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How Do African-American Community Members' Perceptions About Environmental Risks of Breast Cancer Compare with the Current State of the Science?

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Abstract

African-American (AA) women experience higher mortality from breast cancer than any other racial group. Understanding community-held perceptions of environmental contaminants as risk factors for breast cancer can inform the development of tailored prevention and education efforts for improve health outcomes. Six focus groups were conducted with AA participants in two counties in South Carolina, and themes were identified using open and axial coding. Perceived environmental risks for breast cancer most frequently discussed by participants were compared to findings from published systematic reviews. Frequently discussed environmental risk factors by participants were deodorants containing aluminum, plastics, pesticides, and air and water pollution. While perceptions of aluminum and air pollution as risk factors did not align with the state of the science, perceived risk factors of chemicals in plastics and pesticides were found

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to be in alignment. There is some congruence between perceived environmental risks for breast cancer within the AA community and the current state of the science; however, there is a need to communicate information that reflects current science regarding commonly held misconceptions. Development of evidence-based, clear, and culturally appropriate messaging that reflects the current state of the science is warranted.

Keywords

Community health; Risk perceptions; Breast cancer; Environment; Focus groups; Literature review

Introduction

In the United States (US), breast cancer affects 1 in 8 women and is the second leading cause of cancer death [1]. African-American (AA) women experience higher mortality from breast cancer than any other racial group [1, 2]. In addition, AA women are more often diagnosed with later stage breast cancer and have lower stage-specific survival rates [3, 4]. Environmental, biological, behavioral, and socio-cultural factors influence breast health and breast cancer risk [3-5].

There are several known and suspected environmental risks for breast cancer, including exposure to pesticides, industrial pollutants, plastics, traffic emissions, and radiation [5-15]. Residence in an economically segregated environment, increased psychosocial stress, and poor access to health care and quality education can all increase cancer risk [3, 16]. However, much debate surrounds the specific risks, timing of exposure, and dose-response relationship between environmental contaminants and breast cancer [5, 6, 17-20]. A variety of socio-cultural and economic factors also influence environmental exposure and thereby may contribute to breast cancer disparities affecting AA women [3, 11, 21, 22]. Understanding community perceptions of environmental risk can inform the development of tailored prevention and education programs that can effectively edify this population. For the purpose of this study, environmental risks were defined as exogenous exposures to potentially hazardous chemicals or physical agents, and did not include behavioral/lifestyle factors, such as diet and exercise [4].

Race, ethnicity, and socio-economic position correlate with social, political, and cultural affiliations that impact perceptions of cancer risk and screening [16]. Social and cultural influences on beliefs about health can impact understanding and acceptance of health messages. This necessitates the use of culturally sensitive approaches to ensure effective educational efforts for community members from diverse backgrounds [3, 22, 23]. Identification of appropriate strategies for effectively communicating accurate, evidence-based information regarding breast cancer risk factors for diverse audiences is essential, as health literacy skills and health information delivery preferences may vary [24-27]. In previous research on the content, readability, and cultural sensitivity of online information regarding environmental contaminants as risk factors for breast cancer available in the US, we found that the majority of online resources were not appropriately targeted for or sensitive to diverse audiences, and included technical references and language written at or

above a high school reading grade level [24]. This lack of plain language and culturally relevant messaging serves as a barrier to universal understanding of breast cancer risk information [24-26]. In addition, our larger qualitative study exploring AA perceptions about breast cancer, health messaging, and environmental risk highlighted cultural mistrust in medical information received. Participants requested tactile, visual, and reliable plain language information that can be used as a reference in their household [25]. These findings suggest that AA perceptions of environmental risk for breast cancer are influenced by perceptions of source reliability and messaging format. Effective communication of scientific research and health messaging thus requires a collaborative, community-engaged approach, which aids in trust building between the research community and the target population, and generates messaging and prevention strategies that are generated from the community itself [3, 25, 28-30].

Based on the above discussion, there is a critical need to understand how personal perceptions about environmental risks for breast cancer relate to the current scientific evidence [25, 30, 31]. We assume, appropriately, that the peer-reviewed literature represents our best current understanding of these risks, although we acknowledge that there is incomplete data and understanding in a number of areas and research is ongoing. Nevertheless, this comparison will allow an assessment of possible limitations or misperceptions in community knowledge and inform the development of effective health communication strategies to address them. This study comparing the qualitative assessment of AA community members' beliefs about environmental risks for breast cancer with current scientific evidence on environmental risks aims to fill this gap and to enhance targeted prevention and education efforts for this high-risk population.

Methods

Study Setting

The purpose of this study was to compare the AA community's perceptions of environmental risks for breast cancer to the current state of the science on environmental risks. Guided by grounded theory, as defined by Corbin and Strauss [32], we conducted a qualitative inquiry through focus group discussions regarding knowledge, beliefs, and perceptions of environmental contaminants as risks of breast cancer in the AA community in South Carolina. The current analysis focuses on the perceptions of specific environmental risks of breast cancer that were identified by focus group participants. This study was approved by the University's institutional review board. Additional details on participant selection, focus group methodology, and analysis are published elsewhere as part of our larger qualitative study [25].

Data Collection

An analysis of systematic reviews on environmental risks of breast cancer was conducted to synthesize the current state of the science. Systematic reviews were collected in October of 2018 through a PubMed and Google Scholar search utilizing the search terms "organic pollutants," "radiation," "antiperspirants," "pollution," "endocrine disruptors," "UV," and "metals," in combination with the terms "breast cancer" or "BrCA" and "systematic review,"

as well as the search combination “breast cancer” and “environment” and “meta-analysis.” These search terms were based on a review of the literature regarding environmental risk factors for breast cancer and the US Interagency Breast Cancer and Environmental Research Coordinating Committee (US IBCERCC) guidelines [4, 24]. Ten relevant reviews were located and scientific findings from these reviews were compared to the perceptions of environmental risks most frequently discussed by AA participants in focus groups [6-15]. For this comparison, only the portion of focus group discussion that focused on environmental risk perceptions was included in analysis.

Participant Selection

Recruitment for this study utilized purposive and convenience sampling methods [32]. Participants were recruited in collaboration with a local adult literacy organization and four faithbased partners who assisted with direct recruitment and information dissemination within the community. Research assistants also distributed flyers and printed posters in public spaces, advertised on local radio stations, and contacted potential study participants directly upon referral. All eligible participants were AA community members caring for a female family member under the age of 18 years old.

Focus Group Protocol

Six audio-recorded focus groups, ranging from 45 to 90 min in length, were conducted in a roundtable format at an adult literacy center in the community. Each focus group consisted of 6–15 participants, with two or three research team members, and at least one community partner. Researchers and the community partner were all female, and each focus group was led by at least one race concordant moderator. Community partners assisted with introductions and registration, and research team members served as note-takers and moderators. Interviews were semi-structured, with an open-ended question format, and field notes, drafted by research team members, were used to support data analysis. Participants completed a demographic survey and a reading comprehension assessment, utilizing a modified Cloze procedure [33], before the initial focus group, and all participants were given a small monetary incentive for their participation at the conclusion of each session.

Data Analysis

All focus groups were professionally transcribed. Focus group question format was guided by similar focus group studies [23]. Two specific questions were posed to elicit community members’ perceptions of breast cancer risk. The first question was: “What do you know about breast cancer in general?” This question was followed by the following prompts: “In your opinion, what are some of the risk factors for breast cancer?”, and “What are some of the signs and symptoms?” The second question was: “When thinking about risk factors for breast cancer, what comes to mind?” This question was followed by keyword prompts such as “genetics,” “family history,” “environmental,” and “personal care products.” Two research team members (KRL, SK), who also served as interviewers, used open and axial coding procedures to identify themes that emerged from the focus group data [32], and data were analyzed until there were no new emerging themes. For the purpose of this analysis, we focused solely on the theme of “perceptions about environmental risks of breast cancer” that emerged from the responses to the two questions listed previously. With this specific

analytic code, frequencies were calculated to determine how often certain words associated with certain risks were discussed during the focus groups using the Word Cruncher function in Atlas.ti. After selecting for the most commonly discussed environmental risks, these perceptions were compared to the systematic review evidence and noted as to whether or not they aligned.

Results

This qualitative inquiry consisted of six focus group discussions ($n = 50$ participants) held in two South Carolina counties where the research team has established community partnerships. Participants were community dwelling AAs who were mostly female (98%), with a mean age of 49.4 years (standard deviation/SD = 13.8). The majority of participants (38%) reported full-time employment and some college education. Cloze reading comprehension scores ($n = 49$) showed similar results, with an average Cloze score of 76.8% for the lower grade level document (SD = 18.5), and 78.4% for the higher grade level document (SD = 17.3).

Perceived Environmental Risks for Breast Cancer

From the focus group discussion, several perceived risks emerged that are commonly associated with breast cancer and often noted in media discourse [24]. Each perceived risk was compared to the state of the science, based on reviews published in the peer-reviewed literature, and can be found in Table 1. The most frequently discussed perceived risk by participants related to the use of deodorants containing aluminum (25 mentions or 55.6% of mentions), and was commonly considered a risk mainly due to information that participants had heard or read. Perception of this risk, however, did not align with related scientific literature, that found insufficient evidence of a correlation between aluminum and breast cancer [6, 7]. While deodorants contain a mixture of components that may pose differential risks for breast cancer [6, 7], aluminum was the only component mentioned by participants.

The second most commonly discussed risk was plastics (13 mentions; 28.9%), with specific mention of those containing bisphenol A (BPA) (3 mentions; 6.7%). Some participants suggested that the heating of plastic water bottles could leach chemicals into the water, thereby making it potentially harmful to ingest. A review of clinical literature concluded that endocrine-mimicking properties of BPA could increase the risk of breast cancer [8-11]; thus, there was congruence between public perception and the scientific evidence. Evidence that the heating of plastic water bottles would impact risk, however, was limited and thus not confirmatory based on these particular reviews.

Use of pesticides (4 mentions; 8.9%) and water pollution were also discussed as potential risks, although with lesser frequency than that of deodorants and plastics. Use of pesticides was of particular concern in reference to perception of agricultural practices that introduce hazardous chemicals from pesticides into the food chain. Discussion around water pollution was also related to pesticides as water as other contaminants. These concerns aligned with the general scientific consensus regarding dichlorodiphenyltrichloroethane (DDT), polychlorinated biphenyls (PCBs), and other organic compounds. Although there are studies that show no link, a substantial number of epidemiology and laboratory studies show that

a link between increased DDT and PCBs concentrations and increased incidence of breast cancer is likely [10-13].

Air pollution resulting from factories and vehicular traffic was the least suggested risk (3 mentions; 6.67%). Air pollution is a complex mixture of a range of different chemicals and particles, whose concentrations are spatially and temporally variable. Current reviews demonstrate an increased risk of breast cancer due to certain specific components of air pollution but not others, specifically where polycyclic aromatic hydrocarbons (PAH), nitrogen dioxide, and nitrogen oxides are implicated with breast cancer [11-15]. Due to a lack of evidence and the complexity of the exposure, it is unclear as to whether or not perceptions of air pollution as a risk of breast cancer align with the state of the science.

Discussion

During focus group discussions, participants most commonly identified aluminum (in deodorant) and plastics/BPA as environmental risks for breast cancer, followed by pesticides, and water and air pollution, which were mentioned with lesser frequency. Perceptions of these risks were mostly congruent with the state of the science for all risks besides that of aluminum in deodorant, for which evidence has not confirmed an association, and air pollution, for which there is some support for a correlation with specific constituents of pollution [6-15]. Findings also demonstrated that participants were generally aware of the same environmental risks but lacked awareness regarding the degree to which each factor posed a risk for breast cancer. In addition, participants did not mention specific chemicals (besides BPA) or compounds when discussing risk. The US IBCERCC recommends a “precautionary approach” regarding risk communication where there are areas of uncertainty in the state of the science [4]. This approach considers the “weight of the evidence” and takes into account that relationships between risk factors and outcomes may not always be clear. Precautionary efforts then focus on prevention when there is uncertainty, exploration of alternatives to possible harms where feasible, and an increase of community participation in the decision making process [4]. To improve knowledge of breast cancer risks and related health outcomes, it is crucial to understand in more detail how AA community members are informed about these risks, and to what extent they understand each risk, building on the data provided in this study. As health information source, method, and channel preferences differ between races [34, 35], the development of messaging that is evidence-based, clear, and culturally relevant can aid in both the reduction of popular misperceptions and the solidification of community-held knowledge that accurately reflects the current state of the science [25, 28, 29].

Implications

Regarding the commonly held perceptions that emerged from focus group dialogue, message familiarity can be considered in the design of prevention or risk communication strategies for AA community members [36, 37]. For example, as the science does not demonstrate causation between aluminum in deodorant and breast cancer, leveraging clearer messages that impart source reliability may serve as an important strategy to refute this common perception. Additional discussion about preferred messaging sources and the age segment

that shares this belief will aid message design that accurately addresses the literacy and format needs for this perceived risk. As the commonly mentioned risks of plastics and related chemicals (e.g., BPA) align with the science, comprehensive messaging that builds upon message familiarity and provides specific details regarding exposure pathways and dose-response will likely provide greater benefit to the general AA population [36]. Less mentioned risks, such as pesticides, and water and air pollution, may necessitate concise and plain language messaging to account for more limited message familiarity. Inclusion of feasible alternatives or practices that reduce exposure to confirmed environmental risks is also warranted [4]. Environmental risks not mentioned by focus group participants were exposure to radiation and other metals [4, 10]. Understanding what knowledge of these unmentioned risks exists within this community, and assessing familiarity with specific chemicals and compounds that comprise mentioned risks could be explored in further studies. Exploring community members' definition of "risk" will also be important as messages are developed. While lifestyle factors, such as poverty, night shift work, urbanization, poor diet and exercise habits, and use of alcohol and tobacco were not discussed, we recognize that the interrelationships between these factors and increased exposure to environmental risks is relevant for future discussion.

Tailored educational materials and campaigns regarding environmental risks for breast cancer should contain concise, accurate information that is presented both visually and in a variety of formats [4, 25]. Imagery should also accurately represent the AA population as the target of the messaging, and should consider depictions of AA individuals that are diverse and culturally sensitive. Guided by results from this analysis, key considerations for the design of appropriate environmental risk communication also include identification of health information source preference specific to the target population [22-25, 34, 35], segmented and tailored communication that considers subgroups within larger community systems and varying motivation levels of population subgroups [23, 25, 27, 28, 36, 37], messaging that comprehensively addresses varying age groups in order to encourage an intergenerational dialogue that can ensure community learning [22, 29], multiple messaging formats that account for both delivery preference and hard to reach audiences [4], discussion of alternative practices/products [4, 27] or exposure reduction strategies for participant consideration [28, 29], and inclusion of calls to action with relevant follow-up contact information [27, 29].

Limitations and Conclusions

This study has limitations as findings pertain to a specific population and geographic region and may not be generalizable to other populations. As most of the discussion on participant perceptions was anecdotal (stories from friends and family), or unverifiable (non-specific Internet or media sources), limited information on resource viability can be offered. Participant perceptions regarding the degree and extent of each environmental risk were not assessed, and necessitate future study. Our study mirrors findings from interviews with residents in another Southeastern state by Spector and colleagues (2010), which demonstrated that 75% of AA women and 80% of Caucasian women perceived a variety of environmental exposures as risk factors for breast cancer despite uncertainty regarding their specific role in causation [31]. This suggests that there is universal need for improved

education that imparts current, accurate information regarding the specifics of causation and exposure. As AA breast cancer mortality rates are higher than those of other populations [1, 2], early intervention and appropriately tailored education efforts regarding confirmed risk factors and screening are critical. For comparison to participant perceptions, our evaluation of systematic reviews was focused on content, and quality of reviews was not formally assessed; we relied on the expertise of the authors and the peer review system. This study contributes to the literature by identifying whether AA community members' awareness and perceptions of environmental risks for breast cancer are congruent with current science. This information can inform the development of effective, tailored health prevention messages that use plain language and aim to improve communities' scientific understanding and informed decision-making, as well as potential screening efforts. More research is needed to gain an in-depth understanding of perceptions of a host of environmental and lifestyle risk factors for breast cancer in order to provide comprehensive education materials that meet the information needs and delivery preferences of this high-risk population. Additional research in cancer messaging source selection and specific needs for population subgroups is also warranted.

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References

1. Siegel RL, Miller KD, Jemal A (2019) Cancer statistics, 2019. *CA Cancer J Clin* 69:7–34. 10.3322/caac.21551 [PubMed: 30620402]
2. DeSantis CE, Miller KD, Goding Sauer A, Jemal A, Siegel RL (2019) Cancer statistics for African Americans, 2019. *CA Cancer J Clin* 69(3):211–233 [PubMed: 30762872]
3. Williams DR, Mohammed SA, Shields AE (2016) Understanding and effectively addressing breast cancer in African American women: unpacking the social context. *Cancer* 122(14):2138–2149. 10.1002/cncr.29935 [PubMed: 26930024]
4. Interagency Breast Cancer and Environmental Research Coordinating Committee (2013) Breast cancer and the environment: prioritizing prevention. https://www.niehs.nih.gov/about/assets/docs/breast_cancer_and_the_environment_prioritizing_prevention_508.pdf.
5. Bergman Å, Heindel JJ, Jobling S, Kidd K, Zoeller TR, World Health Organization (2013) State of the science of endocrine disrupting chemicals 2012. World Health Organization
6. Allam MF (2016) Breast cancer and deodorants/antiperspirants: a systematic review. *Cent Eur J Public Health* 24(3):245–247. 10.21101/cejph.a4475 [PubMed: 27755864]
7. Willhite CC, Karyakina NA, Yokel RA, Yenugadhathi N, Wisniewski TM, Arnold IM, Momoli F, Krewski D (2014) Systematic review of potential health risks posed by pharmaceutical, occupational and consumer exposures to metallic and nanoscale aluminum, aluminum oxides, aluminum hydroxide and its soluble salts. *Crit Rev Toxicol* 44(Suppl 4):1–80. 10.3109/10408444.2014.934439

8. Seachrist DD, Bonk KW, Ho SM, Prins GS, Soto AM, Keri RA (2016) A review of the carcinogenic potential of bisphenol A. *Reprod Toxicol* 59:167–182. 10.1016/j.reprotox.2015.09.006 [PubMed: 26493093]
9. Romagnolo DF, Daniels KD, Grunwald JT, Ramos SA, Propper CR, Selmin OI (2016) Epigenetics of breast cancer: modifying role of environmental and bioactive food compounds. *Mol Nutr Food Res* 60(6): 1310–1329. 10.1002/mnfr.201501063 [PubMed: 27144894]
10. Gray JM, Rasanayagam S, Engel C, Rizzo J (2017) State of the evidence 2017: an update on the connection between breast cancer and the environment. *Environ Health* 16(1):94. 10.1186/s12940-017-0287-4 [PubMed: 28865460]
11. Rodgers KM, Udesky JO, Rudel RA, Brody JG (2018) Environmental chemicals and breast cancer: an updated review of epidemiological literature informed by biological mechanisms. *Environ Res* 160:152–182. 10.1016/j.envres.2017.08.045 [PubMed: 28987728]
12. Maqbool F, Mostafalou S, Bahadar H, Abdollahi M (2016) Review of endocrine disorders associated with environmental toxicants and possible involved mechanisms. *Life Sci* 145:265–273. 10.1016/j.lfs.2015.10.022 [PubMed: 26497928]
13. Brody JG, Moysich KB, Humblet O, Attfield KR, Beehler GP, Rudel RA (2007) Environmental pollutants and breast cancer: epidemiologic studies. *Cancer* 109(12 Suppl):2667–2711. 10.1002/cncr.22655 [PubMed: 17503436]
14. Keramatinia A, Hassanipour S, Nazarzadeh M, Wurtz M, Monfared AB, Khayyamzadeh M, Bidel Z, Mhrvar N, Mosavi-Jarrahi A (2016) Correlation between nitrogen dioxide as an air pollution indicator and breast cancer: a systematic review and meta-analysis. *Asian Pac J Cancer Prev* 17(1):419–424 [PubMed: 26838249]
15. White AJ, Bradshaw PT, Hamra GB (2018) Air pollution and breast cancer: a review. *Curr Epidemiol Rep* 5(2):92–100. 10.1007/s40471-018-0143-2 [PubMed: 30271702]
16. Dean LT, Gehlert S, Neuhaus ML, Oh A, Zanetti K, Goodman M, Thompson B, Visvanathan K, Schmitz KH (2018) Social factors matter in cancer risk and survivorship. *Cancer Causes Control* 29(7):611–618. 10.1007/s10552-018-1043-y [PubMed: 29846844]
17. Michels KB (2002) The contribution of the environment (especially diet) to breast cancer risk. *Breast Cancer Res* 4(2):58–61 [PubMed: 11879564]
18. Wolff MS, Teitelbaum SL, McGovern K, Pinney SM, Windham GC, Galvez M, Pajak A, Rybak M, Calafat AM, Kushi LH, Biro FM, Breast C, Environment Research P (2015) Environmental phenols and pubertal development in girls. *Environ Int* 84:174–180. 10.1016/j.envint.2015.08.008 [PubMed: 26335517]
19. Sharpe RM, Irvine DS (2004) How strong is the evidence of a link between environmental chemicals and adverse effects on human reproductive health? *BMJ* 328(7437):447–451. 10.1136/bmj.328.7437.447 [PubMed: 14976101]
20. Gatto NM, Longnecker MP, Press MF, Sullivan-Halley J, McKean-Cowdin R, Bernstein L (2007) Serum organochlorines and breast cancer: a case-control study among African-American women. *Cancer Causes Control* 18(1):29–39. 10.1007/s10552-006-0070-2 [PubMed: 17186420]
21. Freedman RA, Kouri EM, West DW, Keating NL (2015) Racial/ethnic disparities in knowledge about one's breast cancer characteristics. *Cancer* 121(5):724–732. 10.1002/cncr.28977 [PubMed: 25624186]
22. Hempstead B, Green C, Briant KJ, Thompson B, Molina Y (2018) Community empowerment partners (CEPs): a breast health education program for African-American women. *J Community Health* 43(5):833–841. 10.1007/s10900-018-0490-4 [PubMed: 29488155]
23. Friedman DB, Thomas TL, Owens OL, Hébert JR (2012) It takes two to talk about prostate cancer: a qualitative assessment of African American men's and women's cancer communication practices and recommendations. *Am J Mens Health* 6(6):472–484. 10.1177/1557988312453478 [PubMed: 22806569]
24. Kulkarni S, Lewis K, Adams SA, Brandt HM, Lead JR, Ureda JR, Fedrick D, Mathews C, Friedman DB (2018) A comprehensive analysis of how environmental risks of breast cancer are portrayed on the internet. *Am J Health Educ* 49(4):222–233. 10.1080/19325037.2018.1473182 [PubMed: 30079123]

25. Lewis K, Kulkarni S, Adams SA, Brandt HM, Lead JR, Ureda JR, Fedrick D, Mathews C, Friedman DB (2018) “For lack of knowledge, our people will perish”: using focus group methodology to explore African-American communities’ perceptions of breast cancer and the environment. *Environ Int* 121 (Pt 1):111–118. 10.1016/j.envint.2018.08.062 [PubMed: 30195624]
26. Stableford S, Mettger W (2007) Plain language: a strategic response to the health literacy challenge. *J Public Health Policy* 28(1):71–93. 10.1057/palgrave.jphp.3200102 [PubMed: 17363939]
27. Smith SW, Hitt R, Russell J, Nazione S, Silk K, Atkin CK, Keating D (2017) Risk belief and attitude formation from translated scientific messages about PFOA, an environmental risk associated with breast cancer. *Health Commun* 32(3):279–287. 10.1080/10410236.2016.1138350 [PubMed: 27219106]
28. Claudio L, Gilmore J, Roy M, Brenner B (2018) Communicating environmental exposure results and health information in a community-based participatory research study. *BMC Public Health* 18(1):784. 10.1186/s12889-018-5721-1 [PubMed: 29940915]
29. Friedman DB, Toumey C, Porter DE, Hong J, Scott GI, Lead JR (2015) Communicating with the public about environmental health risks: a community-engaged approach to dialogue about metal speciation and toxicity. *Environ Int* 74:9–12. 10.1016/j.envint.2014.09.015 [PubMed: 25305416]
30. Avis-Williams A, Khoury A, Lisovicz N, Graham-Kresge S (2009) Knowledge, attitudes, and practices of underserved women in the rural south toward breast cancer prevention and detection. *Fam Community Health* 32(3):238–246. 10.1097/FCH.0b013e3181ab3bbb [PubMed: 19525705]
31. Spector D, Mishel M, Skinner CS, Deroo LA, Vanriper M, Sandler DP (2009) Breast cancer risk perception and lifestyle behaviors among White and Black women with a family history of the disease. *Cancer Nurs* 32(4):299–308. 10.1097/NCC.0b013e31819deab0 [PubMed: 19444084]
32. Corbin J, Strauss A (2008) Basics of qualitative research: techniques and procedures for developing grounded theory. 10.4135/9781452230153
33. Friedman DB, Hoffman-Goetz L (2006) A systematic review of readability and comprehension instruments used for print and web-based cancer information. *Health Educ Behav* 33(3):352–373. 10.1177/1090198105277329 [PubMed: 16699125]
34. Tanner A, Bergeron CD, Zheng Y, Friedman DB, Kim SH, Foster CB (2016) Communicating effectively about clinical trials with African American communities: a comparison of African American and White information sources and needs. *Health Promot Pract* 17(2):199–208. 10.1177/1524839915621545 [PubMed: 26715695]
35. Friedman DB, Laditka JN, Hunter R, Ivey SL, Wu B, Laditka SB et al. (2009) Getting the message out about cognitive health: a crosscultural comparison of older adults’ media awareness and communication needs on how to maintain a healthy brain. *The Gerontologist* 49(S1):S50–S60. 10.1093/geront/gnp080 [PubMed: 19525217]
36. Hitt R, Perrault E, Smith S, Keating DM, Nazione S, Silk K, Russell J (2016) Scientific message translation and the heuristic systematic model: insights for designing educational messages about progesterone and breast cancer risks. *J Cancer Educ* 31(2):389–396. 10.1007/s13187-015-0835-y [PubMed: 25903053]
37. Ng AW, Chan AH (2020) Participatory environmentally friendly message design: influence of message features and user characteristics. *Int J Environ Res Public Health* 17(4):1353. 10.3390/ijerph17041353

Table 1

Comparison of focus group participant perceptions of environmental risks of breast cancer with current scientific evidence and related agreement

Chemical or consumer product	Participant perception of risk (summary and quotes)	Systematic review evidence regarding risk	Alignment of perception and scientific evidence
Antiperspirants	<p>Summary: Perceived as cancer risk mainly due to the aluminum</p> <p>They say it is deodorant, that's why that what is it, that Tom's, they say Tom's is the one that do not have that something that the other deodorant have</p> <p>And deodorant. They say deodorants can cause breast cancer.</p> <p>And so I do try to use natural deodorants with my daughter, but it's very difficult to find something that's good and really works...It's Aluminum-free...</p> <p>... and what I recently found out I'm not sure if it's a risk factor certain additives or certain ingredients in certain deodorants.</p>	<p>Reviews (Allam [6]; Willhite et al. [7]) discussed available research data and previously published reviews on aluminum-containing deodorants. Aluminum (Al) is known to cause certain health issues given a large enough amount and time of exposure, dependent on exposure route. Al penetration of the skin from deodorants is likely to be extremely limited. Most current studies are limited but several sufficient to assess data. No good evidence of a correlation between aluminum-containing deodorant usage and breast cancer was found, and no realistic mechanism of action has been proposed.</p>	<p>A range of studies have investigated this link and found limited or no evidence of any correlation or potential mechanism. There are limits and uncertainties and potential gaps, but a reasonable assessment is that risk is low. Comments reflect the uncertainty of the science as known, but not the overall conclusions. The concern is rational given the high (voluntary) exposure and data gaps, but does not fully align with the scientific evidence. As deodorants contain a mixture of chemicals, more than one could present a risk for breast cancer, but the only perceived risk mentioned by participants was that of aluminum, for which there was no confirmatory evidence.</p>
Plastic/BPA	<p>Summary: Perceived as cancer risk because chemicals can leach into water/food</p> <p>The chemical out of this plastic can give you breast cancer or any other cancer. So basically, if you got hot water – you know, water in plastic, just throw it away. You always hear like plastics, not leaving your [BPA] water or anything in the car because of the properties change and could – in the plastic and can cause, uh, breast cancer. I mean I know frozen vegetables is a vegetable but you got that process of sitting in the freezer and it's in a plastic bag. And I seen the other day, like, if we sit this water out in a hot car... And you go back and drink it... The chemicals are in this plastic can give you breast cancer. The chemical out of this plastic can give you breast cancer or any other cancer. So basically, if you got hot water – you know, water in plastic, just throw it away.</p>	<p>Seachrist et al. [8], Romagnolo et al. [9], T Gray et al. [10], and Rodgers et al. [11] all reviewed peer-reviewed information on BPA and its relation to cancer, including breast cancer. There is a ubiquitous exposure to BPA in food, water and the environment. BPA is a weak endocrine disrupting chemical (EDC). Animal studies provide extensive and mechanistic information suggesting that BPA is a likely human carcinogen. Dose effects are not straightforward with non-monotonic dose-response relationships and important windows of susceptibility e.g., during gestation and puberty. Human studies are less conclusive, most likely due to the difficulties inherent in epidemiological research.</p>	<p>There was a strong perception of risk that is allied to the known science. Causation is implied in people's views, which tallies with the extensive mammalian data. Equivocal human studies on the link do not enter into people's perceptions, and this matches the explanation in the science community that the lack of correlation between exposure and breast cancer incidence was a methodological issue.</p>
Pesticides	<p>Summary: Perceived as cancer risk because harmful chemicals from the pesticides enter the food chain</p> <p>[Food] can be a risk because if you do not detox your body, all that toxin's within you. And it goes in your blood level, I mean, your blood. It may go in, like, it might go to your breast. It might go cause problems with your hand, your legs, your feet, your brain.</p> <p>Now you hear of people dying of cancer, but I'm saying you never heard nobody talking about - So it's the food we eat, the things we drink and what we put in it's what we put in our bodies.</p> <p>So I mean anything we eat, we can get cancer. Anything we drink can be cancer, because they put, I mean, you do not know. A lot of water now, yeah, it was contaminated. Mm-hmm, bottled</p>	<p>Brody et al. [13], Maqbool et al. [12], and Gray et al. [10] reviewed the scientific literature available. Pesticides are a class of compounds not a single chemical or homologous group. Evidence suggests that exposure to certain pesticides, but possibly not others, correlate with increased breast cancer risk. Greatest evidence exists for organochlorines with EDC-type behavior.</p>	<p>A perception of a link between pesticides and breast cancer, which agreed well with the scientific literature. People perceptions did not distinguish between the likelihood of risk or pesticides with different chemistries and behaviors. Consequently, the perception of risk was stronger than the effect as shown by the scientific literature.</p>

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Pollution	<p>water. I agree with what she's saying, um, not just dealing with breast cancer but with other, um, health issues I believe it's the additives, the pesticides, those different things of the fillers that they are putting in, in foods.</p> <p>Summary: Perceived as cancer risk because of the harmful chemicals in air and water Um, like things they were talking about, pollution, like waste, radioactive, things that they were talking about that's real scary, about you do not know what type of disease that you can get from these different types of materials that's in the environment. Pollution from cars. Exhaust, you know. On the ground. I mean think about Savannah [River Site] in South Carolina. You know, we do not know. My, my OB/GYN told me when I was pregnant with my second child and she said you know, we do not know the ramifications 30, 40 years down the road. I think of when I hear environment I think of like certain pollutants in the air. Sometimes, the area where you live, if there's been factories, manufacturers and stuff like that, and contaminated water. Even the, uh, fumes and stuff from the cars and air conditioning, stuff like that.</p>	<p>Brody et al. [13], Maqbool et al. [12], Keramatinia et al. [14], Rodgers et al. [11], and White et al. [15] reviewed the scientific literature available. Evidence suggests exposure to certain pollutants may correlate with increased breast cancer risk. PCB and PAH were associated with an increase in breast cancer, based on epidemiologic and experimental studies. Evidence regarding dioxins and organic solvents was sparse and methodologically limited, though associations between breast cancer risk and air pollution from traffic containing nitrogen oxides and nitrogen dioxide, but not for particulate matter, were found in epidemiologic studies.</p>	<p>A perception of a link between pollutants and breast cancer, which agreed somewhat with the scientific literature, however, perception of risk was stronger than the moderate effect as shown by the scientific literature.</p>

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