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Short Communication

# An opportunity to address modifiable breast cancer risks: Mammography screening and physical activity readiness to change

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ABSTRACT

Breast cancer risk is significantly reduced by improvements in lifestyle factors such as physical activity. Previous work suggests personal experiences such as false positive mammography or family history of breast cancer may influence these health behaviors. Surveys were distributed to women aged 40–75 who had received a negative mammogram from an academic hospital in Virginia in 2015. Measures assessed breast cancer worry and perceived risk, awareness of cancer risk factors, family history of breast cancer, false positive mammography experience, and readiness to change physical activity. Surveys were collected from 106 women. The regression for readiness to change physical activity was significant, $F(7, 91) = 3.7$, $p = 0.001$, $R2 = 0.22$. Physical activity readiness to change was positively associated with income ($p = 0.034$) and receipt of a false positive mammogram ($p = 0.045$). African American women ($p = 0.031$) and women with family history of breast cancer ($p = 0.027$) reported lower readiness to change physical activity. Results support previous qualitative work suggesting the receipt of a false positive mammogram may stimulate motivation to increase physical activity. Mammography screening may serve as a strategic opportunity to target modifiable breast cancer risk factors at a time when women are highly receptive to a lifestyle change intervention.



## 1. Background

Strong epidemiological evidence indicates that up to 26% of breast cancers may be attributed to inadequate physical activity (Goncalves et al., 2014). While the mechanisms linking physical activity (PA) and breast cancer are not fully understood, the interplay between weight maintenance and the effects of PA on biomarkers associated with decreased breast cancer risk, including insulin resistance and chronic inflammation, is promising (Patterson et al., 2013; Patterson et al., 2010; Schmid and Leitzmann, 2014). On a population scale, only 43% of women meet the recommended 150 min of moderate weekly physical activity (Promotion OoDPaH, 2015; CDC, 2015). However, participation in mammography screening is high with up to 73% of eligible women being screened (Centers for Disease Control Prevention, 2012). Given this extraordinary participation rate, combining prevention and early detection by introducing a lifestyle intervention targeting modifiable risks at the time of mammography screening may have the potential to reach a large target audience that is likely to be more receptive to lifestyle change messaging (McBride et al., 2008).

Our prior qualitative work has indicated that women's motivation for lifestyle change may be especially high after receipt of a false positive mammogram due to temporary increases in cancer worry and anxiety (Thomson and Siminoff, 2015). False positive mammograms are particularly common in the US; 61% of women who are screened annually (42% biannually) for 10 years will receive at least one false positive result (Hubbard et al., 2011). Cues to action, such as a false positive cancer screen, and enhanced risk perceptions are components of the Health Belief model known to stimulate health protective behaviors (Atkinson et al., 2015; Cohen et al., 2011; Senore et al., 2012). However, as behavior change typically occurs in stages over a period of time (Marcus and Forsyth, 2003), we were interested in assessing readiness to change physical activity, as described by the Trantheoretical (TTM)/Stages of Change model. Guided by components of the Health Belief and TTM/Stages of Change behavioral models the objective of this pilot study was to assess the relationships between women's false positive mammography experience, breast cancer worry, perceived risk, risk factor

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awareness, and family history of breast cancer with readiness to change PA, a modifiable breast cancer risk. We hypothesized that in a sample of current mammography screeners, greater breast cancer risk awareness, increased breast cancer worry, increased perceived risk and family history of breast cancer and false positive experiences would be associated with greater readiness to adhere to recommendations for physical activity.

## 2. Methods

### 2.1. Participants

A convenience sample of women ages 40–75 were recruited from an academic hospital in Virginia. Women were eligible if they had received a negative mammogram within the previous 12 months as indicated by a Breast Imaging-Reporting and Data System (BI-RADS) score of 1–3, no prior cancer diagnoses, and had valid contact information (email or mailing). Using electronic medical records to identify potential participants the following information was extracted patient name, date of birth, BI-RADS score, and email and mailing address. The Institutional Review Board approved this study.

### 2.2. Survey distribution

All eligible women were sent an invitation to participate accompanied by either a survey link (email, n = 233) or a paper and pencil survey (n = 345). Collection occurred from December 2014 to February 2015, and respondents were entered into a drawing for an iPad. Data were managed using REDCap (Harris et al., 2009) and analyzed with IBM SPSS 22.0.

### 2.3. Measures

Demographic measures included age, race, education, household income, height and weight. Self-reported height and weight were used to calculate body mass index (BMI).

#### 2.3.1. Outcome variables

Readiness to change physical activity in accordance with recommendations was assessed using a measure based on Marcus et al. (Marcus et al., 2009). Participants were presented with the American Cancer Society behavior recommendations (Kushi et al., 2012) for PA associated with cancer prevention (i.e., 150 min/week moderate activity) and asked to indicate their readiness to change PA. Five response options ranged from "No [don't meet recommendations] and I don't intend to change this in the next 6 months" (i.e., precontemplation) to "Yes and I have done so for more than 6 months" (i.e., maintenance).

#### 2.3.2. Predictor variables

*2.3.2.1. Knowledge.* Risk factor knowledge was measured using the Breast Cancer Awareness Measure (Linsell et al., 2010). Women were asked to rate their agreement that eight items (e.g. history of cancer, being overweight) could increase the chances of getting cancer (5-point likert, strongly agree/disagree).

*2.3.2.2. Worry and perceived risk.* Breast cancer worry was measured using a single item from the Lerman scale (Lerman et al., 1991). Women were asked how often they worried about breast cancer in the last month (1 = rarely or never, 4 = all the time). Breast cancer risk perception was measured by asking women about their lifetime likelihood of developing breast cancer (5-point likert: very unlikely/likely).

*2.3.2.3. Personal history.* As personal breast cancer experiences can increase perceived risk, cancer worry and screening participation (Aro et al., 2000), we included measures assessing women's family history of breast cancer and experiences with false positive mammograms. Using a dichotomous (yes/no) question, women were asked whether or not they had ever had a false positive mammogram or had a family member (i.e., mother, sister or daughter) diagnosed with breast cancer.

### 2.4. Statistical analysis

Descriptive statistics, correlation and t-tests analyses were used to describe variables and assess the relationships between the predictor and outcome variables. Predictor variables that were significantly associated with the dependent variable (PA) and demographics were included in a linear regression model to predict readiness change PA. The following predictors were entered into the model simultaneously: false positive status, family history of breast cancer, age, race, education, and income.

## 3. Results

Complete survey responses were received from 106 women. Sample demographics are displayed in Table 1. Distributions for readiness to change PA were as follows: maintenance (n = 31, 29%), action (n = 24, 23%), preparation (n = 28, 27%), contemplation (n = 22, 21%), precontemplation (n = 7, 7%).

Breast cancer risk factor awareness across all eight factors ranged from 1.00 to 5.00 (M = 3.66, SD = 0.73). Women agreed strongly that having a relative with breast cancer (M = 4.46) or a history of cancer (M = 4.30) increased their personal risk. Women expressed moderate agreement that physical inactivity (M = 3.48) increased breast cancer risk. Descriptive statistics of all risk knowledge items are shown in Table 1.

Most women believed their lifetime risk of having breast cancer was average (n = 55; 51%) or unlikely (n = 29; 28%). In the last month women reported worrying about breast cancer: Never (60%), Sometimes (29%), Often (8.5%), All the time (2%).

More than two-thirds of women (n = 74; 69%) experienced at least one false positive mammogram in their lifetime. Experiencing a false positive mammogram was significantly associated with greater PA readiness to change, t = −2.19, p = 0.031. Forty percent (n = 43) of participants had a family member who was diagnosed with breast

**Table 1**
Sample characteristics (n = 106), Virginia 2015.

| Characteristic | M[SD]/n (%) |
|---|---|
| Age, y (n = 106) | 52.0 [8.0] |
| Race/ethnicity (n = 104) | |
| White | 65 (62.5) |
| African American | 31 (29.8) |
| Other | 8 (7.7) |
| Education (n = 105) | |
| ≤High school | 11 (10.5) |
| Some college | 19 (18.1) |
| Associate's degree | 18 (17.1) |
| Bachelor's degree | 32 (30.5) |
| Postgraduate degree | 25 (23.8) |
| Household income, $ (n = 101) | |
| 0–19,999 | 20 (19.8) |
| 20,000–59,999 | 19 (18.8) |
| 60,000–99,999 | 21 (20.8) |
| >100,000 | 41 (40.6) |
| Breast cancer risk factor awareness | |
| Personal cancer history | 4.30 [1.12] |
| Alcohol consumption | 3.39 [1.14] |
| Overweight | 3.80 [1.08] |
| Family breast cancer history | 4.46 [0.90] |
| Age at first childbirth | 3.35 [1.13] |
| Early menarche | 3.32 [0.99] |
| Late menopause | 3.17 [0.93] |
| Physical activity | 3.48 [1.0] |

cancer. Women with a family history of breast cancer had significantly lower readiness to change PA than those without family history, $t = 2.18$, $p = 0.031$. Women with family history of breast cancer reported significantly greater perceived absolute risk ($p < 0.01$) than women without family history.

Linear regression predicting readiness to change PA was significant, ($F_{7, 91} = 3.7$, $p = 0.001$, $R^2 = 0.22$), as shown in Table 2. Readiness to change PA was higher in participants with higher income ($B = 0.29$) and false positive mammogram experience ($B = 0.19$) and lower in participants with family history of breast cancer ($B = -0.21$) and those identifying as African American ($B = -0.24$).

## 4. Discussion

In a sample of highly-educated current mammography screeners knowledge about the risks associated with hereditary sources of breast cancer were high while knowledge about modifiable lifestyle risks was moderate. Readiness to change PA was higher in women with false positive mammography experience and lower among African American women and women with a family history of breast cancer.

We were interested in examining PA readiness to change in the context of mammography screening because our previous work suggested that it might represent a teachable moment (Thomson and Siminoff, 2015). Given the current controversy associated with mammography and the high frequency of false positive results, the introduction of a PA intervention may provide women with concrete, actionable information to reduce their personal risk of breast cancer at a time of increased worry or perceived risk.

African American women in our sample reported lower readiness to change PA than white women. Known disparities in outcomes among African American women as compared to white women following a breast cancer diagnosis or recurrence (DeSantis et al., 2014) make it important to understand why African American women may be less interested in PA change. More work is needed to understand how PA interventions could be developed and implemented to better address the preferences and needs of African American women.

Women with a family history of breast cancer expressed lower readiness to change PA but higher perceived breast cancer risk. Women with family history of breast cancer may attribute their increased risk or place greater emphasis on hereditary rather than modifiable factors. An alternative explanation is that women with lower readiness to change PA may be more likely to have family members with breast cancer due to shared lifestyle factors which increase cancer risk. We found knowledge regarding genetic risk to be high yet knowledge about lifestyle risk to be moderate, which signals an important opportunity for increased educational efforts focusing on the benefits of PA as a modifiable breast cancer risk factor. Increased PA may be particularly important for women who have a family history of breast cancer, at the very least providing concrete non-medical action that women can take to address their anxiety about being at increased risk.

**Table 2**
Predictors of readiness to change physical activity, Virginia 2015.

| Characteristic | B (95% CI) | p |
|---|---|---|
| Constant | 2.93 (0.84, 5.01) | 0.006 |
| Education | −0.12 (−0.29, 0.06) | 0.203 |
| Income | 0.10 (0.01, 0.19) | 0.008 |
| False positive | 0.54 (0.01, 1.07) | 0.045 |
| Family history | −0.56 (−1.05, 0.06) | 0.027 |
| Age | 0.01 (−0.02, 0.04) | 0.669 |
| Race | | |
| White (reference) | – | |
| African American | −0.66 (−1.26, −0.06) | 0.031 |
| Other | 0.04 (−0.89, 0.98) | 0.929 |

### 4.1. Conclusions

Despite the use of self-report measures and a low response rate our pilot study provides novel insights regarding women's knowledge of modifiable breast cancer risks and links between past cancer experiences (family history and false positive mammograms) and PA readiness to change. We are not aware of any studies that link receipt of a false positive mammogram as a behavioral cue to action with PA readiness to change. Our results suggest that introducing a PA intervention to women who have received a false positive may harness and amplify women's heightened motivation for lifestyle change triggered by the false positive experience. One caveat for interpretation is that we recruited women who had a negative mammogram without restriction based on experiencing a false positive screen. As we assessed any experience of a false positive mammogram we were unable to assess whether time or exposure (number of prior false positive mammograms) moderated the effect on PA readiness. However, it could be expected that this would underestimate the association.

There is prior evidence that PA interventions are successful at increasing engagement in PA. (Davies et al., 2012; Broekhuizen et al., 2012). However, the ability to reach and engage large numbers of participants is often limited (Marcus et al., 2009). Linking a PA intervention to mammography screening would offer services when participant motivation is high and at a point that is easily identifiable and common to three quarters of the risk population (Centers for Disease Control Prevention, 2012).

## Conflict of interest

The authors declare there is no conflict of interest.

## Transparency document

The Transparency document associated with this article can be found, in the online version.

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