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RESPIRATORY MEDICINE | RESEARCH ARTICLE

Identifying barriers to physical activity among African American women with asthma

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Abstract: Objective: African American Women (AAW) are disproportionately impacted by both physical inactivity and asthma. The aims of this study were to: 1) understand barriers to physical activity among AAW with asthma; 2) obtain feedback from AAW on an evidence-based walking intervention; and 3) modify the intervention using input from AAW with asthma.

Methods: Focus groups and interviews were conducted with sedentary AAW with uncontrolled asthma to identify barriers to walking. Women also suggestions for tailoring an existing walking intervention. Qualitative data were coded using domains from the Behavior Change Wheel and guided modifications of the existing walking intervention to tailor the content for sedentary AAW with asthma.

Results: Six focus groups (2–4 /group) and five interviews were completed. Women (n = 20) represented an obese (37 kg/m² ± 11), middle-aged (46 years ± 15) and low-income population. Barriers to physical activity were mapped to 8 theoretical domains: 1) Limited physical capability; 2) Lack of knowledge; 3) Lack of self-monitoring skills; 4) Complex decision making processes; 5) Lack of areas to walk; 6) Lack of social support; 7) Beliefs about consequences; 8) Beliefs about capability. To target these barriers, the existing walking intervention was modified to include an asthma education session, text messages, monthly group meetings, a walking session and informational materials.

Conclusion: AAW with asthma reported unique barriers to engaging in physical activity. An assessment of the feasibility, acceptability and efficacy of a modified intervention that addresses these barriers is warranted to address physical inactivity and poor asthma outcomes among AAW with asthma.



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ABOUT THE AUTHOR

Dr. S. M. Nyenhuis is committed to address disparities in unique and minority population with asthma. Her research portfolio has included working to understand reasons for increased asthma severity in older adults, to working with urban populations with recurrent emergency room visits for asthma to her current work in identifying barriers to physical activity among African American women with asthma. Her overall goal is to expand our knowledge of lifestyle behavior change in asthma to improve to lives of minority asthma populations

PUBLIC INTEREST STATEMENT

Asthma affects over 330 million people worldwide. African American women in particular, are impacted by both asthma and physical inactivity. Physical inactivity is associated with poor asthma control, greater health care utilization, and poorer asthma-related quality of life. Strategies that target physical inactivity in African American women with asthma are needed to address the disparities found in asthma.

Subjects: Exercise Psychology; Exercise Therapy; Asthma

Keywords: asthma; African American; walking; women; focus groups; barriers

1. Background

Engaging in regular physical activity has well-known health benefits, yet only 48% of Americans achieve recommended levels (≥ 150 minutes/week of moderate-vigorous physical activity) (Physical Activity Guidelines for Americans, 2008). Compared to other races and males nationally, data suggest that African American women are the least likely to meet physical activity guidelines (34%) (Roger et al., 2012; Whitt, Kumanyika, & Bellamy, 2003). Equally concerning, African American women experience poor health outcomes from common health conditions (obesity, cardiovascular disease, type II diabetes, asthma and cancer) that are associated with insufficient regular physical activity (*Diabetes and African Americans; Diet and physical activity: a public health priority*; National Center for Health Statistics Health, 2007). Strategies that target physical inactivity in African American women are needed to address the disparities in health outcomes of chronic diseases associated with physical inactivity (Banks-Wallace & Conn, 2002; Whitt-Glover, Brand, Turner, Ward, & Jackson, 2009).

While physical inactivity is not a risk factor for asthma, it is associated with poor asthma control and lung function, greater health care utilization, and poorer asthma-related quality of life (Dogra & Baker, 2006). African American women with asthma are more likely to experience these poor asthma-related health outcomes (higher rates of asthma exacerbations, worse lung function, poorer asthma-related quality of life, and higher asthma mortality rates) compared to Caucasian women (Akinbami & Bailey, 2012; Northridge, Meyer, & Dunn, 2002; Sherman, Tollerud, Heffner, Speizer, & Weiss, 1993). Research to date shows that engaging in regular, moderate physical activity is safe and improves asthma-related quality of life, asthma control and decreases asthma healthcare utilization (Carson et al., 2013; Dogra, Kuk, Baker, & Jamnik, 2011; Mancuso et al., 2013). Based on the negative effects of physical inactivity on asthma and data that demonstrate the safety of and improved asthma clinical outcomes with physical activity, guidelines recommend patients with asthma engage in low to moderate intensity exercise at least 2 times per week (Carson et al., 2013; Durstine, Moore, Painter, & Roberts, 2009; Garcia-Aymerich, Varraso, Antó, & Camargo, 2009; Mendes et al., 2011; Nici et al., 2006). This recommendation is not as specific or intense as what was recently outlined for the general population (Piercy et al., 2018). Despite the benefits of physical activity in asthma and guideline recommendations, individuals with asthma, particularly women, are less likely to engage in physical activity than those without asthma (Avallone & McLeish, 2013; Durstine et al., 2009; Ford, Heath, Mannino, & Redd, 2003; Global Initiative for Asthma [GINA], 2006; Nici et al., 2006; van 'T Hul et al., 2016).

The barriers to physical activity among individuals, particularly African American women, with asthma are not well understood. One study to date has examined barriers to physical activity among men and women with asthma (Mancuso et al., 2006). The barriers identified included concerns of physical activity triggering their asthma symptoms (a condition known as exercise-induced asthma), extreme weather triggering asthma symptoms and a lack of knowledge regarding the benefits of physical activity in asthma (Mancuso et al., 2006). While African Americans made up 47% of the study population, this study did not address race-/gender-specific barriers to physical activity in asthma. This is an important gap in the current literature as research shows there are numerous social and cultural barriers (physical appearance concerns, family/caregiving responsibilities, lack of social support, lack of physically active role models) to a healthier lifestyle that African Americans, more specifically African American women, face (Gaston, Porter, & Thomas, 2007; Joseph, Ainsworth, Keller, & Dodgson, 2015). Research supports the development of tailored physical activity interventions in African American women, as they are more successful than interventions developed for other race groups (Banks-Wallace & Conn, 2002). Given the connection between poor asthma-related health outcomes and physical inactivity among African

American women, understanding of the barriers to physical activity among African American women with asthma and developing a tailored physical activity intervention is the next logical step in improving asthma outcomes in this subgroup of patients.

The current study reports on the first focused assessment of barriers to physical activity among African American women with asthma (phase 1) and applied our findings to tailor a physical activity intervention, the Women’s Lifestyle Physical Activity Program, for African American women with asthma (phase 2).

2. Methods

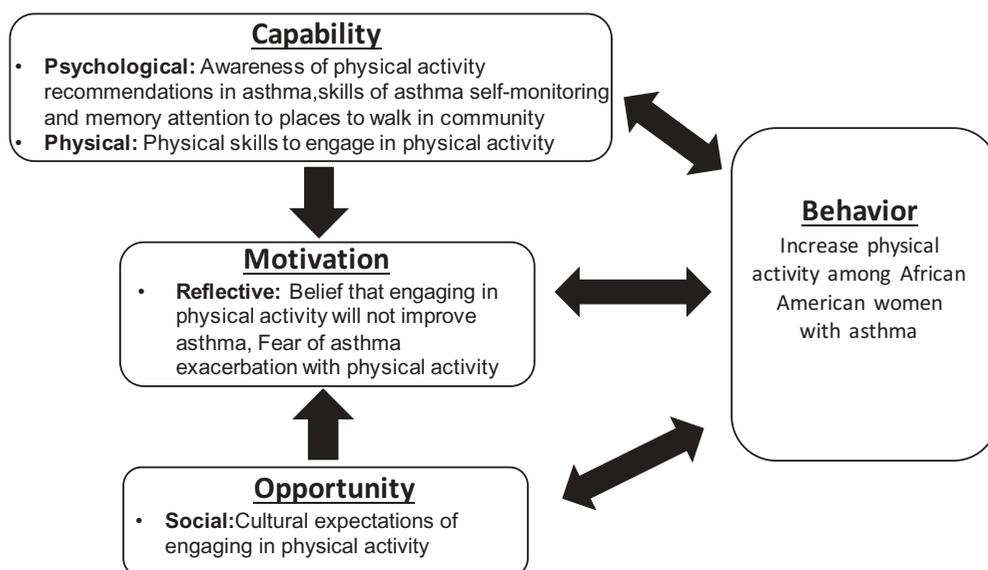
2.1. Overview

This manuscript describes the developmental process undertaken to modify an evidence-based physical activity intervention for African American women. The first phase involved focus group discussions (FGDs) and interviews among African American women with asthma to assess barriers to engaging in physical activity, with a focus on walking. In addition, the women provided feedback on materials from an evidence-based walking program designed for healthy, sedentary African American women (Women’s Lifestyle Physical Activity Program-See below). Women unable to attend a focus group due to scheduling were offered an individual interview. We used the Behavior Change Wheel (BCW) framework to develop the FGD guide (Figure 1) and categorize barriers identified through analysis of FGD transcripts (Ayton et al., 2017; Cadogan, McHugh, Bradley, Browne, & Cahill, 2015; Handley et al., 2015; Moore et al., 2014). Briefly, the BCW was developed from a synthesis of 19 frameworks of behavior change in a systematic literature review (Michie, van Stralen, & West, 2011). It links a general model of behavior change (COM-B: Capability, Opportunity and Motivation-Behavior) with an evidence-based approach to intervention design. In the second phase of this study, we utilized the data collected from the FGDs/interviews to tailor the Women’s Lifestyle PA Program to target unique barriers and improve acceptability among African American women with asthma.

2.2. Women’s lifestyle physical activity program

The Women’s Lifestyle Physical Activity Program is a 12-month program for midlife sedentary African-American women age 40 to 65 (Wilbur et al., 2015). The purpose of the program is to increase physical activity at home, work, and leisure. This program includes a physical activity prescription (with a goal to eventually increase the number of steps walked to 3000 steps over

Figure 1. COM-B Components Applied for Focus Group Discussion COM-B (Capability, Opportunity, Motivation-Behavior) system is a framework for understanding behavior (Gaston, Porter, & Thomas, 2007). This system was used to identify barriers to our target behavior, engaging in physical activity with asthma.



baseline) and 6 group meetings at a health care site. Group meetings consisted of an individual component for reviewing physical activity steps and updating physical activity goals, as well as a group component emphasizing self-management. Social Cognitive Theory concepts and strategies, including vicarious experience, behavioral capability, behavioral rehearsal, self-regulation, and reciprocal determinism, were applied systematically in group meetings. The program has shown to be efficacious with an improvement in daily physical activity (steps) as well high adherence to the walking program (Wilbur et al., 2015, 2017).

2.3. Setting and participant recruitment

Participants were recruited from a minority-serving academic medical center. Women meeting the following criteria were identified: asthma diagnosis (defined using a validated electronic health record algorithm (Pacheco et al., 2009)), African American race, 18–69 years old and ≥ 1 health care visit within the health system over the past 2 years based on the electronic health record (EHR). The inclusion criteria were selected to ensure representation of a diverse age range. The sample size of was determined by theoretical saturation, the accepted standard for focus group methodology. Theoretical saturation is the point when no new ideas relevant to the question are obtained (Kvale, 1996).

A random selection of women from the EHR list were identified for recruitment through mailings. The letter explained the study and informed them that someone from the study team would contact them via phone within the next two weeks. Patients were able to opt-out of being contacted by returning a response card with free postage. Those that did not send a response card were contacted by telephone or met in-person during routine healthcare visits to review study eligibility. Potential participants were contacted a maximum of five times at different times of the day, and then no further attempts to contact them were made.

During phone or in-person eligibility screening, patients were screened further for the following inclusion criteria: low levels of PA (<150 minutes/week of moderate intensity PA and sub-optimally controlled asthma (Asthma Control Questionnaire ≥ 1.5). Interested women who met all inclusion criteria were scheduled for a FGD.

The study was approved by the University of Illinois at Chicago Institutional Review Board (IRB 2016–0466) in accordance with the approval requirements. All participants were informed that study participation was voluntary and all data collection was confidential.

2.4. Focus group format

Six focus groups ranged in size from 2–4 women and five women who were unable to attend focus groups completed individual interviews (total 20 women). Transcripts of each focus group or interview were assessed throughout the study to assess for signs of theoretical saturation. By the twentieth participant, redundancy in the data was consistently apparent suggesting theoretical saturation had been met. Focus groups were conducted between 90–120 minutes with interviews lasting 60 minutes. Written informed consent was obtained from each participant followed by demographic data collection (marital status, income, children living in the home, education, employment, health insurance, and current health conditions). At the start of each focus group session, the participants were asked to keep any information they obtained during the discussion confidential. Each FGD was led by a trained moderator. FGDs were led by one of two moderators with assistance from a second who monitored the audio recorders and took field notes. The moderators were two middle-aged multi-racial females. One had over 10 years' experience conducting qualitative research and the other had 8 years' experience working with minority populations with asthma. The individual interviews were conducted by a single moderator. A standardized guide was used for the focus group sessions (Appendix A). Development of the standardized FGD guide was informed by the Theoretical Domains Framework (TDF), which structures the collection of more detailed data within each category of the COM-B model. The guide was formatted with explicit sections to prompt opinions about current knowledge of asthma and

physical activity, self-monitoring/perceived competence to engaging in physical activity with asthma, attention/physical resources available to engage in physical activity, social support and beliefs about capability to and consequences of being physically active with asthma. Physical activity was defined for participants as activity that increased their heart rate. Probing questions focused on walking. Women were shown existing intervention materials (video clips, participant manual) from the Women's Lifestyle Physical Activity Program to obtain acceptability feedback. Participants were reimbursed \$50 for their time and travel.

2.5. Data analysis

Audio recordings were transcribed verbatim immediately following each focus group or individual interview. To ensure that the FGD guide was responsive to unexpected themes that might emerge from participants, the transcripts were then analyzed and coded for content. This also allowed for monitoring of saturation which guided the sample size. Three team members (SN, ND, LS) met to outline a deductive coding scheme grounded in theory (based on the COM-B categories and TDF domains addressed in the FGD guide) (Appendix A). Subsequently, one transcript was independently coded and the group met to discuss. Discrepancies allowed for discussion and clarification of the codes. Remaining transcripts were independently coded by two members (SN, ND) and reviewed as a group. A third qualitative expert (LS) contributed to reach consensus when needed. Coded statements from the transcripts were entered in an Excel worksheet.

Participant demographic information was collected and entered into REDCap. R software was used for statistical analysis of quantitative data and reported as median (interquartile range; IQR).

3. Results

Participant demographics are shown in Table 1. Overall, the women represented an obese and middle-aged population. More than half of the women reported an annual household income of < \$30,000/year. Sixty-five percent of the women reported having a high school or lower education level.

3.1. Phase 1: Assessing behavioral and contextual barriers to physical activity among African American women with asthma

During the FGDs and interviews, the women identified several physical activity barriers in the context of their asthma, environment, resources and social support. Below we categorize key themes (Table 2) (Atkins et al., 2017).

4. Capability

4.1. Physical

4.1.1. Limited physical capability

All 20 women expressed the belief that asthma limited their ability to be physically active. Many women stated that they could not run or jog because of their asthma. Most felt that their asthma limited them to walking as a primary source of physical activity. Some women indicated that their asthma limited their ability to play with their children or grandchildren as expressed by one: "Because, you know I like to play, you know with my babies and I can't do too much because of my asthma. So it's kinda hard sometimes." Overall, responses were striking for the degree to which asthma was perceived to be a primary barrier for women's inactivity even when low exercise tolerance adversely impacted their quality of life.

4.2. Psychological

4.2.1. Lack of knowledge of benefits of physical activity

Half of the women (n = 10) were not aware that there were exercise recommendations for people with asthma or that exercising with asthma had any benefits. One woman stated: "My doctor only

Table 1. Focus group participant characteristics (n = 20)

Age (mean years± SD)	46 (15)
Body Mass Index (BMI) kg/m ² Median (IQR)	37 (11)
Asthma Control Questionnaire (ACQ) score Median (IQR)	2.5 (1.2)
Education n (%)	
Some high-school	3 (15%)
High-school graduate	10 (50%)
College graduate	5 (25%)
More than college graduate	2 (10%)
Employment Status n (%)	
Employed for wages	17 (85%)
Disabled	3 (15%)
Annual Household Income (USD) n (%)	
Less than \$30,000	11 (55%)
\$30,001 to \$60,000	5 (25%)
>\$60,000	3 (15%)
Prefer not to answer	1 (5%)
Number of dependents (<18 years old) living in the home	
0	8 (40%)
1–2	8 (40%)
3 or more	4 (20%)
Marital Status	
Single	10 (50%)
Married	6 (30%)
Divorced	3 (15%)
Prefer not to answer	1 (5%)
Insurance Status	
Insured through employer	7 (35%)
Medicaid, medical assistance, or government insurance	13 (65%)

discussed if you can or can't exercise, never discussed benefits of exercise for an asthmatic". Another woman indicated: "I have not heard of a regimen that would be ideal to help me with my symptoms. I have not seen any literature, and I haven't researched anything either to see what is available and what would be recommended."

4.2.2. Lack of self-monitoring skills

Half of the women indicated that their health care provider had educated them on how to prevent asthma symptoms induced by physical activity. However, 16 women reported feeling that they lacked the skills to prevent or manage asthma symptoms related to physical activity. Hence, despite receiving education, six women remained uncertain about managing their asthma if they wanted to be more physically active.

Table 2. Coded themes of barriers to physical activity from focus groups of African American women with asthma	
Barriers to physical activity	Example Quotes
Capability	
Physical	<p>Limited physical capability</p> <p>“She (primary care doctor) just told me to avoid walking up the stairs because when I was going back, I was coming to the emergency room back to back.” “I can’t exercise because it flares up my asthma” “Asthma limits me to walking only” “Because, you know I like to play, you know with my babies and I can’t do too much because of my asthma. So it’s kinda hard sometimes.” “Allergies especially mold, impact my ability to exercise”</p>
Psychological	<p>Lack of knowledge of benefits of physical activity</p> <p>“I have not heard of a regimen that would be ideal to help me with my symptoms. I have not seen any literature, and I haven’t researched anything either to see what is available and what would be recommended.” “My doctor only discussed if you can or can’t exercise, never discussed benefits of exercise for an asthmatic” “I am not aware of any exercise recommendations for asthmatics.”</p>
	<p>Lack of self-monitoring skills</p> <p>“Doctors don’t provide any advice with how to deal with asthma symptoms before or after workout” “They never told me no recommendations for asthma, they just ask us to stay busy exercising.” “My doctor did not give specific instructions on what to do to prevent asthma symptoms.”</p>
	<p>Complex decision making process</p> <p>“...you would have to think about the time, the day, what the weather is outside. If it’s too warm, your asthma flares up. If it’s too cold, your asthma flares up. You have to be mindful, did you take all of your medication?...” “First I would need to get asthma under control!” “...I don’t like to exercise in the winter because you got on all them clothes and you start to sweat and then that sweat goes into your pores... That’s another barrier, not to be making excuses however and this is what I mean about doing the research.” “...you got to get on the bus and go there (gym). And so being able to be actual(ly) physical; the physicality of getting up from my bed, getting dressed, to get up get on the bus, to go. Ain’t nobody going to do all that”</p>

(Continued)

Table 2. (Continued)

Barriers to physical activity		Example Quotes
Opportunity		
Physical	Lack of areas to walk	<p>“Violence has changed my walking habits because I would walk to the bus but now I cannot.”</p> <p>“I’m more concerned about my safety, I want to make sure I’m safe to walk in that neighborhood, so I just walk to where I have to go and walk back. That’s it.”</p> <p>“African-American neighborhoods don’t have the paths you see up north”</p> <p>“If there are sidewalks, there are bumps and grooves in the sidewalk, so that you fall down and hurt yourself...”</p> <p>“A challenge is the weather. I don’t like to be cold, because then I can’t breathe right..”</p> <p>“Heat is also a factor. If it’s too hot outside, you know what I’m saying, you’re not going to want to go outside. When it was really hot, those hot days, (I) stayed in the house with the air conditioner. I’m not even going out there, because I already know what’s expected, you know, what could happen I should say. I know what could happen so, to alleviate that I would stay in the crib.”</p> <p>“Gyms are expensive. There’s a lot of people that don’t have the money for some of these gym memberships. You’ve got the park district, they charge like \$30 a month; you know people don’t have that \$0, \$30. You have small kids, you know, kids need stuff. And you don’t have the financial. Who’s going to finance this for?”</p> <p>“(A gym membership), that’s way down here on the totem pole. Versus I got to eat. Gotta pay light, gotta pay gas, Financial constraints is the deal.”</p>
Social	Lack of social support	<p>“In my community, I don’t have nobody that I can really just talk to about it.”</p> <p>“I don’t like walking by myself. And I can’t get my daughter to walk with me you know.”</p> <p>“I would include them (family) in the walking. And for some support if you will, because you really want somebody to do it with you.”</p> <p>“So if it’s something that I can get into that I can exercise with other women and with my condition, with the same conditions and everything I think that’ll be good.”</p>
Motivation		
Reflective	Beliefs about consequences	<p>“Asthma can be deadly”</p> <p>“I’ve seen other peoples die in the condition that I was in. Got to the emergency room and died right there. So it’s not easy—it’s a hard life to live.”</p>
	Beliefs about capability	<p>“... with asthma it’s difficult dealing with life, because you have to get physically through life. With asthma, a lot of stuff gotta stop because of asthma. You’ve gotta work with your asthma, you can’t work around it. It’ll always pull you back.”</p> <p>“In grade school, they told us not to exercise so we don’t flare up our asthma”</p>

4.2.3. Complex decision making process

Many of the women described a complex decision making process underlying the decision to be physically active or not. Whereas many people can go outside giving little thought to the weather, women described a list of factors they had to consider because of the vulnerability they felt due to asthma. This included checking the weather for temperature and pollen counts (asthma triggers), choosing a proper balance of warm clothes to wear in the winter without getting overheated, seeking alternatives to exercising outdoors, ensuring they had taken all of their asthma medications and carrying a quick-relief inhaler with them in case they developed asthma symptoms while engaging in physical activity. One woman stated: “...you also would have to think about the time, the day, what the weather is outside. If it’s too warm, your asthma flares up. If it’s too cold, your asthma flares up. You have to be mindful, did you take all of your medication? Can you walk in the winter with all of the clothes on?” For many women, assessing these factors was an added burden and barrier to engaging in physical activity.

5. Opportunity

5.1. Physical (lack of areas to walk)

Physical opportunities related to the women’s environmental context and resources to engage in physical activity with asthma. Neighborhood violence was a realistic concern that reportedly impacted walking habits for several women. Many women resided in neighborhoods plagued by random gun violence among other safety concerns. One woman stated: “I’m more concerned about my safety, I want to make sure I’m safe to walk in that neighborhood, so I just walk to where I have to go and walk back. That’s it.” A lack of properly maintained sidewalks and walking paths were also identified as barriers to walking safely: “I think if we had paths that were close and good sidewalks, I think more people would come out, especially elderly people that run the risk of falling. Our sidewalks don’t crack in Chicago, they buckle. You’ll be flat, on a hill, and then flat.” The weather was also a concern, particularly extreme cold or heat: ‘...depends on the weather (not too hot or cold)’. Many women indicated that this was a barrier to walking safely as it would flare up their asthma. Gyms were identified as an alternative place to exercise when extreme weather was an issue but the cost of gyms was another barrier. One woman stated: “Gyms are expensive. There’s a lot of people that don’t have the money for some of these gym memberships. You’ve got the park district, they charge like \$30 a month; you know people don’t have that 30, \$30. You have small kids, you know, kids need stuff. And you don’t have the financial. Who’s going to finance this for?”. Many of the women were impacted by not one but all three barriers which impacted their motivation to engage in walking.

5.2. Social opportunity

5.2.1. Lack of social support

Many of the women lacked support from their friends or family to engage in physical activity. As stated by one woman: “In my community, I don’t have nobody that I can really just talk to about it (physical activity).” Another woman said “I don’t like walking by myself. And I can’t get my daughter to walk with me you know.” Interestingly, many of the women expressed the desire for an asthma-specific support system that included women with asthma as opposed to friends or family members without asthma. ‘I just wanted to get somebody else’s input about like the asthma, besides the doctor. Somebody that is literally going through it.’

Most of the women felt that lack of support or encouragement was a barrier to engaging in physical activity. There was general agreement among participants that a walking partner with or without asthma would be motivating, “I would include them (family) in the walking. And for some support if you will, because you really want somebody to do it with you.” If the women had the option though they would prefer to walk with other women with asthma. They felt that women with a similar health condition would better understand the accommodations people with asthma must take when engaging in physical activity. “So if it’s something that I can get into that I can

exercise with other women and with my condition, with the same conditions and everything I think that'll be good."

6. Motivation

6.1. Reflective motivation

This theme related to negative beliefs about the consequences and capability of engaging in physical activity with asthma.

6.1.1. Beliefs about consequences

The perception that asthma was a dangerous, life-threatening disease was supported by real life experiences of the women. Specifically, one-third of the women indicated they had been intubated in the past for their asthma or that someone close to them had died from asthma (child, cousin, aunt). These experiences substantiated the concern for many that engaging in physical activity with asthma could be dangerous. They also contributed to a sense of vulnerability associated with having asthma. Women with a past intubation history indicated that the experience was frightening and they never wanted to experience it again. As expressed by one: *"I don't want to go out of bounds so that I'm laying back up in the hospital, to where I'm back up intubated."* Addressing and overcoming these specific beliefs about asthma would likely be required before this subset of women would feel comfortable engaging in physical activity.

6.1.2. Beliefs about capability

Many of the women in the focus groups and interviews indicated that asthma uniquely impacted their motivation to engage in physical activity. As mentioned earlier, many women saw themselves as being less capable of being physically active in part because the asthma rendered them vulnerable. This belief was reinforced as many women recalled being told as a child that they "should be careful" and "limit their physical activity because they had asthma." Others described that asthma added complexity to their life requiring them to work harder. As one woman expressed: *"It'll always pull you back."*

Collectively, these qualitative results were used to modify an evidence-based PA intervention for African American with asthma (Phase 2).

6.2. Phase 2: Modifying a physical activity intervention to address modifiable barriers for African American women with asthma

The second phase of our study focused on integrating the results of the qualitative interviews into an evidence-based walking intervention. As the original intervention was designed for healthy, sedentary African American, this phase was intended to tailor the intervention components in the program for AAW with asthma. We linked barriers identified from phase 1 (Table 2) with relevant intervention functions (Table 3): 1. Education to target Psychological Capability/Reflective Motivation barriers; 2. Training to target Physical Capability/Physical Opportunity barriers; 3. Enablement to target Psychological Capability/Social Opportunity barriers; and 4. Modeling to target Social Opportunity barriers. Table 4 highlights the asthma-specific intervention modification developed in response to the qualitative FGD and interviews.

The revised intervention components includes a dedicated asthma education session, text messages, monthly group meetings, a walking session and informational materials. The asthma education session was added to address a lack of knowledge of how physical activity can impact asthma symptoms and how to prevent/treat asthma symptoms that occur during physical activity. Text message content includes reminders on asthma triggers and walking safely (self-monitoring) and motivational/inspirational messages (beliefs about capabilities). The monthly group meetings for the proposed intervention will include peer interaction with other African American women with asthma (social support), reinforce the benefits of physical activity in asthma (beliefs of

Table 3. Suggested intervention components and mechanisms of action using COM-B model and Theoretical Domains Framework

Intervention Component	Mechanisms of Action: COM-B and Theoretical Domains Framework							Behavioral Change Wheel Intervention functions	
	Capability			Opportunity		Motivation			
	Lack of physical capability	Lack of knowledge	Lack of action planning and self-monitoring	Complex decision making process	Lack of areas to walk	Lack of social support	Beliefs about consequences		Beliefs about capabilities
1. One time interactive group training/education session with asthma educator -Benefits of physical activity in asthma -Strategies for preventing exercise-induced asthma		X							Education
2. Text Messaging (up to 3 x's/week) -Reminders on asthma triggers/walking safely -Motivational and inspirational messages			X					X	Education, Enablement
3. Monthly group meetings at Chicago Park District with trained interventionist -Individualized feedback -Watch and discuss videos of African American women sharing PA experiences -Problem solving to overcome barriers -Engage in walking/stretching -Reinforcing benefits of physical activity in asthma -Peer interaction	X		X	X		X	X	X	Training, Modelling, Enablement, Education
4. Intervention manual -Information on how/where to walk and reinforces the benefits of physical activity in asthma		X			X				Education, Training

X indicates barrier(s) addressed by each intervention component; COM-B: Capability, Opportunity, Motivation-Behavior;

Table 4. Intervention modifications and barriers addressed

Original Intervention Women's Lifestyle Physical Activity Program	Revised Intervention	Reason for revisions
<p>Motivational telephone calls</p>	<p>Add a one time interactive group asthma and PA training/education session with an asthma educator. -Benefits of PA in asthma -Appropriate exercises -Strategies for preventing exercise-induced asthma</p>	<p>To address the lack of knowledge of the benefits of exercise in asthma, what is exercise-induced asthma and how to prevent it, and how to handle symptoms of asthma that may occur during physical activity a educational training session with an asthma educator was added.</p>
<p>Group meeting with trained interventionist (every 5 weeks) at community clinic -Individualized feedback -Watch and discuss videos of AA women sharing PA experiences -Problem solving to overcome barriers -Reinforcing benefits of PA in asthma -Peer interactions -10 minute walking and stretching session</p>	<p>Text messaging -Reminders on asthma triggers/walking safely -Motivational and inspirational messages</p>	<p>Based on participant feedback from the original intervention and from our focus groups which included a wider age range, the women preferred to receive text messages compared to telephone calls. The text message content also includes reminders on outdoor asthma triggers and walking safely with asthma.</p>
<p>Participant manual - Information on how/where to walk, PA benefits, PA relapses</p>	<p>Monthly group meetings with other women with asthma at Chicago Park District location close to their home. The intervention incorporates information on engaging in PA with asthma and overcoming barriers related to asthma and is led by an AA woman with asthma. Incorporating information on engaging in PA with asthma in participant manual</p>	<p>Monthly meetings were based on participant feedback from the original intervention and from our focus groups. The meeting location was chosen for convenience and to promote awareness of community locations to engage in PA. Addressing asthma-specific barriers were added to the interventionists guide manual and to be reviewed during the group sessions. An AA women with asthma will be used for intervention delivery and only AA women with asthma will be in the group sessions to provide social support. To address lack of knowledge related to asthma and PA, educational information was added to the manual.</p>

consequences), problem solving to overcoming barriers related to asthma (decision processes), and engaging in walking/stretching (physical capability). The walking session is designed to provide a safe environment where women can experience first hand that being physical activity can be done safely. The intervention manual will be modified to incorporate educational information on the benefits of physical activity in asthma (knowledge).

7. Discussion

The purpose of this study was to assess barriers to physical activity among African American women with asthma (phase 1) and apply the results to tailor a physical activity intervention for African American women with asthma. Using focus groups with African American women with asthma, we identified several unique barriers to engaging in physical activity that were modified in the physical activity program. These included a lack of knowledge of the benefits of physical activity for asthma, lack of social support from others with asthma, and negative beliefs of capability and consequences of engaging in physical activity with asthma. This study is unique as it examines barriers to physical activity in a vulnerable segment of the asthma population that is not well represented in prior research—low income African American women with asthma—and adapts an intervention to target the barriers in a theory-informed manner.

Many barriers to physical activity identified in our focus groups and interviews are consistent with the findings in the literature. Mancuso and colleagues qualitatively explored barriers and facilitators to exercise in a mixed racial/ethnic asthma population. Similar to our study, they found extreme weather and the cost of exercise facilities to be barriers and support from their social network as a facilitator to exercise (Mancuso et al., 2006). Janevic and colleagues performed interviews with 25 African American women with asthma and other co-morbid conditions (diabetes, heart disease, arthritis) with the goal of identifying asthma self-management challenges. While the focus of the study was not on physical activity, similar to our findings, they found that the women were not aware of the benefits of regular physical activity in managing asthma. Furthermore, women were not aware of how to safely engage in physical activity such as use of asthma pre-medication (Janevic, Ellis, Sanders, Nelson, & Clark, 2014). A lack of awareness regarding the safety and benefits of physical activity in the context of asthma were not identified by Mancuso and colleagues suggesting they may be unique to African American women or at least to our population. The knowledge of how to safely engage in physical activity with asthma is fundamental to basic asthma education. Thus, we have included an asthma and physical activity training/education session in our modified intervention. The results of our study are similar to those reported in studies with African American women unaffected by asthma that identified safety concerns, lack of social support, lack of a physical activity partner and lack of adequate sidewalks as barriers to activity (Joseph et al., 2015). However, in addition to those, unique barriers for AAW with asthma that were identified in this study included the desire for social support from women with asthma and beliefs about risk of death/intubation from an asthma exacerbation. These barriers will be addressed in the group sessions and asthma education session of our modified intervention.

Some barriers we identified need further evaluation to understand the contextual factors association with them. For example, many of the comment related to social support suggested that women may be socially isolated due to their asthma and lack of physical activity. While we did not ask about social isolation, patients with severe asthma experience greater social isolation which is a manifestation of depression and anxiety. (Foster, 2017; Wingate & Hansen-Flaschen, 1997) These disorders are more commonly seen in asthma patients and are associated with increased health care utilization and asthma exacerbations (Wang et al., 2011; Wingate & Hansen-Flaschen, 1997; Zhang et al., 2016). Further exploration of these factors are needed. Additionally, neighborhood violence is associated with social isolation (Graif, Lungeanu, & Yetter, 2017). Many of the women included in our study were from neighborhoods that have high rates of violence. They noted that neighborhood safety was a concern for

engaging in physical activity. The lack of interconnectedness and the desire for greater health socialization are important cultural values of African American women (Akbar, 1989; Ashing-Giwa, 1999). Addressing these values through group sessions and modeling or “role model interventions” have been effective in several health promotion interventions targeting physical activity with chronic health conditions but none have addressed asthma, a common chronic disease in African American women (Bronner & Boyington, 2002; Erwin, Spatz, & Turturro, 1992; Stolley, Sharp, Oh, & Schiffer, 2009; Wilbur, Chandler, Dancy, Choi, & Plonczynski, 2002; Wilbur, Michaels Miller, Chandler, & McDevitt, 2003). With this in mind, our modified intervention includes group sessions where African American women with asthma can share their experiences, barriers to engaging in physical activity with asthma and identify African American female role models that engage in physical activity. The other unique life experience barrier to physical activity identified by almost one-third of the women was a real fear of death from an asthma exacerbation. This fear impacted their motivation to engage in physical activity and is a critical barrier that needs to be addressed. The modified intervention addresses this barrier through asthma education, teaching problem-solving skills to improve enablement to engage in physical activity, and the opportunity to experience increased physical activity safely (walking groups in the intervention).

A novel component of our study is the use of a comprehensive theory-informed approach, which was not used in prior studies. This enables for a more detailed and thorough process of intervention modification. Interventions designed for behavior change have had varied effects which may be due, in part, to a lack of explicit rationale for the intervention choice and the use of inappropriate methods to design the interventions (French et al., 2012). The use of a theory-informed approach for intervention modification has identified potential behavior change techniques and modes of delivery that are likely to be effective. We are currently assessing whether each intervention component modifies its targeted barriers and is effective in promoting physical activity as part of a pilot study (Clinical Trials # NCT03265665).

The African American women included in our study were predominantly low-income and from an urban academic center. The barriers identified may not be generalized to all African American women, especially those not living in an urban environment or with higher incomes. While our intent was to conduct FGDs, due to scheduling conflicts of other group participants, we conducted five individual interviews in African American women with asthma. The lack of a group setting, may have impacted the responses from these women.

8. Conclusion/key findings

Maintaining an active lifestyle and engaging in moderate physical activity at least twice a week is recommended as a part of optimal asthma management (Nici et al., 2006). Urban-dwelling African American women face unique barriers to physical activity which include a lack of knowledge of the benefits of physical activity for asthma, a lack of social support from others with asthma and negative beliefs of capability and consequences of engaging in physical activity with asthma. As evidence for the asthma benefits of physical activity continue to accrue, implementing physical activity interventions in the patients that could benefit most will be crucial (Nyenhuis, Dixon, & Ma, 2017). Obtaining and incorporating the input of a high-risk population, such as African American women with asthma, and adapting a physical activity intervention designed to address their specific barriers to behavior change may ultimately have important implications for improving the standard of asthma care.

List of Abbreviations

COM-B Model	Capability, Opportunity, Motivation-Barriers Model
EHR	Electronic Health Record
FGD	Focus Group Discussion
TDF	Theoretical Domains Framework

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Disclosure Statement

The authors declare that they have no competing interests. The authors alone are responsible for the content and writing of the paper.

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Appendix A. Theoretical Domains Addressed in Focus Group Discussion/Interview Guide

Capability	Opportunity	Motivation	Sample Focus Group Questions
Knowledge			Are you familiar with any physical activity recommendations for patients with asthma? What do you think the recommendations say about physical activity in patients with asthma? What types of physical activity do you think are recommended for people with asthma?
Behavioral regulation • Action planning • Self-monitoring • Self-confidence • Perceived competence			What steps would you need to take to prepare to start walking regularly? What do you currently do if you have asthma symptoms during PA? What are your biggest challenges for engaging in physical activity (Walking)? How difficult is it for you to walk?
Attention	Environmental context/resources		Have you noticed any efforts in your community to promote walking? When is the last time you remember seeing a walking trail/paths in your neighborhood/community? To what extent does not having adequate sidewalks or walking trails hinder you from walking in your community? To what extent does violence prevent you from walking in your community?
	Social Influences		Do you think most women with asthma engage in physical activity (walking)? Do you feel like you walk more when you have a walking partner(s) OR when you are alone? Or the same?
		Beliefs about capabilities/consequences	How do you think not being physically active affects your asthma? What problems have you encountered in the past when walking? What do you think are the benefits of walking: to you personally? to your family? to the wider community?



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