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Perceived Synergistic Risk for Lung Cancer After Environmental Report-Back Study on Home Exposure to Tobacco Smoke and Radon

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Abstract

Purpose: To examine the short-term impact of a personalized environmental report-back intervention to reduce home exposure to tobacco smoke and radon on perception of synergistic risk for lung cancer. Radon-induced lung cancer is more common among those exposed to tobacco smoke.

Design: Randomized controlled trial.

Setting: Primary care clinics and a pharmacy waiting area at a University Medical Center in the Southeastern United States and community events.

Participants: Five hundred sixty adult homeowners and renters (3-month follow-up, n = 334).

Intervention: Personalized environmental report back.

Measures: Single-item synergistic risk perception measure using 5-point Likert-type scale.

Analysis: Change in synergistic risk from baseline to 3 months was evaluated using a generalized estimating equation model containing main effects of treatment group and time. Covariates in the model included age, gender, education, and home smoking status.

Results: For treatment and control groups combined, there was a significant increase in perception of synergistic risk from baseline to 3 months, but the study groups did not differ. There was no association between perceived synergistic risk and whether or not there were smokers at home.

Conclusion: Learning about combined risks for lung cancer, with or without dual home screening for secondhand smoke and radon and environmental report-back, may enhance perceived risk for combined environmental exposures. Evaluation of perceived synergistic risk with a single item is a study limitation.

Keywords

secondary prevention, environment, passive smoking, radon

Purpose

Lung cancer is the second most commonly diagnosed cancer, has the highest death rate of all cancers in the United States,[1] and is preventable by eliminating tobacco smoke and radon exposure.[2] Smoking is responsible for 80% of lung cancer deaths, followed by radon (15 000-22 000 deaths/year) and second-hand smoke (SHS) exposure (7300 deaths/year). [3-5] More radon-related lung cancers occur in individuals with history of SHS exposure.[6] Synergistic risk, or exposure to SHS *and* radon, increases lung cancer risk dramatically.[7] Among never smokers, exposure to radon may be more harmful for

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those exposed to SHS.[8] Few residents are aware of the combined risk of exposure to SHS and radon.

Although the home is the major source of SHS and radon exposure, screening the home is a neglected area of secondary prevention. Because radon is a colorless, odorless gas, many individuals may fail to recognize the potential for home radon exposure.[9] The US Surgeon General and the environmental protection agency (EPA) estimate that 1 in 15 US residences exceed 4.0 pCi/L of radon.[10] Testing a personalized environmental report-back intervention to reduce home exposure to SHS and radon, this study examined perceived synergistic risk for lung cancer.

Methods

Design and Sample

The University Office of Research Integrity approved this study to assure protection of human participants. We examined perception of synergistic risk among homeowner participants at 3-month follow-up to a larger randomized controlled trial to test the impact of Freedom from Radon Exposure and Smoking in the Home (FRESH), an environmental report-back intervention. FRESH was based on a teachable moment model, in which a significant event (eg, home testing for SHS/radon) can serve as a cue by increasing risk perception, creating a teachable moment.[11]

An equal number of participants with and without smoking in the home were recruited in primary care clinics, a pharmacy waiting area, and community events (2013-2016). Within each stratum, those randomly assigned to the treatment group received free home test kits for SHS and radon on-site, along with detailed instructions. Trained interventionists delivered a brief problem-solving phone consultation to report back test results, assess stage of action and response to report back, and deliver tailored queries and messages based on stage of action. Those randomized to the control group received only a coupon for free test kits, enabling the participant to request the kits from the research team at a later date. Participants reported synergistic risk perception as part of online baseline (N = 560) and 3-month surveys (n = 334). The retention rate was 59.6% at 3 months postintervention.

Measures

Synergistic risk perception was a single item asking participants to "Rate the risk from being exposed to radon and smoking a pack of cigarettes per day, compared to the risk of only smoking a pack of cigarettes a day with no radon exposure." The responses were on a 5-point Likert-type scale ranging from (1) "Much less risky" to (5) "Much more risky." The lowest 3 categories were combined for analysis purposes. Participants were categorized as smokers if they had smoked any cigarettes in the last 30 days. Home smoking was assessed with "Do you or any other members of your household smoke cigarettes, cigars, or pipes?" Demographic characteristics were age, sex, race/ethnicity, and education.

Table 1. Comparison of Sociodemographic Characteristics by Group at Baseline.[a]

Characteristic	Total Sample Mean (SD) or n (%)	Treatment (n = 303) Mean (SD) or n (%)	Control (n = 257) Mean (SD) or n (%)	*P* Value
Age	50.5 (13.0)	50.1 (13.4)	50.9 (12.6)	.48
Gender				
Male	183 (32.7%)	102 (33.7%)	81 (31.5%)	.59
Female	377 (67.3%)	201 (66.3%)	176 (68.5%)	
Race/ethnicity				
White/non-Hispanic	468 (83.9%)	253 (83.5%)	215 (84.3%)	.79
Other	90 (16.1%)	50 (16.5%)	40 (15.7%)	
Education				
< College graduate	228 (40.8%)	133 (44.0%)	95 (37.0%)	.090
College graduate	331 (59.2%)	169 (56.0%)	162 (63.0%)	
Home smoking group				
Yes	227 (49.5%)	150 (49.5%)	127 (49.4%)	.98
No	283 (50.5%)	153 (50.5%)	130 (50.6%)	
Participant smoking[b]				
Yes	147 (26.3%)	81 (26.8%)	66 (25.7%)	.76
No	412 (73.7%)	221 (73.2%)	191 (74.3%)	
Synergistic risk				
Much less, less, or equal risk	184 (32.9%)	95 (31.3%)	89 (34.6%)	.51
More risk	219 (39.1%)	125 (41.3%)	94 (36.6%)	
Much more risky	157 (28.0%)	83 (27.4%)	74 (28.8%)	

[a]N = 560.
[b]Due to the strong association between home smoking and the participant's smoking status, the latter was not included as a covariate in the generalized estimating equation model.

Statistical Analysis

Study variables were summarized using means and standard deviations or frequency distributions. Baseline differences between study groups were assessed using the *t* test and χ^2 test. Change in synergistic risk from baseline to 3 months was evaluated using a generalized estimating equation (GEE) model that contained main effects of study group and time as well as their interaction; covariates in the model included age, gender, education, and home smoking status. Given lack of significance for the interaction ($P > .8$), the final model contained main effects and covariates only. Analysis was conducted in 2017 using SAS version 9.3 with an α of .05.

Results

The average age of the participants was 50 years. The majority were female (see Table 1) and white/non-Hispanic with a college degree. By design, half had smoking in the home; one-fourth of the participants were smokers themselves. In the GEE model, the group main effect was not significant. However, the significant time main effect indicated synergistic risk increased from baseline to 3 months (Figure 1). Compared to baseline, 3-month synergistic risk scores for the study groups combined were 55% more likely to be rated in the next higher risk perception category (ie, 4 vs 3 or 5 vs 4; $P < .001$). College

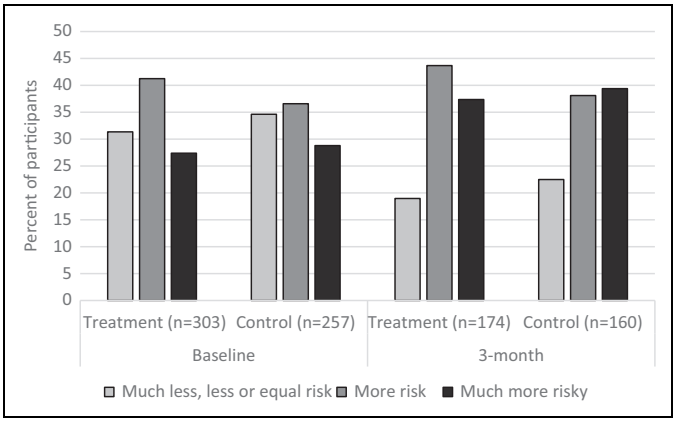

Figure 1. Perceived synergistic risk of tobacco smoke and radon by study group at each time point. The generalized estimating equation (GEE) model demonstrated a significant time main effect. The group main effect and Group ×Time interaction were not significant.

graduates were 150% more likely than those with less education to rate synergistic risk in the next higher risk category ($P < .001$). Treatment group, age, gender, and home smoking group were not significantly associated with perceived synergistic risk.

Discussion

Summary

There was a significant increase in perception of synergistic risk from baseline to 3 months for treatment and control groups combined. While those in the treatment group benefitted from FRESH, even controls gained understanding of the combined risk of SHS and radon exposure from baseline to 3 months. Because the treatment group received the intervention and the control group did not, it is not clear what drove this change. However, it is possible that the act of enrolling in the study (which implies that homes should be tested), resulting in availability of free home test kits, constituted a brief educational intervention in itself, which may provide support for educational interventions to reduce SHS and radon exposure.[11] In the case of this study, learning about combined risks of lung cancer, with or without dual home screening for SHS and radon and environmental report back, may have enhanced perceived synergistic risk for lung cancer.

Limitations

More research is needed to examine sociodemographic variations in perceived synergistic risk and whether increased perceived synergistic risk influences quit attempts or reduced exposure to SHS and/or radon. The primary limitation of the study was the attrition rate; compared to dropouts, those who completed the 3-month survey were older, more educated, and less likely to have a smoker in the home. These demographic factors were included as covariates in the GEE model to mitigate these retention differences. Importantly, there was no attrition rate difference between treatment and control participants. Another study limitation was the single-item perceived synergistic risk measure. The use of multiple items to ascertain a more precise assessment is warranted in future studies. Further, this secondary analysis does not allow for a confirmation of causal relationship between perceived synergistic risk and participation in an educational intervention. Although the study findings are compelling and reveal a need for greater awareness of combined environmental exposures, generalizability of findings is limited by the regional convenience sample and lack of ethnic diversity.

Significance

Health promotion professionals can play a pivotal role in raising public awareness about risk associated with combined home exposure to SHS and radon. Although the Guide to Clinical Preventive Services[12] briefly mentions exposure to SHS and radon as part of risk assessment associated with lung cancer screening, greater emphasis on directly discussing these common environmental exposures with all patients is crucial. As health-care providers engage with their patients, they can emphasize the importance of establishing smoke-free home/car policies and radon testing with mitigation as needed.

So what?

Research efforts and investment are needed to test the effects of innovative interventions (including policy change) to reduce home exposure to SHS and radon. Learning about the combined risks for lung cancer, with or without dual home screening and personalized environmental report-back, can enhance perception of synergistic risk. Continued efforts to educate the public on the *combined* health effects of SHS and radon exposure, along with efforts to motivate individuals, particularly those with current or past tobacco smoke exposure, to test for radon are critically important for lung cancer prevention.

Authors' Note

All contributors to this manuscript are listed as authors, and include Drs Karen Butler, Luz Huntington-Moskos, Mary Kay Rayens, Amanda Wiggins, and Ellen J. Hahn.

Declaration of Conflicting Interests

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