BAILA: A Randomized Controlled Trial of Latin Dancing to Increase Physical Activity in Spanish-Speaking Older Latinos

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Abstract

BACKGROUND: Latinos are the fastest growing minority group of the older adult population. Although physical activity (PA) has documented health benefits, older Latinos are less likely to engage in leisure time PA than older non-Latino whites. Dance, popular among Latinos, holds promise as a culturally relevant form of PA. **PURPOSE**: To describe self-reported and device-assessed changes in PA as a result of a randomized controlled trial of BAILAMOS™, a 4-month Latin dance program with a 4-month maintenance program, versus a health education control group. **METHODS**: Adults, aged 55+, Latino/Hispanic, Spanish speaking, with low PA levels at baseline, and risk for disability were randomized to the dance program (n = 167) or health education condition (n = 166). Data was analyzed using multilevel modeling with full information maximum likelihood. **RESULTS**: A series of multilevel models revealed significant time X group interaction effects for MVPA, dance PA, leisure PA, and total PA. Exploring the interaction revealed the dance group to significantly increase their MVPA, dance PA, leisure PA, and total PA at months 4 and 8. Household PA and activity counts from accelerometry data did not demonstrate significant interaction effects. **CONCLUSIONS**: The study supports organized Latin dance programs to be efficacious in promoting self-reported PA among older Latinos. Efforts are needed to make dancing programs available and accessible, and to find ways for older Latinos to add more PA to their daily lives.

Trial Registration: ClinicalTrials.gov: NCT01988233

Keywords: Physical activity; Latin Dance; Hispanic; Aging; Older adults

Introduction

Over the next four decades the American older population will experience an increase in its racial and ethnic diversity. By 2050, 18.4% of the older population in the U.S. will be comprised of Latinos [1]. This is an increase of 11.1% since 2012 and is significant because the health of many older Latinos is poor. Currently, Latinos have higher prevalence of chronic diseases [2-4] and are at greater risk for Alzheimer's disease compared to non-Latino whites [5-7]. Participation in regular physical activity (PA) is a well-established means to mitigate risk for these outcomes [8]. However, Latinos currently have very low leisure time PA rates [9-12], largely attributed to low socioeconomic status [11], and many older Latinos do not have a history of engaging in traditional structured exercise (e.g., jogging or going to a gym to run on a treadmill, lifting weights, etc.) [12, 13].

PA in the form of structured exercise is not considered age-appropriate by many older Latinos, who believe exercising is for young people [14]; however, older Latinos value functional independence, and relate physical fitness to feeling healthy and being able to perform activities with ease [14]. Dancing and walking have been cited as age-appropriate forms of PA for older Latina women [13], and have been the most commonly reported forms of PA among older Latinos [15]. Latinos have even suggested that community dancing events featuring various types of Latin music would be an important community resource for engaging in PA [16]. Despite these findings, few PA interventions with Latinos have included dance as a mode of PA [17]. Dance is an important form of socialization and leisure in Latin cultures [18, 19] that has the advantage of challenging individuals both physically and cognitively. The literature on the health effects of dance for older adults indicates that regular dancing can significantly improve mobility [20-23], cognition [24-29], quality of life and social engagement [20].

Moreover, dance is enjoyable [30], a feature that could lead to increased maintenance of behavioral change [31]. Thus, there is a need to test culturally appropriate options for increasing PA in Latinos. Moreover, interventions that utilize theories such as Social Cognitive Theory [32] have been shown to support behavior change such as physical activity [33], thus including opportunities for mastery, social modeling, and verbal persuasion in older Latinos is useful in an intervention.

There is still much to be learned about methods to reduce PA disparities among older Latinos. To date, *interventions with older Latinos that incorporated PA* in some way have not focused on increasing PA, but rather have primarily focused on: diabetes or chronic disease management [34-37], females [38, 39], older adults with mild cognitive impairment [40], improving cognitive function [41, 42], improving depressive symptoms [41] or improving physical function [43]. Only one study specifically aimed to increase PA in older Latinos [44] in which King et al. used a virtual advisor available to participants in a community center. Studies of *dance interventions for older adults* have: (1) focused on older adults with cardiovascular risk factors [45, 46] or Parkinson's disease [47], (2) focused on outcomes such as risk of falls [48], physical health [25, 49], and cognition [24]; (3) largely been conducted outside the U.S., and (4) not been conducted with older Latinos. Thus, the purpose of the current randomized controlled trial (named B.A.I.L.A.: *B*eing *A*ctive, *I*ncreasing *L*atinos' healthy Aging) was to test whether a Latin dance program (BAILAMOS™ – *B*alance and *A*ctivity *I*n *L*atinos, *A*ddressing *M*obility in *O*lder *A*dult*s*) could increase PA relative to a health education control condition among Spanish-speaking older Latinos. We hypothesized that participants in the BAILAMOS™ intervention condition would have greater increases in self-reported and device-assessed PA relative to the control condition at both the primary (month 4) and secondary (month 8) timepoints.

Methods

Overview and study design

This study is registered with ClinicalTrials.gov as NCT01988233, and CONSORT guidelines were followed for delivering and reporting the intervention. Study approval was obtained from the Institutional Review Boards (IRB) at the University of Illinois at Chicago, University of Illinois at Urbana-Champaign, and Rush University. This study used a two-condition randomized controlled trial (RCT) with randomization at the level of the individual to the BAILAMOS^{TM} dance program or to a health education control group. Participants were randomized within 12 study sites, located in geographic areas with a high concentration of Latinos. Attempts were made to minimize contamination across conditions in that instructors did not allow participants from the other condition to attend their respective classes. This strategy helped to ensure that all sites had the opportunity to offer a dance program, which was important for continuing positive relationships with community centers that serve older adults.

Participants

Inclusion criteria (self-reported) were: (1) age $\geq$ 55 years old; (2) self-identification as Latino/Hispanic; (3) ability to speak Spanish; (4) self-reported participation in $\leq$2 days/week of aerobic exercise [“how many days per week do you exercise to improve your health or fitness (defined as structured, planned, and repetitive aerobic activity such as walking or swimming, for a long period of time with a specific goal, such as increasing your conditioning physical, physical functioning, or your health; activity to run errands, such as transportation, etc., is something different)?]; (5) at risk for disability (see operationalization below); (6) adequate cognitive status as assessed by the Mini Mental State Examination (>14/21) [50]; (7) danced < 2 times/month over the past 12 months; (8) willingness to be randomly assigned to intervention or control group; (9) no plans to leave the country for more than two consecutive weeks over the next year.

Exclusion criteria (self-reported) included: (1) presence of uncontrolled cardiovascular disease or uncontrolled diabetes mellitus, (2) pacemaker in situ, (3) stroke within the past 12 months, (4) severe chronic obstructive pulmonary disease (COPD), (5) recent healing or unhealed fracture(s) [51], (6) use of an assistive device to walk (cane, walker, or wheelchair) since such individuals are already considered mobility disabled [52, 53].

At risk for disability (one inclusion criterion) was operationally defined as one of the following: (1) presence of diabetes [54, 55]; (2) underweight (BMI lower than 18.5) [56]; (3) overweight or obese (BMI greater than 25.0) [56, 57]; or (4) difficulty or change with any one of the following four tasks: (a) walking a long distance (4 blocks or ½ mile), (b) climbing 10 steps, (c) transferring from a bed or chair, (d) walking a short distance on a flat surface. Two questions were asked for each task: ‘‘Have you had difficulty (task)’’ and ‘‘Have you changed the way you (task) or how often you do this, due to a health or physical condition?’’ Older adults with difficulty or change with any one of the four tasks were eligible for the study, similar to methods used by Weiss et al. [53] and those used in our BAILAMOS™ pilot study [58].

In addition to study inclusion/exclusion criteria we used the Exercise Assessment and Screening for You (EASY) questionnaire to detect presence of conditions that could preclude study participation [59, 60]. Items include “Do you have pain, tightness or pressure in your chest during physical activity (walking, climbing stairs, household chores, similar activities)?” and “Do you currently experience dizziness or lightheadedness?” The EASY has recommendations for use when evaluation by a physician is needed before beginning a PA program (e.g., when the individual reports new-onset of a problem, or a problem that has not been previously evaluated by a health care provider), and we followed these recommendations.

Recruitment procedures

Participants were recruited using established relationships developed by the study team who had been working with Latino communities in the Chicagoland area since 2007. The Community Engagement Advisory Board (CEAB) of the Center for Clinical and Translational Science (CCTS) at the University of Illinois at Chicago also provided assistance. Recruitment was conducted for up to two months prior to intervention start through presentations at each study site (n=4 churches, 6 senior centers, 1 community center, and 1 dance center), churches with Spanish masses, parks, and coalition meetings; health centers and clinics, word of mouth, flyers in mailboxes of senior housing facilities, presence at supermarkets, senior fairs and health fairs, and articles and ads in neighborhood and city-wide newspapers and websites. We attempted to recruit until we had 40 participants recruited for a site, so that half would be randomized to treatment and half to health education control group. When we could not recruit 40 participants for a site or if we were limited by space at some of the community places (in order to keep participants safe from tripping), recruitment was stopped.

Randomization, Enrollment, and Testing

Potential participants could consent to be screened in two different ways, including learning about the study and signing a sheet agreeing to be called by a research staff member at a later time; and learning about the study another way and calling our office to be screened. Bilingual study staff screened all interested individuals for eligibility based on inclusion and exclusion criteria using REDCap™, a secure, web-based application for building and managing online surveys and databases [61, 62].

Those who qualified were scheduled for baseline testing, which primarily took place at the Center for Clinical and Translational Science; remaining testing took place in the Principal Investigator's lab space. We aimed for baseline assessment to be within 2 weeks prior to the start of the intervention, however, it varied from 1-4 weeks depending on participant availability. Data collection staff were not informed about participants' study condition. At the assessment, a staff member read the Informed Consent to the participant and questionnaires and tests (available in Spanish or English) were then administered. Classes for the two study conditions were in Spanish so participants had to be able to speak Spanish to be eligible for the study; however, some participants preferred to complete questionnaires in English. At baseline participants received an accelerometer at the end of the assessment visit and wore it for 7 days. At the follow up visits, we asked participants to wear it during the week after the assessment.

Those who completed baseline testing were randomly assigned by Almedtrac, Inc. staff to the dance condition or the health education control condition using randomization based on sex offered in the Study360™ software (Almedtrac, Inc.). This was a group-based intervention, so those at a particular site all started at the same time. Study360™ software has the previous site randomizations stored, so that overall, approximately the same number would be randomized to each of the two study conditions.

At 4-months and 8-months, post-intervention and post-maintenance testing occurred, respectively. Questionnaires and tests were administered in the same order as the baseline testing. Participants received $10 for completing testing and $10 for wearing an accelerometer at each of the three respective study timepoints.

The BAILAMOS™ dance program

The BAILAMOS™ dance program was co-created by (Dr. David X. Marquez) and (Miguel Mendez), a professional Latin dance instructor who led the dance classes by following the dance manual they created. The dance instructor was trained on study details such as taking attendance, leading stretching, and completing session logs; and was paid by the grant. The BAILAMOS™ dance program is a 4-month, twice-weekly (one hour per session) dance program (32 sessions total). BAILAMOS™ encompasses four dance styles: Merengue, Cha Cha Cha, Bachata, and Salsa presented in that order with the simplest dance style introduced first and the most difficult style last to promote self-efficacy through mastery and accomplishment. The program has structured and unstructured dancing, for example, every other week one session is devoted to "*Fiestas de Baile*," ("Dance Parties") during which participants spend time dancing and practicing what they had learned. In addition, the instructor emphasizes increasing household and transportation PA outside of the program. Monthly discussion sessions, done the hour before the dancing session, utilize a Social Cognitive Framework [32] and are delivered in-person, by a research team member with expertise in PA to the dance/treatment group participants. Discussion session leaders reviewed the discussion sessions with the PI (Dr. Marquez) before the intervention began to ensure clarity of information.

During the 4-month maintenance phase (months 5–8), 2–3 volunteer indigenous leader(s) (i.e., participants from the initial 4-month dance condition from each site who were especially proficient at dancing, regularly attended the program, and were sociable) were asked about their interest and willingness to become "dance instructors." In a "train the trainer" model, indigenous leaders were trained to teach the BAILAMOS™ dance program, including new dance moves that were choreographed by the professional dance instructor. Indigenous leaders across study sites were taught the same additional dance moves to add to existing moves, and they led the original treatment group members at the respective site. Thus, the indigenous leaders and others in the group did the same dance moves, ensuring that the leaders and other participants were doing the same PA in class. As a result, all treatment group participants had the opportunity to continue dancing in months 5–8. More details about the program can be found in Marquez et al. [58] and Marquez et al. [63].

Study fidelity

The Behavior Change Consortium's (BCC) model of treatment fidelity was used to monitor the reliability and validity of the intervention [64].

Control group

Older Latinos randomly assigned to the health education control condition participated in classes developed for older adults and offered by the University of Illinois Extension. All classes were conducted in Spanish by Extension staff using Spanish-language materials. The curriculum covered topics such as stress, My (food) Pyramid, food labels, diabetes, cancer, osteoporosis, immunizations, building a better memory, and making the most of medical appointments. Classes met one day per week for two hours, to provide similar social contact to that in the intervention group.

Measures

Assessments were administered by a research assistant in Spanish or English to reduce participant burden and literacy concerns. Answers were collected using forms from the Pendragon Software Corporation on an iPad.

Antecedent variables

Demographics. Information about age, gender, education, income, marital status, country of origin, race, ethnicity, preferred language, and number of children was obtained.

Body composition. Staff of the UIC CCTS assessed current height and weight in stocking feet, and body mass index (BMI)(kg/m^2).

Acculturation. The Short Acculturation Scale for Hispanics (SASH) quantifies domain-specific language- and social-based acculturation levels [65]. The authors note that an average of 2.99 is the recommended cut point with scores above this point representing higher levels of acculturation and scores below this point representing lower levels of acculturation.

Primary Outcome

Self-Report PA. The Community Healthy Activities Model Program For Seniors (CHAMPS) Physical Activity Questionnaire for Older Adults [66] is a change-sensitive PA scale that assesses weekly frequency and duration of lifestyle PA (broken down into leisure time, household, occupational, transportation, and total PA) typically undertaken by older adults, reported as minutes per week. The CHAMPS has been translated into Spanish and used with older Latino adults [67], with established validity and reliability [66].

Device-Assessed PA. ActiGraph Model GT3X-Plus accelerometers (The Actigraph, Pensacola, FL) are small and lightweight triaxial accelerometers. These accelerometers provide valid assessments of lifestyle PA in men and women [68, 69], typically on the waist. In this study accelerometers were worn on the non-dominant wrist, as is done in NHANES data collection [70], and data were included in analysis if the accelerometer displayed at least 10 hours of data (> 0 count values for each hour) in a 24-hour period on at least 4 days [71]. Data were analyzed as total physical activity counts, as validated cutpoints for older adults from wrist-worn accelerometers are not currently available.

Adherence. We used the number of classes attended divided by classes offered for those who attended one or more class of the initial program or never attended the initial program but for whom we have M4 data available (n=4). We removed those who were randomized but never attended the program and did not do follow up testing at M4 (n=15).

Sample Size

A power analyses was performed for two groups nested within twelve clusters, with assessments at three time points revealed that a sample of 264 participants (132 participants/ study arm) would be required to detect significant differences at a small effect-size (f^2 = .25) [72].

Data Analysis

Descriptive statistics were obtained, and a series of multilevel models using full information maximum likelihood were conducted to investigate change in each type of physical activity outcome using STATA 16 MP [73]. Multilevel modeling allows for simultaneous assessments of within person variations at each time measurement (level 1), which was nested within study condition (level 2). Finally, study condition was nested within study site/cluster (level 3). Five models were tested to investigate the change of each PA outcome that included four measures derived from the CHAMPS (MVPA, total PA, leisure PA, home PA), and accelerometry PA. Dance PA was derived by the CHAMPS item asking about participation in dance. A time X group interaction was included in the model to test whether the change over time differed in the intervention versus control conditions. A significant interaction was further explored by reporting the simple slope effects for each study condition.

Prior to hypotheses tests, recommendations for assessing model structure were conducted to identify model features that would provide the best fit for the data. This was first performed by testing the necessity of including a random intercept. A random intercept anticipates the potential that each participant can have their own physical activity level starting point. Models that reveal significant chi-squared tests indicate that random intercept would improve the fit for that level of the model [74]. For the present study, tests for random intercept were conducted at the group and cluster level. Next, tests for slope analyses were performed to identify which time polynomial (linear, quadratic or cubic), or independent growth curve (IGC), would provide the best fit for the model [74-76]. The 2-log likelihood was used to calculate the Chi square difference, which was compared between models. The best polynomial can be identified by a model that yields a significant chi-square test. In a scenario where the chi-square tests are significant in two more polynomial tests, then the Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC) were compared. Models that have lower AIC and BIC values reflect strong model fit [74-76].

Results

Participant Flow

A total of 1,731 older adults were screened for eligibility of whom 333 met eligibility criteria and were randomized between May 2013 and October 2015 (Figure 1). Of those, 167 were randomized to the BAILAMOS™ intervention condition and 166 to the health education control group. Participants received the treatment of control condition at one of the 12 sites, and participants were roughly equally distributed across 12 sites. Thirty-four participants did not receive the allocated intervention ($N_{experimental} = 11$ and $N_{control} = 23$). Data from all randomized participants who attended at least one dance class and have month 4 data were included in the analysis. Of the 333 participants randomized, 218 completed testing at Month 8, representing a 65.5% retention rate. Across sites participants attended 60.5% of initial program classes, and 32.8% of maintenance program classes. No serious adverse events were reported.

Missing Outcomes

Missing data analysis that accounted for all tested variables and demographic data found 80.55% of the data were complete.

Baseline Analysis and Model Setup

Participants were on average 64.9 (SD = 7.09) years of age with low levels of acculturation, and an average BMI of 31.14 (SD = 4.78). The groups were homogeneous on baseline and all demographic variables (Table 1). Baseline analyses revealed that the groups did not differ in baseline MVPA, leisure PA, total PA, household PA and accelerometry PA. Central tendencies (mean, SD), in addition to effect size changes of between and within groups for each outcome variable can be found in Table 2.

Tests for random intercept revealed non-significance in chi-squared test for cluster, $\chi^2 = 7.47$, $p = .11$, and group, $\chi^2 = 6.98$, $p = .14$, which indicated that participants' random starting points based on randomization of group and cluster did not significantly change the model. Tests comparing independent growth curves (IGC) was used to identify which polynomial pattern of time would provide the best fit of investigating change in PA. The Chi squared difference from the 2-log likelihood of each polynomial model was found to be significant across all three models. Since all three-time slopes demonstrated significant Chi squared values, comparisons for best fit were performed using AIC and BIC values. From comparing these parameters, the linear time slope showed stronger model fit with the data.

Hypotheses Tests

Table 2 presents the means and standard deviations of each type of physical activity measure by study condition. The table also shows the effect size change for each type of physical activity measure from baseline to month four, and baseline to month eight. The model that tested change of MVPA found there was a significant effect of time, ($\beta = .19$, $p < .001$), indicating that

MVPA increased on average over the course of the study. The model also found group to be a significant predictor of MVPA, (β = .25, p = .004), but cluster was not found to be a predictive determinant (β = .025, p = .055) of MVPA. The group X time interaction was found to be significant, F (5, 745) = 8.75, p < .00 (Figure 2). Simple slope effects revealed the experimental group significantly increased in MVPA at month 4 (β = .60, p < .001), and at month 8 (β = .59, p < .001). The slope effects of the control group was found to predict an increase in MVPA at month 4 (β = .30, p = .029), but not at month 8 (β = .18, p = .208). The model that tested change in dance PA revealed a significant effect of time, (β = .28, p < .001), group, (β = .44, p < .001), but not cluster, (β = .01, p = .339). The group X time interaction was found to be significant, F (5, 745) = 25.96, p < .001. Simple slope effects revealed that the experimental group significantly increased in dance PA at month 4 (β = .92, p < .001), and at month 8 (β = .84, p < .001). The slope effects of the control group was not found to predict an increase in dance PA at month 4 (β = .11, p = .365), or month 8 (β = .20, p = .092).

The model that tested change in leisure PA found all levels to be significant determinants [time (β = .19, p < .001); group (β = .21, p = .040); cluster group (β = .04, p = .006)]. The time X group interaction was found to be significant, F(5, 745) = 8.15, p < .001 (Figure 3). Probing the interaction found the slope effects of experimental group was found to predict an increase in leisure PA at month 4 (β = .61, p < .001), and month 8 (β = .50, p < .001). However, the slope effects for leisure PA did not reveal significant effects at month 4 (β = .26, p = .081), or month 8 (β = .19, p = .232).

The model that tested change in total PA found a significant effect of time, (β = .13, p = .014), indicating that total PA increased as the study progressed. Effects of group (β = .12, p = .195), and cluster, (β = .02, p = .098) were not found to significantly change total PA. The group

X time interaction was found to be significant, $F(5, 745) = 4.41$, $p < .001$. The simple slope effects revealed the experimental group predicted an increase in total PA at month 4 ($\beta = .43$, $p = .008$), and month 8, ($\beta = .40$, $p = .017$). The control group was found to predict an increase in leisure PA at month 4 ($\beta = .36$, $p = .019$), but not month 8 ($\beta = .14$, $p = .358$). Finally, models that tested change in household PA and accelerometry PA did not reveal significant effects of time, cluster, or a significant time X group interaction ($p > .05$).

Discussion

The older Latino population in the U.S. is growing, and many older Latinos have poor health. The benefits of participating in regular PA are numerous, yet many older Latinos do not engage in much leisure time PA. This level of engagement is partly due to a lack of experience or interest in traditional structured exercise. Thus, the purpose of the current randomized controlled trial was to test whether a Latin dance program (BAILAMOS™) could increase PA (self-reported and device-assessed) relative to a control condition among Spanish-speaking older Latinos. We found that participants in the dance program significantly improved their self-reported MVPA and leisure time PA at four and eight months when compared to the control condition. Accelerometer counts increased in the dance program participants at four months, but not significantly.

The 2018 PA Guidelines for Americans state that individuals should attempt to engage in 150-300 minutes/week of MVPA [77]; however, the guidelines do not specify which PA domain yields optimal benefits. That said, studies show that regular participation in leisure PA activity results in many health benefits [78, 79]. Older Latinos in the current study who participated in the dance intervention increased their self-reported MVPA and leisure time PA during the 4-month intervention, and maintained those increases during the maintenance dance program. This finding provides evidence that having the option of engaging in a culturally acceptable form of leisure PA, such as Latin dance, can indeed increase MVPA and leisure PA.

The increase in self-reported MVPA and leisure PA from this study may be due to two primary factors: participation in the dance program and also PA outside the program. Dance group participants increased their self-reported dancing over time, whereas the control group did not. Additionally, participants were encouraged to be physically active outside of the dance program. Throughout the BAILAMOS™ dance program participants were encouraged to increase their lifestyle PA. Some participants reported seeing exercise classes at the senior center where the dance classes were held, and they signed up for and participated in those classes. Furthermore, discussion sessions of the BAILAMOS™ dance program incorporated methods to increase self-efficacy and ways to overcome barriers to PA. These discussion sessions may also have contributed to participants in the dance condition learning ways to overcome their PA barriers and thus continuing to self-report increased time in MVPA and leisure time during the maintenance period. Thus it appears it was not just the dance classes that helped participants increase their PA, but the BAILAMOS™ program as a whole.

This study did not demonstrate a significant increase in accelerometer-assessed PA from pre- to post-intervention at M4 or M8. Dance group participants did increase their recorded movement at M4, and control group participants decreased their movement at both M4 and M8, however, the differences were not significant. It is unclear why changes in self-reported PA did not match with accelerometer-assessed PA. However, self-reported PA reflects change in behavior, and accelerometer data reflects change in movement, and congruency is not to be expected [81]. The literature currently has not identified a gold standard measure for assessing PA, as accelerometers and self-report carry their respective strengths and limitations [82]. Given that the literature remains inconclusive on identifying a superior approach, and that these measures are not interchangeable, collecting and reporting data from both measures reflects the most comprehensive approach [83]. Collecting self-report and device-assessed PA data in tandem within an intervention study allows researchers to understand the amount of movement occurring but also the PA behaviors that are potentially being altered as a result of participation in a PA intervention. In epidemiological studies, higher levels of device-assessed PA have been found among Latinos, but this has been largely attributed to transportation and occupation PA [84].

A key component of the BAILAMOS™ dance program appears to have been the maintenance program. Center directors of the study sites were very accommodating to our request that the participants be able to continue with dance classes after the initial 4-month program had ended, even though the professional dance instructor would not be present to lead such classes. Interventions that identify program champions and provide the proper tools (e.g., coordination with center staff, secured space and time, sound system for music, and instructional classes) to continue an intervention/program appear to be important elements for participants to feel empowered to continue engaging in PA once the structured intervention has ended. More research is needed to specifically identify and understand which tools were the most important for creating a sustainable health promotion intervention. It is important to create interventions with sustainability in mind and recognize that sustainability of interventions is dynamic, and that researchers must allow for adaptation given the population, community, and other community factors [85].

Although this study advanced the PA literature in several ways, the study also had limitations. First, the study only recruited older Latinos from the Chicagoland area. It is possible that Latinos in other parts of the U.S. differ from Latinos in the Chicagoland area. A multi-site effectiveness trial in urban areas in the U.S. should be conducted in the future. Second, we did not have an assessment-only control group, based on prior trials showing that control groups without a PA intervention do not experience any benefit in PA by participating in the trial [86]. We also believe that with community-based research it is potentially unethical to recruit participants for whom there would be no perceived benefits. Third, by randomizing within sites, contamination was possible. However, the dance instructor did not allow non-intervention condition participants into the dance classes. The same held for the health educators and their classes. Self-reported dance data supports that there was little or no contamination. Study staff monitored implementation of both study conditions closely and intervened immediately if any crossover was detected. Fourth, further work is needed as the extent that accelerometers worn on the wrist provide similar findings to those worn on the waist, as some have shown differences up to 41% across wear locations [87]. Also, wrist-based cutpoints of PA intensity are currently not available for older adults. That said, the mean activity counts of participants from the current study are within the ranges of other studies of older adults from the Baltimore Longitudinal Study of Aging [88] and the Women's Health Study [89], and compare favorably with a study of adults [90]. Finally, the dance classes that met two times per week (less than 120 minutes of PA) did not meet recommended PA guidelines and, as such, the intervention was potentially under-dosed to achieve more meaningful changes.

In sum, increasing PA in all segments of the U.S. population is important, especially in disenfranchised and marginalized segments such as older Latinos. Further, segments of society that have low levels of socioeconomic status, and whose primary language is not English, have fewer health-related programs available and directed towards them compared to English speaking, middle- and upper-education and income individuals. Thus, interventions and programs that are targeted to disenfranchised and marginalized groups are urgently needed, especially testing dance as a culturally acceptable option for increasing PA.

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Figure 1. CONSORT flowchart

Figure 2. Means and standard errors of self-reported moderate-to-vigorous physical activity by study condition and time-point. *Note: MVPA = moderate-to-vigorous physical activity. *Denote statistical significance ($p < .05$) between conditions.*

Figure 3. Means and standard errors of self-reported leisure physical activity by study condition and time-point. *Note: PA = physical activity. *Denote statistical significance ($p < .05$) between conditions.*

Figure 1. CONSORT flowchart

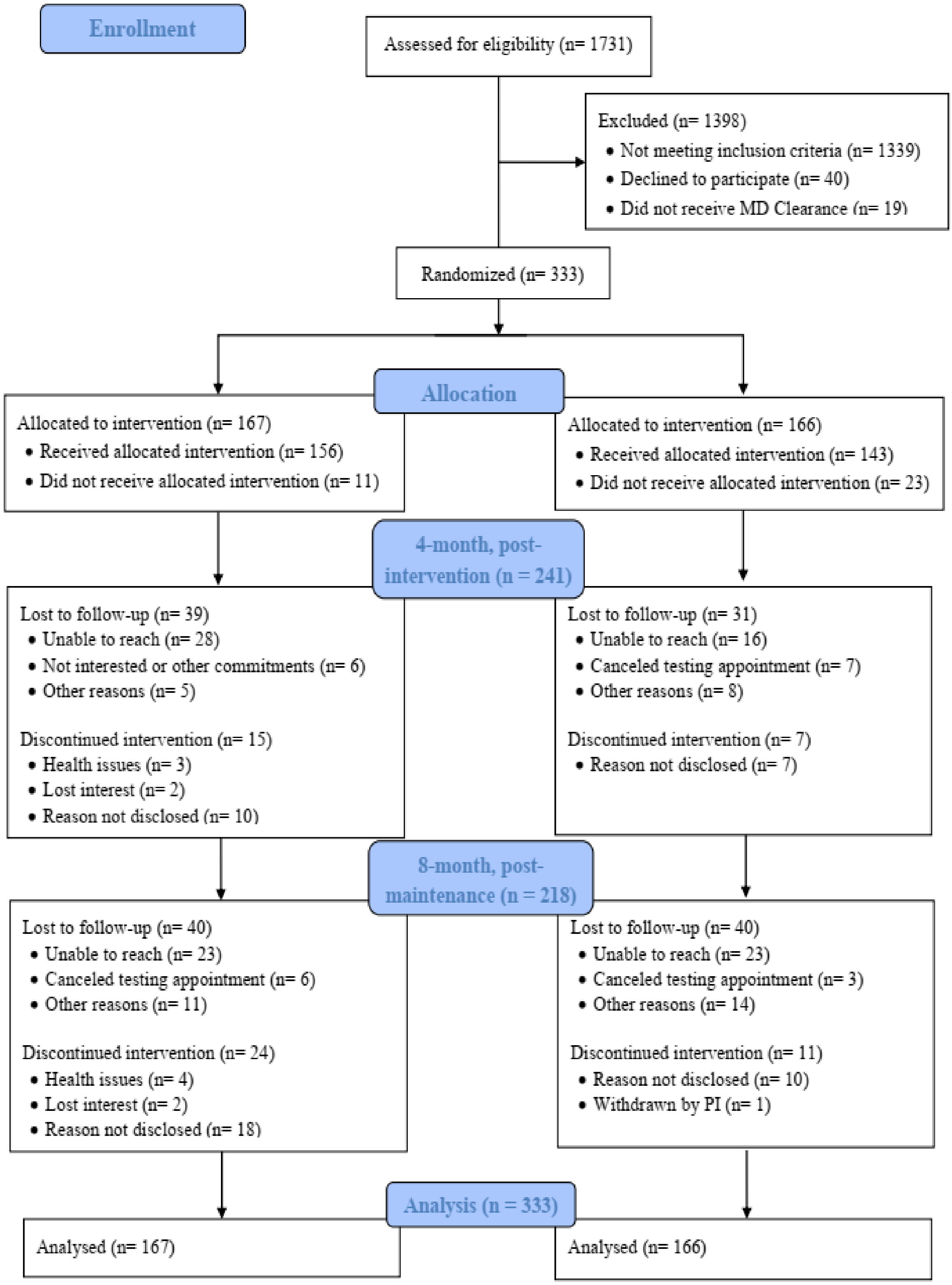

Figure 2.

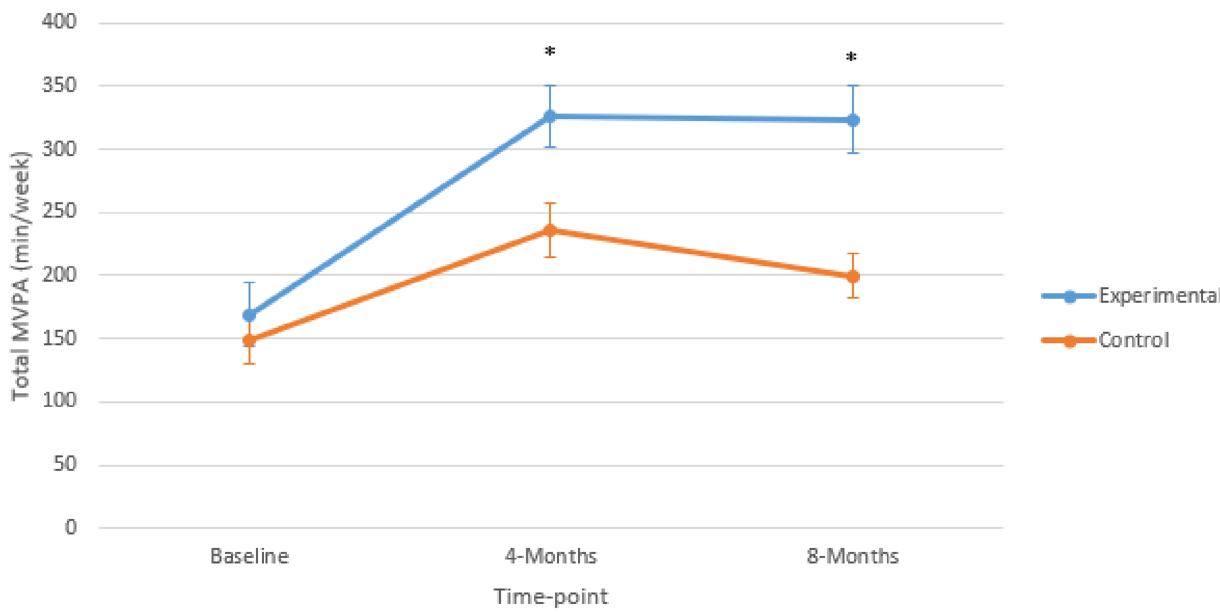
400
350
300
250
200
150
100
50
0
Total MVPA (min/week)
*
*
Baseline
4-Months
8-Months
Time-point
Experimental
Control

Figure 3.

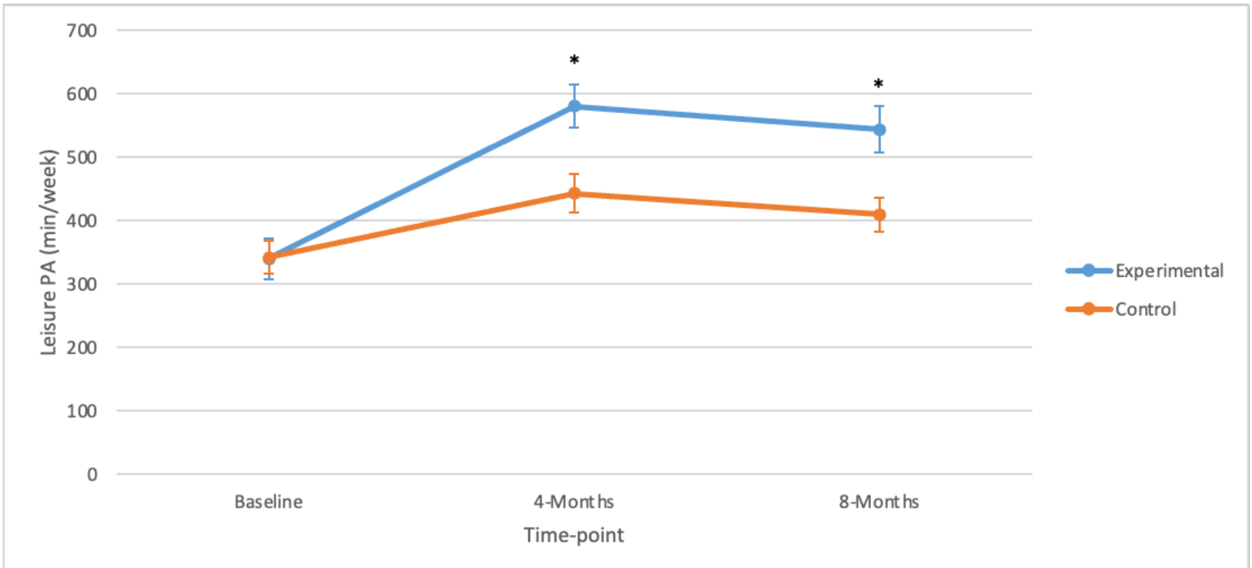
700
600
500
400
300
200
100
0
Leisure PA (min/week)
*
*
Baseline
4-Months
8-Months
Time-point
Experimental
Control

Table 1

Demographic Characteristics of the Sample

Characteristic	F or χ2	*p*	Control condition Mean (SD) *N* = 166	Dance intervention condition Mean (SD) *N* = 167
Age	F = 3.87	.050	65.67 (7.68)	64.14 (6.39)
BMI	F = 1.67	.197	30.84 (5.05)	31.47 (4.54)
Number of Children	F = 1.36	.25	3.73 (2.86)	3.43 (1.95)
Income	F = 1.02	.27	1.27 (.54)	1.20 (.46)
Health Status	F = 2.44	.12	2.26 (.66)	2.15 (.61)
Years in School	F = .01	.91	8.40 (4.10)	8.35 (3.91)
Acculturation: language	F = .03	.83	1.62 (.70)	1.64 (.77)
Acculturation: social	F = .18	.65	2.23 (.57)	2.19 (.48)
Female	χ2 = .07	.78	141	140
Married/common law	χ2= .01	.92	65	98
Country of birth				
Mexico	NA	NA	123	122
USA	NA	NA	15	4
Caribbean	NA	NA	17	19
Central America	NA	NA	7	11
South America	NA	NA	4	11

Table 2

Means, standard deviations, and effect sizes for self-reported and accelerometer physical activity by study condition

Constructs	Condition E (N = 167) C (N = 166)	*Baseline Mean (SD)*	Month 4 Mean (SD)	Month 8 Mean (SD)	Cohen's D within condition (Month 4)	Cohen's D within condition (Month 8)	Cohen's D between condition (Month 4)	Cohen's D between condition (Month 8)
Device-assessed Physical Activity								
Accelerometer Physical Activity Counts	E	1801940 (497715)	1861157 (511261)	1762646 (472178)	.12	-.08	.16	.18
	C	1815825 (497340)	1797544 (503228)	1687390 (546690)	-.04	-.24		
Self-reported Physical Activity (CHAMPS min/week)								
Dance data	E	16.67 (59.18)	87.22 (89.89)	81.62 (96.17)	.93*	.81*	1.16*	.88*
	C	17.10 (50.78)	23.79 (54.28)	33.46 (75.25)	.13	.26		
Moderate to Vigorous Physical Activity	E	169.21 (322.92)	326.05 (310.35)	323.37 (347.85)	.50*	.46*	.25*	.37*

	C	148.73 (229.87)	235.57 (273.77)	199.95 (223.80)	.34*	.23		
Total Physical Activity	E	717.16 (533.34)	909.68 (537.64)	905.05 (576.81)	.36*	.34*	.05	.25*
	C	695.06 (438.54)	861.00 (555.68)	761.91 (454.38)	.33*	.15		
Leisure Physical Activity	E	339.79 (411.49)	580.23 (435.07)	543.95 (472.37)	.57*	.46*	.37*	.36*
	C	341.75 (334.56)	442.83 (395.32)	409.81 (340.00)	.28*	.20		
Household Physical Activity	E	377.38 (274.40)	360.68 (189.59)	361.11 (251.53)	-.07	-.06	-.29	-.08
	C	353.31 (279.56)	418.17 (311.22)	358.11 (241.79)	.11	-.08		

Note. I = *Intervention condition, C= Control condition. * Denote significance (p < .05) between conditions.*

References

1. Ortman JM, Velkoff, V. A., & Hogan, H. : An aging nation: the older population in the United States. In E. a. S. A. US Department of Commerce (ed). Washington, DC: United States Census Bureau, 2016.
2. Daviglus ML, Talavera GA, Aviles-Santa ML, et al.: Prevalence of major cardiovascular risk factors and cardiovascular diseases among Hispanic/Latino individuals of diverse backgrounds in the United States. *Jama.* 2012, *308:*1775-1784.
3. Davis J, Penha, J., Mbowe, O., & Taira, D. A. : Prevalence of Single and Multiple Leading Causes of Death by Race/Ethnicity Among US Adults Aged 60 to 79 Years. *Prev Chronic Dis.* 2017, *14*.
4. Velasco-Mondragon E, Jimenez A, Palladino-Davis AG, Davis D, Escamilla-Cejudo JA: Hispanic health in the USA: a scoping review of the literature. *Public Health Rev.* 2016, *37:*31.
5. Alzheimer'sAssociation: 2021 Alzheimer's Disease Facts and Figures. *Alzheimers Dement.* 2021 *17*.
6. Mehta KM, Yeo GW: Systematic review of dementia prevalence and incidence in United States race/ethnic populations. *Alzheimers Dement.* 2017, *13:*72-83.
7. Wu S. RF, Jin H., Vega W.A. : Latino and Alzheimer's: Social Determinants and Personal Factors Contributing to Disease Risk. In A. J. Vega W., Gutiérrez Robledo L., Markides K. (ed), *Contextualizing Health and Aging in the Americas*: Springer, 2019, 63-84.
8. Chodzko-Zajko WJ, Proctor DN, Fiatarone Singh MA, et al.: American College of Sports Medicine position stand. Exercise and physical activity for older adults. *Med Sci Sports Exerc.* 2009, *41:*1510-1530.
9. Ham SA, Yore MM, Kruger J, Heath GW, Moeti R: Physical activity patterns among Latinos in the United States: putting the pieces together. *Prev Chronic Dis.* 2007, *4:*A92.
10. Keadle SK, McKinnon R, Graubard BI, Troiano RP: Prevalence and trends in physical activity among older adults in the United States: A comparison across three national surveys. *Prev Med.* 2016, *89:*37-43.
11. Marquez DX, Neighbors CJ, Bustamante EE: Leisure time and occupational physical activity among racial or ethnic minorities. *Med Sci Sports Exerc.* 2010, *42:*1086-1093.
12. Marshall SJ, Jones DA, Ainsworth BE, et al.: Race/Ethnicity, Social Class, and Leisure-Time Physical Inactivity. *Med Sci Sports Exerc.* 2007, *39:*44-51.
13. Cromwell SL, Berg JA: Lifelong physical activity patterns of sedentary Mexican American women. *Geriatr Nurs.* 2006, *27:*209-213.
14. Melillo KD, Williamson E, Houde SC, et al.: Perceptions of older Latino adults regarding physical fitness, physical activity, and exercise. *J Gerontol Nurs.* 2001, *27:*38-46.
15. Marquez DX, Hoyem R, Fogg L, et al.: Physical activity of urban community-dwelling older Latino adults. *J Phys Act Health.* 2011, *8 Suppl 2:*S161-170.
16. Valenzuela JM, McDowell T, Cencula L, Hoyt L, Mitchell MJ: Hazlo bien! A participatory needs assessment and recommendations for health promotion in growing Latino communities. *Am J Health Promot.* 2013, *27:*339-346.
17. Ickes MJ, Sharma M: A systematic review of physical activity interventions in Hispanic adults. *J Environ Public Health.* 2012, *2012:*156435.
18. Delgado CF, Munoz JE: *Everynight Life: Culture and Dance in Latin/o America*. Durham, NC: Duke University Press, 1997.

19. Lewis D: Introduction: Dance in Hispanic Cultures. *Choreography and Dance.* 1994, *3:*1-5.
20. Brustio PR, Liubicich, M. E., Chiabrero, M., & Rabaglietti, E. : Dancing in the golden age: a study on physical function, quality of life, and social engagement. *Geriatr Nurs.* 2018, *39:*635-639.
21. Hackney ME, Byers C, Butler G, et al.: Adapted Tango Improves Mobility, Motor-Cognitive Function, and Gait but Not Cognition in Older Adults in Independent Living. *J Am Geriatr Soc.* 2015, *63:*2105-2113.
22. Li P, Yu L, Lim ASP, et al.: Fractal regulation and incident Alzheimer's disease in elderly individuals. *Alzheimers Dement.* 2018, *14:*1114-1125.
23. Yan AF, Cobley, S., Chan, C., Pappas, E., Nicholson, L. L., Ward, R. E., ... & Wewege, M. A.: The effectiveness of dance interventions on physical health outcomes compared to other forms of physical activity: A systematic review and meta-analysis. *Sports Med.* 2018, *48:*933-951.
24. Predovan D, Julien A, Esmail A, Bherer L: Effects of Dancing on Cognition in Healthy Older Adults: a Systematic Review. *J Cogn Enhanc.* 2018, *3:*161-167.
25. Hwang PWN, & Braun, K. L. : The effectiveness of dance interventions to improve older adults' health: a systematic literature review. *Altern Ther Health Med.* 2015, *21:*64-70.
26. Hamacher D, Hamacher D, Rehfeld K, Hokelmann A, Schega L: The Effect of a Six-Month Dancing Program on Motor-Cognitive Dual-Task Performance in Older Adults. *J Aging Phys Act.* 2015, *23:*647-652.
27. Merom D, Grunseit A, Eramudugolla R, et al.: Cognitive Benefits of Social Dancing and Walking in Old Age: The Dancing Mind Randomized Controlled Trial. *Front Aging Neurosci.* 2016, *8:*26.
28. Muller P, Rehfeld K, Schmicker M, et al.: Evolution of Neuroplasticity in Response to Physical Activity in Old Age: The Case for Dancing. *Front Aging Neurosci.* 2017, *9:*56.
29. Kosmat H, & Vranic, A. : The efficacy of a dance intervention as cognitive training for the old-old. *J Aging Phys Act.* 2017, *25:*32-40.
30. Judge JO: Balance training to maintain mobility and prevent disability. *Am J Prev Med.* 2003, *25:*150-156.
31. Robinson TN, Killen JD, Kraemer HC, et al.: Dance and reducing television viewing to prevent weight gain in African-American girls: the Stanford GEMS pilot study. *Ethn Dis.* 2003, *13:*S65-77.
32. Bandura A: *Self-Efficacy: The Exercise of Control*. New York: W.H. Freeman and Company, 1997.
33. Young MD, Plotnikoff RC, Collins CE, Callister R, Morgan PJ: Social cognitive theory and physical activity: a systematic review and meta-analysis. *Obes Rev.* 2014, *15:*983-995.
34. Castaneda C, Layne, J. E., Munoz-Orians, L., Gordon, P. L., Walsmith, J., Foldvari, M., ... & Nelson, M. E.: A randomized controlled trial of resistance exercise training to improve glycemic control in older adults with type 2 diabetes. *Diabetes Care.* 2002, *25:*2335-2341.
35. Hu J, Wallace, D. C., Amirehsani, K. A., McCoy, T. P., Coley, S. L., Wiseman, K. D., ... & Hussami, C. R.: Improving Physical Activity in Hispanics with Diabetes and their Families. *Public Health Nurs.* 2015, *32:*625-633.
36. Lorig KR, Ritter PL, Jacquez A: Outcomes of border health Spanish/English chronic disease self-management programs. *Diabetes Educ.* 2005, *31:*401-409.

37. Rosal MC, Olendzki B, Reed GW, et al.: Diabetes self-management among low-income Spanish-speaking patients: a pilot study. *Ann Behav Med.* 2005, *29:*225-235.
38. Schwingel A, Galvez P: Divine Interventions: Faith-Based Approaches to Health Promotion Programs for Latinos. *J Relig Health.* 2016, *55:*1891-1906.
39. Staten LK, Gregory-Mercado, K. Y., Ranger-Moore, J., Will, J. C., Giuliano, A. R., Ford, E. S., & Marshall, J.: Provider counseling, health education, and community health workers: the Arizona WISEWOMAN project. *J Women's Health.* 2004, *13:*547-556.
40. Aguinaga S, Marquez DX: Feasibility of a Latin Dance Program for Older Latinos With Mild Cognitive Impairment. *Am J Alzheimers Dis Other Demen.* 2017, *32:*479-488.
41. Hernandez R, Cheung E, Liao M, et al.: The Association Between Depressive Symptoms and Cognitive Functioning in Older Hispanic/Latino Adults Enrolled in an Exercise Intervention: Results From the " inverted exclamation markCaminemos!" Study. *J Aging Health.* 2018, *30:*843-862.
42. Piedra LM, Andrade FCD, Hernandez R, et al.: The Influence of Exercise on Cognitive Function in Older Hispanic/Latino Adults: Results From the " inverted exclamation markCaminemos!" Study. *The Gerontologist.* 2017, *57:*1072-1083.
43. Siu KC, Rajaram SS, Padilla C: Impact of psychosocial factors on functional improvement in Latino older adults after Tai Chi exercise. *J Aging Phys Act.* 2015, *23:*120-127.
44. King AC, Bickmore TW, Campero MI, Pruitt LA, Yin JL: Employing virtual advisors in preventive care for underserved communities: results from the COMPASS study. *J Health Commun.* 2013, *18:*1449-1464.
45. Rodrigues-Krause J, Farinha JB, Krause M, Reischak-Oliveira A: Effects of dance interventions on cardiovascular risk with ageing: Systematic review and meta-analysis. *Complement Ther Med.* 2016, *29:*16-28.
46. Herrod PJ, Doleman, B., Blackwell, J. E., O'Boyle, F., Williams, J. P., Lund, J. N., & Phillips, B. E.: Exercise and other nonpharmacological strategies to reduce blood pressure in older adults: a systematic review and meta-analysis. *J Am Soc Hypertens.* 2018, *12:*248-267.
47. Shanahan J, Morris, M. E., Bhriain, O. N., Saunders, J., & Clifford, A. M.: Dance for people with Parkinson disease: what is the evidence telling us? *Arch Phys Med Rehabil.* 2015, *96:*141-153.
48. Fernandez-Arguelles EL, Rodriguez-Mansilla J, Antunez LE, Garrido-Ardila EM, Munoz RP: Effects of dancing on the risk of falling related factors of healthy older adults: a systematic review. *Arch Gerontol Geriatr.* 2015, *60:*1-8.
49. Fong Yan A, Cobley S, Chan C, et al.: The Effectiveness of Dance Interventions on Physical Health Outcomes Compared to Other Forms of Physical Activity: A Systematic Review and Meta-Analysis. *Sports Med (Auckland, N.Z.).* 2018, *48:*933-951.
50. Folstein MF, Folstein SE, McHugh PR: "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res.* 1975, *12:*189-198.
51. Hui E, Chui BT, Woo J: Effects of dance on physical and psychological well-being in older persons. *Arch Gerontol Geriatr.* 2008.
52. Simonsick EM, Newman AB, Visser M, et al.: Mobility Limitation in Self-Described Well-Functioning Older Adults: Importance of Endurance Walk Testing. *J Gerontol A Biol Sci Med Sci.* 2008, *63:*841-847.
53. Weiss CO, Fried LP, Bandeen-Roche K: Exploring the hierarchy of mobility performance in high-functioning older women. *J Gerontol A Biol Sci Med Sci.* 2007, *62:*167-173.

54. Al Snih S, Fisher MN, Raji MA, et al.: Diabetes mellitus and incidence of lower body disability among older Mexican Americans. *J Gerontol A Biol Sci Med Sci.* 2005, *60:*1152-1156.
55. Blaum CS, West NA, Haan MN: Is the metabolic syndrome, with or without diabetes, associated with progressive disability in older Mexican Americans? *J Gerontol A Biol Sci Med Sci.* 2007, *62:*766-773.
56. Al Snih S, Ottenbacher KJ, Markides KS, et al.: The effect of obesity on disability vs mortality in older Americans. *Arch Intern Med.* 2007, *167:*774-780.
57. Chen HL, Bermudez OI, Tucker KL: Waist circumference and weight change are associated with disability among elderly Hispanics. *J Gerontol A Biol Sci Med Sci.* 2002, *57:*M19-M25.
58. Marquez DX, Bustamante EE, Aguinaga S, Hernandez R: BAILAMOS(c): Development, Pilot Testing, and Future Directions of a Latin Dance Program for Older Latinos. *Health Educ Behav.* 2014.
59. Resnick B, Ory MG, Hora K, et al.: A proposal for a new screening paradigm and tool called Exercise Assessment and Screening for You (EASY). *J Aging Phys Act.* 2008, *16:*215-233.
60. Resnick B, Ory MG, Hora K, et al.: The Exercise Assessment and Screening for You (EASY) Tool: Application in the oldest old population. *Am J Lifestyle Med.* 2008, *2:*432-440.
61. Harris PA, Taylor R, Minor BL, et al.: The REDCap consortium: Building an international community of software platform partners. *J Biomed Inform.* 2019, *95:*103208.
62. Harris PA, Taylor R, Thielke R, et al.: Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform.* 2009, *42:*377-381.
63. Marquez DX, Wilbur J, Hughes SL, et al.: B.A.I.L.A. - a Latin dance randomized controlled trial for older Spanish-speaking Latinos: rationale, design, and methods. *Contemp Clin Trials.* 2014, *38:*397-408.
64. Resnick B, Bellg AJ, Borrelli B, et al.: Examples of implementation and evaluation of treatment fidelity in the BCC studies: where we are and where we need to go. *Ann Beh Med.* 2005, *29 Suppl:*46-54.
65. Marin G, Sabogal F, Marin BV, Otero-Sabogal R, Perez-Stable E: Development of a short acculturation scale for Hispanics. *Hisp J Behav Sci.* 1987, *9:*183-205.
66. Stewart AL, Mills KM, King AC, et al.: CHAMPS physical activity questionnaire for older adults: outcomes for interventions. *Med Sci Sports Exerc.* 2001, *33:*1126-1141.
67. Rosario MG, Vazquez JM, Cruz WI, Ortiz A: Internal consistency of the CHAMPS physical activity questionnaire for Spanish speaking older adults. *P R Health Sci J.* 2008, *27:*224-228.
68. Ainsworth BE, Bassett DR, Jr., Strath SJ, et al.: Comparison of three methods for measuring the time spent in physical activity. *Med Sci Sports Exerc.* 2000, *32:*S457-464.
69. Hendelman D, Miller K, Baggett C, Debold E, Freedson P: Validity of accelerometry for the assessment of moderate intensity physical activity in the field. *Med Sci Sports Exerc.* 2000, *32:*S442-449.
70. Troiano RP, McClain JJ, Brychta RJ, Chen KY: Evolution of accelerometer methods for physical activity research. *Br J Sports Med.* 2014, *48:*1019-1023.
71. Troiano RP, Berrigan, D., Dodd, K. W., Masse, L. C., Tilert, T., & McDowell, M.: Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc.* 2008, *40:*187-188.

72. Faul F, Erdfelder E, Lang AG, Buchner A: G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods.* 2007, *39:*175-191.
73. StataCorp: Stata Statistical Software. College Station, TX, 2019.
74. Field AP: *Discovering statistics using SPSS*. London: Sage publications, 2018.
75. Shek DTL, Ma CMS: Longitudinal data analyses using linear mixed models in SPSS: Concepts, procedures and illustrations. *Sci World J.* 2011, *11:*42-76.
76. West BT: Analyzing longitudinal data with the linear mixed models procedure in SPSS. *Eval Health Prof.* (Vol. 32), 2009, 207-228.
77. Piercy KL, Troiano RP, Ballard RM, et al.: The Physical Activity Guidelines for Americans. *Jama.* 2018, *320:*2020-2028.
78. Huai P, Han H, Reilly KH, et al.: Leisure-time physical activity and risk of type 2 diabetes: a meta-analysis of prospective cohort studies. *Endocrine.* 2016, *52:*226-230.
79. Fransson EI, Alfredsson LS, de Faire UH, et al.: Leisure time, occupational and household physical activity, and risk factors for cardiovascular disease in working men and women: the WOLF study. *Scand J Public Health.* 2003, *31:*324-333.
80. Stephan AJ, Strobl R, Muller M, et al.: A high level of household physical activity compensates for lack of leisure time physical activity with regard to deficit accumulation: Results from the KORA-Age study. *Prev Med.* 2016, *86:*64-69.
81. Prince SA, Adamo KB, Hamel ME, et al.: A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. *Int J Behav Nutr Phys Act.* 2008, *5:*56.
82. Troiano RP, McClain JJ, Brychta RJ, Chen KY: Evolution of accelerometer methods for physical activity research. *Br J Sports Med.* 2014, *48:*1019-1023.
83. Kaushal N, Rhodes RE, Meldrum JT, Spence JC: Mediating Mechanisms in a Physical Activity Intervention: A Test of Habit Formation. *J Sport Exerc Psychol.* 2018, *40:*101-110.
84. Ham SA, Ainsworth BE: Disparities in data on Healthy People 2010 physical activity objectives collected by accelerometry and self-report. *Am J Public Health.* 2010, *100 Suppl 1:*S263-268.
85. Shelton RC, Cooper BR, Stirman SW: The Sustainability of Evidence-Based Interventions and Practices in Public Health and Health Care. *Annu Rev Public Health.* 2018, *39:*55-76.
86. Conn VS, Phillips LJ, Ruppar TM, Chase JA: Physical activity interventions with healthy minority adults: meta-analysis of behavior and health outcomes. *J Health Care Poor Underserved.* 2012, *23:*59-80.
87. Kerr J, Marinac CR, Ellis K, et al.: Comparison of Accelerometry Methods for Estimating Physical Activity. *Med Sci Sports Exerc.* 2017, *49:*617-624.
88. Cai Y, Schrack JA, Wang H, et al.: Visual Impairment and Objectively Measured Physical Activity in Middle-Aged and Older Adults. *J Gerontol A Biol Sci Med Sci.* 2021, *76:*2194-2203.
89. Kamada M, Shiroma EJ, Harris TB, Lee IM: Comparison of physical activity assessed using hip- and wrist-worn accelerometers. *Gait Posture.* 2016, *44:*23-28.
90. Dieu O, Mikulovic J, Fardy PS, et al.: Physical activity using wrist-worn accelerometers: comparison of dominant and non-dominant wrist. *Clin Physiol Funct Imaging.* 2017, *37:*525-529.