



Rhythm experience and Africana culture trial (REACT!): A culturally salient intervention to promote neurocognitive health, mood, and well-being in older African Americans

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ABSTRACT

The Rhythm Experience and Africana Culture Trial (REACT!) is a multi-site randomized controlled intervention study designed to examine the efficacy of using African Dance as a form of moderate-intensity physical activity to improve cognitive function in older African Americans. African Americans are almost two times more likely than Caucasians to experience cognitive impairment in late adulthood. This increased risk may be attributed to lower level and quality of education, lower socioeconomic status, and higher prevalence of vascular diseases, type 2 diabetes, hypertension, and obesity, all of which are recognized as risk factors for dementia. Fortunately, interventions targeting cardiovascular health (i.e., physical activity) are associated with improved neurocognitive function and a reduced risk for dementia, so African Americans may be particularly suited for interventions targeting cardiovascular health and cognitive function. Here, we describe a randomized intervention protocol for increasing physical activity in older (65–75 years) African Americans. Participants (n = 80) at two study locations will be randomized into one of two groups. The treatment group will participate in African Dance three times per week for six months and the control group will receive educational training on Africana history and culture, as well as information about health behaviors, three times per week for six months. If successful, the REACT! study may transform community interventions and serve as a platform and model for testing other populations, age groups, and health outcomes, potentially identifying novel and creative methods for reducing or eliminating health disparities.

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1. Introduction

African Americans are almost two times more likely than Caucasians to develop Alzheimer's disease and related disorders (ADRD) [1]. In a 2010 report from the Alzheimer's Association on race and ethnicity, for those over the age of 65, the prevalence of cognitive impairment was 8.8% in Caucasians and 23.9% in African Americans [2,3]. Even in the age range of 55–64 when the incidence and prevalence of dementia is lower, African Americans are about 4 times more likely to experience cognitive impairment than their age-matched Caucasian counterparts [2,3].

These striking health disparities do not appear to be driven by known genetic factors. Instead, this increased risk could be attributed to lower levels and quality of education, lower socioeconomic status, or higher prevalence of cardiovascular disease and obesity, all of which have been recognized as risk factors for dementia [4–6]. In terms of vascular risk factors, 72% of African Americans who are older than 55 have high blood pressure, compared to 54% of Caucasians [3]. Adjusting for age, 46.5% of African Americans meet criteria for obesity, compared to 33.8% of Caucasians. Because of elevated vascular risks in African Americans, decline in brain integrity and function may occur earlier in the lifespan than for Caucasians [7]. In fact, vascular problems have been related to lower mood (i.e., depression) and poorer quality-of-life in older samples [8–10]. As such, this at-risk population may be particularly suited for interventions targeting cardiovascular health, such as increased physical activity.

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Fortunately, physical activity is a promising, low-cost method for improving neurocognitive function and reducing risk for dementia in older adults [11–13]. Prospective epidemiological studies indicate that a lower level of physical activity is a risk factor for dementia and contributes to 21% of Alzheimer's disease cases in the United States [14]. Randomized interventions have shown restorative effects of physical activity on cognitive and brain outcomes in older adults [13,15]. For example, higher fit adults have larger hippocampal volumes than their less fit counterparts [16] and a one-year walking intervention increased the size of the hippocampus in cognitively normal adults [13]. Further, the effects of physical activity may be augmented when examining adults who are at a higher risk of decline [17,18]. It has also been shown that walking approximately 1 mile/day was sufficient to spare gray matter volume in prefrontal and hippocampal circuits, which decreased the risk of cognitive impairment by half [12,19,20].

Unfortunately, despite the known benefits of physical activity, few older adults actively and regularly engage in moderate-intensity activities. Hence, there is a growing interest and need to identify approaches that make physical activity more enjoyable and widely adopted. One such activity may be dancing, which is often used in senior centers and nursing homes as a therapeutic tool to increase activity [21]. Randomized interventions have demonstrated that dancing may be effective at increasing physical activity and improving physical fitness. For example, traditional ballroom, tango, or salsa dancing has been associated with improvements in mobility, balance, motor skills, coordination, and resting heart rate in older adults [22,23]. Dancing may also improve self-confidence, mood [24], and cognitive function [25–28]. Furthermore, epidemiological studies find that dancing is associated with a reduced risk for cognitive impairment [29].

2. Objectives

In this paper, we describe the protocol for a multi-site study examining the effects of an African Dance intervention on cognition, mood, quality-of-life, and physical fitness in a sample of older African Americans. We predict that African Dance will appeal to older African American adults more than traditional physical activity interventions because of its cultural, ethnic, and spiritual salience. Although there are many (thousands) of different forms of dance originating from Africa, we focus on Western African dance routines that are commonly adopted at community centers in the United States. Specifically, Western African Dance (hereafter referred to as African Dance) refers to a loose constellation of dance practices derived from Western Africa. In part because of the large African diasporic population in the US, African Dance is surging in popularity in many cities and has helped revitalize the roots and traditions of African culture. African Dance treats the body as having multiple, semi-independent centers. Each region of the body follows a different rhythm and gestural pattern. Because of this, total body articulation is heightened and requires significant movement, coordination, and endurance. Thus, African Dance may be an effective approach to engage older African Americans in an enjoyable and culturally sensitive mode of physical activity. Our aims are to [1] document interest, recruitment and enrollment rates, and adherence to the intervention in order to illustrate feasibility; [2] establish the infrastructure for conducting and translating the intervention to the community; [3] determine effect sizes; and [4] examine whether the intervention improves cognitive performance, quality of life, mood, or fitness levels when compared to the educational control group.

3. Study population

3.1. Inclusion and exclusion criteria

The REACT! study intends to enroll a total of 80 African Americans between 65 and 75 years of age in two separate waves (40 in the first wave and 40 in the second wave). The second wave is expected to

begin six months after the conclusion of the first wave. This will allow sufficient time to identify the strengths and weaknesses of the protocol and make adjustments accordingly. Participants are recruited from the Pittsburgh and Philadelphia communities ($n = 40$ total at each site). Both sites will implement the protocol simultaneously. Recruitment is open to both men and women, although equal numbers of men and women are not required. Eligible participants must 1) report English as their primary language; 2) not have dementia or any other neurological or severe psychiatric disorder; 3) report no history or evidence of type 2 diabetes or non-medicated hypertension; 4) be mobile and ambulatory; 5) report no history of balance problems, falls, or any other physical condition that would preclude minimal risk of an exercise-related injury; 6) not have had any serious cardiac or cardiovascular event within the past 2 years; 7) score at least 21 points (i.e., normal to mildly-impaired range) during administration of the Telephone Interview of Cognitive Status (TICS); and 8) be available at the times classes will occur and be able to coordinate their own transportation to the class and test sites. Individuals with Type 2 diabetes and hypertension would probably benefit from an intervention such as this, but were excluded to reduce heterogeneity in the sample characteristics and outcomes. Participants must also successfully complete and pass their baseline cognitive assessment and cardiovascular fitness test (submaximal VO_2 test performed on a treadmill) as an additional measure of their ability to participate safely in the physical activity intervention.

3.2. Recruitment, screening, and enrollment

Participants are recruited from the Pennsylvania Pharmaceutical Assistance Contract for the Elderly (PACE) registry in the Pittsburgh and Philadelphia communities. This registry is exclusive to low-income individuals, many of whom are urban and African American. To introduce the study, letters from the Director of PACE and both sites' Principal Investigators are sent to randomly selected African American PACE enrollees aged 65–75 in the Pittsburgh and Philadelphia areas. REACT! study coordinators then follow up the letter with a telephone call to provide further information, ascertain interest, and assess eligibility. To complement the recruitment letter, promotional flyers are distributed within each community. Additional prospective participants are identified through the University of Pittsburgh and University of Pennsylvania Alzheimer's Disease Centers. Eligible subjects are scheduled for baseline cognitive and fitness assessments.

One member of the research team at each site is responsible for randomization, which occurs immediately following completion of all baseline assessments. Subjects are randomized to one of the two groups through a computer algorithm.

4. Neurocognitive, mood, and fitness measures

Self-reported demographic information, current and past history of cigarette smoking, and family history of age-related cognitive issues are collected. A series of cognitive and mood tests, as well as a submaximal VO_2 fitness test, are administered at baseline and again within 2 weeks of completion of the 24-week intervention. Participants are compensated for completing the pre-intervention and post-intervention cognitive and fitness assessments.

To assess cognitive function, a comprehensive neuropsychological battery of pencil-and-paper tasks is administered to potential subjects. These tasks are designed to measure cognitive abilities such as memory, attention, processing speed, executive function, language, and spatial reasoning. The battery is comprised of: Mini-Mental State Exam (MMSE); Repeatable Battery for the Assessment of Neuropsychological Status (RBANS); National Adult Reading Test (NART); Digit Span Backwards; and Trail Making Test Parts A & B. The RBANS is a standardized neurocognitive battery consisting of 5 indices: immediate memory, visuospatial and constructional skills, language, attention, and delayed

memory. Digit Span Backwards and the Trail Making Test B serve as executive function measures.

Participants also complete questionnaires regarding mood and quality of life. These tests include: Positive and Negative Affect Schedule (PANAS); a questionnaire to assess feelings of connection and interest in activities; Satisfaction with Life Scale (SWLS); UCLA Loneliness Scale; Instrumental Activities of Daily Living (IADL); Global Health Scale; Center for Epidemiologic Studies Depression Scale (CES-D); and the Geriatric Depression Scale (GDS).

Fitness is measured by a submaximal VO_2 test. This test requires walking between 2.0–4.0 mph with increasing grade increments of 1% every 1 min. The test is terminated when the subject reaches 85% of his/her age-predicted heart rate, a rating of perceived exertion (RPE) of 15 or greater in subjects taking beta-blocking medication, or at volitional exhaustion. Submaximal VO_2 is highly correlated ($r > 0.80$) with VO_2 max [30] and is often used for at-risk populations as a safer approach to measuring cardiorespiratory fitness. Blood pressure is monitored before and after the fitness test to ensure safety of the procedure.

5. Experimental design

Upon completion of the baseline assessments and randomization, subjects are provided a study folder containing contact information (names, phone numbers, and email addresses) to enable communication with research personnel in the event of injury, illness or health/medical updates, or other circumstances resulting in missed classes, as well as to obtain additional study information. The folder also contains the assignment information to either the African Dance or Culture Education group, along with relevant addresses, maps, and parking instructions. Additionally, there is a calendar of class dates (including expected topics to be taught for the education group). Other content in the study folder consists of an introduction letter from the lead researchers, biographies of the instructors, and an outline of the research protocol.

At the start of the intervention, all participants are contacted via phone by members of the research team. Subjects are reminded of their group assignment as well as the date, time, and location of the dance or education classes.

5.1. African dance intervention

In the African Dance group, basic principles and guidelines for exercise programming (ACSM, 2010) are followed. This includes adequate warm-up and cool-down, progressive and gradual increments in duration, and instruction regarding avoidance of physical activity-related injury. The African Dance group receives moderate-intensity dance instruction for 1 h per day (including warm-up and cool-down), 3 days per week, for 24 weeks. Instructors track attendance at each class. We chose a 24-week timeframe for the intervention based on prior exercise studies that have shown larger effect sizes for interventions of 6-months or greater [11].

African music and dance is suitable for those with no formal musical experience. Instruction in African Dance begins with participants copying simple movements from the instructor. Once a basic repertoire of movements has been developed, the movements are choreographed into sequences. Dance sessions are standardized across the Pittsburgh and Philadelphia sites, with highly trained instructors contacting each other on a weekly basis to discuss protocols and any issues with the classes as they arise. Dance sessions occur in senior/community centers in Pittsburgh and Philadelphia neighborhoods that are predominantly African American. Classes are taught by trained African Dance instructors, and research coordinators are also present at both sites for all sessions to monitor heart rate, exertion, and safety.

Levels of exertion during dance are prescribed and monitored based on baseline assessments of heart rate and cardiorespiratory fitness. For the first two weeks of the intervention, the target heart rate is maintained at 50%–60% (light-moderate intensity) of the age-based maximum heart

rate ($220 - \text{age}$). For the remaining 22 weeks, dance instructors and research coordinators use a target heart rate of 60%–70% (moderate intensity) of the age-based maximum heart rate. Exercise programs that increase heart rate to this extent are effective at improving aerobic capacity by 15% or more over a period of 4–6 months [31].

To monitor heart rate and intensity of the dancing, each participant is equipped with a Bluetooth-enabled Polar H7 Heart Rate Sensor at the start of each class. Using the Polar Team App, research personnel are able to continuously monitor the heart rates and percent of maximal heart rates in real time of all participants simultaneously. Screen shots of the Polar Team App are taken at 15 min intervals throughout each exercise session, thus providing data for each participant at 0, 15, 30, 45, and 60 min of exercise. At the conclusion of each exercise session, the Polar Team App automatically calculates the average percent time in the heart rate zone, maximum heart rate percent, and number of calories burned for all participants.

Each exercise session begins with a warm-up of 5–10 min at an intensity below the target heart rate, and the sessions conclude with an instructor-led cool-down period of stretching for 5–10 min. Participants' vital signs are measured and recorded at the beginning and end of every session. Also upon completion of each session, subjects are asked to provide a rating of perceived exertion (RPE) of the dance class. Participants are monitored until heart rate and blood pressure have returned to resting levels ($\text{HR} < 100$ bpm; $\text{systolic BP} < 190$; $\text{diastolic BP} < 100$). Frequent assessment of heart rate and RPE help to ensure appropriate levels of intensity during each session.

5.2. Culture education intervention

The Culture Education control group receives materials focused on African culture, history, geography, religion, and politics, as well as art interpretation and creation. Participants also are instructed about healthy lifestyles, behaviors, and risks for disease. Topics vary from session to session to maintain engagement in the intervention. As with the African Dance group, the Culture Education group meets 1 h per day, 3 days per week, for 24 weeks, with attendance taken at each session.

Culture Education classes are designed to be as useful, interactive, and entertaining as the African Dance classes to increase the likelihood of adherence as well as promotion of well-being. The educational sessions are led by instructors with expertise in each particular topic area and are conducted in a group format similar to the dance sessions. Participants receive handouts at the start of every class to help maintain engagement. After a few weeks of classes on pre-planned topics, participants are asked to rate various subject matters according to their interest, and the content of future classes is planned based on the feedback.

5.3. Similarities and differences

Both the African Dance and Culture Education groups receive an equivalent amount of social interaction with fellow participants and study coordinators. Both groups also receive intellectual stimulation and cognitive engagement, as both education and dance are cognitively engaging. The two groups only differ in that the treatment group will be receiving an interactive form of aerobic physical activity.

5.4. Retention

During recruitment, prospective participants are informed about the general design of the study and are told that the investigators are examining whether dance or educational classes improve the health and well-being of African Americans. Researchers will emphasize the time commitment and the importance of maximal attendance.

The informed consent process and document are used to clarify goals and increase initial participant commitment to the goals, in addition to providing full disclosure and understanding of all procedures.

This document, which is read and signed by the participant and staff member prior to completing baseline measures, restates the responsibilities of both the participant and the research team with respect to the study. The research team also maintains frequent contact with all participants, both via telephone and in-person at the scheduled sessions. These interactions focus on individual instruction, support, goal-setting, and feedback throughout the intervention period, all tailored to facilitate each individual's ongoing involvement.

To promote adherence in the African Dance group, participants are encouraged to set individualized goals based on their baseline submaximal VO₂ testing results, and they receive personalized feedback on their progress. To ensure that participants' expectations are reasonable and realistic, the research team carefully structures expectations regarding the effects of physical activity. Investigators also employ consciousness-raising and similar experiential processes related to the problems of under-activity and the benefits of adopting a more active, heart-healthy lifestyle.

In the education group, subjects are asked to provide feedback about the class structure and content at the conclusion of each session. Furthermore, they are given the opportunity to guide the curriculum by rating their relative interest in a list of potential future topics. Handouts are provided for each education class to keep participants engaged, and sedentary activities such as art projects are incorporated regularly to maintain enthusiasm by reducing potential monotony.

Certificates are awarded at the end of six months to all study participants in both groups and all will be invited to informal graduation ceremonies.

5.5. Data management

Each site maintains a password-protected database to store identifiable subject contact information. Data is collected and stored with de-identified Subject ID labels on secure data management systems. The University of Pittsburgh team is responsible for integrating the data from both sites in preparation for analysis.

Spreadsheets and forms are standardized across both sites. These standardized documents are used by the University of Pennsylvania team to send secure collected data to the University of Pittsburgh site. This ensures that the same data is collected and recorded in the same format to enhance reliability and quality control during data collection and analysis.

Regular conference calls, as well as a joint meeting at the University of Pennsylvania site prior to initiating the intervention, provide a forum for discussing standardization, data collection, progression of classes, and plans for future classes. Video recordings of the African Dance classes at both sites also facilitate standardization.

5.6. Statistical methods

Effect sizes for the intervention will be determined by comparing changes or differences in outcomes between groups (e.g., Cohen's *d* and Hedge's *g*) for all variables of interest to determine appropriate sample sizes for future interventions using African Dance.

Primary analysis is planned in an intent-to-treat (ITT) manner, such that all participants will be invited to return for the follow-up assessment regardless of their attendance or completion of the intervention. Secondary analyses will be conducted using a per-protocol approach, which restricts the analysis to the participants who completed the intervention. Baseline demographic characteristics of the entire sample and individual intervention groups will be summarized by conducting Pearson, Spearman, and Chi-square statistics as appropriate. A mixed effects General Linear Model will be used to assess effects of Time (baseline/24 weeks), Group (African Dance/Culture Education), and Time by Group interactions.

6. Discussion

The main purpose of REACT! is to examine the feasibility of using African Dance as a moderate-intensity physical activity intervention with an African American population in a randomized controlled trial. If successful, the data from this pilot study will provide preliminary data for a much larger randomized trial. Another purpose of this pilot study is to standardize the protocol at two sites that are not geographically proximal. This step is essential since a larger randomized trial will most likely have multiple implementation sites spread across the country. Protocol and measurement standardization will allow the data from all sites to be combined for analysis and dissemination. If successful, this innovative African Dance intervention will be able to be implemented at other locations.

Outstanding questions include: What challenges are encountered during recruitment and screening? What are rates of adherence and compliance in both groups? Is the Culture Education control group an appropriate control group? What effect will African Dance have on fitness, quality-of-life, and cognitive measures? What unanticipated problems might occur and how can they be corrected? What are the barriers to protocol initiation at each site?

One strength of the intervention is that it is an engaging and culturally-salient activity that is already being widely adopted in many communities. If we find that African Dance may promote cognitive health and well-being, it may be a way to reach multiple communities relatively rapidly compared to other potential approaches to improve cognitive function (e.g., cognitive training using video games). In addition, some individuals report not "liking" exercise but may still be interested in dancing. Therefore, dancing may be an effective way to get individuals more active without an explicit reference to "exercise". One weakness of this study is that we do not have sufficient resources to be able to identify biological mechanisms for the effects of the intervention. It will be important for future research to examine potential biological pathways by which African Dance or Education positively influences cognitive, mood, or quality-of-life outcomes.

In summary, REACT! has been developed to investigate a culturally salient form of physical activity that could enhance the neurocognitive health and physical and emotional well-being of older African Americans. Prior studies have shown promising effects of physical activity, but REACT! specifically seeks to provide a fun, engaging, and broadly-translatable platform for reducing the health disparities that currently exist for older African Americans.

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