⁵ Professional residential radon testing costs range from \$50 to \$150.³⁶ Licensed professional radon mitigation can cost between \$800 and \$2500.^{17,37} To assist home buyers with lead testing and abatement costs by licenses professionals, Ohio enacted a lead abatement tax credit program capped at \$10,000 per taxpayer and per eligible pre-1978 dwelling.³⁸ This program began in 2020.

We found one state-to-state difference among home buyers. In North Carolina, respondents who understood the health issues related to lead-based paint had their home buyer decision affected more than were respondents from the other 3 states. Analyzing, interpreting, and understanding the effects of differences in state policies and attributing them to home buyer responses is complex. Future studies can analyze differences by state to determine if state policies influence home buyer behavior and knowledge. Regardless of current state lead disclosure policies, real estate agents are valuable partners for communication of home-related health issues to home buyers and sellers. Their interaction with buyers and sellers can help to bring about outcomes to decrease lead exposure and be a resource for lead-abatement contractors. Ohio has developed and is using its own residential property disclosure form, which includes checklists for lead-based paint and radon.¹⁹ The North Carolina Lead-Based Paint Hazard Management Program, which is funded and authorized by EPA, provides education related to disclosure, which might have an even broader reach.³⁹

As expected, compared with persons who bought homes built post-1977, persons who bought homes built pre-1978 were more likely to have discussed lead issues with their real estate agent, signed lead disclosure paperwork, and received educational brochures during inspection or closing. Regardless of when the house being purchased was built, we did not find differences in whether the home buyer's decision to purchase the home was affected by health issues caused by lead exposure or knowledge of contractors in the area who test for and fix lead-based paint issues.

This study is subject to several limitations. The response rate of 33% is lower than reported for other mail survey response rates (50%).⁴⁰ Respondents might not be representative of the 4 states surveyed, and generalizability of these results should be interpreted with caution. Home buyers were not asked if they had children. We speculate that respondents with children might be more likely to be concerned about lead-based paint disclosure and remember signing lead disclosure paperwork; however, we were not able to analyze this information. We were not able to obtain the purchase price of the home. We would have liked to assess the relationship between purchase price and whether real estate agents discussed lead-based paint with the home buyer. The survey did not ascertain the home buyer's intended use of the property. While it is possible that a small proportion of homes may have been for investment, it is likely that a large majority of these would have been excluded from the sample. All purchased properties excluded names where the buyer was listed as something other than a person (e.g., corporation or Limited Liability Company). Lastly, as with most surveys, self-reported data might be subject to social desirability in responses or recall bias.

Conclusion

With lead still present in tens of millions of homes and lead dust the main source of lead exposure among children, increasing the number of home buyers who acknowledge, and sign lead disclosure paperwork is important to potentially prevent lead exposure. During the home buying experience, the role that real estate agents play and home buyer awareness of local contractors who work on lead-based paint are important influences in the decision to buy the home. Further study is needed to understand why home buyers in our sample did not sign lead disclosure paperwork as required by state and federal guidelines. Home buyers had greater knowledge, awareness, and practice of radon prevention than of lead prevention, suggesting the need to further study the discrepancy and to strategize about ways to increase knowledge, awareness, and practice of lead exposure prevention. Future studies may focus on homeowners with young children in more racially diverse locations. A cohort study is an appropriate study design to assess if homeowners improved their home environment (eg, employed lead safe repairs).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements:

Chris Yoon for his work to begin analyses and interpretation of the survey data. Ed Norman (Environmental Health Section, Division of Public Health, North Carolina Department of Health and Human Services), Dr. Stephanie Yendell (Minnesota Department of Health Lead Poisoning Prevention Program), John Belt (Ohio Bureau of Environmental Health and Radiation Protection), and Kert McAfee (Illinois Department of Public Health) for their assistance with interpreting the results and suggestions to improve the manuscript. Don Meadows for his outstanding edits of the manuscript.

Financial support:

The authors received no financial support to conduct these analyses.

References

1. Zhao N. Half of US homes built before 1980. Washington, DC: National Association of Home Builders; 2018. <https://eyeonhousing.org/2018/08/half-of-us-homes-built-before-1980/>. Accessed October 7, 2023.
2. Dignam T, Kaufmann RB, Lestourgen L, Brown MJ. Control of lead sources in the United States, 1970-2017: public health progress and current challenges with eliminating lead exposures. *J Public Health Manag Pract. Lead Poisoning Prevention*, 2019;25(1):S13–S22. . doi:10.1097/PHH.0000000000000889
3. Levin R, Brown MJ, Kashtock ME, et al. Lead exposures in U.S. children, 2008: implications for prevention. *Environ Health Perspect.* 2008;116(10):1285–1293.doi:10.1289/ehp.11241. [PubMed: 18941567]
4. Jones D. Primary prevention and health outcomes: treatment of residential lead-based paint hazards and the prevalence of childhood lead poisoning. *J Urban Economics.* 2012;71(1):151–164. doi:10.1016/j.jue.2011.06.002.
5. Centers for Disease Control and Prevention. Preventing lead poisoning in young children. Atlanta, GA: US Department of Health and Human Services; 2005. <http://www.cdc.gov/nceh/lead/publications/prevleadpoisoning.pdf>. Accessed August 30, 2023.
6. US Department of Housing and Urban Development, Office of Healthy Homes and Lead Hazard Control. American Healthy Homes Survey. Lead and arsenic findings. Washington, DC:

US Department of Housing and Urban Development; 2011. https://www.hud.gov/sites/documents/AHHS_REPORT.PDF. Accessed August 30, 2023.

7. US Department of Housing and Urban Development; US Environmental Protection Agency. Requirements for disclosure of known lead-based paint and/or lead-based paint hazards in housing. 24 CFR 35.80–89 and 40 CFR 745.100–119, respectively. Fed Reg. 1996;61(45):9063. <https://www.govinfo.gov/content/pkg/FR-1996-03-06/pdf/96-5243.pdf>. Accessed August 30, 2023.
8. US Environmental Protection Agency. Real estate disclosures about potential lead hazards. Washington, DC: US Environmental Protection Agency; 1996. <https://www.epa.gov/lead/real-estate-disclosures-about-potential-lead-hazards#homebuyers> Accessed August 30, 2023.
9. US Environmental Protection Agency. A citizen's guide to radon: the guide to protecting yourself and your family from radon. EPA 402/K12/002. Washington, DC: US Environmental Protection Agency; 2016. https://19january2021snapshot.epa.gov/radon/citizens-guide-radon-guide-protecting-yourself-and-your-family-radon_.html Accessed August 30, 2023.
10. Bae H. Reducing environmental risks by information disclosure: evidence in residential lead paint disclosure rule. J Policy Anal Manage. 2012;31(2):404–431. doi:10.1002/pam.21600.
11. Vogeltanz-Holm N, Schwartz GG. Radon and lung cancer: what does the public really know? J Environ Radioact. 2018;192:26–31. doi:10.1016/j.jenvrad.2018.05.017. [PubMed: 29883874]
12. Neri A, McNaughton C, Momin B, Puckett M, Gallaway MS. Measuring public knowledge, attitudes, and behaviors related to radon to inform cancer control activities and practices. Indoor Air. 2018;00:1–7.
13. Illinois Lead Poisoning Prevention Code. Title 77: Public Health Chapter I: Department of Public Health Subchapter p: hazardous and Poisonous Substances Part 845 Lead Poisoning Prevention Code Section 845.25 Disclosure Requirements. Amended at 43 Ill. Reg. 2440, effective February 8, 2019. <https://www.ilga.gov/commission/jcar/admincode/077/077008450A00250R.html>. Accessed August 30, 2023
14. Ohio Revised Code 2005. Property disclosure form required for all residential real property transfers. Title 53 Real Property, Chapter 5302 Statutory Forms of Land Conveyance. <https://codes.ohio.gov/ohio-revised-code/section-5302.30>. Accessed August 30, 2023.
15. Minnesota Department of Health. Minnesota's Lead Poison Prevention Programs biennial report to the legislature. St. Paul: Minnesota Department of Health; 2007. <https://www.leg.mn.gov/docs/2007/mandated/070319.pdf>. Accessed August 30, 2023.
16. North Carolina Childhood Lead Poisoning Prevention Program. N.C. strategic plan to eliminate childhood lead poisoning. Raleigh: North Carolina Department of Environment and Natural Resources; 2010. <https://ehs.dph.ncdhhs.gov/hhccehb/cehu/lead/docs/NC-LeadEliminationPlanSummary-FINAL-12-17-10-Revision.pdf>. Revised December 17, 2010. Accessed August 30, 2023.
17. Illinois Department of Public Health. Radon. Springfield: Illinois Department of Health; 2024. <https://dph.illinois.gov/topics-services/environmental-health-protection/toxicology/indoor-air-quality-healthy-homes/radon-faqs>. Accessed August 30, 2023.
18. Minnesota Department of Health. Radon in real estate. 2023. St. Paul, MN. <https://www.health.state.mn.us/communities/environment/air/radon/radonre.html>. Last Updated: January 5, 2024. Accessed February 10, 2024.
19. Ohio Department of Commerce. Residential property disclosure form. https://com.ohio.gov/wps/wcm/connect/gov/cb8c4337-d589-49f1-93b8-494d4d24d822/New+Residential+Property+Disclosure+Form+3.28.22.pdf?MOD=AJPERES&CONVERT_TO=url&CACHEID=ROOTWORKSPACE.Z18_M1HGGIK0N0J000QO9DDDDM3000-cb8c4337-d589-49f1-93b8-494d4d24d822-o46VFPPA. Revised 2022. Accessed August 30, 2023.
20. Kennedy C, Yard E, Dignam T, et al. Blood lead levels among children aged <6 years—Flint, Michigan, 2013–2016. MMWR Morb Mortal Wkly Rep. 2016;65(25):650–654. doi:10.15585/mmwr.mm6525e1. [PubMed: 27359350]
21. Environmental Law Institute. Database of Indoor Air Quality Laws—Database Excerpt: Radon Laws. Washington, DC: Environmental Law Institute; 2013.

22. Hanna-Attisha M, LaChance J, Sadler RC, Champney Schnepf A. Elevated blood lead levels in children associated with the Flint drinking water crisis: a spatial analysis of risk and public health response. *Am J Public Health*. 2016;106(2):283–290. doi:10.2105/AJPH.2015.303003. [PubMed: 26691115]
23. Rajaram S. An action-research project: community lead poisoning prevention. *Teach Sociol*. 2007;35(2):138–150. doi:10.1177/0092055X0703500203.
24. Goebel M, Wardropper CB. Trust and subjective knowledge influence perceived risk of lead exposure. *Risk Anal*. 2024;44(5):1204–1218. Sep 2. doi:10.1111/risa.14212 [PubMed: 37658828]
25. US Department of Housing and Urban Development. Disclosure of information on lead-based paint and/or lead-based paint hazards. Washington, DC: US Department of Housing and Urban Development; 2000. https://www.hud.gov/program_offices/healthy_homes/enforcement/disclosure Accessed August 30, 2023.
26. Weissman S Don't paint yourself into a corner! REALTORS® targeted for enforcement of lead-based paint disclosure rule; 2006. REALTORS®. <https://studylib.net/doc/7246273/enforcement-of-lead-based-paint-disclosure-rule>. Accessed September 10, 2023.
27. National Association of Realtors. Profile of home buyers and sellers 2016. Chicago, IL: National Association of Realtors; 2016. <https://www.nar.realtor/sites/default/files/reports/2016/2016-profile-of-home-buyers-and-sellers-10-31-2016.pdf>. Accessed August 30, 2023.
28. Rupert DJ, Poehlman JA, Damon SA, Williams PN. Risk and protective behaviours for residential carbon monoxide poisoning. *Inj Prev*. 2013;19(2):119–123. doi:10.1136/injuryprev-2012-040339. [PubMed: 22653781]
29. Phoenix JA, Green RD, Thompson AM. Can realtor education reduce lead exposures for vulnerable populations? *J Environ Health*. 2013;76:28–36. [PubMed: 23947286]
30. Ohio Department of Health. Ohio Lead Advisory Council. Columbus, Ohio; 2023. <https://odh.ohio.gov/know-our-programs/childhood-lead-poisoning/ohio-lead-advisory-council#:~:text=The%20Ohio%20Lead%20Advisory%20Council,child%20lead%20poisoning%20prevention%20program>. Accessed February 10, 2024.
31. US Environmental Protection Agency(a). EPA maps of radon zones and supporting documents by state. <https://www.epa.gov/radon/epa-maps-radon-zones-and-supporting-documents-state>. Last updated June 23, 2023. Accessed December 2, 2023.
32. Massachusetts Department of Health. All about deleading: what you need to know about safely fixing the lead in your home. Boston, MA. <https://www.mass.gov/doc/all-about-deleading-brochure-1/download>. Accessed February 10, 2024.
33. Turn-Key Environmental Consultants. Ohio lead paint testing, investigation, and risk assessment. Last updated 2024. <https://www.turn-keyenvironmental.com/environmental-investigation-assessment-testing-and-consulting-services/lead-paint-testing-investigation-and-risk-assessment#:~:text=What%20is%20the%20cost%20of,on%20size%20of%20the%20property>. Accessed March 17, 2024.
34. US Environmental Protection Agency(b). How to Make Your Home Lead-Safe. <https://www.epa.gov/lead/how-make-your-home-lead-safe>. Last updated September 13, 2023. Accessed February 10, 2024.
35. McLaine P, Shields W, Farfel M, Jj C Jr, Dixon S. A coordinated relocation strategy for enhancing case management of lead poisoned children: outcomes and costs. *J Urban Health*. 2006 Jan;83(1):111–128. doi:10.1007/s11524-005-9011-8. [PubMed: 16736359]
36. Michigan Department of Environment, Great Lakes, and Energy. Ten questions about radon, a cancer-causing gas found in one in four homes in Michigan. State of Michigan; January 11, 2023. <https://www.michigan.gov/egle/newsroom/mi-environment/2023/01/11/ten-questions-about-radon-a-cancer-causing-gas-found-in-one-of-four-homes-in-michigan>. Accessed February 10, 2024.
37. North Carolina Department of Health and Human Services. Radon Mitigation. Raleigh: North Carolina Department of Health and Human Services; 2024. <https://www.ncdhhs.gov/divisions/health-service-regulation/north-carolina-radon-program/radon-mitigation#Howmuchdoesitcostoreduceraidoninanexistinghome-3349>. Accessed February 10, 2024.

38. Ohio Department of Health. Lead abatement tax credit program. Columbus, Ohio; 2020. <https://odh.ohio.gov/know-our-programs/lead-abatement-tax-credit-program>. Accessed February 10, 2024.
39. North Carolina Department of Health and Human Services. Lead-based paint management—renovation, repair, and painting. Raleigh: North Carolina Department of Health and Human Services; 2010. <https://epi.dph.ncdhhs.gov/lead/rtp.html>. Updated October 13, 2021. Accessed September 25, 2023.
40. Dillman DA, Smyth JD, Melani Christian L. Internet, Mail, and Mixed-Mode Surveys: The Tailored Design Method. 3rd. Hoboken, NJ: John Wiley & Sons Inc; 2009.

Implications for Policy & Practice

- With lead still present in tens of millions of homes and lead dust the main source of lead exposure among children, increasing the number of home buyers who acknowledge, and sign lead disclosure paperwork is important to potentially prevent lead exposure.
- Environmental health professionals are important partners to strengthen lead paint disclosure compliance since their work focuses on developing and implementing programs to minimize risks and eliminate hazards in the built and natural environment.
- Collaboration among agencies like CDC, EPA, HUD, and health departments may also increase implementation of Title X compliance.
- During the home buying experience, real estate agents are an important influence on the decision to buy the home. Including real estate agent trade association members on health department housing advisory committees may strengthen collaboration to address housing-related human health.
- Home buyers had greater knowledge, awareness, and practice of radon prevention than of lead prevention, suggesting the need to further study the discrepancy and to strategize about ways to increase knowledge, awareness, and practice of lead exposure prevention.

TABLE 1

Demographics of Recent Buyers of Homes Built Before 1978 and Effect of Understanding of Health Issues Related to Lead on Purchase (N = 477)

Characteristic	Number (%)	Understanding of the health issues related to lead-based paint affected homebuyer decision to purchase home Odds Ratio (95% CI)
Gender		
Male	227 (47.6)	0.79 (0.4–1.5)
Female	246 (51.5)	Ref
Missing	4 (1.4)	N/A
Age (years)		
<25	7 (1.5)	N/A
25–44	273 (57.2)	Ref
45–64	145 (30.4)	0.3 (0.1–0.7)
65+	38 (8.0)	1.0 (0.3–3.3)
Missing	14 (2.9)	N/A
Race		
White	402 (84.2)	Ref
Black of African American	9 (1.9)	2.3 (0.1–37.9)
Asian	8 (1.7)	N/A
Native Hawaiian or Other		
Pacific Islander	4 (1.4)	N/A
Prefer not to answer	9 (1.9)	0.9 (0.1–5.3)
Missing	45 (8.9)	N/A
Ethnicity		
Hispanic or Latino	11 (2.3)	1.3 (0.1, 15.0)
Not Hispanic or Latino	413 (86.6)	Ref
Missing	53 (11.1)	N/A
Education		
≤ High school	21 (4.4)	1.4 (0.4–5.2)
Some college	79 (16.6)	0.50 (0.2–1.3)
College degree	311 (65.2)	Ref
Prefer not to answer	10 (2.1)	N/A
Missing	56 (11.7)	N/A
Season of home purchase		
Spring (March–May)	107 (22.0)	3.4 (1.3–9.3)
Summer (June–Aug.)	175 (36.6)	Ref
Fall (Sept.–Nov.)	130 (27.2)	4.2 (1.6–9.3)
Winter (Dec.–Feb.)	61 (12.8)	4.2 (1.4–13.1)
Missing	4 (1.4)	N/A
Flint, Michigan, water crisis impact		
Pre-Flint (before Sept. 24, 2015)	139 (29.1)	Ref

Characteristic	Number (%)	Understanding of the health issues related to lead-based paint affected homebuyer decision to purchase home Odds Ratio (95% CI)
Post-Flint (after Sept. 23,2015)	338 (70.9)	1.2 (0.5–2.7)
Home buyer location		
Illinois	99 (20.8)	Ref
Minnesota	187 (39.2)	1.5 (0.6–4.0)
North Carolina	112 (23.5)	4.6 (1.7, 12.6)
Ohio	79 (16.5)	0.57 (0.1–2.5)
Year home built		
<1900	9 (1.9)	N/A
1900-1919	46 (9.6)	1.3 (0.4–4.4)
1920-1939	96 (20.1)	1.1 (0.4–3.2)
1940-1959	166 (34.8)	1.3 (0.5–3.1)
1960-1977	160 (33.5)	Ref
First-time home buyer		
Yes	3 (0.6)	N/A
No	473 (99.1)	N/A
Missing	1 (0.3)	N/A
Buyer or seller signed paperwork during closing to indicate specifically whether the home contained lead-based paint		
Yes	201 (42.1)	1.7 (0.7–4.2)
No	97 (20.3)	Ref
Unsure	175 (36.7)	1.9 (0.7–4.9)
Missing	4 (0.9)	N/A
Home purchase involved special homeowner association paperwork		
Yes	23 (4.8)	4.5 (1.3–16.2)
No	446 (93.5)	Ref
Missing	8 (1.7)	N/A
Number of homes previously owned		
0-1	211 (44.2)	2.9 (0.9–9.5)
2-4	194 (40.7)	1.8 (0.5–5.9)
5+	68 (13.7)	Ref
Missing	4 (1.4)	N/A

Abbreviations:

N/A = Not applicable or estimate too unstable

Ref = Referent category

TABLE 2

Bivariable Analysis of the Relationship Between Signing Lead Disclosure Paperwork with Number of Previously Owned Homes Built Pre-1978 (N = 477)

“Did you or the sellers have to sign any paperwork during the closing to indicate specifically whether lead-based paint was present?”	Chi-squared ^a	P value	Odds Ratio (95% Confidence Interval)
Number of homes previously owned	5.46	0.05	
0-1			Ref
2-4			0.95 (0.5–1.8)
5+			3.0 (1.1–8.0)
Missing			N/A

^aChi-square test used to compare the means between signing lead disclosure paperwork and number of homes previously owned

TABLE 3

Home Buyer Knowledge, Awareness, and Safety Practice of Lead Hazards and Sources of Lead-related Information (N = 477)

Characteristic	Number (%)	Understanding of the health issues related to lead-based paint affected homebuyer decision to purchase home Odds Ratio, 95% Confidence Interval
Aware of health issues related to lead-based paint		
Yes	466 (97.6)	Ref
No	9 (1.9)	0.7 (0.08–6.1)
Missing	2 (0.5)	N/A
Source of information of health issues related to lead-based paint *		
Family member, friend, neighbor, coworker	262 (22.1)	2.8 (1.3, 6.4)
Real estate agent	251 (21.2)	2.7 (1.2, 6.1)
Television / Web advertisement	235 (19.8)	0.96 (0.47, 2.0)
Home inspector	217 (18.3)	1.8 (0.87, 3.8)
Contractor (home repair/remodeling)	111 (9.4)	1.1 (0.48, 2.5)
Professional lead testing company	18 (1.5)	1.0 (0.26, 4.0)
Other	91 (7.7)	0.51 (0.20, 1.3)
Understanding of the health issues related to lead-based paint affect homebuyer decisions at any point during the home buying process		
Yes	107 (22.4)	N/A
No	368 (77.1)	N/A
Missing	2 (0.5)	N/A
Understanding of health issues related to lead-based paint affected decision during the home buying process (n = 107)		
Yes, knowledge of lead-based paint was present helped decide during homebuying process	49 (45.8)	N/A
Yes, knowledge of lead-based paint helped decide whether action was needed to repair/remediate	50 (46.7)	N/A
Yes, other reason	4 (3.7)	N/A
Missing	4 (3.7)	N/A
Understanding of health issues related to lead-based paint did not affect decision during the home buying process		
Had no knowledge of lead and did not influence homebuying decision	5 (1.4)	N/A
Did not think lead was a concern and did not influence homebuying decision	15 (4.1)	N/A
Had knowledge of lead-based paint and did not influence homebuying decision	311 (84.5)	N/A
No, other reason	23 (6.3)	N/A
Missing	14 (3.8)	N/A
Real estate agent discussed lead-based paint with homebuyer that lead to purchase of home		
Yes	244 (51.2)	5.1 (2.0–13.1)
No	162 (34.0)	Ref
Unsure	63 (13.2)	0.58 (0.06–5.3)
Missing	8 (1.6)	2.3 (0.21–26.2)

Characteristic	Number (%)	Understanding of the health issues related to lead-based paint affected homebuyer decision to purchase home Odds Ratio, 95% Confidence Interval
Home tested for presence of lead-based paint		
Yes	101 (21.2)	1.9 (0.91–4.1)
No	212 (44.4)	Ref
Unsure	159 (33.3)	1.0 (0.42–2.5)
Missing	5 (1.1)	N/A
Person who recommended home be tested for presence of lead-based paint (n = 101)		
Home inspector	30 (29.7)	Ref
Real estate agent	12 (11.9)	1.2 (0.23–6.4)
Home seller	18 (17.8)	2.0 (0.32–12.3)
Self (survey respondent)	18 (17.8)	1.5 (0.30– 7.5)
Lead paint professional	2 (1.9)	N/A
Other	15 (14.9)	0.38 (0.06–2.4)
Missing	6 (6.0)	N/A
Homebuyer received brochure(s) about lead-based paint during home inspection or closing		
Yes	176 (36.9)	1.8 (0.83–4.1)
No	167 (35.0)	Ref
Unsure	130 (27.2)	1.5 (0.60–3.7)
Missing	4 (0.9)	N/A
Contractors who test for and fix lead-based paint issues are available in your area		
Yes	210 (44.0)	2.1 (1.3–3.4)
No	4 (0.9)	N/A
Unsure	259 (54.2)	Ref
Missing	4 (0.9)	N/A
Contractors who test for and fix lead-based paint issues in area are certified by the state or a national organization (n = 210)		
Yes	74 (35.2)	1.2 (0.61–2.3)
No	1 (0.5)	N/A
Unsure	117 (55.7)	Ref
Missing	18 (8.6)	N/A

* Among persons who reported “yes” to having heard about health issues related to lead (n = 1,185). Percentages do not total to 100% due to home buyer ability to choose more than one response.

Abbreviation: N/A = Not applicable or estimate too unstable

TABLE 4

Multivariable analysis of the relationship between homebuyer understanding of health issues related to lead-based paint on the decision to purchase home with home buying process activities, among homes built pre-1978, adjusted for season and state of purchase (N = 477)

Understanding of the health issues related to lead-based paint affect homebuyer decision to purchase home	Chi-squared ^a	P value	Odds Ratio (95% CI)
“Did any real estate agent discuss lead-based paint with you during the home buying experience that led to the purchase of this home?” Yes No Unsure Missing	10.3	0.016	5.4 (1.7–17.5) Ref 0.75 (0.07–7.9) 2.7 (0.18–39.9)
“Has the home you bought been tested for lead-based paint?” Yes No Unsure Missing	4.29	0.117	2.3 (0.94–5.7) Ref 0.95 (0.32–2.8) N/A
“Did you or the sellers have to sign any paperwork during the closing to indicate specifically whether lead-based paint was present?” Yes No Unsure Missing	0.520	0.915	1.1 (0.38–3.3) Ref 1.5 (0.47–4.5) N/A
“Did you receive any brochures about lead-based paint during the negotiation or closing?” Yes No Unsure Missing	0.332	0.847	0.98 (0.38–2.5) Ref 1.3 (0.44–3.8) N/A
“Are contractors who work on lead-based paint available in your area?” Yes No Unsure Missing	20.24	0.005	1.8 (1.2– 2.7) NA Ref NA

^aChi-square test used to compare the means between understanding of health issues related to lead-based paint on the decision to purchase home with home buying process variables.

TABLE 5

Relationship of Lead- and Radon-content Home Buyer Questions Related to Health Issues and the Home Buying Process, Among Homes Built Pre-1978, (N = 477)

Lead and Radon Knowledge, Awareness, and Practice Questions	Lead Number (%)	Radon Number (%)	Prevalence Ratio (95% CI)	Chi-squared (df), P value
Understanding of the health issues related to radon/lead-based paint affect homebuyer decisions at any point during the home buying process				56.0 (1), <.0001
Yes	107 (22.4)	186 (39.0)	1.7 (1.4–2.1)	
No	368 (77.1)	290 (60.8)		
Missing	2 (0.5)	1 (0.2)		
Real estate agent discussed radon/lead with you during the homebuying experience that led to the purchase of this home				112.5 (4), <.0001
Yes	244 (51.2)	272 (57.0)	1.4 (1.1–1.8)	
No	162 (34.0)	156 (32.7)		
Unsure	63 (13.2)	45 (9.4)		
Missing	8 (1.6)	4 (0.9)		
Buyer or seller signed paperwork during closing to indicate specifically whether the home contained radon/lead-based paint				43.9 (4), <.0001
Yes	201 (42.1)	236 (49.5)	1.5 (1.2–1.8)	
No	97 (20.3)	117 (24.5)		
Unsure	175 (36.7)	122 (25.5)		
Missing	4 (0.9)	2 (0.5)		
Homebuyer received brochures about radon/lead during home inspection or closing?				211.1 (4), <.0001
Yes	176 (36.9)	213 (44.7)	2.3 (1.8–3.0)	
No	167 (35.0)	160 (33.5)		
Unsure	130 (27.2)	103 (21.6)		
Missing	4 (0.9)	1 (0.2)		
Contractors who test for and fix radon/lead-based paint issues are available in your area				119.5 (4), <.0001
Yes	210 (44.0)	354 (74.2)	4.5 (2.7–7.5)	
No	4 (0.9)	2 (0.5)		
Unsure	259 (54.2)	118 (24.7)		
Missing	4 (0.9)	3 (0.6)		