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Multilevel Influences on Physical Activity Participation in Rural and Cancer Populations with Obesity

Nashira Inika Brown
University Of Alabama At Birmingham

MULTILEVEL INFLUENCES ON PHYSICAL ACTIVITY PARTICIPATION IN RURAL AND CANCER POPULATIONS WITH OBESITY

by

NASHIRA INIKA BROWN

DORI PEKMEZI, COMMITTE CHAIR
LAURA Q. ROGERS, CO-COMMITTEE CHAIR
KEVIN R. FONTAINE
ROBERT OSTER
GREGORY PAVELA

A DISSERTATION

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NASHIRA INIKA BROWN

HEALTH EDUCATION/HEALTH PROMOTION

ABSTRACT

Despite the strong evidence of physical activity benefits, the prevalence of physical inactivity and associated obesity continues to increase. Rural and cancer survivor populations with obesity, in particular, remain highly inactive and are at increased risk of comorbidities. Thus, physical activity interventions are needed to promote active lifestyles. However, before developing or adapting existing multi-level physical activity interventions, more research is needed to understand the necessary components to meet the needs and preferences of these unique populations. Therefore, this project involved identifying the gaps in literature followed by three studies to investigate the multilevel influences on physical activity in rural and cancer populations with obesity.

This dissertation consists of three cohesive papers. Paper 1 is a systematic review of physical activity intervention barriers, facilitators, and preferences among individuals with obesity in rural counties. Paper 2 examined the associations between body mass index, physical activity, and related psychosocial factors among breast cancer survivors enrolled in a physical activity randomized controlled trial. Lastly, paper 3 assessed and described the built environment, programs and policies related to physical activity opportunity in six underserved rural Alabama counties.

Keywords: physical activity, cancer survivors, rural, obesity

DEDICATION

This dissertation is dedicated to my four angels: my father, Ronald Maurice Brown, my grandmother, Rosemary Buford Williams, my baby, Mason Pierre Buford, and my soon-to-be father-in-law Douglas Jerome Phillips.

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INTRODUCTION

Physical Inactivity, a Modifiable Risk Factor for Obesity

From 2008 to 2018, the prevalence of obesity in the United States (US) increased by 26% to 42.4%.[1] High rates of obesity are a problem consistently associated with debilitating, chronic diseases (i.e., Type II diabetes, cardiovascular diseases, stroke and some cancers),[2] increases in years of life lost (9-13 years)[3] and increased risk of premature mortality(>45%).[4] While many factors (e.g., genetics, metabolism, diet) play a role in obesity, living an inactive or sedentary lifestyle is a key modifiable risk behavior. Yet, across the US, 25.3% of adults remain physically inactive and/or do not meet the minimum physical activity recommendations.[5] According to the Centers for Disease Control and Prevention physical activity guidelines, adults (18 years of age and older) need to regularly engage in 1) 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic activity and 2) at least 2 days of muscle strengthening activities per week.[6] However, there are special physical activity recommendations (200-300 minutes of moderate to vigorous physical activity per week)[7] for individuals with overweight or obesity. There are various, well-documented obesity-related benefits (i.e., reduction of adipose tissue and long-term weight loss/weigh maintenance when combined with dietary modifications) [] of meeting these specified physical activity recommendations which are particularly relevant to at-risk (i.e., cancer survivors) and underserved (rural, mainly minority) populations, as the rates of physical inactivity and health-related consequences are even higher for these groups.

Thus, individuals with obesity from these populations are in dire need of physical activity to improve their quality of life and long-term health-related outcomes.

Physical Inactivity, Obesity, and Cancer Survivorship

While guidelines encourage cancer survivors to achieve and maintain a healthy weight and engage in regular physical activity to reduce risk of cancer recurrence, improve quality of life and survival,[9] higher levels of inactivity (34%)[10] and obesity (33.7%)[11] are found among cancer survivors, compared to the general population (25.3% and 30.8% respectively).[11] Breast cancer is the most prevalent cancer type in women,[12] with 3.8 million US women living with a history of breast cancer.[12] This population faces health problems (e.g., cardiovascular disease, poor physical functioning, chronic pain, and memory problems)[13] which can impede exercise participation during and following treatment (i.e., chemotherapy, radiation, anti-estrogen therapy, and surgery),[14] along with non-health related barriers (i.e., inaccessible/lack of physical activity facilities for cancer survivors,[15] safety concerns,[16] finances,[15] lack of social support, and non-tailored/individualized physical activity programs[15]). Assisting cancer survivors in adopting a physically active lifestyle will require better understanding barriers specific to this population (i.e., joint stiffness, fatigue, pain, weakness, etc.) and developing strategies consistent with their program preferences. This is particularly important for cancer survivors with obesity who are more likely to face health- related exercise barriers.[17]

Obesity and Physical Inactivity in Rural Populations

Like breast cancer survivors, adults in rural regions encounter non-health physical activity-related obstacles which likely contribute to related conditions (i.e., certain cancers, cardiovascular disease, diabetes). Though previous studies have indicated barriers (i.e., financial strain, limited access to health care and limited availability of recreational amenities) may contribute to rural disparities in physical activity and the aforementioned chronic diseases and call for intervention.[18-21] There has been limited research on establishing the existing physical activity-related resources and amenities (i.e., recreational facilities, safety features, walkable streets and sidewalks) that are available for rural residents.[18] Thus, more research in understanding barriers, facilitators, and preferences along with what resources/amenities are available is warranted to develop needed behavioral interventions to decrease sedentary lifestyle and related health disparities in rural populations.

Gaps in Literature on Physical Activity Interventions for Underserved and At-Risk Populations with Obesity

There is a paucity of research on the effective components needed when designing and implementing physical activity programs for underserved/at risk obese populations. Some past studies indicate that standard physical activity behavioral interventions are not as effective for individuals with higher body mass indexes (BMIs).[22] Most programs to date have been developed among general populations and do not necessarily consider the additional physical activity concerns for those with obesity, especially in the contexts of rural health disparities and cancer survivorship.

To increase acceptability, engagement, and improve physical activity levels in these populations, more research needs to be conducted to identify the unique individual (preferences, needs), interpersonal (supports) and environmental level barriers to physical activity among at risk (i.e., cancer survivors) and underserved (rural, mainly minority) populations with obesity.

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PHYSICAL ACTIVITY BARRIERS, FACILITATORS, AND PREFERENCES AMONG RURAL-DWELLING ADULTS WITH OBESITY: A SYSTEMATIC REVIEW

by

NASHIRA BROWN, PETER ABDELMMESIH, LAURA Q. ROGERS, DORI PEKMEZI

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Abstract

Introduction: Rates of physical inactivity and obesity are higher among adults residing in rural areas. Consequently, the prevalence of preventable chronic diseases is also high and continues to rise. Before developing or adapting physical activity interventions for rural adults with obesity, it is pertinent to analyze the current literature to have a nuanced understanding of the necessary components.

Methods: Following the Preferred Reporting Items for Systematic Reviews and Meta- analysis (PRISMA) guidelines, a systematic review was conducted to identify reported barriers, facilitators, and preference for physical activity among rural adults with obesity.

Results: Of 13,765 citations identified through searching PubMed, Embase, Google Scholar, and Web of Science, 10 articles were included in this review. The most commonly reported barriers were health factors (i.e., knee issues, weight), lack of self- discipline, negative environmental perceptions (e.g., crime, loose dogs, etc.), lack of social support, and lack of available resources. Among the one study comparing by obesity severity, there were no differences in barriers among obesity classes I-III. Facilitators were reported for the majority of the studies and consisted of fitness trackers (e.g., Fitbit), being part of a group, higher education, occupation, income, and family history of diabetes. One article reported a preference for intervention delivery mode as face-to-face over web-based and group-based with instructor.

Conclusion: Lack of self-discipline/motivation, negative environmental perceptions/concerns, available resources, sources of social support, health factors (i.e., knee issues, weight), preferences for activity monitor and face-to-face

programs in a group setting are factors that should be addressed when adapting or developing physical activity interventions for rural adults with obesity.

INTRODUCTION

There is a greater prevalence of obesity and insufficient activity levels in rural regions than urban/metropolitan areas (34.2% vs 28.7% and 25.5% vs 19.6%, respectively).[1, 2] Correspondingly, death rates from related conditions are higher (189.1 per 100,000 vs 156.3, respectively, for heart disease; 164.1 vs 142.8, for cancer) in rural areas and such rural-urban differences have been rising in recent years.[3] Common factors such as environmental (lack of recreational facilities/resources, walkability), economic (i.e., employment and poverty), and social (i.e., networks, support from family and friends, and community engagement)[4] barriers may be linked to this rural health disparity.[5]

In response, several researchers have developed and tested physical activity interventions (i.e., web-based, mobile applications, and interactive curriculum and group sessions) among children, adults, and older adults in rural regions that have yielded promising results (i.e., increases in physical activity, improvements in environmental awareness, and increases in self-reported quality of life).[6] However, limited physical activity intervention development and testing has been conducted specifically among rural individuals with obesity. Of these interventions, challenges ((i.e., physical symptoms, pain, psychological distress, depressive symptoms)[7] still emerge for rural- dwelling adults with obesity.[7, 8]

Past research suggests there may be additional challenges to promoting physical activity in this population. On top of the previously mentioned rural physical activity barriers, studies indicate that obese individuals have additional physical activity concerns[9] and may even benefit less from standard physical activity interventions, compared to those in lower body mass index (BMI) categories.[10] For example, one study found that a participant with BMI= 25-29.9 would, on average, report 27.5 more minutes per week of physical activity compared to a participant with obesity (BMI= >30) after participating in the same 6-month physical activity intervention. Such findings have important practical implications for practitioners, clinicians, and researchers, especially in higher BMI/inactivity rural regions and call for further investigation.

Prior physical activity reviews have focused on rural health or obesity but none to our knowledge have examined physical activity intervention barriers, facilitators, and preferences for rural-dwelling adults with obesity.[11] Therefore, the aim of the current review is to synthesize the existing literature on physical activity among rural populations with obesity and highlight areas for further research. Findings will provide a better understanding of the complexity and necessary components of effective physical activity interventions for such populations and provide future directions for this field.

METHODS

Research Strategy

The Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines were followed to conduct this review. A systematic search of eligible, published studies were conducted in four electronic databases (i.e., PubMed, Embase, Web of Science, and Google Scholar). The search terms that were established for this review included the following: physical activity (exercise, recreation, sport), rural (rural population), obesity (obese), adult, preferences (attitude, opinion, perspective), barriers, facilitators. Unique search strings consisting of the terms were created for each individual database. All articles retrieved from the four electronic databases were imported to EndNote and duplicates were removed. Then, article titles and abstracts were reviewed, followed by full-text review. Titles and abstracts were reviewed by two independent investigators. Articles deemed relevant were further reviewed by two additional investigators. When disagreements occurred, a consensus decision was reached after discussion with content experts.

Study Selection

Articles that were eligible for inclusion met the following criteria: 1) focused on adults (18 years of age and older), 2) study sample included participants with obesity (BMI of ≥ 30kg/m^2, OR more than 50% of the sample with BMI of at least 30 kg/m2 if the study did not exclusively include people with obesity OR physical activity outcome differences by BMI category were provided, 3) focused on rural population or at least included rural (or a rural comparison), 4) reported barriers, facilitators, and/or preferences to physical activity and 5) published within the last ten years (i.e., 2011-2021) to capture most recent trends within this literature. Articles that are not published in English were excluded during the title/abstract screening process.

RESULTS

Study Selection

Of 13,765 citations identified through searching PubMed, Embase, Google Scholar, and Web of Science, we screened 546 titles and abstracts, and reviewed 39 full-text articles (Appendix A). After further exclusions (i.e., lack of BMI data, different focus, etc.), 10 articles were included in the review (Figure 1).

Study Characteristics

Table 1 presents the summary of study characteristics. Of the 10 included articles, there were 6 cross sectional,[12-17] 3 mixed methods design,[18-20] and 1 longitudinal study.[21] The cross-sectional studies consisted of self-reported, and interviewer administered surveys, telephone interviews and anthropometrics.[12-16] The mixed methods design studies included self-administered surveys (close ended and open-ended questions) and semi structured interviews.[18-20] Lastly, the longitudinal study entailed self-report surveys and anthropometrics.[21] A majority of the studies were conducted in the US[12, 14, 16, 18-21] while two were in Australia[13, 17] and one was in Nepal.[15]

Participant Characteristics

The total sample size across all 10 studies was 5308 with an average sample size of 520 (range= 8-2025). Nine of the 10 studies provided sample mean BMI.[12, 13, 15, 17- 21] Of those nine studies, the mean BMI was 31.3 kg/m^2 (range= 27-35.9). Six of the 10 studies provided overall obesity prevalence.[13, 15-19] On average, more than half (54.7%) of each sample had obesity. Five studies reported comorbidities among participants with Hypertension and Diabetes (i.e., previous Gestational and Type II) being the most commonly reported. [15-17, 19, 20]. Other comorbidities included Polycystic Ovary Syndrome (n=1)[17], Dyslipidemia (n=1)[20], Osteoarthritis (n=1)[20] and sleep apnea (n=1)[20]. One study reported 'chronic illness' but did not specify the participant's condition(s).[13] The mean age of the participants was 52.9 years old (range= 39.4-74.4). The overall gender distribution was 65.9% female and 34.1% male. Three of the study samples were solely comprised of female participants [17, 18, 21] and one was male only.[19]

Barriers to Physical Activity

A majority of the studies (n=7) assessed barriers to physical activity.[12, 14, 17-21] The most commonly reported barriers were environmental (i.e., lack of sidewalks, bike lanes, parks, and recreational facilities, n=3, [12, 14, 21]) and psychosocial factors (i.e., depression, low self-efficacy, and low social support), fatigue and/or exhaustion, time and obligations (n=3, [17, 18, 21]). Four articles provided associations between BMI and barriers.[12, 14, 17, 21] Adachi et al, 2017, found that difficulty walking and environmental concerns (i.e., unattended dogs), were associated with a higher BMI.[12] Similarly, the three other studies mentioned associations between higher BMI, negative neighborhood-level environmental perceptions, and reduced social support, lack of self-efficacy, and depression.[14, 17, 21]

Using a mixed methods approach (i.e., closed and open-ended survey questions), one study sought to examine the differences in barriers to physical activity among women by weight class (obesity classes I-III).[18] The close-ended approach (i.e., questions with limited possibilities) showed a consistent reporting of lack of self-discipline across all classes. However, the open-ended survey approach (i.e., questions with up to 3 free-form responses) revealed coded emergent themes, psychological (i.e., depression), time (i.e., work), physical (i.e., asthma, weight, knee, back, and hip issues), social (i.e., lack of social support/company) and resources (i.e., too hot outside) as barriers to physical activity.[18]Overall, there were no differences in barriers among obesity classes I-III.

Facilitators to Physical Activity

Four of the 10 studies assessed facilitators to physical activity. The top two reported facilitators to physical activity were the incorporation of a wearable device for motivation (i.e., FitBit, n=2)[19, 20] and group/social interaction (n=2).[19, 20] More specifically, a device as such is useful for feedback and self-monitoring.[19, 20] With regard to group/social interaction, rural men reported that being part of a group creates implicit competition amongst group members that would encourage them to exercise.[19] Further, older rural men with obesity reported environmental factors (i.e., weather) as a facilitator. Particularly, they mentioned "better weather" (i.e., late spring, summertime, no ice/snow) would allow for consistent exercise.[20] In contrast, one study found that there was a discrepancy between motivation for weight loss versus exercise.[16] First, those who were motivated for weight loss were two times more likely to have obesity. Further, this particular motivation was significantly associated with race and sex. Specifically, African American women were more likely than their white/Caucasian counterparts to be motivated for weight loss, not exercise. [16] One study among patients with Type II diabetes reported positive family history of Type II diabetes, being married and knowledge as motives to engage in physical activity.[15]

Preferences for Physical Activity

Preferences were the least assessed (n=1) area of physical activity. In one study of predominately adults with obesity, participants overall preferred face-to-face interventions over web, print, and group-based interventions.[13] Further, analyses indicated that web-based preference was positively associated with rural residence. Preference for a group-based program (i.e., group setting, group leader, interaction with others) was positively associated with residing in a regional area (i.e., town) and negatively associated with marital status (i.e., separated) and obesity. Thus, those living in a rural area and not separated prefer web-based interventions while those with obesity preferred face-to-face.

Figure 1. PRISMA Flow Chart

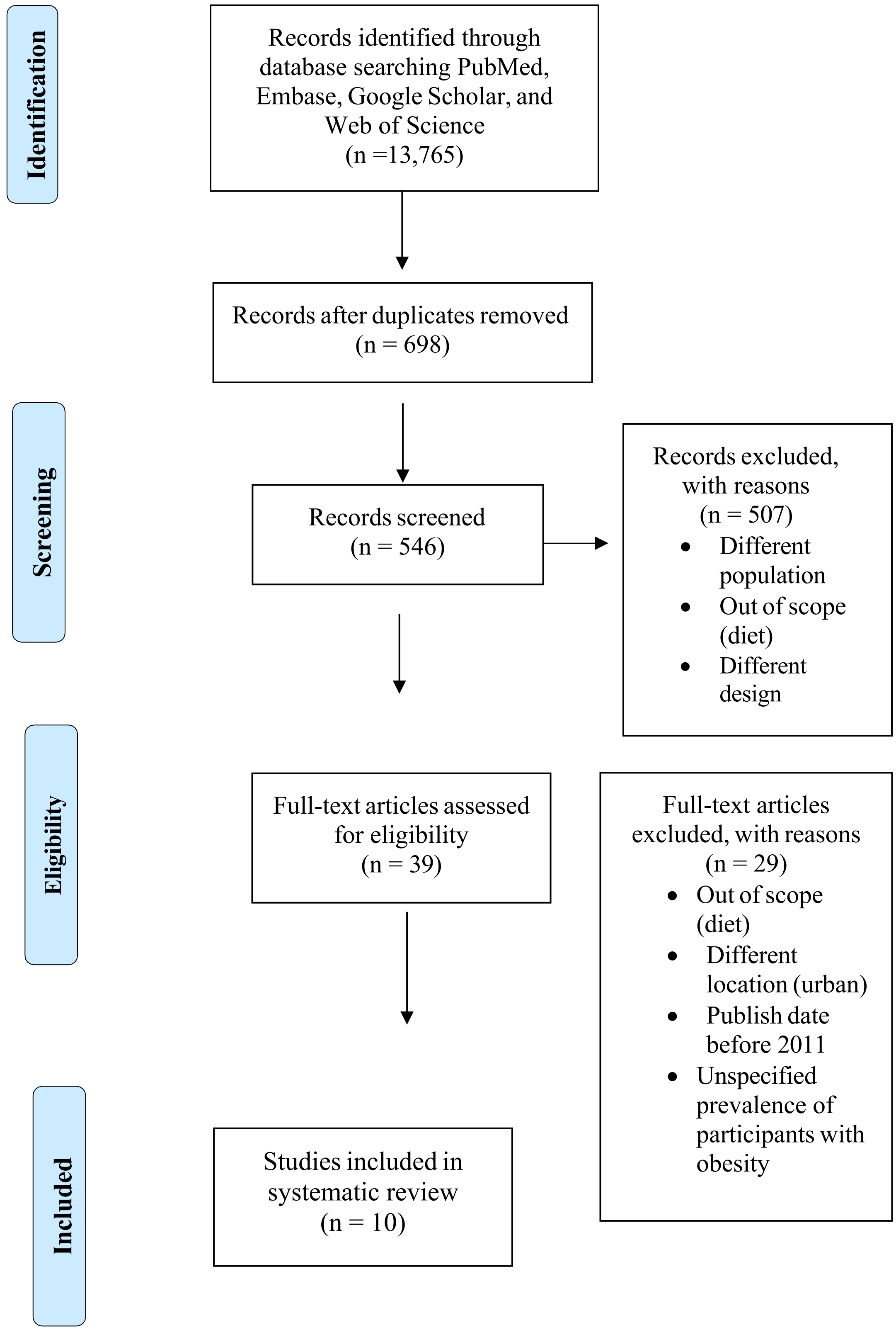

Table 1. Summary Characteristics of Included Studies (N=10)

Author, year, [ref], country	**Methods**	**Participant Characteristics (sample size (n), Age, Gender, BMI (mean, (SD)), Obesity (%), Comorbidities**	**Rural Characterization, BMI Comparisons, Rural Comparison (*if not purely rural*)**	**Barriers**	**Facilitators**	**Preferences**
Cross Sectional						
Adachi-Mejia, AM., 2017, [12], United States	Telephone Interview	**N=**2,025; **Age**: 57.82 (15.57); **Gender:** female (60%); **BMI=** 27 (5.3); **percent obese=** not provided; **Comorbidities**: not assessed	**Rural characterization:** "nine small towns located within micropolitan statistical areas in Washington, Texas, and the Northeast (New Hampshire and New York); **BMI comparisons?** Yes: **Rural Comparison?** No	Difficulty walking was associated with higher BMI in all regions (Northeast, Texas, and Washington); Environmental barriers/concerns (unattended dogs crime) were associated with higher BMI in Northeast	Not assessed	Not assessed
Short, CE. 2014, [13], Australia	Telephone Interview	**N=**1,261; **Age**: 52.79 (16.31); **gender**: male (50%), female (50%); **BMI=** 30.03 (14.67); **percent obese**= 30%; **Comorbidities:** unspecified chronic illness (42-58%)	**Rural characterization:** 22% rural, 52% city, 26% town; **BMI comparisons?** Yes-preference (delivery mode); **Rural**	Not assessed	Not assessed	**Face-to-face** preference with an instructor was strongly associated with obesity. **Web-based intervention** preference positively

			comparisons? yes, city and town			associated with living in rural area but negatively associated with obesity. **Print-based intervention** preference was negatively associated with obesity. **Group-based program (with instructor)** preference negatively associated with obesity
Jilcott Pitts, SB., 2015, [14] United States	Self- and interviewer-administered measures; Anthropometrics	**N=** 366; **Age:** 55; **Gender**: 76% female; **BMI**= 35.9 (9.4); **percent obese=** Not mentioned; **Comorbidities:** not assessed	**Rural characterization**: Rural eastern North Carolina; **BMI comparisons?** Yes-associations with neighborhood barriers and PA behaviors	Not enough sidewalks, bike lanes; not enough parks, trails, or tracks for walking; too much crime associated with higher BMI	Not assessed	Not assessed
Parajuli, J., 2014, [15] Nepal	Interviewer administered questionnaire	**N=**385, **Age:** 54.4 (11.5); **Gender**: 51.4% female**; BMI**= 24.26 (3.33); **percent obese=** 48%; **Comorbidities:** type II diabetes	**Rural characterization:** rural, urban, semi-urban **(**distributions not mentioned); **BMI comparisons?** No; **Rural**	Not assessed	Participants with positive family history of diabetes were more adherent to PA advice while marital status was	Not assessed

			comparisons? Yes, urban, semi urban		associated with increased adherence to PA advice	
Warren, JC., 2017, [16] United States	Self-administered measures; Questionnaires	**N=** 497; **Age:** 52.98 (12.37); **Gender:** Female (72.2%); **BMI**: not specified; **precent obese**= 65% **Comorbidities:** diabetes and hypertension (46.1%), hypertension only (46.5%), diabetes only (7.4%)	**Rural Characterization:** "rural South"; **BMI comparisons?** No;	Not assessed	Those who were motivated for weight loss but not for increasing exercise alone were more likely to be African American, female, with obesity	Not assessed
Harrison, C., 2017, [17] Australia	Self-administered questionnaires, Anthropometrics	**N=** 649; **Age**: 39.6(6.7); **Gender:** female (100%); **BMI** =28.8(6.9); **percent obese=** 34%; **Comorbidities:** hypertension, PCOS, previous gestational diabetes.	**Rural characterization:** Rural community in Australia; **BMI comparison?** Yes, compared across BMI categories (healthy, overweight, and obese)	Higher BMI was associated with reduced social support from friends, negative PA environment perceptions	Not assessed	Not assessed
Mixed Methods						
Adachi-Mejia, AM., 2016, [18]	Self-administered survey (close ended and open-ended questions); Anthropometrics	**N=** 78; **Age:** 52.8 (14.5); **Gender:** Female (100%); **BMI=** 35.4; **percent obese=** 76%; **Comorbidities:** Not assessed	**Rural characterization:** 100% rural (New Hampshire and Vermont); **BMI comparisons?** Yes, pre-obese, and classes I-III	**Close-ended survey approach:** Participants with Obesity reported - Lack of self-discipline	Not assessed	Not assessed

				Open-ended survey approach: Most common across all classes of obesity - knee issues, lack of motivation, weather too hot outside; lacking time; work Class I: ankle injury, asthma, weight, back issues, chronic illness, hip issues, low energy, pain depression, mood, prefers doing other things, care duties, family demands Class II: asthma, weight, dislike exercise, migraines, procrastination, lazy Class III: asthma, weight, exhaustion, diabetes, doesn't see results, out of shape, lazy, obligations		

Eisenhauer, CM., 2017, [19] United States	Self-administered survey, semi-structured interview	**N=** 12; **Age**: 50.9; **Gender:** 100% male; **BMI =** 34.1; **percent obese=** 75%; **Comorbidities:** Hypertension	**Rural characterization:** Rural Northern Plains state; **BMI comparisons?** No.;	Technological disparities; poor technology infrastructure; seasonal fluctuations in PA demands (i.e., occupational, religious, and Recreational); resource access; fatigue	Being part of a group; activity monitor	Not assessed
Batsis, JA., 2016, [20] United States	Self-administered measures; semi-structured interviews	**N=** 8; **Age:** 73.4 (4); **Gender:** female (50%); **BMI=** 32.9 (2.5); **percent obese=** not specified "among older rural obese adults"**;** **Comorbidities:** hypertension (75%), dyslipidemia (63%), diabetes (38%), osteoarthritis (50%), and sleep apnea (50%)	**Rural characterization:** geriatric primary care practice at a rural academic medical center; **BMI comparisons?** No	Lack of time/finding time	Feedback and self-monitoring; motivation from fitness tracker; "better" weather (i.e., late spring or summer), and environment; group engagement; social interaction	Not assessed
Longitudinal						
Peterson, JA., 2013, [21] United States	Self-administered questionnaires	**N=** 27; **Age:** 39.38 (11.52); **Gender:** 100% female; **BMI =** 33.38 (6.64); **percent obese= Not** mentioned; **Comorbidities:** Not assessed	**Rural characterization:** all rural; **BMI comparisons?** Yes, associations with barriers	Depression and lack of self-efficacy to exercise alone were significantly associated	Not assessed	Not assessed

			and facilitators	with higher BMI; lack of recreational facilities		

Abbreviations: PA, physical activity; PCOS, Polycystic Ovary Syndrome

DISCUSSION

Adults with obesity face unique obstacles when participating in physical activity interventions and thus may not be as successful in standard interventions as their counterparts in lower BMI categories. Moreover, these challenges may be increased for those residing in rural areas due to environmental barriers (i.e., lack of space/facilities to be active), thereby further contributing to existing rural health disparities. Despite the substantial need, no systematic reviews (to our knowledge) have focused on physical activity among rural-dwelling adults with obesity. Thus, we sought to examine the existing literature on the distinct physical activity needs, barriers, and facilitators of this population and identify future directions for intervention research in this area.

Comparisons to Previous Research

Barriers to Physical Activity

Our findings that key barriers were negative environmental perceptions (i.e., lack of sidewalks, bike lanes, and recreational facilities) and psychological factors (i.e., depression, lack of social support, and lack of self-efficacy) are consistent with past studies among non-rural adults with obesity,[22, 23] dementia,[24] and hemodialysis patients.[25] Previous research suggests women with obesity are more likely than men with obesity to experience depression due to several factors such as stigma and discrimination. [26] It is important to note that lack of motivation/willpower is a barrier that was consistent across all classes of obesity similar to what Bastin and colleagues found among Canadian adults with obesity class I, II, and III.[27] Despite the similarities, the findings from this review are inconclusive with regards to differences in reported barriers by class of obesity among rural adults. Contrary to our hypotheses, the one study that sought to elicit barriers to physical activity among women with obesity, did not find any differences across the obese classes I-III.[18] Further, there was a trend of overlapping self-reported difficulties.[18]

Facilitators to Physical Activity

We found that that the top facilitator was an activity monitor (i.e., FitBit), for feedback and self-monitoring. We hypothesize that tracking personal activity with easy to view screen (e.g., daily steps, minutes of activity, etc.) and frequent reminders to move were motivating. Diverse groups (i.e., young, middle, and older-aged populations, chronic stroke survivors) have also reported wearable devices as facilitators to physical activity.[28, 29] Conversely, past studies in non-obese, non-rural samples have reported different (enjoyment, appearance, social),[30] and health-related (e.g., avoid disease)[31] motives for physical activity. We speculate that the motivational aspect of these devices among rural adults with obesity is related to psychosocial and resource related factors. With regard to psychosocial aspects, activity can be tracked independently, and there is a sense of accountability without feelings of being judged or stigmatized.[32] For resources, factors include convenience (i.e., automated health behavior change or user- driven mobile health applications)[32] and the fact that transportation is not needed.

Preferences for Physical Activity

Though limited literature was available in this area, we found that rural adults with obesity have preferences for physical activity (i.e., delivery modes, social/group interaction). With regard to the delivery mode, we found that rural adults with obesity prefer face-to-face delivery similar to findings from other rural samples (breast cancer survivors).[33] As for the preference of social interaction and group engagement, this is also a quite common preference among varying populations (e.g., adults with obesity, rural cancer survivors).[33] We suspect this preference for group interaction is due to the motivation from others and the fear/difficulty of exercising alone. Conversely, Burton and colleagues found engaging in physical activity alone versus in a group setting was more preferential among obese adults aged 42-67 years old.[34] This might be due to concerns regarding stigma and/or comparisons (e.g., weight, appearance, capabilities, etc.) with other individuals. In sum, findings from the current study are mixed which introduces difficulty in drawing conclusions on physical activity preferences.

Strengths and Limitations

This review has several strengths. To our knowledge this is the first systematic review that focuses on physical activity in rural-dwelling adults with obesity. Additionally, this review includes both quantitative and qualitative literature, which allows numerical data to be elaborated upon by commentary from interviews. However, there are limitations that should be noted. First, several articles were excluded due to language (i.e., published in Spanish). Also, participant characteristics were not consistently provided. For instance, some articles did not include mean BMI, prevalence of obesity, or comorbidities which does not allow for clear representation of included participants and effects our ability to generalize findings to the broader population. Further, there are caveats to consider when concluding top reported barriers and facilitators. For example, one study with a small sample size reported lack of motivation.

CONCLUSION

With higher rates of inactivity, obesity, and preventable chronic diseases among adults residing in rural areas, effective physical activity interventions are needed. Before developing or adapting physical activity interventions for individuals with obesity who reside in rural areas, perceived lack of self-discipline, negative environmental perceptions (i.e., lack of sidewalks, parks, etc.), available resources (e.g., recreational facilities), sources of social support, and health factors (i.e., knee issues, asthma, weight) should be carefully considered. Such concerns need to be addressed for future efforts in adapting physical activity programs from the “one size fits all” notion to better meet the intervention preferences and barriers of this population. To push this field forward, more research eliciting preferences of rural adults with obesity and investigating potential variations in barriers, facilitators, and preferences among classes of obesity is warranted.

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RELATIONSHIPS BETWEEN OBESITY, EXERCISE PREFERENCES, AND RELATED SOCIAL COGNITIVE THEORY VARIABLES AMONG BREAST CANCER SURVIVORS: A SECONDARY DATA ANALYSIS

by

NASHIRA BROWN, ROBERT OSTER, DORI PEKMEZI, LAURA Q. ROGERS

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Abstract

Introduction: Breast cancer survivors, especially with obesity, have an increased risk of cancer recurrence, second malignancy, and comorbidities. Hence, this population needs physical activity interventions. However, investigation of the relationships between obesity and factors influencing physical activity program content and delivery remain understudied in cancer survivors. Thus, we conducted a cross-sectional study examining associations between body mass index (BMI) and baseline physical activity program preferences, current physical activity, cardiorespiratory fitness, and related Social Cognitive Theory variables from a randomized controlled physical activity trial with 320 post-treatment breast cancer survivors.

Methods: Descriptive analyses were conducted to summarize participant characteristics. Chi Square analyses were used to assess and understand the dichotomized categorical factors associated with 3-level categorical BMI (non-obese, obese classes I/II and obese class III). Independent t-tests were used to compare the means between categorical factors based on continuous BMI variable. Pearson and Spearman correlation coefficients assessed associations between continuous factors and the continuous BMI variable. Simple and multiple linear regressions determined the extent to which the associations were independent of covariates.

Results: When analyzed with continuous BMI and 3-level BMI outcome, we found similar statistically significant relationships with race, income, marital status, education, comorbidities, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and a program preference (i.e., location). Higher BMI was related to being

African American, having lower annual income, being divorced, widowed, or single, lower educational attainment, higher number of self-reported comorbidities, and greater joint pain and stiffness based on WOMAC. Participants with a higher BMI preferred to exercise at a facility. Further, higher BMI was significantly correlated with higher perceived exercise barriers and lower walking self-efficacy. Walking self-efficacy, negative outcome expectations and cardiorespiratory fitness differed between classes of obesity. Survivors with class III obesity had the lowest walking self-efficacy score and level of cardiorespiratory fitness. Those with class I/II obesity reported the most negative outcome expectations. There were no statistically significant differences or associations between BMI and levels of current physical activity.

Conclusion: Location, walking self-efficacy, negative outcome expectations, and fitness are factors which should be considered for future physical activity programs among breast cancer survivors with obesity. Tailoring for such individuals should involve a theoretically driven program targeting self-efficacy and various intensity levels of cardiovascular exercises.

INTRODUCTION

The prevalence of breast cancer survivors continues to grow as diagnosis, treatment, and control advance. However, quality of life after diagnosis among this population is affected by modifiable lifestyle behaviors including physical activity engagement. American Cancer Society Guidelines for physical activity recommend at least 150 minutes of exercise per week and 2 days of strength training per week for cancer survivors [1] to help reduce risk of cancer recurrence, second malignancy, and comorbidities (e.g. obesity). Notably, nearly a third of cancer survivors in the U.S. are obese, a prevalence higher than that of adults without a history of cancer.[2] Moreover, breast cancer survivors are among the cancer survivor subgroups suffering a more rapid rise in obesity and thus in need of effective lifestyle intervention.[2]

Best practices for assisting this population in adopting a physically active lifestyle include using evidence-based theories as a guide for addressing their unique health-related exercise barriers (i.e., joint stiffness, fatigue, pain, etc.) and program preferences. The Social Cognitive Theory is one of the most widely applied health behavior theories in physical activity research.[3, 4] This framework posits that behavior is a dynamic interaction of a triad of factors (i.e., personal cognitive, the physical and social environment [socioenvironmental], and behavioral). Several Social Cognitive Theory constructs that are commonly targeted in physical activity interventions are self-efficacy, perceived barriers interference, outcome expectations, and social support. Self-efficacy, or the confidence in one's ability to act and overcome obstacles and situations to reach a goal, is deemed as the primary personal factor that mediates behavior change.[3] This construct has been associated with BMI in cancer survivors[5, 6] along with other constructs such as social support and perceived barriers interference.[6]

In addition to Social Cognitive Theory constructs, research focusing on what individuals prefer could be vital to optimizing participant engagement and acceptability when designing programs.[6] Although multiple studies have reported physical activity preferences for breast cancer survivors,[7] none that we are aware of have examined how preferences may vary by level of obesity. Further, studies in populations without a history of cancer have shown that preferences (i.e., intervention delivery, supervision, and scheduling) differed among those with and without obesity.[8, 9] Given the paucity of research on the relationship between obesity and potential differences in preferences among breast cancer survivors with cancer, further examination is warranted.

Thus, to inform future physical activity promotion programs for breast cancer survivor populations with obesity, we performed a secondary analyses of baseline data from a randomized physical intervention trial.[10] Our study purpose was to examine the associations between BMI and factors influencing program content and delivery including preferences [source, mode, structure, location, etc.]), current physical activity [accelerometer], cardiorespiratory fitness, and related social cognitive theory constructs (i.e., self-efficacy [barriers and task], perceived barriers interference, social support, outcome expectations) among the enrolled breast cancer survivors (N=320). We hypothesize that BMI will be significantly associated with program preferences, current physical activity, cardiorespiratory fitness, and related Social Cognitive Theory constructs. Our specific hypotheses are as follows:

Program Preferences (H_1)

BMI will be significantly associated with program preferences as in a previous study among endometrial cancer survivors with overweight and obesity.[11] Specifically, we hypothesize that physical activity program preferences (e.g., supervised, scheduled) among cancer survivors will differ by BMI category.

Current Physical Activity (H_2) and Cardiorespiratory Fitness (H_3)

BMI will be inversely associated with physical activity as found in past studies in adults with obesity and no report of cancer history.[12] Specifically, breast cancer survivors with a higher BMI will have lower physical activity participation than those in lower BMI categories. Also, BMI will be inversely related with cardiorespiratory fitness as in previous studies in populations with obesity.[13] Particularly, as BMI increases, level of fitness will decrease.

Social Cognitive Theory Constructs (H_4)

BMI will be significantly associated with related Social Cognitive Theory constructs (i.e., physical active social support, self-efficacy, and outcome expectations), as in other adults with obesity and no cancer history.[14] Physical activity-related Social Cognitive Theory construct scores will vary based on BMI classification.

Overall study aims were to corroborate past findings that physical activity levels, program preferences, and related social cognitive theory constructs vary by BMI and extend this work to a new population. This study sought to fill gaps in the literature by shedding light on potential unique program preferences and intervention targets for breast cancer survivors with obesity who are most in need of intervention.

METHODS

Study Design

This cross-sectional study examined relationships amongst BMI, baseline physical activity program preferences, current physical activity, cardiorespiratory fitness, and related Social Cognitive Theory variables. Data for these secondary analyses were taken from a randomized controlled physical activity behavior change trial with 320 post-treatment breast cancer survivors.

Study Sample

Three hundred twenty post-primary treatment breast cancer survivors were recruited through newspaper advertisements, cancer support groups, flyers posted in relevant locations (e.g., hospitals, physician offices, cancer centers/clinics) and frequented areas of women (e.g., retail stores, beauty salons). Eligible women met the following criteria: English speaking, between the ages of 18 and 70 years of age with a history of ductal carcinoma in situ (DCIS) or Stage I, II, or IIIA breast cancer and post-primary chemotherapy or radiation therapy, medically cleared for participation by their physician and underactive (participating in no more than 60 minutes of moderate intensity physical activity or no more than 30 minutes of vigorous intensity activity per week, on average, over the past 6 months).

Measures

Demographics and Body Mass Index

Self-reported participant demographics included age, race, ethnicity, years of education, annual household income, employment status, marital status, cancer stage at diagnosis, history of chemotherapy, history of radiation therapy, hormonal therapy type, Functional Comorbidity Index score,[15] and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score.[16] Body mass index was assessed by trained research staff in person (calculated using weight and height [weight (kg)/ height (m^2)], which was obtained via scale and stadiometer).[17]

Exercise Program Preferences

Exercise program preferences were assessed using a 15-item multiple choice self-administered survey that has been used in prior studies among breast cancer survivors.[6, 18-20] The counseling preference items included queries regarding counseling source (i.e., cancer exercise physiologist, personal trainer, etc.), mode of delivery (i.e., face-to-face, phone, etc.), and company (i.e., individual or with a group). Exercise training preference items focused on location (i.e., at home, health club, etc.), exercise type (i.e., walking, jogging, etc.), and supervision (i.e., supervised, or unsupervised). Programming preference items inquired about program type (i.e., aerobic, strength, or both), structure (i.e., flexible vs scheduled), maximum price willing to pay for an exercise program (i.e., $0, $1-10/month, $11-20/month, $21-30/month, $31-40/month, $40+/month), farthest distance willing to travel to an exercise program (0 miles, 1-15 miles, 16-30 miles, 31-45 miles, 46-60 miles, 60+ miles), and the farthest distance willing to travel to an exercise program if gas expenses were covered (0 miles, 1-15 miles, 16-30 miles, 31-45 miles, 46-60 miles, 60+ miles)

Physical Activity and Cardiorespiratory Fitness

Weekly minutes of moderate plus vigorous intensity physical activity were assessed with ActiGraph accelerometer (model: GT3X, Pensacola, FL). Participants were instructed (orally and written) to wear the device for at least 10 waking hours for seven consecutive days. The parameters used to validate the minimum wear time of 4 days was comprised of wear time >60% of waking hours. The cut points that were used to establish activity intensity were: inactive (0-499 counts/min), light (500-1951 counts/min), moderate (1952-5724 counts/min), and vigorous (5725+ counts/min).[17]

Following the American College of Sports Medicine guidelines for testing[21] cardiorespiratory fitness was estimated with submaximal treadmill testing[22] in which speed and elevation were gradually increased until the participant achieved 85% of age-predicted maximal heart rate.[22] Following the modified Naughton protocol tests were begun at a slower speed and progressed at lower increments, as in past studies with individuals who are sedentary, older, fatigued, or have balance complications.[21]

Physical Activity-Related Social Cognitive Theory Variables

Self-efficacy. Both barriers and task self-efficacy were assessed. Barriers self-efficacy, or one's confidence in his/her ability to act and overcome obstacles and situations to reach a goal, was assessed using a reliable (α =.97-.98) 9-item scale designed for breast cancer patients.[23] Walking task self-efficacy was assessed using a valid and reliable (r=.89 and α= .96), 6-item scale to measure confidence in walking at a moderate pace for six different intervals of time (i.e., 5, 10, 15, 20, 25, and 30 minutes).[24] Both measures of self-efficacy asked participants to indicate their confidence [(0-100%, at 10% intervals (i.e., not at all confident, 0–20%; slightly confident, 20–40%; moderately confident, 40–60%; very confident, 60–80%; extremely confident, 80–100).[23, 25] Responses were averaged separately for barriers and task self-efficacy with a range of possible scores (0-100).

Exercise barriers. Perceived barriers (or barriers interference), or how often recognized obstacles (e.g., lack of time, fear of injury, fatigue, and lack of energy) interfered with exercise, was assessed using a 21-item, 5-point Likert scale (1=rare to 5=very often) measure that has demonstrated reliability (α=.92) among breast cancer survivors.[26] Responses were summed for a total Exercise Barriers score[26-28] with a range of possible scores (21-105).

Social support. Social support, or the perception of encouragement to engage in physical activity, from other sources (i.e., friends and family)[26] was measured via a 4-item, 5-point Likert scale (0=none to 4=very often) with an internal consistency of .80.[26] Responses were summed for a total social support score with possible scores ranging from 0 to 20. [29, 30]

Outcome expectations. Outcome expectations, or the anticipated positive and/or negative consequences of engaging in a behavior (e.g., exercise) was evaluated using a reliable (α=.79 and .70, respectively) 17-item (14 positive expectations and 3 negative expectations), 5-point Likert scale (1=strongly disagree to 5=strongly agree). Responses were summed for positive and negative outcomes separately (i.e., higher score indicates greater perceived benefit [positive expectations] or greater perceived risk [negative expectations]) with possible scores ranging from 14 to 70 and 3 to 15, respectively. [27]

Statistical Analyses

Descriptive analyses were conducted to summarize participant characteristics. Body mass index was analyzed as a continuous variable and also as a 3-level categorical outcome (i.e., non-obese, obese classes I/II and obese class III). Creating a 3-level BMI (non-obese, obese classes I/II and obese class III) provides the capability to examine important differences at a higher BMI that cannot be provided when analyzing with a continuous BMI.

To test (H_1 and H_2):

Exercise program preferences were collapsed into two categories as many variables had so few responses that analyzing comparisons with other variables was not advisable due to the small stratum specific sample sizes. Hence, each preference was reviewed based on number of participants preferring each option within a specific preference question and then collapsed based on preference with greater potential to alter a program design (e.g., facility vs. other options not requiring a facility). Program preferences were dichotomized as follows: location (at home/no preference vs facility); exercise counseling source (personal trainer vs other); exercise counseling delivery (face-to-face vs other [telephone, written, no preference, etc.]); supervision (supervised vs unsupervised); exercise program type (aerobic or strength training vs both/no preference);

exercise counseling session company (individual vs group); exercise structure (flexible vs structured); price willing to pay for an exercise program ($0-$20/month vs $21-$40+/month); farthest distance willing to travel to an exercise program (0-15 miles vs 16-45+ miles) and the farthest distance willing to travel to an exercise program if gas expenses were covered (0-15 miles vs 16-45+ miles).

Objectively measured physical activity (minutes of vigorous intensity doubled before adding to minutes of moderate intensity) was analyzed as a 2-level, categorical outcome [(met physical activity recommendations: ≥150 minutes of moderate to vigorous physical activity) vs did not meet physical activity recommendations: <150 minutes of moderate to vigorous physical activity). The physical activity variable was dichotomized into "met" or "did not meet" based on the American Cancer Society guidelines [1] for physical activity for cancer survivors and to simplify interpretation and application.

Chi Square analyses were used to assess and understand the dichotomized categorical factors (i.e., program preferences) associated with 3-level categorical body mass index (non-obese, obese classes I/II and obese class III). Independent t-tests were used to compare the means between categorical factors (i.e., dichotomized demographics and program preferences) based on continuous body mass index variable.

To test (H_3 & H_4)

Cardiorespiratory fitness and the Social Cognitive Theory variables were analyzed as continuous outcomes. Pearson and Spearman correlation coefficients were used to assess associations between continuous factors and the continuous body mass index variable. A One-way Analysis of Variance (ANOVA), followed by the Tukey *post hoc* test, were used to assess significant differences between group means within the 3-level categorical BMI and continuous variables (i.e., demographics, Social Cognitive Theory variables, comorbidity and WOMAC score).

Potential associations between body mass index, participant characteristics, social cognitive theory variables, physical activity, and cardiorespiratory fitness outcomes were assessed to identify potential covariates with follow-up regression analyses performed as indicated (linear regression analysis for continuous outcomes and logistic regression analysis for dichotomous outcomes). Potential covariates of BMI were identified through performing bivariate analyses (i.e., independent t-Test, Chi Square test, ANOVA, Pearson, and Spearman correlation analyses). Dependent variables (i.e., continuous BMI) that were statistically significantly associated and correlated ($P<.05$) with independent variables (i.e., Social Cognitive Theory constructs, cardiorespiratory fitness, etc.), were used for the regression models. No imputations were performed for missing data since the amount of missing data were very small (<1%); there were no missing data for most of the study variables. All analyses were performed using IBM SPSS Statistics software (SPSS) Version 28 (Armonk, NY: IBM Corp), and $P<.05$ was deemed as statistically significant.

RESULTS

Participants

The participant characteristics are summarized in Table 1. Overall, participants were post-treatment breast cancer survivors with over half (52.2%) having obesity (BMI of 31.1±7.34 kg/m^2). Most participants were white (83%), non-Hispanic (98.7%), and employed (67.5%) with an annual household income greater than $50,000 (67.6%) and history of chemotherapy (61.6%) or radiation (65.6%). At cancer diagnosis, most were stage I (39.1%) or II (38%).

Table 1. Overall Sample Characterization (N=320)

Characteristic	**Overall (n= 320)**
Age (years) [mean± SD (range)]	54.8 ± 8.3 (21-70)
Race n (%)	
Caucasian	256 (80)
African American	48 (15)
Other	16 (5)
Ethnicity n (%)	
Non-Hispanic	315 (99)
Education, (years) [mean± SD (range)]	15.5 ± 2.5 (9-21)
Income n (%)	
>$50K	214 (68)
Employed n (%)	216 (68)
Marital Status n (%)	
Married or living with significant other	221 (69)
Widowed/Divorced/Single	99 (31)
BMI [mean± SD (range)]	31± 7.3 (18-58)
Cancer Stage at Diagnosis n (%)	
DCIS	40 (13)
I	125 (39.1)
II	121 (38)
III	33 (10.3)
Months since diagnosis [mean± SD (range)]	53.4 ±54.2 (2-276)
History of chemotherapy n (%)	197 (62)
History of radiation n (%)	210 (66)
Hormonal Therapy (type) n (%)	
Estrogen receptor modulator	75 (23)
Aromatase inhibitor	85 (27)
None	160 (50)
Number of comorbidities [mean ± SD (range)]	2.2 ±1.8 (0-7)
Lower extremity joint dysfunction [mean ± SD (range)]	16.7± 15 (0-68)

Note: Lower extremity joint dysfunction characteristic signifies the total WOMAC score, or summation of lower extremity pain, stiffness, and physical dysfunction sub scores.

Abbreviations: BMI, body mass index; DCIS, Ductal carcinoma in situ; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index

Differences in Body Mass Index by Participant Characteristics

Similar statistically significant relationships for BMI with race, income, marital status, education, comorbidities, and WOMAC were found when analyzed with continuous and 3-level BMI outcome as shown in Tables 2, 3, and 4. Higher BMI was related to being African American, lower annual income, being divorced, widowed, or single, lower educational attainment, higher number of self-reported comorbidities, and greater lower extremity joint dysfunction based on WOMAC.

Table 2. Pearson Correlation Matrix for Continuous BMI and Continuous Demographic and Clinical Outcomes

	BMI	Age	Education	Months Since Diagnosis	Comorbidity Score	WOMAC Score
BMI						
Age	.020					
Education	-.137**	-.069				
Months Since Diagnosis	-.043	.212**	-.051			
Comorbidity Score	.370**	.259**	-.037	.034		
WOMAC Score	.320**	.115*	-.161**	-.034	.417**	

** Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

Abbreviation: WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index

Table 3. Associations between Continuous BMI and Dichotomized Demographic and Clinical Characteristics

		N	Mean BMI (SD)	P-value
Race	African American	48	36.18 (8.43)	<.001**
	Caucasian/Other	272	30.21 (6.77)	
Ethnicity	Not Hispanic	315	31.12 (7.35)	.939
	Hispanic	4	31.41 (7.74)	
Income	<$49,999	102	32.66 (8.18)	.031*
	≥$50,000	214	30.36 (6.86)	
Employed	No	104	32.05 (7.47)	.110
	Yes	216	30.65 (7.26)	
Marital Status	Married/Lives with Significant Other	221	30.28 (7.10)	.003*
	Divorced/Widowed/Single	99	32.95 (7.57)	
Cancer Stage at Diagnosis	DCIS/I	166	31.02 (7.15)	.831
	II/III	154	31.20(7.57)	
Ever Chemotherapy	No	123	30.68 (6.87)	.409
	Yes	197	31.37 (7.63)	
Ever Radiation	No	110	30.60 (6.62)	.376
	Yes	210	31.37 (7.7)	
Hormonal Therapy	No	160	30.81 (6.67)	
	Yes	160	31.41 (7.97)	.467

Note: **p < .001, *p <.05

Abbreviation: DCIS, Ductal carcinoma in situ

Table 4. One-way ANOVA for 3-level Categorical BMI and Continuous Demographic and Clinical Characteristics

	Group	Mean	SD	F (2,317)	P-value
Age	Non-obese	54.71	8.41	.169	.844
	Obese Class I/II	55.13	8.21		
	Obese Class III	54.33	8.41		
Education	Non-obese	15.87	2.46	3.114	.046*
	Obese Class I/II	15.19	2.53		
	Obese Class III	15.13	2.50		
Months Since Diagnosis	Non-obese	54.74	55.82	.092	.912
	Obese Class I/II	52.03	51.20		
	Obese Class III	52.59	58.58		
Comorbidity Score	Non-obese	1.45	1.46	29.010	<.001**
	Obese Class I/II	2.70	1.86		
	Obese Class III	3.28	1.81		
WOMAC Score	Non-obese	10.98	11.92	24.91	<.001**
	Obese Class I/II	14.67	1.29		
	Obese Class III	24.43	18.64		

Note: **p < .001, *p <.05

Abbreviation: WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index

Body Mass Index and Program Preferences

Similar statistically significant relationships for BMI with dichotomized program preferences were found when analyzed as a continuous and 3-level BMI outcome (p=.009, p=.038, respectively). Participants who preferred to exercise at a facility had a higher BMI (32.77 ±8.63 vs 30.28 ±6.48, respectively). No other program preferences were associated with the continuous or 3-level BMI outcomes.

Body Mass index, Current Physical Activity, Cardiorespiratory Fitness, and Social Cognitive Theory Variables

There were no statistically significant differences or associations with levels of current physical activity when BMI was analyzed as a continuous and 3-level categorical outcome. However, there was a significant inverse correlation between BMI and cardiorespiratory fitness ($r = -.414$, $p < .001$) which suggests that excess body weight is related to lower cardiorespiratory fitness as shown in Table 5. Pearson correlation coefficients between continuous BMI and physical activity-related Social Cognitive variables are also presented in Table 5. Higher BMI displayed a significant but weak correlation with higher perceived exercise barriers ($r = .131$, $p = .019$) and a significant moderate correlation with lower walking self-efficacy ($r = -.364$, $p < .001$). No other Social Cognitive variables were significantly correlated with BMI.

Table 5. Pearson Correlation Matrix for BMI, Social Cognitive Variables, and Cardiorespiratory Fitness

	BMI	Exercise Barriers	Walking SE	Barriers SE	Positive OE	Negative OE	Total SS	CRF
BMI								
Exercise Barriers	.131*							
Walking SE	-.391**	-.228**						
Barriers SE	.019	-.220**	.179**					
Positive OE	.012	-.083	.106	.250**				
Negative OE	.073	.373**	-.217**	-.122*	-.126*			
Total SS	.014	-.251**	.091	.074	.178**	-.035		
CRF	-.414**	-.199**	.319**	-.025	-.031	-.104	.002	

Abbreviations: SE, self-efficacy; CRF, Cardiorespiratory Fitness; OE, Outcome Expectations; SS, Social Support

Note: ** correlation is significant at the 0.01 level, * correlation is significant at the 0.05 level

In terms of Social Cognitive constructs and cardiorespiratory fitness, the One-way ANOVA showed statistically significant differences in walking self-efficacy, negative outcome expectations and cardiorespiratory fitness as reflected in Table 6. A Tukey *post hoc* test indicated that there was a significant difference in walking self-efficacy scores and cardiorespiratory fitness between all levels of BMI (all $p<.001$). Both walking self-efficacy scores and cardiorespiratory fitness were significantly lower among obese class III vs non-obese and obese class I/II. As for the negative outcome expectations, there was a significant difference between two levels of BMI ($p=.020$). Specifically, obese class I/II reported significantly higher negative outcome expectations than non-obese. The remaining constructs did not show any significant differences.

Table 6. Differences in Social Cognitive Variable and Cardiorespiratory Fitness between the Three Levels of BMI

	Group	**Mean**	**SD**	**F (2, 317)**	***p-value***
Exercise Barriers	Non-obese	56.83	11.76	1.869	.156
	Obese Class I/II	59.43	13.41		
	Obese Class III	59.95	13.33		
Walking Self-Efficacy	Non-obese	77.63	22.65	22.587	<.001**
	Obese Class I/II	65.89	22.193		
	Obese Class III	49.83	30.72		
Barriers Self-Efficacy	Non-obese	38.63	21.43	.042	.959
	Obese Class I/II	39.34	20.29		
	Obese Class III	39.29	25.73		
Positive Outcome Expectations	Non-obese	58.09	6.23	.129	.879
	Obese Class I/II	57.75	6.165		
	Obese Class III	57.68	7.69		
Negative Outcome Expectations	Non-obese	7.57	2.58	3.756	.024*
	Obese Class I/II	8.43	2.80		
	Obese Class III	7.74	2.72		
Total Social Support	Non-obese	4.47	4.30	.845	.430
	Obese Class I/II	4.02	3.93		
	Obese Class III	4.90	3.858		
Cardiorespiratory Fitness	Non-obese	22.44	4.53	35.175	<.001**
	Obese Class I/II	20.16	4.91		
	Obese Class III	15.65	3.77		

Note: **p < .001, *p <.05

Abbreviation: SD, Standard Deviation

Linear Regression Models

Simple linear regression analyses were performed to predict exercise barriers, walking self-efficacy, and cardiorespiratory fitness (all three separately) using BMI as the independent predictor variable. The results of the unadjusted regression model including BMI and exercise barriers indicated that the model explained only 1.7% of the variance (of exercise barriers) and that the model was significant, $F(1,318)=5.586$, $p=.019$. The results of the unadjusted regression model including BMI and walking self-efficacy indicated that the model explained 15.3% of the variance (of walking self-efficacy) and was significant, $F(1,318)=57.310$, $p<.001$. The results of the unadjusted regression model that included BMI and cardiorespiratory fitness indicated that the model explained 18.5% of the variance (of cardiorespiratory fitness) and that the model was significant, $F(1,318)=72.366$, $p<.001$.

Multiple linear regression analyses were performed to assess whether BMI predicted exercise barriers, walking self-efficacy, and cardiorespiratory fitness (all three separately) while adjusting for demographic and clinical covariates that were shown (Tables 3 and 4) to be significantly associated with BMI (income, comorbidity score, WOMAC score, race, and income). The model including BMI (predictor variable), exercise barriers (outcome variable), and comorbidity score, and WOMAC as covariates, explained just 4.8% of the variance (of exercise barriers) and was significant, $F(3, 316)=5.350$, $p=.001$. BMI was not significantly associated with exercise barriers independent of comorbidity and WOMAC scores ($p=.392$). Comorbidity score was significantly associated with exercise barriers in the model, $p=.024$. The final predictive model was as follows: exercise barriers score = *52.141+ (.089*BMI) +*

*(.995*comorbidity score) + (.071*WOMAC score).* The model consisting of BMI (predictor variable), walking self-efficacy (outcome variable), and income, comorbidity score and WOMAC as covariates, explained 25.1% of the variance (of walking self-efficacy) and the model was significant, F(4,311)=26.028, p<.001. It was found that BMI was associated with walking self-efficacy score independent of income (p<.001). Comorbidity score and WOMAC score were also significantly associated with walking self-efficacy (p=.015 and p<.001, respectively). The final predictive model was as follows: walking self-efficacy score = *100.79 - (.889*BMI) + (4.451*income) - (1.978*comorbidity score) - (.405*WOMAC score).* Lastly, the model containing BMI (predictor variable), cardiorespiratory fitness (outcome variable), and education, race, income, comorbidity score, and WOMAC score as covariates, explained 25.6% of the variance (of cardiorespiratory fitness) and was significant, F(6,309)= 17.745, p=<.001. BMI was associated with cardiorespiratory fitness independent of education and income (p<.001). Cardiorespiratory fitness was significantly and independently associated with education (p=.003), race (p=.006) and comorbidity score (p=.003). The final predictive model was as follows: cardiorespiratory fitness = *25.443 - (.213*BMI) + (.315*education) - (2.142*race) + (.212*income) - (.476*comorbidity score).* In summary, BMI was a statistically significant predictor of walking self-efficacy and fitness independent of covariates.

Logistic Regression Models

Binomial logistic regression analyses were performed to predict the likelihood that participants prefer to engage in physical activity at a facility based on BMI, when the models were unadjusted, and then adjusted for the covariate walking self-efficacy score. The unadjusted logistic regression model with BMI and location preference was statistically significant, $\chi2(1)= 8.058$, $p=.005$. For every 1-unit increase in BMI, there are 1.047 greater odds of preferring a facility as location preference with a 95% confidence interval of (1.014-1.081). The adjusted logistic regression model including BMI, walking self-efficacy, and location was also statistically significant, $\chi2(2) = 10.292$, $p=.006$. For every 1-unit increase in BMI, there are 1.036 greater odds of preferring to exercise at a facility independent of walking self-efficacy score with a 95% confidence interval of (1.001-1.073).

DISCUSSION

Cancer survivors are living longer than ever thanks to advances in diagnosis and control of cancer. Healthy lifestyle habits (physical activity, weight control) can enhance the quality of these years by reducing risk of cancer recurrence and other chronic diseases. Effective lifestyle programs are needed and should take into consideration the physical activity preferences and mediators specific to this population, particularly among those with obesity who are most in need.

Overall, our findings show that breast cancer survivors prefer to exercise at home or have no preference which is consistent with existing literature among diverse cancer survivors.[7] A recent systematic review reported a similar finding that adults with obesity prefer to engage in exercise "close to home" while Hussien et al found that adults with severe obesity prefer exercising outdoors.[31] However, when assessing preference by BMI category, we found that as obesity increased (i.e., obese class I/II to class III), there was an increased preference for exercising at a facility which is similar to findings from another study among rural breast cancer survivors with overweight and obesity.[32] Potential hypotheses are that survivors with obesity may appreciate the support/supervision of facility staff (e.g., personal trainers, health coaches, etc.), social context (i.e., seeing others exercise), and facility resources (e.g., recumbent cycles, pools, etc.).

The current study did not find any significant association between BMI and current physical activity, similar to a past study among adults with obesity and multiple sclerosis.[33] Our sample consisted of breast cancer survivors who were not currently active (i.e., engaging in no more than 60 minutes of moderate intensity physical activity or no more than 30 minutes of vigorous intensity activity per week), as noted earlier in the inclusion criteria, which may have impacted our ability to test this relationship. However, we did find that BMI was inversely correlated with cardiorespiratory fitness as in past studies among adults with obesity and no history of cancer.[34, 35] Improvements in cardiorespiratory fitness among breast cancer survivors with obesity can be achieved through incorporating physical activity and ultimately reducing excess adiposity.[36]

We found a significant relationship between BMI and a few Social Cognitive constructs. Specifically, higher BMI was inversely correlated with walking self-efficacy and positively correlated with exercise barriers scores. Past studies have found associations between BMI self-efficacy,[14] exercise self-efficacy,[37] and family social support[14] among adults with obesity, no cancer history[14] and presence of chronic illness (i.e., multiple sclerosis).[33] The lower levels of self-reported walking self-efficacy among cancer survivors with higher BMI in the current study could possibly be due in part to joint pain, stiffness, and discomfort when walking, which makes it more difficult to walk at a moderately fast pace without stopping. With regard to high BMI and high exercise barriers, participants with increased weight reported more barriers to physical activity which has been previously discussed. Similar to walking self-efficacy, bearing more weight increases the likelihood of barriers (i.e., lack of energy, lack of confidence, lack of enjoyment, etc.).

Strengths and Limitations

The findings of the current study provide insight on a population that needs tailored physical activity programing and can be useful for informing future interventions. Specifically, location preference and health related factors (i.e., walking self-efficacy and cardiorespiratory fitness) that can affect participation in programs. However, there are limitations. First, the entire sample consisted of post-treatment cancer survivors, mainly educated, affluent Caucasian women. Hence, findings may not be generalizable to the larger population of cancer survivors (e.g., those who are not White, have not undergone treatment or are currently receiving treatment, less educated, less affluent, or male). Also, our sample consisted of few participants with class III obesity which warrants future research with more representation from this group.

CONCLUSION

Location, walking self-efficacy and fitness are factors which should be considered when designing future physical activity programs among breast cancer survivors with obesity. We found that participants with a higher BMI preferred to exercise at a facility, had lower levels of walking self-efficacy and cardiorespiratory fitness. Tailoring for such individuals should involve a theoretically driven program which targets walking self-efficacy and involves activities appropriate for various levels of cardiorespiratory fitness.

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ASSESSING THE BUILT ENVIRONMENT, PROGRAMS, AND POLICIES THAT SUPPORT PHYSICAL ACTIVITY OPPORTUNITIES IN RURAL ALABAMA

by

NASHIRA BROWN, MARY ANNE POWELL, LAUREN BOONE, ROBERT OSTER, LAURA Q. ROGERS, DORI PEKMEZI

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Abstract

Introduction: Environmental features and community resources likely contribute to existing disparities in physical activity and related conditions (i.e., chronic diseases) in rural regions. Before implementing programs to increase physical activity it is important to characterize the opportunities and barriers that influence activity in rural areas.

Purpose: To assess the built environment, programs and policies related to physical activity opportunity in six rural Alabama counties (Hale, Greene, Choctaw, Sumter, Dallas, and Marengo).

Methods: Assessments were conducted August 2020-May 2021 and included all three components of the Rural Active Living Assessment (RALA). Town demographics and characteristics, and recreational amenities were captured using the Town Wide Assessment (TWA). Physical activity programs and community policies were examined with the Program and Policy Assessment (PPA). Walkability was evaluated using the Street Segment Assessment (SSA).

Results: Across the six counties, the overall TWA score was 49.67 out of a possible 100 points (range: 22-73), indicating low prevalence of schools within walking distance (i.e., within 5 miles of the town's center) and town-wide amenities (i.e., trails, water/recreational activities) for physical activity. Results from the PPA showed a paucity of programming and guidelines to support active living (overall average score of 24.67 out of a possible 100 points [range: 22-73]). Only one county had a policy requiring walkways/bikeways in new public infrastructure projects. Of 96 street segments assessed, 30% had sidewalks present, 61% had safety features, and 24% had connectivity

to other parts of town or another segment. Subjectively, 65% of segments were rated as walkable, with 87% of segments having pleasing aesthetics.

Conclusion: Opportunities for engagement in physical activity (i.e., parks and playgrounds) were identified using RALA throughout these six rural counties. However, barriers such as few policies and safety features (i.e., crossing signals, children at play signs, speed bumps) were also revealed as factors that should be addressed to maximize resident physical activity opportunities and inform future policy.

INTRODUCTION

Rates of physical activity are low in the United States, but the prevalence in the most southern region, or the Deep South, remains the lowest in the US. Currently, 30% of adults residing in the Deep South, the southeastern states (Alabama, Georgia, South Carolina, Louisiana, and Mississippi),[1] remain physically active. However, within the rural regions, the prevalence is even lower with fewer adults meeting the physical activity guidelines in comparison to their urban counterparts. It is evident that interventions promoting physical activity in these areas are necessary to decrease the burden of chronic disease, morbidity, and mortality. However, existing literature suggests there are disparities in physical activity across geographical regions with environmental characteristics and community resources playing important roles.[2]

The environment, programs, and policies impact physical activity engagement, particularly in rural settings. Specifically in these areas, residents are more likely to be physically inactive due in part to barriers (i.e., walkability, lack of recreational facilities, lack of transportation) that are not as prevalent in other regions.[3] Challenges related to built environment factors have been evaluated using the Rural Active Living Assessment (RALA) in North Carolina,[4] Alabama,[5] Mississippi,[5] Washington[6] and Hawaii.[7] Findings from these studies[4-7] have revealed environmental barriers (i.e., walkability, lack of safety features), and gaps in town programs (i.e., “Walk to School”) and existing policies (i.e., requiring pedestrian walkways/bikeways in new infrastructure projects) that all contribute to low levels of physical activity.[7] Despite the findings of these previous assessments there are still persistent issues with physical inactivity, particularly in Alabama.

In order to reduce physical activity disparities and implement necessary programs that are conducive to healthy, physically active lifestyles, there is a need for further research and extension of the prior limited work in rural areas. To our knowledge, built environment has not been examined in several rural Alabama counties (i.e., Greene, Choctaw, Marengo, Dallas, and Hale). Thus, the purpose of this study is to update and extend research by evaluating the physical environment environments and existing community program and policies that support physical activity in six rural counties in Alabama. We hypothesize that there will be limited support (i.e., program and policies) and numerous physical environmental barriers to physical activity in these six rural counties.

METHODS

Research Design

Physical activity built environment data for the current study were collected using the RALA in six rural Alabama counties, in which residents are participating in an ongoing registered physical activity randomized controlled trial[8] (NCT03903874). This instrument helps assess the physical environment, town characteristics, recreational amenities, and community programs and policies that can affect the physical activity in rural communities. This study was approved by the University of Alabama at Birmingham Institutional Review Board. Data collection occurred August 2020-May 2021.

Setting

RALA data were collected on Hale, Marengo, Choctaw, Greene, Dallas, and Sumter counties, given resident involvement in the parent study.[8] According to 2019 county-level census data,[9] residents were mostly African American (62.2%) and poverty levels for each county were more than double the national average (range: 20.5%-36.4% vs. 10.5%). Resident demographic characteristics are provided in Table 1 along with comparison to United States population as a whole.

Table 1. Resident Demographic characteristics by county, US Census Bureau, 2010-2019

	Hale	**Greene**	**Marengo**	**Choctaw**	**Dallas**	**Sumter**	**United States**
Population	14,785	7,730	19,323	12,665	38,462	12,345	331,449,281
Age							
Persons <18 years	23.0%	21.8%	22.5%	19.7%	23.3%	19.0%	22.3%
Race							
White	40.7%	18.5%	46.6%	57.1%	27.6%	25.6%	76.3%
Black/AA	58%	79.9%	51.6%	41.7%	70.7%	71.4%	13.4%
Education							
Bachelor's degree or higher, age >25 years*	14.2%	10.1%	16.1%	11.9%	14.7%	21.6%	32.1%
Health							
With a disability*	14.9%	15.8%	18.5%	19.5%	12.3%	16.5%	8.6%
Income & Poverty							
Median household income (in 2019 dollars)**	$34,046	$24,145	$33,241	$35,892	$33,845	$24,320	$62,843
Persons in poverty	20.5%	31.7%	24.8%	22.6%	26%	36.4%	10.5%
* <age 65 years, **2015-2019							

Abbreviations: AA, African American

Instrument and Procedures

The RALA is a comprehensive assessment composed of three separate assessment components: the Town Wide Assessment (TWA), the Program and Policy Assessment (PPA), and the Street Segment Assessment (SSA).[10] The TWA is composed of 18 town demographics and characteristic items (e.g., county population, town topography, and location of schools) and 15 recreational amenity questions (e.g., hiking/biking/walking trails, public parks, playgrounds, recreational centers).[10] In the current study, this component was completed by a trained research staff member (i.e., rural county coordinator) using publicly available information from the US Census Bureau website (https://www.census.gov/data.html) and local town officials.

The PPA consists of 11 questions across four domains (i.e., town policies, town programs, school policies, and school programs). This component evaluates the presence or absence of town and school programs (e.g., local public transportation, sponsored physical activity initiatives for students) and policies (e.g., requirement of bikeways or pedestrian walkways in new public infrastructure projects, public recreation department that offers physical activity programs) that could contribute to active living within the community. In the current study this portion was also completed by the designated local rural county coordinator, who collected the relevant data from local town officials, town recreation directors, school faculty/administration, parks directors, and church directors.

The SSA is a 25-item observational audit of individual street segments within the towns. This component characterizes walkability (i.e., sidewalks, safety features, and road/traffic characteristics), land use (i.e., residential, commercial, industrial, public/civic), and aesthetics. Features that affect segment walkability were noted for their presence or absence, as well as condition, if present. Observations related to land use were recorded including the presence and condition of public/civic destinations (e.g., playground, post office, community center), commercial destinations (e.g., restaurant, convenience store, small retail), and schools within each segment. To complete this assessment in the current study, first, “ground-truthing,” or verifying existing and absent street segments, boundaries and locations[11] was conducted by trained research staff members (i.e., rural county coordinator from The O'Neal Comprehensive Cancer Center at the University of Alabama at Birmingham Office of Community Outreach & Engagement). Following, distinct street segments (16 per county, 96 total) were chosen and then together, the two research staff members mapped out the street segments using Google Maps and scheduled dates/times to audit the chosen streets.

Scoring and Statistical Analyses

The TWA and PPA were scored using a guide and scoring algorithm developed by RALA creators, Hartley and colleagues.[10] Both components are individually scored across their domains to form a TWA score (0-100) and PPA score (0-100), with a higher score indicating more opportunity and support for physical activity. For the TWA, school location is assessed for the presence of an elementary, middle, and/or high school that a child would be able to walk to within the town, for a maximum possible score of 15 points (i.e., "*There is an elementary school in my town that children can walk to*" Response and assigned points: Yes, 6 points; No, 0 points. "*There is a middle school in my town that children can walk to*." Response and assigned points: Yes, 5 points; No, 0 points. "*There is a high school in my town that children can walk to*." Response and assigned points: Yes, 4 points; No, 0 points). The trails category assesses, and scores based on the presence of hiking/walking trails, biking paths, and other types of trails, as well as their distances from the town center for a maximum possible score of 20 points. The parks and playgrounds section assesses and scores the presence of public parks, public playgrounds, school playgrounds, and other types of parks/playgrounds, as well as their distances from town center for a maximum possible score of 25 points. The water activities component assesses if public swimming pools, swimming beaches, rivers with boat/water sport-access, or other water activities are present within fifteen miles of the town center for a maximum possible score of 10 points. Lastly, recreational activities examine the presence and distance from town center of a town recreational facility, playing field or courts, skate parks, private fitness facilities, roller/ice skate rinks, and other public access facilities, for a maximum possible score of 30 points.

For the PPA component, the town policies section assesses the presence of policies concerning bikeways and pedestrian walkways in the town's infrastructure for a maximum score of 10 points. The town programs section evaluates the existence of public recreational departments and organizations within the town as well as their accessibility for a maximum score of 30 points. The school policies section considers after school hours transportation offerings for children as well as if the facilities are open for public use after hours for a maximum score of 30 points. Finally, the school programs portion evaluates the presence of a walk or route to school program for children, as well as the existence of additional physical activity initiatives programs (e.g., afterschool athletics/sports teams) for students for a maximum of 30 points.

The SSA individually assesses each street segment's walkability (e.g., sidewalks, Type: *both sides of street, one side of street, intermittent, footpath only, or none)*, land use (e.g., residential type: *single family detached, multi-family homes/apartments, mobile homes, other, or none),* and corresponding condition (i.e*., Poor/fair, or not well-maintained/shows signs of deterioration* =1 or *Good/excellent, or well-maintained/shows little to no sign of deterioration* =2). The two subjective items regarding each street segment's walkability and aesthetics were rated on a 4-point Likert scale (i.e., strongly disagree, disagree, agree, or strongly agree).

Data were summarized using descriptive statistics (frequencies and percentages), as suitable, for the SSA, PPA, and TWA scales. All analyses were conducted using SPSS Version 27 (Chicago, IL).

RESULTS

Town Wide Assessment

Across the six counties, the overall TWA score was 49.67 out of a possible 100 points (range: 22-73), indicating low prevalence of schools within walking distance (i.e., within 5 miles of the town's center) and town-wide amenities for physical activity. Most towns did not have a middle or high school (9.67/15 points), or water activities (1.5/10 points). A majority (83%) of the towns had trails (i.e., walking, jogging, hiking, and biking) but were not within proximity (>5-15 miles from the town center) resulting in a mean score of 10.17/20 points. As for recreational activities (mean score of 8.33/30 points), there was variation in the presence of town recreational facilities (e.g., YMCA), private facilities (e.g., Gold's Gym, Curves), and playing fields/court. Most of the towns (67%) had a private facility and playing courts, while there was a limited number of town recreational centers (17%). However, there was a high prevalence of parks/playgrounds (20/25 points). Table 2 provides the TWA points and total scores by domain.

Table 2. Town Wide Amenity Scores by County

	Hale	**Greene**	**Marengo**	**Choctaw**	**Dallas**	**Sumter**	**Avg Score/ Max Points Possible**
Domain							
School location	15	6	15	5	6	11	9.67/15
Trails	8	0	16	4	13	20	10.17/20
Parks/ Playgrounds	8	16	23	23	25	25	20.00/25
Water Activities	0	0	0	0	5	4	1.50/10
Recreational Activities	2	0	9	7	19	13	8.33/30
Total Score	32	22	63	39	68	73	49.67/100

Program and Policy Assessment

Overall, the existence of physical activity programs and policies in the six counties was low with a total average score of 24.67/100. Marengo was the only county identified during our assessment with a town program such as a public recreation department and/or private recreation organization with a sliding fee/scholarship. Most counties (67%) had a school policy that consisted of allowing public access to their recreation facility after school hours. As for school programs, only Sumter County offered sponsored physical activity initiatives (i.e., football, basketball, baseball, volleyball, track, etc.) for students in addition to gym/physical education classes. None of the counties scored in all six areas of this assessment indicating a lack of programs and policies for each county. However, Sumter County scored highly in the majority (83%) of program and policy domains and received the best overall PPA score (47/100).

Table 3. Program and Policy Scores by County

County	**Hale**	**Greene**	**Marengo**	**Choctaw**	**Dallas**	**Sumter**	**Avg Score**
Town Seat	Greensboro	Eutaw	Demopolis	Butler	Selma	Livingston	
Town Policies	0	0	10	0	0	0	1.67
Town Programs	0	0	10	10	26	22	11.33
School Policies	15	15	0	15	0	15	10.00
School Programs	0	0	0	0	0	10	1.67
Total score	15	15	20	25	26	47	24.67/100

Street Segment Assessment

A total of 96 street segments were audited across the six counties (i.e., 16 segments over 18 towns). In all of the towns, sidewalks were present, with 18% of segments having them on both sides of the street. Shoulders in good condition were found throughout 28% of the town segments. Overall, 61% of segments had at least one pedestrian-friendly safety feature including sidewalks, crosswalks, pedestrian signs, stop signs and public lighting. Conversely, additional safety features like crossing signals (2%), children at play signs (6%), yellow school flashing lights (2%), and speed bumps (3%) were not as common as other features throughout town segments. The average road condition within these segments was 1.87 out of a possible 2 points. All towns had non-vehicular routes (i.e., sidewalks, bike paths, or trails) with connectivity to other segments and other parts of town. There was variance in land use within the segments. Public/Civic destinations (i.e., post office, courthouse, playground) were the most common (overall, 42% of segments), followed by commercial destinations (i.e., restaurant/café, convenience store, small/big box retail) (overall, 28% of segments), then school destinations (i.e., public elementary middle/high school, private school) (overall, 22% of segments). Table 5 provides the street segment characteristics by county.

Table 4. RALA Street Segment Characteristics by County

County Segments	Hale (N=16)	Greene (N=16)	Marengo (N=16)	Choctaw (N=16)	Dallas (N=16)	Sumter (N=16)	Total (N=96)
Towns	Greens-boro Sawyer-ville Newbern	Eutaw Boligee Forkland	Demopolis Linden Dixons Mills	Butler Lisman Pennington	Selma Orrville Valley Grande	Livingst-on York Cuba	
Total number of present feature (total number of present feature/number of segments %)							
Sidewalks Present	5 (31%)	4 (25%)	6 (38%)	3 (19%)	8(50%)	5 (31%)	31 (32%)
Both Sides of street	3 (19%)	1 (6%)	4 (25%)	1 (6%)	3 (19%)	5 (31%)	17 (18%)
Other*	2 (13%)	3 (19%)	2 (13%)	2 (13%)	0	3 (19%)	12 (13%)
Shoulders Present	5 (31%)	5 (31%)	4 (25%)	4 (25%)	2 (13%)	7 (44%)	27 (28%)
Any Safety Feature Present	8 (50%)	7 (44%)	8 (50%)	10 (63%)	10 (63%)	16 (100%)	59 (61%)
Crosswalk	3 (19%)	1 (6%)	4 (25%)	4 (25%)	3 (19%)	3 (19%)	18(19%)
Crossing signals	0	0	1 (6%)	0	1 (6%)	0	2 (2%)
Pedestrian Signs	1 (6%)	1 (6%)	1 (6%)	1 (6%)	4 (25%)	5 (31%)	13 (14%)
Children at Play Signs	0	2 (13%)	2 (13%)	0	1 (6%)	1 (6%)	6 (6%)
Traffic Lights	2 (13%)	0	4 (25%)	2 (13%)	4 (25%)	5 (31%)	17 (18%)
Stop Signs	3 (19%)	3 (19%)	2 (13%)	1 (6%)	4 (25%)	8 (50%)	21 (22%)
School Flashing Lights	0	0	1 (6%)	0	1 (6%)	0	2 (2%)
Speed Bumps	1 (6%)	0	1 (6%)	0	1 (6%)	0	3 (3%)
Public Lighting	1 (6%)	5 (31%)	4 (25%)	4 (25%)	2 (13%)	4 (25%)	20 (21%)
Average Road Condition**	1.89	1.89	1.94	1.89	1.69	1.94	1.87

Connectivity ***	4(25%)	3(19%)	3(19%)	3(19%)	4 (25%)	6(38%)	23(24%)
Land Use							
Public and Civic Destinations	5 (31%)	5 (31%)	9 (56%)	6 (38%)	9 (56%)	6 (38%)	40 (42%)
Commercial Destination	2 (13%)	4 (25%)	5 (31%)	5 (31%)	5 (31%)	6 (38%)	27 (28%)
School Destination	3 (19%)	3 (19%)	4 (25%)	2 (13%)	4 (25%)	5 (31%)	21 (22%)
Subjective Assessment							
Walkable Segment	12 (75%)	7 (44%)	12 (75%)	15 (94%)	3 (19%)	13 (81%)	62 (65%)
Pleasing Aesthetics	14 (88%)	15 (94%)	15 (94%)	16 (100%)	14 (88%)	15(94%)	89 (93%)

*One side of street only, intermittent, or footpath

** 1 (Poor/Fair, 2 (Good/excellent)

*** Do sidewalks, bike paths, or other trails link segment to other parts of town or to another segment or road?

DISCUSSION

Built environmental characteristics and community resources such as policies and programs play a crucial role in physical activity opportunity;[4] however, there is a paucity of research about the environment and resources in rural areas.[4, 12] Before promoting active lifestyles and informing physical activity interventions, its pertinent to have knowledge of the available and accessible resources within the environment. Understanding environment-related barriers and influences to being active is important for developing physical activity interventions within rural communities. This study sought to use the RALA to assess the environmental characteristics and existing amenities, programs, and policies in six underserved rural counties in Alabama. The results from the Town-wide and Program and Policy assessment indicated limited sources of opportunity (i.e., trails and playgrounds) for physical activity as well as a lack of community programs which encourage physical activity. Additionally, the street segment assessment suggested that there are existing environmental barriers (i.e., lack of crossing signals and crosswalks) that could hinder physical activity engagement.

In the current study, deficiencies in existing physical activity programs and policies (i.e., community programs and policies) were similar to those found in the past study conducted in nearby Alabama and Mississippi.[5] In contrast, more programs and policies that support physical activity engagement were found while using the RALA in four rural Latino communities in Washington.[6] We also found a lack of community programs (i.e., physical activity programs for local youth) and policies (i.e., requiring inclusion of bikeways or pedestrian walkways in new public infrastructure projects). Most counties (i.e., Choctaw, Marengo, Dallas, and Sumter) had a public recreational department that offer physical activity programming, but these programs were restricted to the local youth (ages 3-16) except for Dallas County where programs are offered to adults 18 years and older. Parks and playgrounds were the most prominent recreational amenity across all six counties. The previous RALA studies conducted in North Carolina[4], Alabama and Mississippi[5] reflect this finding. Moreover, these three states scored highest in this domain [North Carolina- mean score= 21, range: 14-25)[4], Alabama and Mississippi, (mean scores= 15 and 16.5, ranges: 12-16 and 16-18, respectively)].[5] Lastly, findings from the Street Segment component indicated that safety features were present in all towns. Also, similar to previous studies, existing sidewalks were in good condition.[5] However, there was a lack of crossing signals, children at play signs, and speed bumps in a majority of the areas audited comparable to issues found in studies conducted in North Carolina, Alabama, and Mississippi. [4-6]

To our knowledge, this is the first time RALA has been conducted in five of the six counties (Greene, Choctaw, Marengo, Dallas, and Hale). In 2011, physical activity built environment in Sumter County was examined by Robinson and colleagues using RALA.[5] The current study reflects identical overall and individual domain PPA scores as the previous audit which indicates minimal or no changes in town and school-related programs and policies in Sumter within 10 years. In contrast, there are subtle differences in the TWA scores. The most notable differences were an increase in parks and playgrounds (16 vs 25) and a decrease in recreational facilities (19 vs 13). We speculate these changes are due in part to variation in towns that were chosen and assessed, observer-related variability, and modifications (i.e., closings) in recreational facilities over time. Also, the COVID-19 pandemic influenced the availability and offerings of physical activity programs. Local rural county coordinators consistently noted pandemic-related changes in accessibility to town recreational facilities, schools, and private organizations where programs were usually scheduled. For instance, in response to “Does the public schools in town allow public access to their recreation facilities after school hours?”, a coordinated checked “Yes” and left a comment “Some of them did before COVID-19.” These modifications resulted as many of locations were closed throughout each county.

Strengths and Limitations

A strength of this study is that the RALA has been previously used in Alabama counties for a past study.[5] The findings of this past audit can be used to corroborate results and expand on updates from the current study. This study utilized all three components of the RALA tool whereas a previous study selected only two of three portions due limited scope of research (i.e., focused on accessibility, availability of built environment components, and walkability).[4] Another notable strength of the current study was the incorporation of well-trusted, knowledgeable community residents and local rural coordinators to help collect Town-wide and Program and Policy assessment data.

There are limitations to note. First, validity and reliability has not been established for the RALA tool. However, inter-reliability for the Street Segment Assessment has been assessed (k= 0.40– >0.80, moderate to outstanding) across seven rural areas in the northeast (i.e., Maine), South (i.e., Alabama, Mississippi, and Kentucky), and west (California).[10] Despite the limited data on reliability and validity, RALA is a great tool for unique characteristics (i.e., variation in physical environment, settlement patterns) that contribute to physical activity behavior at the rural community level.[10] The Street Segment component features Likert-scaled, subjective portions (i.e., walkability and aesthetically pleasing nature of segment) which could vary from person to person and potentially introduce response bias. Additionally, the assessment was conducted during the COVID-19 pandemic. Further, another limitation is that results may be different when a pandemic is not occurring. Although, this would not change some of the outcomes (e.g., infrastructure policies), it does suggest that health emergencies such as a pandemic can further reduce the already insufficient resources for rural individuals. Consequently, RALA protocols were modified. To allow for social distancing, the driver and observer were no longer seated adjacent to another in the vehicle. Instead, both individuals were seated six feet apart in a three-row van or sports utility vehicle. Lastly, this study was conducted in rural regions specifically in Alabama and thus findings may not generalize to other regions.

CONCLUSION

Limited opportunities for engagement in physical activity (i.e., parks and playgrounds) were identified using RALA throughout these six rural Alabama counties. However, important barriers such as few policies and safety features (i.e., crossing signals, pedestrian signs, speed bumps) were identified as areas that should be addressed to maximize resident physical activity opportunities and help inform future policy efforts.

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OVERALL SUMMARY AND CONCLUSION

Rural adults and cancer survivors with obesity are two populations that remain highly inactive and are at increased risk for comorbidities. The existing physical activity programs for rural adults are limited while those for cancer survivors with obesity could be further tailored to meet needs and preferences. Before designing these complex programs, more research was needed to understand the necessary components. Thus, we 1) conducted a systematic review to synthesize the current literature regarding barriers, facilitators and preferences to physical activity among rural adults with obesity; 2) conducted secondary cross-sectional analyses to examine the relationships between BMI, physical activity program preferences, Social Cognitive Theory constructs, current physical activity, and cardiorespiratory fitness, among 320 breast cancer survivors enrolled in a physical activity randomized controlled trial and 3) assessed the built environment, community programs and policies that support physical activity in six rural Alabama counties.

The systematic review provided insights into barriers (i.e., negative environmental perceptions, knee pain, lack of motivation) and facilitators (i.e., fitness trackers) to physical activity among rural adults with obesity. Yet, there was scarce information regarding preferences aside mode of delivery. When considering other populations at risk, specifically, breast cancer survivors with obesity, it is important to grasp their self-reported barriers, facilitators, and preferences to identify and direct attention to addressable determinants that influence physical activity. Therefore, we conducted the secondary data analyses to be understand the relationship between BMI, physical activity program preferences, psychological factors, fitness, and physical activity level. This paper provided information on where breast cancer survivors with obesity prefer to engage in physical activity (i.e., facility-based) and other factors (i.e., walking self- efficacy, cardiorespiratory fitness, etc.) that must be considered when designing interventions for at-risk adults with obesity. Lastly, in the systematic review, negative environmental perceptions and lack of resources were identified as barriers to physical activity which warranted further investigation. Thus, we audited the built environment, existing community programs and policies that support physical activity in six rural counties. This assessment allowed us to identify the numerous environmental barriers (i.e., lack of safety features, lack of recreational facilities, etc.) and limited programs (i.e., sliding scale fee for public recreation department) and policies (i.e., requirement of sidewalks in infrastructure projects). In sum, these findings can provide foundational knowledge for practitioners, clinicians, and researchers when developing or adapting existing physical activity interventions for underserved and at-risk populations, especially those with obesity.

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APPENDIX A

SYSTEMATIC REVIEW SEARCH STRATEGY

The following databases were searched:

- PubMed
- Embase
- Web of Science
- Google Scholar

The following search strings and terms were used:

- PubMed

  ("Rural Population"[MeSH Terms] OR "rural*"[All Fields]) AND ("Exercise"[MeSH Terms] OR "exercise*"[Title/Abstract] OR "physical activit*"[Title/Abstract] OR "sport*"[Title/Abstract] OR "recreation*"[Title/Abstract] OR "Sports"[MeSH Terms] OR "Recreation"[MeSH Terms]) AND ("Obesity"[MeSH Terms] OR "obes*"[All Fields]) AND ("preference*"[All Fields] OR "Attitude"[MeSH Terms] OR "attitude*"[All Fields] OR "opinion*"[All Fields] OR "perception*"[All Fields] OR "belief*"[All Fields]) AND ("adult"[MeSH Terms] OR "adult*"[Title/Abstract])

- Embase

  ('rural population'/exp OR 'rural population' OR 'rural'/exp OR 'rural') AND ('exercise'/exp OR 'exercise' OR 'exercise*':ab,ti OR 'physical activity':ab,ti OR 'sport*':ab,ti OR 'recreation*':ab,ti OR 'sports'/exp OR 'sports' OR 'recreation'/exp OR 'recreation') AND ('obesity'/exp OR 'obesity' OR 'obes*') AND ('preference*' OR 'attitude'/exp OR 'attitude' OR 'attitude*' OR 'opinion*' OR 'perception*' OR 'belief'/exp OR 'belief') AND ('adult'/exp OR 'adult' OR 'adult*':ab,ti)

- Web of Science

  (((((ALL=(rural population))OR ALL=(rural)) AND ALL=(exercise) OR ALL=(physical activity) AND ALL=(obesity) OR ALL=(obes*) AND ALL=(preference) OR ALL=(barrier) OR ALL=(facilitator))))

- Google Scholar*

  With **all** of the words: physical activity
  With the **exact phrase**: rural
  With **at least one** of the words: barriers facilitators preferences obesity
  Without the words: children youth
  Where my words occur: anywhere in the article
  Return articles **dated** between 2011-2021
  Note: the first 200 articles retrieved from this search were included in the review

APPENDIX B

INSTITUTIONAL REVIEW BOARD APPROVAL

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM
Office of the Institutional Review Board for Human Use

470 Administration Building
701 20th Street South
Birmingham, AL 35294-0104
205.934.3789 | Fax 205.934.1301 | irb@uab.edu

APPROVAL LETTER

TO: Brown, Nashira I

FROM: University of Alabama at Birmingham Institutional Review Board
Federalwide Assurance # FWA00005960
IORG Registration # IRB00000196 (IRB 01)
IORG Registration # IRB00000726 (IRB 02)
IORG Registration # IRB00012550 (IRB 03)

DATE: 04-May-2022

RE: IRB-300009307
IRB-300009307-001
Multi-Level Influences on Physical Activity Participation in Rural and At risk Populations with Obesity

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The IRB reviewed and approved the Initial Application submitted on 28-Apr-2022 for the above referenced project. The review was conducted in accordance with UAB's Assurance of Compliance approved by the Department of Health and Human Services.

Type of Review: Exempt
Exempt Categories: 4
Determination: Exempt
Approval Date: 04-May-2022
Approval Period: No Continuing Review

Project Title: Multi-Level Influences on Physical Activity Participation in Rural and At risk Populations with Obesity

Student's Name: Nashira Brown

Documents Included in Review:

- IRB EPORTFOLIO
- IRB PERSONNEL EFORM

To access stamped consent/assent forms (full and expedited protocols only) and/or other approved documents:
1. Open your protocol in IRAP.
2. On the Submissions page, open the submission corresponding to this approval letter. NOTE: The Determination for the submission will be "Approved."
3. In the list of documents, select and download the desired approved documents. The stamped consent/assent form(s) will be listed with a category of Consent/Assent Document (CF, AF, Info Sheet, Phone Script, etc.)