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Disparities in Obesity, Physical Activity Rates, and Breast Cancer Survival

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Abstract

The significantly higher breast cancer (BCa) mortality rates of African-American (AA) women compared to non-Hispanic (NHW) white women constitute a major US health disparity. Investigations have primarily focused on biological differences in tumors to explain more aggressive forms of BCa in AA women. The biology of tumors cannot be modified, yet lifestyle changes can mitigate their progression and recurrence. AA communities have higher percentages of obesity than NHWs and exhibit inefficient access to care, low socioeconomic status, and reduced education levels. Such factors are associated with limited healthy food options and sedentary activity. AA women have the highest prevalence of obesity than any other racial/ethnic/gender group in the United States. The social ecological model (SEM) is a conceptual framework on which interventions could be developed to reduce obesity. The SEM includes intrapersonal factors, interpersonal factors, organizational relationships, and community/institutional policies that are more effective in behavior modification than isolation from the participants' environmental context. Implementation of SEM-based interventions in AA communities could positively modify lifestyle behaviors, which could also serve as a powerful tool in reducing risk of BCa, BCa progression, and BCa recurrence in populations of AA women.

1. INTRODUCTION

Breast cancer (BCa) is the second leading cause of new cancer cases in the United States. Early detection and more effective treatments have resulted in approximately 3.5 million BCa survivors now living in the United States, thus constituting a major public health concern. The long-term health and well-being of BCa survivors is of interest to the scientific community as lifestyle behaviors such as obesity, poor diet, and physical inactivity may have

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distinct molecular consequences for BCa recurrence. The purpose of this chapter is to carefully explicate these relationships.

2. LITERATURE REVIEW AND SYNTHESIS

2.1 Disparities in Breast Cancer Mortality Rates in the United States

Breast cancer accounts for 19% of cancer deaths in African Americans (AA; DeSantis et al., 2016). As DeSantis et al. (2016) note, the causes of the disproportionate breast cancer burden experienced by AA women are complex and primarily reflect social and economic disparities as well as biological differences. These authors point out that in 2014, 26% of AAs compared to 10% of non-Hispanic whites (NHWs) had incomes below the federal poverty level. Similarly, in 2014, only 22% of AAs had 4-year college degrees, compared to 36% of NHWs, indicating a higher earning potential and greater likelihood of having adequate health insurance coverage among whites.

These socioeconomic factors are reflected in the presence of disparities in the lifetime probability (%) of developing or dying from invasive breast cancer in 2010–2012 (DeSantis et al., 2016). These data show that AA women had an 11.1% probability of developing breast cancer, as compared to a 13.1% probability among NHW women during the same time period. However, AA women had a 3.3% probability of dying from breast cancer, as compared to a 2.7% probability among NHW women. The increased mortality in AA women is present despite a lower incidence of BCa. The 5-year relative survival rate is lower in AA women with BCa than for white women, for every stage of diagnosis, as shown below (American Cancer Society, 2016a; DeSantis et al., 2016; Fig. 1).

As McCarthy, Yang, and Armstrong (2015) note, the racial disparity in BCa mortality has widened over the past 30 years. Racial/ethnic disparities in 5-year relative survival rates are believed to be due primarily to differences in timely access to appropriate BCa screening, diagnosis, and treatment. Factors affecting access to care include insurance coverage, transportation, and ability to afford recommended medications. AA women tend to be diagnosed with BCa at later stages than NHW women, indicative of the receipt of fewer mammograms, longer intervals between mammographic screening and untimely follow-up of abnormal BCa screening results (DeSantis et al., 2016; Hoffman et al., 2011; Press, Carrasquillo, Sciacca, & Giardina, 2008; Smith-Bindman et al., 2006). As Reeder-Hayes, Wheeler, and Mayer (2015) note, disparities in cancer care extend to survivorship care, where minority women receive endocrine therapy at lower rates than white women (Reeder-Hayes et al., 2015). Previous studies have demonstrated that when AAs receive cancer treatments similar to those received by NHWs, their cancer mortality outcomes are comparable (Bach et al., 2002; Komenaka et al., 2010). Along similar lines, Daly and Olopade (2015) point to reduced access to care for BCa screening and treatment, coupled with a more aggressive form of BCa, as major contributors to the racial disparity in BCa survival between AA and white women.

The increasing disparity in BCa mortality between AA and NHW women is not due to socioeconomic factors alone. AA women are also more likely to be diagnosed with aggressive BCa tumor subtypes. According to DeSantis et al. (2016), the prevalence of

estrogen receptor-negative, progesterone receptor-negative, and human epidermal growth factor receptor 2-negative (“triple-negative”) BCa is 22% in AA women and only 10–12% among women from other racial/ethnic backgrounds. Among premenopausal AA women, the prevalence of triple-negative BCa is even higher (Danforth, 2013). AA women are also more likely than other women to be diagnosed with basal-like breast tumors, which are associated with poorer survival rates than other breast tumor subtypes (Warner et al., 2015).

Similarly, Warner et al. (2015) note that BCa subtypes may help to account for racial/ethnic differences in survival. These investigators analyzed prospective cohort data from women diagnosed with Stages I–III BCa at National Comprehensive Cancer Network centers between January 2000 and December 2007 with survival follow-up through December 2009. The cases (533 Asian Americans; 1122 Hispanics; 1345 African Americans; and 14,268 non-Hispanic whites) were stratified by subtype (luminal A-like, luminal B-like, human epidermal growth factor receptor 2 (HER2) subtype, and triple-negative). According to the results, AA women were more likely to die from luminal A-like and luminal B-like tumors than NHW women. No disparities were observed for HER2 or triple-negative subtypes, although Asian American and Hispanic women were less likely to die as a result of BCa compared to NHW women.

D’Arcy et al. (2015) examined gene expression breast tumor data from 108 European American (EA) women and 57 AA women and found that AA women have higher mortality rates with luminal A breast cancers, which generally have a more favorable prognosis. These results were corroborated by Ma et al. (2013) who investigated the disparity in BCa mortality, stratified by BCa subtype (ER, PR, and HER2 status). In a sample of 1204 women (523 African Americans and 681 European Americans), older AA women (ages 50–64 years) diagnosed with luminal A invasive BCa were found to have a higher mortality risk than EA women in the same age group who were diagnosed with the same BCa subtype. These investigators argue that disparities in mortality related to luminal A BCas, rather than disparities in mortality related to triple-negative BCa, drive the observed black–white difference in BCa mortality. Conversely, Tao, Gomez, Keegan, Kurian, and Clarke (2015) evaluated data from 93,760 EA women and 9738 AA women and discovered that, among those with luminal A or triple-negative BCa, AA women had higher mortality rates.

To assess the degree to which biological differences (in addition to treatment or health care access issues) may contribute to these mortality differences, D’Arcy et al. (2015) evaluated the expression of race- and survival-associated genes in normal tissue and BCa tumor tissue of AA and EA women. These investigators found that six genes (ACOX2, MUC1, CRYBB2, PSPH, SQLE, and TYMS) were expressed differentially in the luminal A breast cancers of these two groups of women and were linked with survival (HR <0.08; HR >1.25). For all six genes, the tumors in the AA women showed higher rates of expression of poor prognosis genes (CRYBB2, PSPH, SQLE, and TYMS) and lower rates of expression of good prognosis genes (ACOX2 and MUC1). In addition, two of the poor prognosis genes (CRYBB2 and PSPH) had higher expression in the normal tissue of AA women than EA women. These findings demonstrate the importance of assessing potential biological contributors to BCa mortality disparities.

In the Warner et al. (2015) study, a racial disparity was seen in death due to BCa. Specifically, (a) disparities in mortality outcomes persisted for AAs even after controlling for stage at diagnosis, tumor characteristics, and body mass index (BMI); (b) AA women were most likely to be diagnosed with triple-negative tumors. However, the greatest survival disparities were evident among AA women with luminal tumors, as compared to NHW women with luminal tumors. The highest mortality rates among AAs were seen in the first 2 years postdiagnosis with ER-positive tumors (Warner et al., 2015). This differential mortality rate may be at least partially explained by AAs' delays in initiation, or incomplete receipt of BCa surgery, chemo-therapy, or hormonal therapy (Warner et al., 2015).

As there are currently no FDA approved targeted therapies for triple-negative breast tumors, women diagnosed with this form of BCa tend to have a poorer prognosis than other women. While some recent studies have identified genes that may be related to the prevalence of triple-negative BCa in AA women, other studies show that lifestyle factors more common among AA women, such as obesity, having a high number of children, age at first pregnancy, as well as low rates of breastfeeding, may contribute to an increased risk for triple-negative BCa (Dietze, Sistrunk, Miranda-Carboni, O'Regan, & Seewaldt, 2015; Palmer et al., 2014; Phipps et al., 2011; Yang et al., 2007).

Importantly, the racial disparity in BCa mortality rates continues to widen in the United States. In fact, in a comparison of BCa death rates between AAs and NHWs from 2008 to 2012, DeSantis et al. showed the following data: American Cancer Society (2016a) and DeSantis et al. (2016) (Table 1).

As shown in Fig. 2, the disparity gap in BCa mortality between AAs and NHWs remains fairly wide.

The continued gap in BCa mortality rates between AAs and NHWs is attributed to a smaller rate of decrease in BCa mortality rates over time for AA women (American Cancer Society, 2016a). Interestingly, the previously referenced cohort data from Warner et al. (2015) showed that BMI, in addition to breast tumor subtype, contributed to racial differences in BCa survival. While the biological bases of BCa disparities may not be easily modified, the contributions of BMI to racial and ethnic disparities in BCa mortality represent a modifiable behavioral target that could be positively changed through effective behavioral lifestyle interventions.

2.2 Relationship Between Weight, Physical Activity, and Breast Cancer Recurrence and Mortality

The American Cancer Society (2008) reports that obesity and overweight are associated with 14–20% of all cancer-related deaths. Obesity and overweight increase the risk for BCa in postmenopausal women and may increase the risk in some premenopausal women, particularly ages 35 and over with additional risk factors (American Cancer Society, 2008; Cecchini et al., 2012; Demark-Wahnefried, Campbell, & Hayes, 2012; Fabian, 2012; Pischon, Nothlings, & Boeing, 2008; Renehan, Roberts, & Dive, 2008). Indeed, on page 12 of the seminal report titled “Cancer facts & figures for African Americans 2016–2018”, the American Cancer Society states:

All women can help reduce their risk of breast cancer by avoiding weight gain and obesity (for postmenopausal breast cancer), engaging in regular physical activity, and minimizing alcohol intake.

American Cancer Society (2016a)

Among premenopausal women in the National Surgical Adjuvant Breast and Bowel Project, higher BMI levels were significantly related to increased BCa risk among premenopausal women older than 35 years of age who had additional BCa risk factors (primarily due to a diagnosis of lobular carcinoma in situ) (Cecchini et al., 2012). In a study of 73,542 premenopausal and 103,344 postmenopausal women from 9 European countries, it was discovered that among postmenopausal women who did not take hormone replacement therapy, obese women had a 31% excess risk of developing BCa compared to nonoverweight women (Lahmann et al., 2004). Similar results were found by Morimoto et al. (2002) in a study of 85,917 women in the Women's Health Initiative Observational Study, with participants from 40 clinics in the United States.

2.3 Known Biological Mechanisms Link Obesity and Breast Cancer

Emerging research documents the relationship between obesity and BCa etiology and outcomes. Recent investigations suggest that insulin resistance, insulin-like growth factors (IGF-I), and obesity-related inflammatory markers mediate the association between obesity and cancer incidence and mortality (Brown & Simpson, 2012; Costa, Incio, & Soares, 2007; Renehan et al., 2008). It is becoming clear that obesity leads to an increase in circulating insulin and IGF-I, which promotes tumor cell growth.

As Campbell, Foster-Schubert, et al. (2012) and Campbell, Van Patten, et al. (2012) note, overweight/obesity and a sedentary lifestyle significantly increase the risk of BCa. This increased risk may be due primarily to the higher estrogen levels seen in individuals with excess adipose tissue. Higher levels of circulating estrogen are found in women with higher BMIs. Obesity and IGF-I together increase estrogen production in the breast, which significantly increases the risk of BCa and the growth of BCa cells (Brown & Simpson, 2012).

Fortunately, obesity/overweight is a modifiable BCa risk factor. A recent study by Campbell, Van Patten, et al. (2012) demonstrates that among BCa survivors, a 24-week group-based lifestyle intervention modeled after the Diabetes Prevention Program for early stage, BCa survivors produced an average weight loss of 3.8 ± 5.0 kg and a decrease in BMI, percent body fat, and waist and hip circumferences at 24 weeks. These strong results were found in women who had already been diagnosed with BCa. While the focus of their study was on women with BCa, the intervention strategies could easily be modified to focus on AA women at risk of developing BCa due to their high rates of obesity.

Indeed, Campbell, Foster-Schubert, et al. (2012) conducted a single-blind, 12-month, randomized controlled trial from 2005 to 2009 with 439 postmenopausal women in the Nutrition and Exercise for Women Trial. Participants, 8% of whom were AA women, were randomly assigned to one of four groups: (1) reduced-calorie weight loss diet, (2) moderate-to vigorous-intensity aerobic exercise; (3) combined reduced-calorie weight loss diet plus

moderate- to vigorous-intensity aerobic exercise; or (4) control. Their data show that compared with controls, estrone levels (a natural estrogen) decreased 9.6% with diet alone ($p<0.001$), decreased 5.5% with exercise alone ($p<0.01$), and decreased 11.1% with diet plus exercise ($p<0.001$). Given that high estrogen levels increase the risk of breast cancer, these results highlight the significant potential impact of dietary and physical activity lifestyle changes on BCa risk. In a recent meta-analysis, physical activity has been shown to be protective, reducing the risk of breast cancer compared to women less active, by 22% (Pizot et al., 2016). Obesity can also be successfully treated with lifestyle modifications to lower the risk of developing BCa. Weight loss of 5–10% of body weight that is sustained over several years is needed to lower BCa risk (Eliassen, Colditz, Rosner, Willett, & Hankinson, 2006).

2.4 Prevalence of Overweight/Obesity and Physical Inactivity in the United States

Obesity/overweight is a major public health problem in the United States. As shown in a recent report from the *Journal of the American Medical Association*, more than 30% of adults and 17% of youths in the United States are obese, and these prevalence rates have remained stable over the past several years (Ogden, Carroll, Kit, & Flegal, 2014). When obesity and overweight data are combined, 69% of US adults and 21% of US children are obese or overweight (Cecchini et al., 2012; Centers for Disease Control and Prevention (CDC), 2016; Khan et al., 2009). Overweight is defined as a BMI of 25.0–29.9, while obesity is defined as a BMI ≥ 30.0.

The following prevalence maps highlight the widespread geographic distribution of overweight/obesity prevalence rates across the United States (CDC, 2016). Since 1988, although overweight and obesity prevalence rates have increased among both AAs and NHWs, these rates are significantly higher for African Americans as shown below (National Center for Health Statistics, 2015; Figs. 3–5).

2.5 Disparities in Overweight/Obesity and Physical Activity in the United States

Obesity prevalence among AA women is alarming; they have the highest prevalence of obesity than any other racial/ethnic/gender group in the United States (Gaillard, Schuster, & Osei, 2012; James, Pobe, Oxidine, Brown, & Joshi, 2012; Moore-Greene, Gross, Silver, & Perrino, 2012). Less than 20% of AA women have a healthy body weight (Ogden et al., 2006). Even though 70% of AA women report wanting to lose weight and 50% report actively trying to lose weight (Mack et al., 2004), they tend to lose less weight than other women (Kumanyika et al., 2011) and engage in weight loss activities for shorter periods of time.

Large disparities in the prevalence of obesity/overweight are evident across racial, ethnic and socioeconomic status (SES) groups in the United States (Wang & Chen, 2011, 2012). Obesity/overweight occurs with higher prevalence among women, racial/ethnic minorities, and those from a lower SES (Clarke, O'Malley, Johnston, & Schulenberg, 2009; Saueria & Byers, 2012). For example, Wang and Chen (2012) examined nationally representative data from two sources of survey data, the Continuing Survey of Food Intakes by Individuals and the Diet and Health Knowledge Survey. Data from 4356 adults, ages 20–65 years, were

evaluated. Consistent with national data on obesity, these data show that AAs reported the worst average Healthy Eating Index of all racial/ethnic groups ($p<0.05$). However, among participants with a poor diet, those who were female, had greater than a high school education or had comorbidities, were more likely than others to report intention to improve diet ($p<0.05$). Similarly, Coogan, Wise, Cozier, Palmer, and Rosenberg (2012) found that in their sample of 21,457 women ages <55 years in the longitudinal Black Women's Health Study, risk of obesity was lowest among women with college degrees. These findings are significant because they highlight the fact that AA women, who are at risk of developing BCa due to their high BMI, are an ideal focus of weight-reduction interventions.

A recent study of 1280 educated AA women who had at least some college education and who intentionally achieved clinically significant weight loss of at least 10% of body weight showed that 28% of the women maintained 10% weight loss for an average of 5.1 years. Women who were successful in maintaining their weight loss were more likely than other women to limit their fat intake, eat breakfast on most days of the week, shun fast food restaurants, take part in moderate to high levels of physical activity, and monitor their weight using a scale (Barnes & Kimbro, 2012).

Thus, national data demonstrate the complex interplay between race/ethnicity and SES in incidence and prevalence of obesity/overweight. These findings show that while race and ethnicity are nonmodifiable factors, obesogenic correlates of low SES, such as education and access to healthy foods and physical activity, are modifiable targets of interventions to reduce obesity/overweight and BCa risk.

Table 2 shows the high rates of obesity and overweight in the United States, with AAs showing significantly higher rates of obesity and over-weight compared to the national averages.

Tables 3–8 show that since 1988, AA women have consistently had higher BMI rates than NHW women, even though the obesity rates in both groups decreased from 1988 to 2012 (National Center for Health Statistics, 2015).

2.6 Disparities in Overweight/Obesity and Physical Activity in Breast Cancer Survivors

Data show a rising trend in the United States toward significantly increased prevalence rates of obesity among women ages 60 years and older between 2011 and 2012 (from 31.5% to 38.1%; $p=0.006$) (Ogden et al., 2014). Obesity is highly prevalent among BCa survivors (Fazzino, Sporn, & Befort, 2016; Paxton et al., 2010). This is a major public health problem because overweight and obesity are significant risk factors for recurrence (Fazzino et al., 2016; Kroenke, Chen, Rosner, & Holmes, 2005), BCa-specific mortality (Chan et al., 2014; Fazzino et al., 2016), and overall mortality (Chan et al., 2014; Fazzino et al., 2016; Protani, Coory, & Martin, 2010). AA BCa survivors are 70% more likely to be obese than are EA BCa survivors (Ogden, Carroll, Kit, & Flegal, 2012; Sheppard et al., 2016).

In a study, examining the associations between physical activity, BMI, and health-related quality of life in a multiracial/ethnic sample of BCa survivors, Paxton et al. (2010) discovered that compared to women from all other racial/ethnic groups, AA women were

least likely to meet minimum guidelines for physical activity and were most likely to be obese ($p<0.05$).

Barriers to physical activity among AA BCa survivors were recently outlined by Oyekanmi and Raheem (2014). These barriers included lack of energy, lack of time, lack of facilities or space, and lack of knowledge about how to exercise, and significantly increased the risk of not meeting current physical activity guidelines. Interestingly, the study participants who were obese and less educated reported the highest number of barriers to physical activity.

2.7 Evidence-Based Breast Cancer Survivorship Guidelines Related to Physical Activity and Weight Management

The Centers for Disease Control and Prevention recommend that adults in the general population engage in a minimum of 30 min of moderate-intensity physical activity for at least 5 days per week, or at least 20 min of vigorous-intensity activity for at least 3 days per week (Centers for Disease Control (CDC), 2008). Moderate-intensity physical activity is defined as aerobic exercise that raises a person's heart rate and causes them to sweat. Typically, people exercising at this level of intensity can talk but cannot sing the words to a song. In contrast, vigorous-intensity aerobic exercise occurs when a person is breathing hard and their heart rate has significantly increased. A person working out at this level of intensity is unable to say more than a few words without having to stop to breathe.

For BCa survivors, the National Comprehensive Cancer Network, Inc. (NCCN) relies on these published CDC physical activity guidelines, suggesting that survivors who follow the guidelines could reap benefits such as reducing the chance of BCa recurrence. The NCCN guidelines (National Comprehensive Cancer Network, 2016) also note that exercise reduces the number of excess fat cells in the body that produce the high levels of estrogen that are associated with BCa, and could potentially inhibit other hormones that may play a key role in BCa development.

The American Cancer Society recommends that to prevent cancer (and perhaps to prevent cancer recurrence as well), adults engage in at least 150 min of moderate-intensity physical activity per week, or at least 75 min of vigorous-intensity physical activity per week (American Cancer Society, 2016b).

3. CONCLUSIONS AND FUTURE DIRECTIONS

3.1 Multilevel Intervention Approach to Reduce Obesity (Thereby Reducing Breast Cancer Risk)

Dietary choices and physical activity are modifiable via multilevel intervention approaches addressing behavioral and environmental contributors to obesity/overweight. The obesity epidemic in the United States is largely due to an obesogenic environment in which overeating and sedentary lifestyles play a major role. An "obesogenic" environment refers to the "surroundings, opportunities, or conditions of life...that promote obesity in individuals or populations" (Swinburn, Egger, & Raza, 1999).

A limitation of many prior weight-reduction interventions is their focus on individuals rather than on both the individual and the environmental context in which he or she lives. If individuals successfully achieve weight loss but live in neighborhoods that lack a strong focus on physical activity and attend churches that serve weekly fat-laden dinners, their ability to maintain their weight loss will be severely undermined. This is the case with many past interventions.

3.2 The Social Ecological Model Provides a Basis for Interventions with Multilevel Approaches to Reducing Obesity/Overweight

The social ecological model (SEM) provides a multilevel framework for developing interventions to reduce obesity/overweight in BCa survivors (Bronfenbrenner, 1977; Fleury & Lee, 2006; McLeroy, Bibeau, Steckler, & Glanz, 1998). In the SEM, the multiple effects of multiple levels of influence in an environment are hypothesized to interact to influence obesity/overweight outcomes. The SEM postulates that an individual's behavior, such as losing weight and maintaining weight loss, is impacted by and impacts factors on several levels of influence. To successfully maintain weight loss, it is necessary to modify multiple aspects of the environment to support behavior change. The cumulative effects of a comprehensive approach that include simultaneously modifying intrapersonal factors, interpersonal factors, and other factors such as organizational relationships, and community/institutional policies will produce more robust and longer-term weight management outcomes than would be produced by merely focusing on the individual in isolation from his or her environmental context (Gregson et al., 2001).

As noted, behavioral interventions that target multiple levels of environmental influence are likely to produce the strongest results in achieving and maintaining weight loss among intervention participants. Multilevel interventions are defined as those that address at least two levels of influence, such as interpersonal and community/institution factors (Taplin et al., 2012). The multiple levels of influence that may influence eating and exercise habits include:

- Intrapersonal factors related to weight loss/weight loss maintenance
 - Preferences for weight loss
 - Perceptions of their body image as healthy or unhealthy
 - Knowledge about how to achieve and maintain a healthy weight
 - Skills in doing so
 - Self-confidence
 - Motivation to achieve and maintain a healthy weight
 - Sociodemographic characteristics that impact their ability to lose weight and keep it off, such as their age, SES, and health status (including comorbidities)
- Interpersonal relationships related to weight loss/weight loss maintenance
 - Family, friends, and social networks

- Culture
- Food availability at home
- Social support
- Time constraints to prepare food
- Community/institutional factors related to weight loss/weight loss maintenance
 - Food availability at stores
 - Socioeconomic characteristics of the community
 - Options for eating out, portion sizes at restaurants, and the built environment (safe walking trails, etc.)
 - Access to healthy, nourishing food at reasonable prices
- Macrolevel/public policy related to weight loss/weight loss maintenance
 - Media—which types of food are widely advertised in the local community (unhealthy vs healthy food choices)
 - Public policy regarding neighborhood safety to promote participation in outdoor activities
 - Development/zoning regulations and the availability of parks and other forms of outdoor recreation
 - The price of food at local stores.

The SEM helps to identify opportunities for weight loss and management interventions by demonstrating how the multiple levels of influence impact weight-related outcomes. For example, at the policy level, employers could have reduced employee-borne health insurance coverage costs for those at a healthy weight. At the institutional level, interventions could focus on employer policies that promoted walking programs at work. At the community level, interventions could focus on improved pedestrian safety. At the interpersonal level, interventions could focus on weight management and physical activity interventions at the group level, with family, work colleagues, or peers such as church members rather than at the individual level. On each of these levels, social change theories that could be employed to promote weight loss/weight loss maintenance include Social Cognitive Theory (which examines the dynamic ways in which personal factors and environmental factors influence each other), Community Organization and Community Based Participatory Models (which focus on community-led approaches to evaluating and reducing the prevalence of obesity/overweight), Diffusion of Innovations Theory (which demonstrates how new social practices spread within an organization, community or society), and Communication Theory (which demonstrates how different means of communication produce different health outcomes) (Washington State Department of Health, 2012).

Finally, on the intrapersonal level, interventions could employ cognitive behavioral change theories such as the Health Belief Model (which focuses on perception of a threat to health such as obesity, the health benefits of losing weight, and the factors that impact the decision

to lose weight) (Stretcher & Rosenstock, 1997), the Stages of Change (Transtheoretical) Model (which evaluates motivation and readiness to engage in health behavior such as weight loss) (Prochaska & DiClemente, 1983), or the Theory of Planned Behavior (Ajzen, 1991) to help promote weight management (which evaluates the interactions among beliefs, attitudes, intentions, behavior, and perceived control over behavior such as weight loss activities). According to the Theory of Planned Behavior, intention to engage in healthy behavior is the most significant predictor of actually engaging in the behavior.

Recently, Fazzino et al. (2016) developed and tested a 6-month group phone-based weight loss intervention for rural BCa survivors. The intervention included elements of the SEM by focusing on a group-based design, as well as Communication Theory by disseminating the intervention via a weekly 1-h group teleconference. The intervention targeted weight loss as well as physical activity. In terms of weight loss, the participants were instructed to employ a planned meal format that included two whey-based protein shakes per day, two portion-controlled factory-frozen meals per day, and a minimum of five fruits or vegetables per day. The American College of Sports Medicine's physical activity guidelines of completing 225 min/week of moderate-intensity physical activity were used as the culminating physical activity goal, with activity gradually increased per week to meet this goal. Most of the participants chose brisk walking as their preferred form of exercise. During the teleconferences, common barriers to healthy eating and physical activity were discussed and problem solving was used to overcome the barriers. During each weekly call, each participant reported to the group whether they had met their dietary and physical activity goals for the week. Of the 186 rural, obese BCa survivors (3 months from initial cancer treatment; BMI 27–45, with physician clearance) who participated in the intervention, clinically meaningful weight loss (>5%) was reported in 91% of the participants. Weight loss was confirmed via morning fasting weigh-in assessments at baseline, and at 6-, 12-, 18-, and 24-month postrandomization (Fazzino et al., 2016). Height was measured at baseline with a stadiometer, and waist circumference was obtained with two measurements per site within 2 cm (Befort et al., 2014).

3.3 Relevance of the SEM for Obesity Reduction Interventions with AA Women Who Are Breast Cancer Survivors

The SEM has particular relevance for efforts to reduce obesity and over-weight among AA women. As Kumanyika et al. (2007) point out, the causes of obesity among AA women are related to core social environmental factors and therefore interventions to reduce obesity in this population must address these factors. For example, a recent study shows that financial and work-related stress were significant contributors to high levels of obesity among AA women, suggesting that employee health programs could consider the issue of job strain and its impact on the health of employees, and implement employee health programs to decrease stress, reduce obesity, and improve employee health outcomes (Moore-Greene et al., 2012). Race and ethnicity influence life contexts and impact factors that relate to eating and physical activity behaviors (Kumanyika et al., 2007).

SEM approaches that take into account cultural and contextual factors of AA communities are more likely than other approaches to achieve success in obesity/overweight-reduction

interventions. For example, a SEM approach to obesity reduction in AA populations was developed by Kumanyika et al. (2007). Their approach focuses on four themes related to the inclusion of community and family life contexts in obesity research. These themes include community-specific environmental influences, community structure and organization, women as a central focus, and heterogeneity in the AA population. Community-specific environmental influences include poor housing, financial constraints on food choices and lack of availability of recreational activities. Community structure and organization refer to formal and informal social networks and sources of social support. Women as a central focus refer to the influential roles many AA women play as the heads of their households. Heterogeneity refers to the fact, as has been pointed out, that there is considerable within-group diversity among AA women in terms of SES as well as neighborhood characteristics, urban vs rural differences, and religion. An important point that is made by these authors is the need to provide direct economic benefits to the communities that participate in obesity reduction efforts.

SEM approaches for obesity/overweight reduction could also address the issue of collectivism, which is a more prevalent value among AAs than among members of many other groups (Gilbert, Harvey, & Belgrave, 2009). Collectivism refers to a belief that the basic element of society is the family rather than the individual (Steele-Moses et al., 2009). In a recent review, Kuo identified the prominence of collective coping behaviors among African Americans and Asian Americans (Kuo, 2013). Religiosity, another prevalent value among AAs, could also be addressed in SEM approaches. Religiosity refers to a range of activities including church attendance, prayer, and belief in God as a causal agent (Kreuter et al., 2005). In a randomized trial with 1227 lower-income AA women from 10 urban public health centers, Kreuter et al. (2005) found that women who received behavioral construct (BCT, consisting of individualized approaches that do not take contextual variables into account) tailoring plus culturally relevant tailoring (focusing on religiosity, collectivism, racial pride, and present time orientation) produced significantly higher rates of receipt of mammography and increases in daily consumption of fruits and vegetables compared with women who received BCT alone, CRT alone, or the control group. Racial pride refers to interest and involvement in traditional AA cultural practices such as serving collard greens and black-eyed peas on New Year's Day for good luck. Time orientation reflects a tendency to think and act based on immediate, rather than more distal, consequences, perhaps due to the issue of coping with daily stressors (Lukwago, Kreuter, Bucholtz, Holt, & Clark, 2001). Interestingly, instruments to measure collectivism, religiosity, racial pride, and time orientation among AA women have been previously developed and validated (Lukwago et al., 2001).

To cite an example of how an intervention could be developed to promote weight loss in AA women, the results of a study by James et al. (2012) could be extended to intervention development. They conducted a study in which they used the Health Belief Model to develop culturally appropriate weight management materials in a study with 50 AA women. Their findings show that perceived benefits of weight loss included reduced risk for health problems, improved physical appearance, and improved quality of life. Perceived barriers included lack of motivation, lack of trustworthy nutrition information, and social support. Motivators to weight loss included diagnosis of a health problem, physical appearance, and

saving money on clothes. These findings could be used to develop an intervention that included multiple levels of influence such as employing social support to aid women in their weight loss goals, community interventions to enhance opportunities for physical activity, making reliable nutrition information readily available in local grocery stores, and working with local clothiers to offer price reductions to women who could demonstrate weight loss over a specified period of time. Interventions could also address targeted marketing of high-calorie foods and beverages in AA communities (Grier & Kumanyika, 2008).

More recently, Sheppard et al. (2016) conducted a diet and exercise trial with overweight and obese AA BCa survivors. This two-arm randomized trial tested the effectiveness of a culturally targeted 12-week lifestyle intervention ($n=16$) vs usual care ($n=15$). The intervention was developed with input from survivors who were representative of the end-users. The intervention included content related to faith and spirituality, foods that are relevant to AAs, and body image perceptions (Sheppard et al., 2016). Additionally, the risk information that was presented to the intervention group participants included information that was pertinent to AA cancer survivors. The intervention, titled “Stepping STONE (Survivors Taking on Nutrition and Exercise),” was offered to AA BCa survivors who were between 6 months and 5 years postactive treatment, and who were overweight or obese ($BMI \geq 25 \text{ kg/m}^2$ or $BMI \geq 40 \text{ kg/m}^2$, respectively; thus excluding morbidly obese survivors) and were survivors of early stage/localized BCa. The Stepping STONE intervention incorporated elements of the Theory of Planned Behavior and Social Cognitive Theory and individualized sessions were tailored to participant’s intentions, attitudes, and subjective norms toward dietary changes and physical activity that were expressed at baseline. Importantly and highly relevant to the SEM, the intervention includes actionable steps, such as empowering participants to include their families in identifying and preparing healthier meal options (Sheppard et al., 2016). Thus, by developing strategies to influence participants’ social networks, environmental influences on behavior were addressed. Other such influences included barriers to exercise, in which strategies were identified to foster participant’s engagement in physical activity within the constraints of their neighborhoods/towns. The physical activity recommendations in the Stepping STONE intervention included moderate-intensity exercise for at least 30 min per day for 5 or more days per week, and the dietary recommendations included consuming at least five fruits and vegetables per day, with less than 35% of daily calories from total fat. The results of the Stepping STONE intervention showed that the intervention group did not meet the 5% weight loss target, instead losing only 0.8%. However, BMI improved and physical activity levels were higher in the intervention group than in the usual care group.

In summary, few studies demonstrate how to effectively conduct obesity reduction and weight management interventions with AA women (Kumanyika et al., 2011). However, recent multisite efficacy trials of lifestyle interventions (using an intervention adapted from the Diabetes Prevention Program that includes group sessions with registered dietitians, behavioral psychologists, and exercise specialists) to reduce obesity have shown clinically significant weight reductions for AA and Hispanic adults (Wadden et al., 2009). More studies are greatly needed to translate these efficacy findings into community-based interventions given the looming health crisis among AA women.

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REFERENCES

- Ajzen I (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179–211.
- American Cancer Society. (2008). *Cancer facts and figures*. Atlanta, GA: American Cancer Society, Inc., Surveillance Health Policy Research.
- American Cancer Society. (2016a). *Cancer facts & figures for African Americans 2016–2018*. Atlanta, GA: American Cancer Society.
- American Cancer Society. (2016b). *American Cancer Society Guidelines on nutrition and physical activity for cancer prevention*. Atlanta, GA: American Cancer Society.
- Bach PB, Schrag D, Brawley OW, Galaznik A, Yakren S, & Begg CB (2002). Survival of blacks and whites after a cancer diagnosis. *JAMA*, 287(16), 2106–2113. [PubMed: 11966385]
- Barnes AS, & Kimbro RT (2012). Descriptive study of educated African American women successful at weight-loss maintenance through lifestyle changes. *Journal of General Internal Medicine*, 27(10), 1272–1279. 10.1007/s11606-012-2060-2. [PubMed: 22539067]
- Befort CA, Klemp JR, Fabian C, Perri MG, Sullivan DK, Schmitz KH, ... Shireman T (2014). Protocol and recruitment results from a randomized controlled trial comparing group phone-based versus newsletter interventions for weight loss maintenance among rural breast cancer survivors. *Contemporary Clinical Trials*, 37(2), 261–271. 10.1016/j.cct.2014.01.010. [PubMed: 24486636]
- Bronfenbrenner U (1977). Toward an experimental ecology of human development. *American Psychologist*, 32, 513–531.
- Brown KA, & Simpson ER (2012). Obesity and breast cancer: Mechanisms and therapeutic implications. *Frontiers in Bioscience (Elite Edition)*, 4, 2515–2524. [PubMed: 22652657]
- Campbell KL, Foster-Schubert KE, Alfano CM, Wang CC, Wang CY, Duggan CR, ... McTiernan A (2012). Reduced-calorie dietary weight loss, exercise, and sex hormones in postmenopausal women: Randomized controlled trial. *Journal of Clinical Oncology*, 30(19), 2314–2326. 10.1200/JCO2011.37.9792. [PubMed: 22614972]
- Campbell KL, Van Patten CL, Neil SE, Kirkham AA, Gotay CC, Gelmon KA, & McKenzie DC (2012). Feasibility of a lifestyle intervention on body weight and serum biomarkers in breast cancer survivors with overweight and obesity. *Journal of the Academy of Nutrition and Dietetics*, 112(4), 559–567. 10.1016/j.jada.2011.10.022. [PubMed: 22709706]
- Cecchini RS, Costantino JP, Cauley JA, Cronin WM, Wickerham DL, Land SR, ... Wolmark N (2012). Body mass index and the risk for developing invasive breast cancer among high-risk women in NSABP P-1 and STAR breast cancer prevention trials. *Cancer Prevention Research (Philadelphia, PA)*, 5(4), 583–592. 10.1158/1940-6207.CAPR-11-0482.
- Centers for Disease Control (CDC). (2008). *Physical activity guidelines for Americans*. Atlanta, GA: Centers for Disease Control and Prevention.
- Centers for Disease Control and Prevention (CDC) (2015). Behavioral risk factor surveillance system. Prevalence of self-reported obesity among U.S. adults by state and territory, BRFSS, 2015. Retrieved from, <https://www.cdc.gov/obesity/data/prevalence-maps.html>.
- Centers for Disease Control and Prevention. (2016). FastStats on obesity and overweight. Atlanta, GA: Centers for Disease Control and Prevention Retrieved March 21, from, <http://www.cdc.gov/nchs/fastats/obesity-overweight.htm>.
- Chan DS, Vieira AR, Aune D, Bandera EV, Greenwood DC, McTiernan A, ... Norat T (2014). Body mass index and survival in women with breast cancer-systematic literature review and meta-analysis of 82 follow-up studies. *Annals of Oncology*, 25(10), 1901–1914. 10.1093/annonc/mdu042. [PubMed: 24769692]

- Clarke P, O'Malley PM, Johnston LD, & Schulenberg JE (2009). Social disparities in BMI trajectories across adulthood by gender, race/ethnicity and lifetime socio-economic position: 1986–2004. *International Journal of Epidemiology*, 38(2), 499–509. 10.1093/ije/dyn214. [PubMed: 18835869]
- Coogan PE, Wise LA, Cozier YC, Palmer JR, & Rosenberg L (2012). Lifecourse educational status in relation to weight gain in African American women. *Ethnicity & Disease*, 22(2), 198–206. [PubMed: 22764643]
- Costa C, Incio J, & Soares R (2007). Angiogenesis and chronic inflammation: Cause or consequence? *Angiogenesis*, 10(3), 149–166. 10.1007/s10456-007-9074-0. [PubMed: 17457680]
- Daly B, & Olopade OI (2015). A perfect storm: How tumor biology, genomics, and health care delivery patterns collide to create a racial survival disparity in breast cancer and proposed interventions for change. *CA: A Cancer Journal for Clinicians*, 65(3), 221–238. 10.3322/caac.21271. [PubMed: 25960198]
- Danforth DN Jr. (2013). Disparities in breast cancer outcomes between Caucasian and African American women: A model for describing the relationship of biological and non-biological factors. *Breast Cancer Research*, 15(3), 208. 10.1186/bcr3429. [PubMed: 23826992]
- D'Arcy M, Fleming J, Robinson WR, Kirk EL, Perou CM, & Troester MA (2015). Race-associated biological differences among luminal a breast tumors. *Breast Cancer Research and Treatment*, 152(2), 437–448. 10.1007/s10549-015-3474-4. [PubMed: 26109344]
- Demark-Wahnefried W, Campbell KL, & Hayes SC (2012). Weight management and its role in breast cancer rehabilitation. *Cancer*, 118(8 Suppl.), 2277–2287. 10.1002/cncr.27466. [PubMed: 22488702]
- DeSantis CE, Siegel RL, Sauer AG, Miller KD, Fedewa SA, Alcaraz KI, & Jemal A (2016). Cancer statistics for African Americans, 2016: Progress and opportunities in reducing racial disparities. *CA: A Cancer Journal for Clinicians*, 66(4), 290–308. 10.3322/caac.21340. [PubMed: 26910411]
- Dietze EC, Sistrunk C, Miranda-Carboni G, O'Regan R, & Seewaldt VL (2015). Triple-negative breast cancer in African-American women: Disparities versus biology. *Nature Reviews. Cancer*, 15(4), 248–254. 10.1038/nrc3896. [PubMed: 25673085]
- Eliassen AH, Colditz GA, Rosner B, Willett WC, & Hankinson SE (2006). Adult weight change and risk of postmenopausal breast cancer. *JAMA*, 296(2), 193–201. 10.1001/jama.296.2.193. [PubMed: 16835425]
- Fabian CJ (2012). Simplifying the energy balance message for breast cancer prevention. *Cancer Prevention Research (Philadelphia, PA)*, 5(4), 511–514. 10.1158/1940-6207.CAPR-12-0088.
- Fazzino TL, Sporn NJ, & Befort CA (2016). A qualitative evaluation of a group phone-based weight loss intervention for rural breast cancer survivors: Themes and mechanisms of success. *Support Care Cancer*, 24(7), 3165–3173. 10.1007/s00520-016-3149-7. [PubMed: 26932848]
- Fleury J, & Lee SM (2006). The social ecological model and physical activity in African American women. *American Journal of Community Psychology*, 37(1–2), 129–140. 10.1007/s10464-005-9002-7. [PubMed: 16680541]
- Gaillard TR, Schuster D, & Osei K (2012). Characterization of metabolically unhealthy overweight/obese African American women: Significance of insulin-sensitive and insulin-resistant phenotypes. *Journal of the National Medical Association*, 104(3–4), 164–171. [PubMed: 22774383]
- Gilbert DJ, Harvey AR, & Belgrave FZ (2009). Advancing the Africentric paradigm shift discourse: Building toward evidence-based Africentric interventions in social work practice with African Americans. *Social Work*, 54(3), 243–252. [PubMed: 19530571]
- Gregson J, Foerster SB, Orr R, Jones L, Benedict J, Clarke B, ... Zotz AK (2001). System, environmental, and policy changes: Using the social-ecological model as a framework for evaluating nutrition education and social marketing programs with low-income audiences. *Journal of Nutrition Education*, 33(Suppl. 1), S4–S15. [PubMed: 12857540]
- Grier SA, & Kumanyika SK (2008). The context for choice: Health implications of targeted food and beverage marketing to African Americans. *American Journal of Public Health*, 98(9), 1616–1629. 10.2105/AJPH.2007.115626. [PubMed: 18633097]
- Hoffman HJ, Lavendra NL, Levine PH, Young HA, Alexander LM, Patierno SR, & District of Columbia Citywide Patient Navigator Research Program Research Group (2011). Having health

insurance does not eliminate race/ethnicity-associated delays in breast cancer diagnosis in the District of Columbia. *Cancer*, 117, 3824–3832. [PubMed: 21815134]

- James DC, Pobee JW, Oxidine D, Brown L, & Joshi G (2012). Using the health belief model to develop culturally appropriate weight-management materials for African-American women. *Journal of the Academy of Nutrition and Dietetics*, 112, 664–670. [PubMed: 22709771]
- Khan LK, Sobush K, Keener D, Goodman K, Lowry A, Kakietek J, & Zaro S (2009). Recommended community strategies and measurements to prevent obesity in the United States. *MMWR—Recommendations and Reports*, 58(RR-7), 1–26.
- Komenaka IK, Martinez ME, Pennington RE Jr., Hsu CH, Clare SE, Thompson PA, ... Goulet RJ Jr. (2010). Race and ethnicity and breast cancer outcomes in an underinsured population. *Journal of the National Cancer Institute*, 102(15), 1178–1187. 10.1093/jnci/djq215. [PubMed: 20574040]
- Kreuter MW, Sugg-Skinner C, Holt CL, Clark EM, Haire-Joshu D, Fu Q, ... Bucholtz D (2005). Cultural tailoring for mammography and fruit and vegetable intake among low-income African-American women in urban public health centers. *Preventive Medicine*, 41(1), 53–62. 10.1016/j.ypmed.2004.10.013. [PubMed: 15916993]
- Kroenke CH, Chen WY, Rosner B, & Holmes MD (2005). Weight, weight gain, and survival after breast cancer diagnosis. *Journal of Clinical Oncology*, 23(7), 1370–1378. 10.1200/JCO.2005.01.079. [PubMed: 15684320]
- Kumanyika S, Fassbender J, Phipps E, Tan-Torres S, Localio R, Morales KH, ... Wadden TA (2011). Design, recruitment and start up of a primary care weight loss trial targeting African American and Hispanic adults. *Contemporary Clinical Trials*, 32(2), 215–224. 10.1016/j.cct.2010.11.002. [PubMed: 21062645]
- Kumanyika SK, Whitt-Glover MC, Gary TL, Prewitt TE, Odoms-Young AM, Banks-Wallace J, ... Samuel-Hodge CD (2007). Expanding the obesity research paradigm to reach African American communities. *Preventing Chronic Disease*, 4(4), A112. [PubMed: 17875256]
- Kuo BC (2013). Collectivism and coping: Current theories, evidence, and measurements of collective coping. *International Journal of Psychology*, 48(3), 374–388. 10.1080/00207594.2011.640681. [PubMed: 22335198]
- Lahmann PH, Hoffmann K, Allen N, van Gils CH, Khaw KT, Tehard B, ... Riboli E (2004). Body size and breast cancer risk: Findings from the European prospective investigation into cancer and nutrition (EPIC). *International Journal of Cancer*, 111(5), 762–771. 10.1002/ijc.20315. [PubMed: 15252848]
- Lukwago SN, Kreuter MW, Bucholtz DC, Holt CL, & Clark EM (2001). Development and validation of brief scales to measure collectivism, religiosity, racial pride, and time orientation in urban African American women. *Family & Community Health*, 24(3), 63–71. [PubMed: 11563945]
- Ma H, Lu Y, Malone KE, Marchbanks PA, Deapen DM, Spirtas R, ... Bernstein L (2013). Mortality risk of black women and white women with invasive breast cancer by hormone receptors, HER2, and p53 status. *BMC Cancer*, 13, 225. 10.1186/1471-2407-13-225. [PubMed: 23642215]
- Mack KA, Anderson L, Galuska D, Zablotsky D, Holtzman D, & Ahluwalia I (2004). Health and sociodemographic factors associated with body weight and weight objectives for women: 2000 behavioral risk factor surveillance system. *Journal of Women's Health* (2002), 13(9), 1019–1032. 10.1089/jwh.2004.13.1019.
- McCarthy AM, Yang J, & Armstrong K (2015). Increasing disparities in breast cancer mortality from 1979 to 2010 for US black women aged 20 to 49 years. *American Journal of Public Health*, 105(Suppl. 3), S446–S448. 10.2105/AJPH.2014.302297. [PubMed: 25905842]
- McLeroy KR, Bibeau D, Steckler A, & Glanz K (1988). An ecological perspective on health promotion programs. *Health Education Quarterly*, 15(4), 351–377. [PubMed: 3068205]
- Moore-Greene GM, Gross SM, Silver KD, & Perrino CS (2012). Chronic stress and decreased physical exercise: Impact on weight for African American women. *Ethnicity & Disease*, 22(2), 185–191. [PubMed: 22764641]
- Morimoto LM, White E, Chen Z, Chlebowski RT, Hays J, Kuller L, ... McTiernan A (2002). Obesity, body size, and risk of postmenopausal breast cancer: The women's health initiative (United States). *Cancer Causes & Control*, 13(8), 741–751. [PubMed: 12420953]

- National Center for Health Statistics (2015). Health, United States, 2014: With Special feature on adults aged 55–64. Hyattsville, MD.
- National Comprehensive Cancer Network (2016). Exercise for life [patient and caregiver resources]. National Comprehensive Cancer Network, Inc. (NCCN) Retrieved from, https://www.nccn.org/patients/resources/life_after_cancer/exercise.aspx.
- Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, & Flegal KM (2006). Prevalence of overweight and obesity in the United States, 1999–2004. *JAMA*, 295(13), 1549–1555. 10.1001/jama.295.13.1549. [PubMed: 16595758]
- Ogden CL, Carroll MD, Kit BK, & Flegal KM (2012). Prevalence of obesity in the United States, 2009–2010. *NCHS Data Brief*, 82, 1–8.
- Ogden CL, Carroll MD, Kit BK, & Flegal KM (2014). Prevalence of childhood and adult obesity in the United States, 2011–2012. *JAMA*, 311(8), 806–814. 10.1001/jama.2014.732. [PubMed: 24570244]
- Oyekanmi G, & Raheem P (2014). Barriers to physical activity among African American breast cancer survivors. *Psychooncology*, 14(23), 1314–1317.
- Palmer JR, Viscidi E, Troester MA, Hong CC, Schedin P, Bethea TN, ... Ambrosone CB (2014). Parity, lactation, and breast cancer subtypes in African American women: Results from the AMBER consortium. *Journal of the National Cancer Institute*, 106(10). 10.1093/jnci/dju237.
- Paxton RJ, Phillips KL, Jones LA, Chang S, Taylor WC, Courneya KS, & Pierce JP (2010). Associations among physical activity, body mass index, and health-related quality of life by race/ethnicity in a diverse sample of breast cancer survivors. *Cancer*, 118, 4024–4031.
- Phipps AI, Chlebowski RT, Prentice R, McTiernan A, Wactawski-Wende J, Kuller LH, ... Li CI (2011). Reproductive history and oral contraceptive use in relation to risk of triple-negative breast cancer. *Journal of the National Cancer Institute*, 103(6), 470–477. 10.1093/jnci/djr030. [PubMed: 21346227]
- Pischon T, Nothlings U, & Boeing H (2008). Obesity and cancer. *The Proceedings of the Nutrition Society*, 67(2), 128–145. 10.1017/S0029665108006976. [PubMed: 18412987]
- Pizot C, Boniol M, Mullie P, Koechlin A, Boniol M, Boyle P, & Autier P (2016). Physical activity, hormone replacement therapy and breast cancer risk: A meta-analysis of prospective studies. *European Journal of Cancer*, 52, 138–154. 10.1016/j.ejca.2015.10.063. [PubMed: 26687833]
- Press R, Carrasquillo O, Sciacca RR, & Giardina EG (2008). Racial/ethnic disparities in time to follow-up after an abnormal mammogram. *Journal of Women's Health* (2002), 17(6), 923–930. 10.1089/jwh.2007.0402.
- Prochaska JO, & DiClemente CC (1983). Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology*, 51(3), 390–395. [PubMed: 6863699]
- Protani M, Coory M, & Martin JH (2010). Effect of obesity on survival of women with breast cancer: Systematic review and meta-analysis. *Breast Cancer Research and Treatment*, 123(3), 627–635. 10.1007/s10549-010-0990-0. [PubMed: 20571870]
- Reeder-Hayes KE, Wheeler SB, & Mayer DK (2015). Health disparities across the breast cancer continuum. *Seminars in Oncology Nursing*, 31(2), 170–177. 10.1016/j.soncn.2015.02.005. [PubMed: 25951746]
- Renehan AG, Roberts DL, & Dive C (2008). Obesity and cancer: Pathophysiological and biological mechanisms. *Archives of Physiology and Biochemistry*, 114(1), 71–83. 10.1080/13813450801954303. [PubMed: 18465361]
- Sauaia A, & Byers T (2012). Obesity in US children and adults. *JAMA*, 307(20), 2145. 10.1001/jama.2012.4726 author reply 2145–2146. [PubMed: 22618911]
- Sheppard VB, Hicks J, Makambi K, Hurtado-de-Mendoza A, Demark-Wahnefried W, & Adams-Campbell L (2016). The feasibility and acceptability of a diet and exercise trial in overweight and obese black breast cancer survivors: The stepping STONE study. *Contemporary Clinical Trials*, 46, 106–113. 10.1016/j.cct.2015.12.005. [PubMed: 26655430]
- Smith-Bindman R, Miglioretti DL, Lurie N, Abraham L, Barbash RB, Strzelczyk J, ... Kerlikowske K (2006). Does utilization of screening mammography explain racial and ethnic differences in breast cancer? *Annals of Internal Medicine*, 144, 541–553. [PubMed: 16618951]

- Steele-Moses SK, Russell KM, Kreuter M, Monahan P, Bourff S, & Champion VL (2009). Cultural constructs, stage of change, and adherence to mammography among low-income African American women. *Journal of Health Care for the Poor and Underserved*, 20(1), 257–273. 10.1353/hpu.0.0123. [PubMed: 19202261]
- Stretcher VJ, & Rosenstock I (1997). The health belief model In L.ewis FM, Glanz K, & Rimer B (Eds.), *Health behavior and health education: Theory, research and practice*, (2nd ed.), San Francisco, CA: Jossey-Bass Inc (pp. 41–59).
- Swinburn B, Egger G, & Raza F (1999). Dissecting obesogenic environments: The development and application of a framework for identifying and prioritizing environmental interventions for obesity. *Preventive Medicine*, 29(6 Pt 1), 563–570. 10.1006/pmed.1999.0585. [PubMed: 10600438]
- Tao L, Gomez SL, Keegan TH, Kurian AW, & Clarke CA (2015). Breast cancer mortality in African-American and non-hispanic white women by molecular subtype and stage at diagnosis: A population-based study. *Cancer Epidemiology, Biomarkers & Prevention*, 24(7), 1039–1045. 10.1158/1055-9965.EPI-15-0243.
- Taplin SH, Anhang Price R, Edwards HM, Foster MK, Breslau ES, Chollette V, ... Zapka J (2012). Introduction: Understanding and influencing multilevel factors across the cancer care continuum. *Journal of the National Cancer Institute Monographs*, 2012(44), 2–10. 10.1093/jncimonographs/lgs008. [PubMed: 22623590]
- Wadden TA, West DS, Neiberg RH, Wing RR, Ryan DH, Johnson KC, ... Look ARG (2009). One-year weight losses in the look AHEAD study: Factors associated with success. *Obesity (Silver Spring)*, 17(4), 713–722. 10.1038/oby.2008.637. [PubMed: 19180071]
- Wang Y, & Chen X (2011). How much of racial/ethnic disparities in dietary intakes, exercise, and weight status can be explained by nutrition and health-related psychosocial factors and socioeconomic status among US adults? *Journal of American Dietetic Association*, 111, 1904–1911.
- Wang Y, & Chen X (2012). Between-group differences in nutrition and health-related psychosocial factors among US adults and their associations with diet, exercise, and weight status. *Journal of Academy of Nutrition and Dietetics*, 112 486–498 e483.
- Warner ET, Tamimi RM, Hughes ME, Ottesen RA, Wong YN, Edge SB, ... Partridge AH (2015). Racial and ethnic differences in breast cancer survival: Mediating effect of tumor characteristics and sociodemographic and treatment factors. *Journal of Clinical Oncology*, 33(20), 2254–2261. 10.1200/JCO.2014.57.1349. [PubMed: 25964252]
- Washington State Department of Health. (2012). *Partners in action: Good nutrition, active living & healthy communities*. Seattle, WA: Washington State Department of Health UW Center for Public Health Nutrition.
- Yang XR, Sherman ME, Rimm DL, Lissowska J, Brinton LA, Peplonska B, ... Garcia-Closas M (2007). Differences in risk factors for breast cancer molecular sub-types in a population-based study. *Cancer Epidemiology, Biomarkers & Prevention*, 16(3), 439–443. 10.1158/1055-9965.EPI-06-0806.

Fig. 1.

Female breast cancer survival rates in the United States, based on patients diagnosed between 2005 and 2011 and followed through 2012. *Adapted from American Cancer Society (2016a). Cancer facts & figures for African Americans 2016–2018. Atlanta: American Cancer Society.*

Fig. 2.

Age-adjusted US mortality rates by race/ethnicity, female breast, all ages, 1975–2013.

Cancer sites include invasive cases only unless otherwise noted. Rates are per 100,000 and are age-adjusted to the 2000 US Std. Population (19 age groups—Census P25–1130).

Regression lines are calculated using the Joinpoint Regression Program Version 4.2.0, April 2015 National Cancer Institute. (Fast Stats: An interactive tool for access to SEER cancer statistics. Surveillance Research Program, National Cancer Institute <http://seer.cancer.gov/faststats>.)

Fig. 3.

Prevalence* of self-reported obesity among US adults by state and territory, BRFSS, 2015. Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011. Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥30% (CDC, 2015).

Fig. 4. Prevalence of self-reported obesity among non-Hispanic White adults by state and territory, BRFSS, 2013–2015. The sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥30% (CDC, 2015).

Fig. 5. Prevalence of self-reported obesity among non-Hispanic black adults by state and territory, BRFSS, 2013–2015. Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥30% (CDC, 2015).

Table 1

Comparison of Female Breast Cancer Mortality Rates for African Americans (AAs) and Non-Hispanic Whites (NHWs), United States, 2008–2012

Breast Cancer Mortality Rates			
AA Mortality Rate	NHW Mortality Rate	Absolute Difference	Rate Ratio
31.0	21.9	9.1	1.42

Table 2

Current Obesity and Overweight Rates Among Adults by Race, 2011–2012

All adults	68.5%
Race/ethnicity	
Black	76.2%
Latino	77.9%
White	67.2%

Adapted from Robert Wood Johnson Data: <http://stateofobesity.org/disparities/>. retrieved September 19, 2016.

Table 3

Percentage of US Individuals at a Healthy Weight (BMI From 18.5 to 24.9), by Race/Ethnicity, 1988–2012

	1988–1994	1999–2002	2002–2006	2009–2012
Non-Hispanic White female	48.7	39.5	39.6	36.0
Black or African-American female	29.2	21.6	19.2	16.4

Adapted from National Center for Health Statistics (2015). *Health, United States, 2014: With special feature on adults aged 55–64*. <http://www.cdc.gov/nchs/data/abus/abus14.pdf#059>, Retrieved March 21, 2016.

Table 4Percentage of Overweight US Individuals (BMI ≥ 30), by Race/Ethnicity, 1988–2012

	1988–1994	1999–2002	2002–2006	2009–2012
Non-Hispanic White female	47.4	58.2	59.4	62.9
Black or African-American female	66.0	76.9	79.7	82.1

Adapted from National Center for Health Statistics (2015). *Health, United States, 2014: With special feature on adults aged 55–64*. http://www.cdc.gov/nchs/data/health_statistics/14.pdf#059, Retrieved March 21, 2016.

Table 5

Percentage of Obese US Individuals (BMI ≥ 30.0), by Race/Ethnicity, 1988–2012

	1988–1994	1999–2002	2002–2006	2009–2012
Non-Hispanic White female	22.7	31.3	32.2	33.5
Black or African-American female	36.7	48.7	53.2	57.6

Adapted from National Center for Health Statistics (2015). *Health, United States, 2014: With special feature on adults aged 55–64*. http://www.cdc.gov/nchs/data/health_statistics/14.pdf#059, Retrieved March 21, 2016.

Table 6

Percentage of US Individuals With Grade 1 Obesity (BMI 30.0–34.9), by Race/Ethnicity, 1988–2012

	1988–1994	1999–2002	2002–2006	2009–2012
Non-Hispanic White female	13.1	16.6	17.3	17.3
Black or African-American female	18.7	21.7	23.5	27.6

Adapted from National Center for Health Statistics (2015). *Health, United States, 2014: With special feature on adults aged 55–64*. <http://www.cdc.gov/nchs/data/abus/abus14.pdf#059>, Retrieved March 21, 2016.

Table 7

Percentage of US Individuals With Grade 2 Obesity (BMI 35.0–39.9), by Race/Ethnicity, 1988–2012

	1988–1994	1999–2002	2002–2006	2009–2012
Non-Hispanic White female	6.2	9.1	8.5	8.9
Black or African-American female	10.4	13.5	15.3	12.9

Adapted from National Center for Health Statistics (2015). *Health, United States, 2014: With special feature on adults aged 55–64*. [http://www.cdc.gov/nchs/data/14.pdf#059](http://www.cdc.gov/nchs/data/hus/14.pdf#059), Retrieved March 21, 2016

Table 8

Percentage of US Individuals With Grade 3 Obesity (BMI ≥ 40.0), by Race/Ethnicity, 1988–2012

	1988–1994	1999–2002	2002–2006	2009–2012
Non-Hispanic White female	3.5	5.5	6.3	7.2
Black or African-American female	8.0	13.4	14.2	16.9

Adapted from National Center for Health Statistics (2015). *Health, United States, 2014: With special feature on adults aged 55–64*. http://www.cdc.gov/nchs/data/health_statistics/14.pdf#059, Retrieved March 21, 2016.