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The Effectiveness of a Community-Based Breast Cancer Education Intervention in the New York State Capital Region

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Abstract We determined the effectiveness of a community-based breast cancer education intervention among understudied populations in the New York State (NYS) Capital Region by assessing and comparing baseline and post-education breast cancer knowledge. Participants included 417 students recruited from five colleges/universities and 67 women from four community group organizations. Baseline and post-education knowledge was assessed via self-administered mostly multiple-choice questionnaires. An open-ended question soliciting opinions about public health prevention strategies against breast cancer was included on college/university students' questionnaires. Effectiveness of education intervention was estimated through a paired *t* test. Stratified analysis was done using demographic and descriptive variables. Answers to the open-ended questions were analyzed qualitatively. The mean percentage of correct answers increased from 39.9 % at baseline to 80.8 % post-education ($P<0.0001$) among college/university students and from 43.5 % to 77.8 % ($P<0.0001$) among community group members. Effectiveness remained statistically significant in all stratified analyses with similarly high percentage of correct answers achieved post-education irrespective of knowledge level at baseline. Stratified analysis also revealed similar patterns of improvement in overall knowledge and narrowing of the gap in post-education knowledge. Primary prevention emerged as the dominant theme post-education in students' responses to the open-ended question, signifying the effectiveness of our education in raising awareness about modifiable risk factors and inspiring proactive thinking about public health prevention strategies. This community-based education intervention was effective in increasing breast cancer knowledge among demographically diverse groups with low levels of baseline knowledge in the NYS Capital Region. Our findings provide leads for future public health prevention strategies.

Keywords Breast cancer · Community-based education intervention · Public health prevention · Cancer knowledge · New York State

Introduction

Breast cancer is the most common cancer and the second leading cause of cancer death among women in the USA. There were an estimated 226,870 new cases of invasive breast cancer and 39,520 deaths due to breast cancer among US women in 2012 [1]. In New York State (NYS), breast cancer rates have been reported to be higher upstate (including the NYS Capital Region) compared to New York City (NYC) [2]. A number of counties in the NYS Capital Region are among the areas with the highest incidence rates of breast cancer in the state; an example is Rensselaer County where breast cancer rates were 135.6 per 100,000 females during 2005–2009 compared to 112.0 per 100,000 females for NYC during the same period [3]. The 5-year relative survival for breast cancer drops from 98.4 % for localized (early-stage disease) to 23.8 % for metastatic disease [4]. Preventive approaches aimed at reducing risk of breast cancer occurrence and mortality require knowledge of etiologic risk factors and screening guidelines among individuals.

There are no reports of breast cancer education intervention or knowledge assessment among communities in upstate New York in the published literature. Most published

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national and international studies have reported low levels of awareness and knowledge about breast cancer among women from the general population [5–20] as well as among college/university students [21–26]. Examples include a meta-analysis of 221 studies in the USA, which identified lack of knowledge about breast cancer risk factors and screening guidelines as one of the main barriers of adherence to screening recommendations [17]. In a British study, 50 % of the 1,400 women surveyed did not recognize age as a risk factor for breast cancer [14]. Similarly, studies involving college and university students in the USA reported gaps in breast cancer and breast health knowledge among both genders [21–23]. An international study conducted among university students in 23 countries also noted relatively weak knowledge of breast cancer [24].

Higher rates of breast cancer in the NYS Capital Region along with the lack of a readily available breast cancer educational tool in the context of limited knowledge of breast cancer reported for subgroups of the general population [5–26] motivated a community-based breast cancer education intervention in the NYS Capital Region among college/university students and community group members. The main goals of this study were to assess baseline knowledge and determine effectiveness of newly developed educational tools in improving knowledge among these targeted populations.

Methods

Capital Region Action Against Breast Cancer (CRAAB!) Education Intervention

The education intervention assessed in our study was initiated by the Capital Region Action Against Breast Cancer (CRAAB!), a nonprofit community-based organization in upstate New York. CRAAB! created the newly developed educational tools used in this study in collaboration with us as investigators at the University at Albany based on a thorough review of the most current scientific literature. Educational tools consisted of Microsoft PowerPoint® presentations lasting 35–40 min tailored to each of the two target populations of college/university students and community group members. The breast cancer presentation topics covered three general areas of descriptive epidemiology, disease biology, and (established and potential) factors associated with risk. Factors associated with risk included hormonal, genetic, lifestyle, and nutrition as well as environmental and occupational. One member of the project team from CRAAB! delivered the presentations to all participating college/university classes and community groups.

Study Population

Participating centers included five colleges/universities and four community groups representing a cross-section of educational and community organizations in the NYS Capital Region. University/college organizations included University at Albany, Siena College, Fulton Montgomery Community College (FMCC), Maria College, and The College of Saint Rose. These included both public (University at Albany and FMCC) and private (Siena College, Maria College, and The College of Saint Rose) institutions serving from 1,000 students (Maria College) to 17,000 students (University at Albany) and offering a range of degree programs from associate to graduate level. Institutional review board approvals for the study were obtained from University at Albany, the Principal Investigator Institute, and from Siena College.

Community group organizations included Zonta Club, Hope in the Boat, Ladies Auxiliary/West Albany Fire House, and Trinity Alliance. Hope in the Boat is a breast cancer support group whose mission is to empower survivors through physical activity. Trinity Alliance of the Capital Region offers a wide range of social and family services. The Zonta Club of Albany is comprised of female professionals working to improve the status of women. The Ladies Auxiliary of West Albany Fire House supports volunteer members of the West Albany Fire Department.

Assessment Tools and Study Protocol

The assessment tools for the presentation consisted of self-administered mostly multiple-choice pre- and post-education questionnaires targeted to each of the two participating populations of students and community group members. Pre- and pilot testing was conducted on the questionnaires, which led to modifying the questionnaires for use in the study.

Pre- and post-education questionnaires were composed of several demographic and knowledge assessment questions targeted to each of the two participating groups of college/university students (Appendix) and community group members (not shown). Race and ethnicity along with other demographic variables were collected to allow for stratified analysis of effectiveness of education intervention. Race and ethnicity were classified in accordance with the system used by the National Cancer Institute's Surveillance, Epidemiology, and End Results program [27] as well as by other population-based cancer registries in the USA such as the NYS Cancer Registry [3]. All multiple-choice knowledge assessment questions on pre- and post-education questionnaires were similar for both groups of participants. An open-ended question soliciting opinions about public health prevention strategies against breast cancer was included on the pre- and post-education questionnaires administered to the college/university students only.

Recruitment scripts were used to inform that participation in the study was voluntary and that all information would remain anonymous. One member of the research team administered and collected nearly all pre- and post-education questionnaires and consent forms. The questionnaires and

the consent form for each individual were linked via a unique ID.

Statistical Analysis

Analyses were conducted separately for college/university students and community group members. Only participants who had completed both pre- and post-education questionnaires were included in the analysis. Descriptive statistics were obtained on all demographic variables and on the proportion of correct responses for each of the three main breast cancer presentation topics of descriptive epidemiology, disease biology, and established and potential factors associated with risk, on pre- and post-education questionnaires.

Baseline and post-education breast cancer knowledge was assessed by calculating the mean percentage of correct answers to the 18 questions (5.556 % assigned to each correct answer) on each questionnaire. The effectiveness of education on increasing knowledge was assessed through a paired *t* test comparing mean percent correct answers on pre- versus post-education questionnaires while adjusting for dependence of the questionnaires for each individual. Stratified analysis was conducted using demographic and other descriptive variables. Effectiveness was also assessed through a Wilcoxon signed rank sum test, when appropriate; this analysis produced similar results to those obtained from the paired *t* test in all cases. All statistical analyses were performed using the SAS version 9.1 (SAS Institute, Cary, NC). The open-ended questions were analyzed qualitatively to identify general and common themes from the participants' responses.

Results

A total of 417 college/university students (representing both genders) and 67 community group members (all females) participated in this project and received the education intervention as part of 24 educational sessions during a 7-month period. Participation rates (i.e., proportion of individuals present at recruitment who agreed to participate in the study) for college/university students and community group members were 94.3 % and 97.1 %, respectively. Demographic characteristics of college/university student and community group member participants are summarized in Tables 1 and 2.

Analysis of effectiveness of the education material in increasing knowledge showed that the mean percentage of correct answers among college students increased from 39.8 % pre-education (average of 7.2 correct answers out of 18 total) to 80.8 % post-education (14.5 correct answers); this signifies ~41 % statistically significant ($P<0.0001$) improvement in knowledge post-education (Table 3). Similarly, the mean percentage of correct answers among community group members increased from 43.4 % (7.8 correct answers) pre-education to 77.8 % (14.0 correct answers) post-education signifying ~34 % statistically significant ($P<0.0001$) improvement in knowledge post-education (Table 3).

Stratified analyses by each educational organization revealed that effectiveness remained statistically significant for each of the colleges/universities (Table 3). Baseline percentage of correct answers ranged from 32.2–70.2 % signifying a range of 5.8–12.6 correct answers. The range of percent correct answers post-education was 75.0–88.8 % (13.5–16.0 correct answers), signifying both an increase in the overall knowledge for each organization and a narrowing of the gap in post-education knowledge across different organizations (Table 3).

Effectiveness also remained statistically significant for each community group organization. The range of percent correct answers at baseline was 19.7–65.6 % corresponding to 3.5 to 11.8 correct answers out of 18 total. Post-education, the range of percent correct answers was 59.8–84.8 % or 10.8–15.3 correct answers, signifying a similar pattern of improvement in the overall knowledge and narrowing of the gap as mentioned above (Table 3).

When stratified by the three breast cancer education topics, the lowest percent of correct answers at baseline among both groups of college/university students and community members was for the topic of disease biology and the subtopic of "environmental and occupational factors" under the topic of factors associated with risk (Table S1). The highest percent correct answers at baseline among both groups was for "descriptive epidemiology." Post-education, the percent correct answers increased by an average of 38.3–51.2 % across topics among students and by an average of 28.9–42.7 % across topics among community group members (Table S1).

Stratified analyses were done using several demographic and descriptive variables including gender, race, ethnicity, age group, education level/prior degree, knowing/being a breast cancer survivor, and having attended a breast cancer lecture/seminar in the past (Table S2 and S3). Analysis by gender among students revealed similar levels of baseline and post-education knowledge among both genders. Stratified analysis by race and ethnicity among college/university students and community group members revealed a gap in knowledge, which was narrowed down as the result of education intervention (Table S2 and S3).

Stratified analysis by age revealed that among college/university students, the difference in percent correct answers at baseline between the age group with the highest baseline knowledge (≥38 years) and the one with the lowest baseline knowledge (18–22 years) was 28.8 % or an average of 5.2 correct answers. Post-education, this difference was decreased to 9.9 % or an average of 1.8 correct answers (Table S2). Among community group members, the difference between the age group with the highest baseline knowledge (50–59 years) and the group with the lowest

Table 1 Descriptive statistics, college groups

	Number	Percentage[a]
Participating colleges and universities		
University at Albany–SUNY	184	44.12
Siena College	116	27.82
Fulton Montgomery Community College	55	13.19
Maria College	46	11.03
Saint Rose	16	3.84
Gender		
Female	323	77.46
Male	91	21.82
Age		
18–22	331	79.38
23–27	28	6.71
28–32	22	5.28
33–37	13	3.12
38–42	10	2.40
43–47	5	1.20
48 and over	6	1.44
Race		
White	299	71.70
Black	53	12.95
Asian/Pacific Islander	27	6.47
Mixed race[b]	11	2.64
Ethnicity		
Non-Hispanic	356	85.61
Hispanic	53	12.71
Undergraduate college major		
Physical and biological sciences	207	49.64
Social and political sciences	100	23.98
Arts, languages, and general studies	64	15.35
Business and accounting	28	6.71
Undeclared	11	2.64
Education		
High school or GED	365	87.53
Bachelor's degree or equivalent	45	10.79
Master degree or equivalent	1	0.24
Doctorate or equivalent	3	0.72
Knowing or being a breast or ovarian cancer survivor		
No	217	52.04
Yes	200	47.96
Self-assessed breast cancer knowledge		
No knowledge	7	1.68
Minimal	219	52.52
Moderate	172	41.25
Considerable	19	4.56
Prior breast cancer lecture attendance		
No	330	79.14
Yes, in college	51	12.23
Yes, in high school	26	6.24
Yes, elsewhere	10	2.40

[a] Percentages may not add up to 100 % due to missing values

[b] Mixed races include individuals who self-identified with more than one race as follows: white and Asian/Pacific Islander (n=3); white, Black, and American Indian (n=2); and white and Black (n=6)

Table 2 Descriptive statistics, community groups

	Number	Percentage[a]
Participating community groups		
Zonta Club	29	43.28
Hope in the Boat	15	22.39
Trinity Alliance	13	19.40
Ladies Auxiliary/W. Albany Fire House	10	14.93
Age		
18–29	1	1.49
30–39	3	4.48
40–49	6	8.96
50–59	19	28.36
60–69	19	28.36
70–79	14	20.90
80 and over	5	7.46
Race		
White	55	82.10
Black	9	13.43
Asian/Pacific Islander	1	1.49
Mixed race[b]	1	1.49
Ethnicity		
Non-Hispanic	57	85.07
Hispanic	4	5.97
Education		
High school or GED	18	26.87
Bachelor's degree or equivalent	17	25.37
Master degree or equivalent	22	32.84
Doctorate or equivalent	10	14.93
Knowing or being a breast or ovarian cancer survivor		
Yes	47	70.15
No	20	29.85
Self-assessed breast cancer knowledge		
No knowledge	1	1.49
Minimal	14	20.90
Moderate	37	55.22
Considerable	14	20.90
Breast cancer seminar attendance in the past 5 years		
No	56	83.58
Yes	11	16.42

[a] Percentages may not add up to 100 % due to missing values

[b] Mixed race includes an individual who self-identified as white and Asian/Pacific Islander

baseline knowledge (70–79 years) was 30.3 % or an average of 5.4 correct answers. Post-education, the difference was decreased to 22.2 % or about 4.0 correct answers (Table S3).

Stratified analysis by highest level of education, prior attendance at a breast cancer lecture/seminar, and being or knowing a breast cancer survivor revealed similar patterns among both participating groups of students and community group members (Table S2 and S3).

Table 3 Analysis of effectiveness of breast cancer education intervention among college and community groups

College or community group	Number	Baseline knowledge (%)[a]	Post-education knowledge (%)[a]	Mean difference of percentages[b]	95 % CI	*p*-value[c]
All colleges	416	39.85	80.81	40.92	39.13, 42.71	<0.0001
University at Albany–SUNY	183	32.19	76.96	44.72	42.08, 47.36	<0.0001
Siena College	116	43.06	86.69	43.63	40.47, 46.79	<0.0001
Fulton Montgomery Community College	55	35.05	76.26	41.21	37.39, 45.03	<0.0001
Maria College	46	70.17	88.77	18.6	14.96, 22.23	<0.0001
The College of Saint Rose	16	34.03	75.0	40.97	31.07, 50.87	<0.0001
All community groups	67	43.45	77.78	34.33	29.53, 31.30	<.0001
Zonta Club	29	48.66	83.91	35.25	29.16, 41.34	<.0001
Hope in the Boat	15	65.56	84.82	19.26	10.97, 27.55	0.0002
Trinity Alliance	13	19.66	59.83	40.17	24.72, 55.63	0.0001
Ladies Auxiliary/W. Albany Fire House	10	26.11	72.78	46.67	36.04, 57.30	<.0001

CI confidence interval

[a] Represents the mean percentage of correct answers

[b] Represents the mean difference between the percentage of correct answers on the post- and pre-education surveys

[c] *p*-values obtained from paired *t* tests

The response rates to the open-ended questions on the surveys administered to the students regarding preventive actions against breast cancer were 71.9 % and 62.1 %, respectively, for the pre- and post-education questionnaires. Qualitative analysis of students' answers revealed two common overarching themes of screening and primary prevention (which included awareness and avoidance of risk factors at both the individual and the societal levels). On the pre-education questionnaire, the majority of responses (50.7 %) fell under the theme of screening, which included breast self-exam and mammography. Of responses, 36.9 % fell under the theme of primary prevention, which included awareness of lifestyle, family history, genetic, environmental, and hormonal factors. On the post-education questionnaire, primary prevention emerged as the dominant theme with 80.3 % of respondents specifying awareness/avoidance of risk factors. Screening was mentioned either as the sole public health message or in addition to primary prevention by 39.8 % of students post-education.

Discussion

To our knowledge, ours is the first reported community-based breast cancer education intervention among understudied populations in the NYS Capital Region. Our results revealed low levels of baseline knowledge of breast cancer among both participating groups of college/university students and female members of the community in the NYS Capital Region. Our assessment revealed that the targeted education intervention was effective in improving knowledge of breast cancer immediately post-education among these subpopulations across a range of demographic and descriptive variables such as race/ethnicity, age group, prior attendance at a lecture/seminar, and being/knowing a survivor.

The rationale for selection of the target populations in our study was based on maximizing the benefits of educational intervention with respect to breast cancer prevention and/or detection. College/university students constitute a newly independent population who are developing and establishing their individual lifestyle practices with respect to dietary/nutritional habits, oral contraceptive and other exogenous hormone uses, physical activity, and alcohol consumption, factors which influence the risk of breast cancer. Peri- and post-menopausal women in the general population are at the highest risk for developing breast cancer. Therefore, an educational intervention targeting these subpopulations has the potential to increase knowledge and motivation for making informed decisions with respect to primary prevention and risk reduction options.

Our study revealed an overall less-than-optimal level (i.e., correct answers to less than half of the questions) of baseline knowledge of breast cancer among college/university students and community group members. This finding is consistent with the results of previous studies which surveyed college/university students about their breast cancer knowledge in the USA [21–23] and other countries [25, 26] as well as studies which surveyed the general population of women [5–20]. Although breast cancer knowledge at baseline was low across breast cancer topics in our study, weaknesses were most prominent for "disease biology" and "factors associated with risk" among both groups of participants. Previous studies among female college students in three US universities [22] and among women aged 40–74 years [14], which reported

low baseline knowledge of certain risk factors for breast cancer, concur with our findings.

Our assessment revealed that our education intervention was effective in increasing knowledge about breast cancer among demographically diverse populations with low baseline knowledge in the NYS Capital Region. Our results concur with findings of other educational interventions conducted within the USA, including those in Northern [28] and Southern [29] California, Florida [30], Massachusetts and Georgia [19], NYC and Arkansas [9], Texas [6, 31], and North Carolina[32] as well as international studies [5, 10, 12]. Our educational tools consisted of Power Point presentations delivered in lectures catered to each participating group. Previous studies utilized a variety of interventions including presentations, seminars, or workshops [5, 6, 9, 10, 28], focused discussion groups [30], video breast health kits [19], and culturally targeted booklets [6, 12, 29, 31, 32].

Stratified analysis revealed similar patterns of significant increase and narrowing of the range with respect to percent correct answers post-education across nearly all demographic and descriptive variables among both participating groups of college/university students and female community members in our study. For example, stratified analysis by prior education revealed that while individuals without a prior college or graduate degree among both groups of participants had lower baseline knowledge, our education was effective in increasing knowledge and narrowing the range of percent correct answers across all educational levels. Interestingly, two international studies, conducted in an urban slum in Egypt [10] and rural Turkey [5], both found that education interventions dramatically improved participants' breast cancer knowledge even among illiterate women with low levels of baseline information on breast cancer.

Stratified analysis by educational or community group organization revealed that effectiveness remained statistically significant for all organizations. Of note, the highest baseline and post-education level of breast cancer knowledge among all educational organizations in our study was for Maria College, which offers a variety of nursing programs with clinical components. The important point is that through our education intervention, we were able to attain post-education knowledge levels close to that achieved by Maria College (i.e., ~89 %) among other participating institutions in our study, which had much lower baseline knowledge levels, such as the University at Albany. Findings in community group organizations were similar in that we were able to narrow the range of mean percent correct answers post-education (to four correct answers from eight at baseline) across all groups.

Our findings that ~80 % of college/university students had never attended a breast cancer lecture/seminar and that >83 % of female community group members had not attended a breast cancer lecture/seminar in the past 5 years underscore the importance of our education intervention on these subpopulations. Other studies had also reported lack of prior education about breast cancer among university students and general population of women. A large survey of college students in Texas reported that breast cancer was not commonly discussed in classrooms or among family and friends [23]. Deficiency in breast cancer knowledge has also been reported among older women and cited as a barrier to taking preventive and/or risk reducing measures [17].

Our findings with respect to the open-ended questions about preventive actions against breast cancer are noteworthy. The inclusion of this question allowed us to capture unrestricted opinions impossible to obtain from multiple-choice questions typical of education intervention questionnaires. Qualitative analysis revealed a shift in attitudes brought about by the education intervention in that primary prevention emerged as the dominant theme post-education. This shift in attitudes can be interpreted as effectiveness of our education intervention in empowering the students by giving them the knowledge of modifiable risk factors for breast cancer (such as excessive alcohol consumption, long-term oral contraceptive use, low levels of physical activity, etc.) and by inspiring proactive thinking with respect to public health prevention strategies.

The strengths of our study include the demographic diversity of our study subjects, systematic delivery of education and collection of information, and community-based nature of the intervention. Community-based prevention programs were recently noted as particularly effective with respect to their scope of dissemination, which goes beyond clinical-based prevention programs, hence their independence from access to the health care system [33]. Although, our findings are not generalizable to the entire population of the NYS Capital Region, they are interpretable. Furthermore, our findings with respect to baseline knowledge levels and effectiveness of education intervention are consistent with prior studies conducted in other populations, although, publication bias cannot be ruled out.

Limitations of our study include possibility of self-selection bias and lack of information on long-term impact of our education intervention. The possibility of self-selection bias influencing our findings is minimized due to high participation rate (≥95.0 %) in both groups. We assessed effectiveness of our intervention immediately post-education. Due to the nature of our study design (i.e., anonymous subjects), we were not able to determine the long-term impact of our education intervention through assessing retained knowledge and/or lifestyle modifications of the participants. Interestingly, prior studies have suggested that effectiveness of breast cancer education may remain significant up to 4–6 weeks [32], several months [6, 9, 28–31], and 1 year [12] post-intervention.

Besides having long-term assessment plans incorporated in their design, future education intervention studies could

benefit from targeting other relevant subpopulations such as health care professionals who provide counseling regarding appropriate preventive options. Insufficient knowledge among health care professionals has been cited as a barrier to providing breast cancer risk assessment in the primary care setting [34]. Along the same lines, a targeted intervention among nurse practitioners found significant improvement of breast cancer risk assessment knowledge post intervention [34], suggesting potential impact on clinical practice.

In conclusion, our findings revealed low levels of baseline knowledge among subpopulations in the NYS Capital Region, particularly with respect to certain important aspects of breast cancer such as disease biology and associated risk factors. Our study also found a significant improvement in knowledge following the education intervention among these subpopulations. Our findings provide leads for public health prevention strategies in NYS and in other populations by identifying specific areas of knowledge gaps as well as specific subgroups of the population who could benefit the most from future targeted public health efforts.

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