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Increases in Muscle-Strengthening Activities Among Latinas in Seamos Saludables

Tanya J. Benitez, PhD[1], Shira Dunsiger, PhD[1], Becky Marquez, PhD[2], Britta Larsen, PhD[2], Dori Pekmezi, PhD[3], and Bess H. Marcus, BH, PhD[1]

Abstract

Background: Only 17% of Latinas meet national physical activity (PA) guidelines for both moderate-to-vigorous aerobic and muscle-strengthening PA. Additional health benefits are derived from the combination of aerobic and muscle-strengthening PA (vs. aerobic alone), yet there is paucity in research on muscle-strengthening activity in Latinas. The aim of this study was to examine changes in muscle-strengthening activity from baseline to 6 and 12 months in *Seamos Saludables*, a 12-month PA randomized controlled trial for Latinas.

Methods: A secondary data analysis was conducted among 131 Latinas ages 18–65 years, who were randomized to either a PA Intervention or a Wellness Control. Self-reported muscle-strengthening exercise was measured at baseline, 6 months, and 12 months via adapted muscle-strengthening questions from the Behavioral Risk Factor Surveillance System.

Results: There was a 16-minute/week difference in median minute/week of muscle-strengthening activity between Intervention and Wellness at 6 months ($SE = 7.91$, $p = .04$) and 45-minute/week difference at 12 months ($SE = 25.80$, $p = .06$) adjusting for baseline. Significantly more PA Intervention participants met muscle-strengthening guidelines of 2 or more days/week at 6 months versus Wellness Control participants (odds ratio [OR] = 4.29, 95% confidence interval [CI] = [1.03, 17.84]).

Conclusion: Results from the current study showed that Latinas engaged in muscle-strengthening activity in an intervention that emphasized primarily aerobic PA outcomes, suggesting they may be interested in engaging in muscle-strengthening activities. Future interventions targeting both aerobic and muscle-strengthening activity could achieve greater health improvements and help more Latinas reach the full national PA guidelines.

ClinicalTrials.gov Identifier. NCT01583140

Keywords

general terms, health behavior, health disparities, health equity, Latino/Latina/Latinx or Hispanic, physical activity/exercise, population groups, randomized trials

Physical Activity and Health

Although earlier physical activity (PA) recommendations (American College of Sports Medicine [ACSM], 1978, 1990; American Heart Association, 1975; American Heart Association, Committee on Exercise, 1972) focused mostly on aerobic exercise, current national guidelines (U.S. Department of Health and Human Services, 2018) encourage participation in both aerobic (at least 150 minutes/week) and muscle-strengthening PA (all major muscle groups, at least 2 days/week). This shift reflects the growing evidence of distinct benefits to muscle-strengthening activity (MSA) such as increased lean body mass (Olson et al., 2007; Westcott et al., 2009), reduction in body fat (Westcott et al., 2009), and preventing bone loss and increasing bone mineral density (Going & Laudermilk, 2009; Mosti et al., 2013). Moreover, additional advantages are accrued through combining moderate-to-vigorous physical activity (MVPA) and MSA (vs. MVPA alone) (Church et al., 2010). In fact, a recent study found that meeting both aerobic and muscle-strengthening PA guidelines (vs. meeting just one or neither) was associated

[1]Brown University School of Public Health, Providence, RI, USA
[2]University of California San Diego, La Jolla, CA, USA
[3]The University of Alabama at Birmingham, Birmingham, AL, USA

Corresponding Author:
Tanya J. Benitez, Department of Behavioral and Social Sciences, Brown University School of Public Health, Box G-S121-8, Providence, RI 02912, USA.
Email: tanya_benitez@brown.edu

with lower rates of coronary heart disease, diabetes, hypertension, and depression (Bennie, De Cocker, et al., 2019; Bennie, Teychenne, et al., 2019).

Low PA in Latinas

Despite the health benefits of MSA, most Americans, especially ethnic minority women, are not meeting PA guidelines. According to 2018 National Health Interview Survey (NHIS) data, only 17% of Latinas in the United States met the national guidelines for both aerobic PA and MSA, compared with 24% of White women and 26% of Latino men (Villarroel et al., 2019). Moreover, Latinas have disproportionately higher rates of health conditions related to insufficient PA (e.g., diabetes, obesity) than non-Latina White women (National Center for Health Statistics, 2017; Villarroel et al., 2019); thus, engaging in regular MSA can help further reduce such disparities. Low PA levels in Latinas may be due to PA barriers including lack of willpower and motivation, cost of exercise programs, viewing PA as unfeminine, lack of social support, lack of role models for PA, and lack of knowledge on the types of exercises they should do (C. Chang et al., 2018; D'Alonzo, 2012; D'Alonzo & Fischetti, 2008; Pekmezi et al., 2012). While these barriers are not exclusive to type of PA (e.g., aerobic MVPA or MSA), factors such as fear of appearing too muscular can also inhibit Latinas' participation in strength activities (D'Alonzo et al., 2018). Similar factors to the aforementioned barriers may influence Latinas' participation in MSA, such as higher social support for PA, lower PA barriers (e.g., financial strain, family caregiving responsibilities), and higher use of behavioral strategies (e.g., purchase PA equipment, enroll in PA program, set PA goals), as these have been identified as correlates of meeting the national guidelines for MSA in Latinas (Benitez et al., 2021).

While a select number of interventions for Latinas have incorporated strategies to overcome general PA barriers (Arredondo et al., 2017; Koniak-Griffin et al., 2015; Marcus et al., 2013, 2015, 2016), outcomes have focused primarily on aerobic MVPA in this area. For example, *Seamos Saludables* was a culturally and linguistically adapted PA randomized controlled trial for Latinas that emphasized theoretical constructs of the Social Cognitive Theory (SCT; Bandura, 1986) and Transtheoretical Model (TTM; Prochaska & Velicer, 1997) for increasing PA (e.g., social support, self-monitoring, enjoyment) and overcoming Latinas' PA barriers (Pekmezi et al., 2009). The intervention produced significantly greater increases in aerobic MVPA than in the Wellness Control group at 6 months (mean difference = 41.36, $SE = 7.93$, $p < .01$; Marcus et al., 2013) and at 12 months (mean difference = 52 minutes/week, $SE = 9.38$, $p < .01$; Marcus et al., 2015); however, the primary outcome was aerobic MVPA. MSA were exploratory outcomes in *Seamos Saludables* and were not previously examined as the intervention was a culturally adapted version of older interventions (Project Stride, Seamos Activas I; Marcus et al., 2007; Pekmezi et al., 2009), which were based on earlier PA recommendations that focused more on aerobic MVPA than MSA. Despite the emphasis on aerobic MVPA in *Seamos Saludables*, the intervention addressed PA barriers that likely influenced both aerobic MVPA and MSA, and included reference to MSA in intervention materials (e.g., list of resources for finding fitness equipment, and PA programs that include MSA). Moreover, the intervention was individually tailored and targeted theoretical constructs for increasing PA, which may facilitate receptiveness and provide tools for increasing physical activities other than aerobic type. Given that further attention to MSA will be key to addressing related health disparities in this at-risk population (e.g., diabetes, obesity), examining changes in MSA from this study will contribute to the gap in this area of PA research.

Purpose

To examine Latinas' engagement in muscle-strengthening exercise, we conducted a secondary data analysis to assess changes in MSA at 6 and 12 months among Latinas in the *Seamos Saludables* (Marcus et al., 2013, 2015; Pekmezi et al., 2012) study. The purpose of this study was to describe time spent participating in MSA among a subsample of Latinas who engaged in MSA during a 12-month randomized controlled trial of a Tailored PA Intervention versus a Wellness Control group, and to explore intervention effects on this understudied PA category. The current analysis focused on Latinas who reported engaging in any MSA because study eligibility for participating in the *Seamos Saludables* intervention was based on aerobic MVPA (e.g., participants were screened for health conditions that limit walking or other aerobic activities, but not for health conditions that could limit participation in MSA). A sensitivity analysis was conducted to determine whether the pattern of results was similar or different when all *Seamos Saludables* randomized participants were included in the analysis. Our hypotheses were that time spent participating in MSA would be higher among participants in *Seamos Saludables*–Tailored PA Intervention relative to the Wellness Control group. Such findings will help support and inform future comprehensive PA interventions to address related health disparities in this community.

Method

Design

This study examined changes in MSA (i.e., days/week and total minutes/week) from baseline to 6 and 12 months in *Seamos Saludables* (Marcus et al., 2013, 2015; Pekmezi et al., 2012), a 12-month randomized controlled trial of a culturally and linguistically adapted print- and mail-based PA intervention for Latinas. The primary endpoint of the study was 6 months, prior to the tapered maintenance phase (Months 7–12). Participants were Spanish-speaking Latinas ($N = 266$), aged 18–65 years who were randomized to either

(1) a Tailored PA Intervention arm or (2) a Wellness Contact Control arm. Self-reported MSA was assessed at baseline, 6 months, and 12 months using questions adapted from the Behavioral Risk Factor Surveillance System (BRFSS) on muscle-strengthening activities in adults (U.S. Department of Health and Human Services, 2008). A full description of the *Seamos Saludables* study is provided elsewhere (Marcus et al., 2013; Pekmezi et al., 2012).

The current analysis focused on the $n = 131$ participants with at least some MSA reported at baseline, 6 months, and/or 12 months as the goal of the current study was to explore how MSA changed among a subsample of participants who engaged in MSA in the PA intervention. We chose to present the results among the subsample of participants who reported any MSA at any time point as a means of exploring preliminary effects of a PA intervention on MSA. However, we did examine how the pattern of results might be different if all *Seamos Saludables* randomized participants were included regardless of the amount of MSA they reported (at baseline or follow-up) and included findings from this sensitivity analysis in the "Results" section.

Setting and Sample

Seamos Saludables (Marcus et al., 2013, 2015; Pekmezi et al., 2012) was conducted at Brown University in Rhode Island. All study activities were approved by the University's Institutional Review Board. Eligibility for participation in the study was as follows: self-reported Latina/Hispanic woman, ages 18–65 years, and being underactive, defined by self-reporting less than 60 minutes per week of MVPA. Prior to screening for PA, participants were provided an explanation of what MVPA is (e.g., any activity that feels as hard as or harder than a brisk walk, it gets your heart rate going and feels like you are walking fast to get out of the rain), and examples of MVPA (brisk walking, running, aerobic dance) were provided. Exclusion criteria included any health condition that would make PA unsafe as reported on the Physical Activity Readiness Questionnaire (ACSM, 2005) screening tool, being pregnant or planning to become pregnant during the course of the study, taking any medication that may impair PA tolerance or performance (e.g., beta blockers), or body mass index (BMI) more than 45 kg/m^2. Participants who reported controlled hypertension, and were cleared by the study physician, were eligible if blood pressure (checked at orientation session) was within protocol limits ($\leq$140 systolic/$<$90 diastolic).

Measures

Demographic questionnaires completed at baseline assessed participants' age, education, income, marital status, employment, and country of origin. Muscle-strengthening PA was assessed at baseline, 6 months, and 12 months using interviewer-administered questions that were adapted from the BRFSS measure on MSA in adults (U.S. Department of Health and Human Services, 2008) to include the amount and duration of MSA performed for each strengthening activity. Specifically, the original BRFSS question on MSA asks how many times the individual did PA or exercises to strengthen their muscles. Our adapted version included additional questions to assess duration (i.e., how many minutes/session) for each activity that participants reported. These questions assessed frequency (i.e., days per week) and duration (i.e., minutes per session) of MSA: "Do you do any strength and/or flexibility exercises such as using weight machines, free weights, or exercise bands, doing sit-ups or push-ups, doing yoga or pilates, or stretching, at least once per week? (Average over past 3 months)." If participants answered "yes," they were then asked how many days per week and how many minutes per session they dedicate to the following strengthening activities: strength (i.e., weight machines, free weights, exercise bands, sit-ups, and push-ups), yoga/pilates, or other non-MSA activities. MSA questions were added to the 7-Day Physical Activity Recall (PAR) semi-structured interview (see below) administered during participants' baseline and 6- and 12-month study visits. The current analysis examined MSA only, data on other non-MSA were excluded, and yoga/pilates were excluded as these include stretching and balance activities for which our PA assessment did not differentiate. The unit of analysis was total minutes/week.

Aerobic activity was measured using the 7-Day PAR interview. The 7-Day PAR is a semi-structured interview that provides an estimate of total weekly minutes of self-reported aerobic MVPA that has shown acceptable test–retest reliability ($r = .69$) and validity with Latino populations (Rauh et al., 1992) and has been validated against more objective measures of PA, including a high correlation ($r = .67$–$.82$) with Caltrac activity monitors (Rauh et al., 1992).

Protocol

Participants were recruited using community-based strategies that target the Latina population, such as distribution of flyers, attending community events, and advertising in local Spanish-language newspapers, radio, and television stations (described elsewhere in further detail in Marcus et al., 2013, 2015; Pekmezi et al., 2012). At the baseline visit, participants were randomized to one of two intervention conditions described: (1) Tailored PA Intervention arm or (2) Wellness Contact Control arm.

Tailored PA Intervention Arm. The Tailored PA Intervention was previously culturally and linguistically adapted to increase PA levels in Latina women using six focus groups to identify culture-specific attitudes and barriers to PA for Latinas, and then incorporating themes into the intervention content (Pekmezi et al., 2009, 2012). The individually tailored Spanish-language intervention was based on SCT (Bandura, 1986) and TTM (Prochaska & Velicer, 1997),

and emphasized behavioral strategies of these theories for increasing aerobic PA levels, including goal setting, self-monitoring, increasing social support for PA, and self-efficacy. Participants received print-based information in the mail weekly during their first month in the study, twice weekly in the second and third month, and monthly during the fourth to sixth month. In addition, participants received two booster mailings (at the eighth and tenth month) during the tapered maintenance phase.

Mailings consisted of manuals that were matched to participants' stage of change for increasing PA, individually tailored feedback reports, and PA tip sheets that address barriers to PA in Latinas (e.g., caregiving responsibilities, neighborhood safety) identified in our formative research with Latina women (Pekmezi et al., 2009). Tailored reports were generated using a computer expert system that draws appropriate messaging on stages and processes of change and self-efficacy from a bank of 296 messages addressing different levels of psychosocial and environmental factors affecting PA. Computer expert system reports, described elsewhere in further detail (Pekmezi et al., 2012), were informed by participant responses to monthly questionnaires (Stages of Change for PA, Self-Efficacy for PA, Processes of Change for PA). Participants also completed an in-person goal-setting session at their baseline and 6-month visits, and via phone call at 1-month post-baseline. The goal-setting session involved a one-to-one discussion session with a fully bilingual trained research staff member to establish the participants' plan for achieving study goals and nationally recommended PA levels (≥150 minutes per week of aerobic MVPA; U.S. Department of Health and Human Services, 2008). While the intervention focused on aerobic MVPA as a primary outcome, information on MSA was referenced in various newsletters (e.g., list of PA programs available at YMCA to include resistance training; resources and websites for finding fitness equipment, such as free weights, home weights, and resistance bands).

Wellness Contact Control Arm. Participants in the Wellness Contact Control received print information in the mail on health topics other than PA. Mailings were sent on the same schedule as the Tailored PA Intervention arm. Materials included pamphlets on promotion of heart-healthy behaviors (e.g., smoking, diet) for Latinos developed by the National Heart, Lung and Blood Institute.

Analysis

For the current study, baseline sociodemographics were compared between those who reported no MSA ($n = 80$) and at least some MSA at least one time point ($n = 131$), using chi-square tests and *t* tests as appropriate. Furthermore, among those who reported at least some MSA, between-(study) group differences in baseline sociodemographics were tested using *t* tests (for continuous variables) and chi-square tests (for categorical variables).

First, interest was in understanding potential differences between intervention and control conditions with respect to minutes/week of self-reported MSA at 6- and 12-month follow-up. A longitudinal quantile regression model was used to regress median minutes/week of self-reported MSA on treatment assigned (Tailored PA Intervention vs. Wellness Control). Models adjusted error estimates for repeated measures within participant and controlled for baseline MSA and a time-varying indicator of overall minutes/week of MVPA. Quantile regression was chosen instead of a parametric (linear) regression model, to account for the high variation in self-reported MSA. Next, a longitudinal model implemented with Generalized Estimating Equations (GEEs) was used to assess effects of the intervention on meeting MSA guidelines at 6- and 12-month follow-up. Using a similar analytic strategy, we examined whether baseline minutes/week of MSA moderated treatment effects on minutes/week of MSA at 6- and 12-month follow-up using a longitudinal quantile regression model, including the main effect of baseline MSA and the interaction between group and baseline MSA. Finally, correlation analysis (Spearman Rank Correlations) was used to examine associations between minutes/week of MVPA and MSA.

All analyses were run in SAS 9.3 and significance level set at .05 a priori. Models used a quasi-likelihood approach to estimation and thus made use of all available data for estimation without directly imputing missing values. A sensitivity analysis was conducted to determine whether the pattern of results was similar, or different, when all randomized participants from *Seamos Saludables* were included in the analysis (regardless of the amount of MSA they reported at baseline, 6 months, or 12 months). There were no statistical differences in the pattern of results; however, we present both analyses in this article.

Results

Participants in *Seamos Saludables* were 266 inactive adult Latinas whose average age was 40.67 years ($SD = 9.98$ years) and mean BMI was 29.40 ($SD = 4.70$). More than 90% were first-generation Latinas in the United States, and the majority were of Caribbean or South American descent, with the largest groups being Dominican (37%) and Colombian (26%). As published previously, individuals in the Intervention group increased MVPA significantly more than controls both after the main 6-month intervention and after the additional 6-month tapered maintenance period (for both $p < .01$; see Figure 1).

Of the 266 total participants, 131 reported engaging in at least some MSA at any of the study assessment points (baseline, 6 months, 12 months) (68 were Tailored PA Intervention participants versus 63 in Wellness Control participants [$p = .09$], see Table 1) and 80 participants reported no engagement in MSA throughout the study. Of the 131 with at least some engagement in MSA throughout

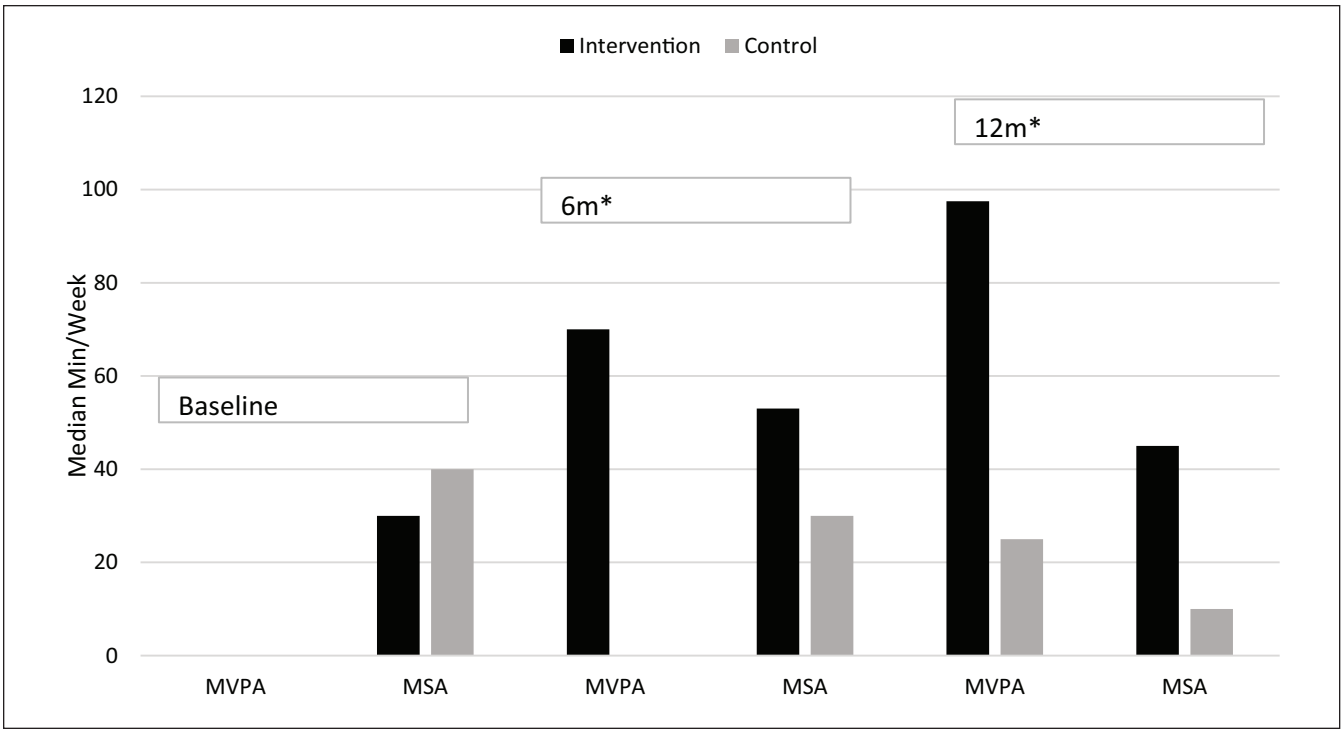

Figure 1. Comparison between MVPA and muscle-strengthening PA by group over time.
Note. Median values of 0 are not displayed on the graph. MVPA = moderate-to-vigorous physical activity; PA = physical activity; MSA = muscle-strengthening activity.
*$p < .05$ for between-group difference in MVPA and MSA.

Table 1. Baseline Characteristics of Participants Who Reported Engaging in Any MSA Versus None at Any Time Point (Baseline, 6 Months, or 12 Months).

	Reported no MSA ($n = 80$)	Reporting any MSA ($n = 131$)		
Intervention	32 (32%)	68 (68%)	Intervention	Control
Control	48 (43%)	63 (57%)	($n = 68$)	($n = 63$)
Age (years; mean ± *SD*)	41.73 (8.50)	41.15 (10.20)	41.49 (10.77)	38.59 (10.73)
BMI* (kg/m^2; mean ± *SD*)	30.02 (4.77)	28.64 (4.36)	28.90 (4.03)	27.97 (4.37)
Baseline minutes/week of MVPA	2.19 (9.71)	3.05 (9.25)	59 (87%)	42 (67%)
Education, at least HS grad	61 (76%)	101 (77%)	2 (3%)	3 (5%)
Income ≥ 50k	6 (7.6%)	5 (4%)	37 (54%)	37 (59%)
Marital status: married or living with partner	48 (61%)	74 (56%)	37 (54%)	36 (57%)
Employment, FT or PT	41 (52%)	73 (56%)	41.49 (10.77)	38.59 (10.73)

Note. MSA = muscle-strengthening activity; BMI = body mass index; MVPA = moderate-to-vigorous physical activity; HS = high school; FT = full-time; PT = part-time.
*$p < .05$ for between-group differences for no MSA versus any MSA.

the study, there were no missing data with respect to the outcome. At baseline, 12.8% ($n = 17$) participants reported meeting the national guidelines for MSA at 2 or more days/week. For the purpose of this study, those who did not respond to questions at either follow-up on strength behavior were removed from the analysis ($n = 55$ of 266). There were no significant differences in demographic characteristics between those who did and did not provide strength data ($ps > .10$). Further exploration of participants reporting any MSA did not suggest significant between-group differences (Intervention vs. Control) in baseline variables. Baseline demographics were compared between those who reported at least some MSA versus none, and results indicated significant differences in BMI at baseline, such that those reporting at least some MSA during the intervention had significantly lower BMI at baseline ($p = .03$). There were no differences in age, education, race, ethnicity, income, or marital status between those who did and did not engage in any MSA ($ps > .05$). Table 1 presents between-group differences (PA Intervention vs. Wellness Control) in the current subsample ($n = 131$).

Effect of Intervention on Minutes Per Week of Muscle-Strengthening PA at 6 and 12 Months Controlling for Baseline

Overall, participants were sedentary/low active at baseline with respect to aerobic PA. However, among those with reported MSA over the course of the study, those in the Tailored PA Intervention increased their minutes/week of MSA from median of 30.00 at baseline (range, 7–210) to 53.00 (range, 7–480) at 6 months to 45.00 (range, 6–240) at 12 months (irrespective of aerobic activity; see Figure 1). Those in Wellness Control reported changes from 40.00 (range, 0–45) at baseline to 30.00 (range, 2–150) at 6 months to 10.00 (range, 3–135) at 12 months. Adjusted models indicate Intervention effects on time spent (minutes/week) in MSA at 6 months and a trend at 12 months. There was a 16-minute/week difference (SE = 7.91, p = .04, 95% confidence interval [CI] = [0.18, 31.82]) in median minute/week of muscle-strengthening PA between the Tailored PA Intervention and Wellness Control at 6 months and 45-minute/week difference at 12 months (SE = 25.80, p = .06, 95% CI = [–6.6, 96.6]) adjusting for baseline. In addition, we explored whether baseline MSA moderated treatment effects on outcomes at follow-up, but with no significant conditional effects (ps > .30); thus, we did not present here. Finally, there were no significant correlations between minutes/week of MVPA and minutes/week of MSA at 6 months (rho = .03, p = .80) or 12 months (rho = .14, p = .24).

Meeting Guidelines for Strength PA (≥2 Days/Week of Muscle-Strengthening PA)

At 6 months, 28.4% (n = 37) of participants met national PA guidelines for MSA and 30.3% (n = 39) met guidelines at 12 months. If we consider these proportions by group, 33.8% of Tailored PA Intervention participants versus 25.4% of Wellness Control participants met guidelines for MSA at 6-month follow-up. Regression models indicate that significantly more Tailored PA Intervention participants met MSA guidelines at 6 months (odds ratio [OR] = 4.29, 95% CI = [1.03, 17.84]) compared with Wellness Control participants. There were no significant intervention effects at 12 months (p = .23).

Sensitivity Analysis

Effect of Intervention on Minutes Per Week of Muscle-Strengthening PA at 6 and 12 Months Controlling for Baseline: Intent-to-Treat Sample

Overall, participants were sedentary/low active at baseline with respect to aerobic PA. Adjusted models indicate Intervention effects on time spent (minutes/week) in MSA at 6 months and a trend at 12 months. There was a 11-minute/week difference (SE = 5.79, p = .04, 95% CI = [0.33, 23.15]) in median minute/week of muscle-strengthening PA between the Tailored PA Intervention and Wellness Control at 6 months and 35-minute/week difference at 12 months (SE = 24.17, p = .00, 95% CI = [–4.67, 41.76]) adjusting for baseline. In addition, we explored whether baseline MSA moderated treatment effects on outcomes at follow-up, but with no significant conditional effects (ps > .45); thus, we did not present here.

Meeting Guidelines for Strength PA (≥2 Days/Week of Muscle-Strengthening PA): Intent-to-Treat Sample Results

At 6 months, 17.5% (n = 37) of the randomized sample of participants met national PA guidelines for MSA and 18.5% (n = 39) met guidelines at 12 months. If we consider these proportions by group, 16.7% of Tailored PA Intervention participants versus 11.2% of Wellness Control participants met guidelines for MSA at 6-month follow-up. Regression models indicate that significantly more Tailored PA Intervention participants met MSA guidelines at 6 months (OR = 2.59, 95% CI = [1.07, 3.23]) compared with Wellness Control participants. There were no significant intervention effects at 12 months (p = .69).

Discussion

The results of the study indicate that an individually tailored and home-based intervention promoting mostly aerobic MVPA also served to benefit increases in MSA among the subsample of participants reporting any MSA. More time per week was spent in MSA, and a greater proportion of participants met the national PA guidelines of 2 or more days per week of MSA in the Intervention group compared with the Wellness Control group. The intervention effects were most pronounced at 6-month follow-up, which was the primary endpoint of the study, prior to the tapered maintenance phase. Results of the sensitivity analysis revealed that there were no statistical differences in the pattern of results when all *Seamos Saludables* participants were included in the analysis.

Seamos Saludables (Marcus et al., 2013, 2015; Pekmezi et al., 2012) may have been successful at increasing MSA in participants for several reasons. The intervention was individually tailored and targeted cognitive constructs such as self-efficacy and enjoyment that could have facilitated receptiveness to physical activities other than aerobic type. The emphasis on behavioral strategies such as goal setting, planning, and self-monitoring may have provided participants with the foundational skills to change their leisure time PA to any type of PA, including MSA. The study sample of Latinas was not limited to older adults or women with obesity (Vermeesch & Stommel, 2014), which are characteristics that have been associated with lower engagement in muscle-strengthening activities, and therefore more likely to seek more intensive physical activities. In addition, although *Seamos Saludables*

did not offer structured trainings or goal-setting sessions for muscle-strengthening exercise, it did provide related information on resources such as equipment (e.g., weights and resistance bands) and strength training programs available in the community (e.g., YMCA), which could have benefited participants given that lack of exercise equipment and knowledge about exercise are noted as major barriers to PA by Latinos (Bautista et al., 2011).

It is also possible that, for individuals who do not regularly exercise, first performing simple aerobic activities like walking helped them initiate regular PA, after which they were able to explore new activities like strengthening exercises. Women in the current study reported a median of 0 minutes/week of activity at baseline and had little experience with MVPA, thus aerobic activities like walking may be the most appropriate for initiating regular activity. Previous studies have shown that for women, low intensity exercises have greater adherence and enjoyment than more intense activities (Cox et al., 2003; White et al., 2005). Consistent with this, a strength training intervention with English-speaking Latinas have had relatively low retention and adherence (Martin et al., 2015) compared with interventions promoting walking and other moderate aerobic activities in Latinas (Hartman et al., 2017; Marcus et al., 2015; Pekmezi et al., 2009). Further studies should examine factors influencing initiation and adherence to MSA in Latinas who do not regularly participate in PA (e.g., whether MVPA facilitates MSA initiation and adherence or initiation of MSA is independent of MVPA).

Introducing MSA through walking/aerobic interventions may be particularly important for this high-risk population of Spanish-speaking, predominantly overweight Latinas. An examination of perceived barriers to PA in Latinas showed that those who predominantly spoke Spanish were more likely to report lack of skill as a barrier to PA, whereas women who were overweight or obese were more likely to report fear of injury as a barrier (M. W. Chang et al., 2008). Thus, simple aerobic activities like walking may be more appealing to this population, as it requires little skill and carries little risk of injury compared with some MSA, which women may become more open to only after participating in other activities. Thus, future interventions should investigate whether muscle-strengthening exercises are more acceptable for women who are already engaged in aerobic activities and whether MSA in Latinas is differentially related to psychosocial predictors of engaging in aerobic MVPA (e.g., self-efficacy, social support; Marcus et al., 2013; Marquez et al., 2016).

Adjusted models showed that individuals in the Intervention group were more than 4 times more likely to meet guidelines at 6 months (OR = 4.29). Differences in adjusted minutes of MSA were also significantly greater in the Intervention group; the difference, however, was modest with 16 more minutes per week in the Intervention versus Control groups. Current guidelines specify the number of weekly episodes of MSA, but not the duration; thus, it is possible to meet guidelines by engaging in multiple short episodes of MSA. Whether this difference is clinically meaningful is difficult to say. Significant increases in strength have been shown in older adults doing strength exercise twice per week for <15 minutes each time (Fisher et al., 2014). Short episodes of MSA may be more clinically meaningful when combined with aerobic activity (Church et al., 2010).

Findings from our study suggest that more research should be done on incorporating MSA into MVPA interventions, as a high percentage of our participants voluntarily increased participation in MSA even though these were not the primary intervention target. Notably, increases were seen in the control group as well, suggesting Latina women who express interest in increasing their MVPA—enough so to participate in a research study—may be generally open to participating in this activity. It is unclear if the greater MSA increases in the Intervention group were due to the limited intervention materials promoting strengthening exercises, or due to branching out to other activities after first engaging in walking and other aerobic activities.

Given the benefits of muscle-strengthening activities for metabolic health and the high prevalence of diabetes in this population (U.S. Department of Health and Human Services Office of Minority Health, 2019), future studies should investigate changes in metabolic biomarkers and other clinical outcomes in combined aerobic and MSA interventions compared with solely aerobic programs. Research should also examine whether adherence and retention differ across various types of PA programs (aerobic MVPA alone, MSA alone, or combined aerobic MVPA and MSA).

There are several limitations to our study. The intervention was not designed specifically to increase MSA. There was some indication from the point estimates that participants randomized to a PA intervention changed their behavior with respect to MSA; however, future work should be done to assess whether this was a function of increased interest. Although participants in our study showed increases in MSA, further research is also needed to develop and test the efficacy of interventions for increasing MSA in Latina women. In addition, at the end of the tapered maintenance phase, the Intervention group still engaged in more minutes of MSA per week, although the difference was not significant. Given the wide range in self-reported MSA, it is difficult to determine whether this was a difference in behavior or due to measurement. This emphasizes another limitation in the current study, namely the lack of objective measures of MSA. Given the use of self-reported measure of MSA, results should be interpreted with caution as they may be subject to reporting biases, such as social desirability. Our study also relied on adapted MSA questions from the BRFSS; thus, they were limited to self-reported muscle-strengthening exercises performed on average during the previous 3 months, and results showed high variability in self-reported MSA. Moreover, the MSA questions did not differentiate between MSA and stretching/balance activities for yoga and pilates; as such, we excluded these from our analyses, and it is possible that we may have

missed some MSA in our data collection. Future PA studies in Latinas should incorporate promotion of both aerobic and MSA and should use more rigorous measures of MSA, including objective measures of muscle strength.

Despite these limitations, our study contributes to the gap in research on muscle-strengthening exercise and provides direction for future research and health promotion efforts in an underrepresented population. Overall, results provide encouraging evidence that a high-risk population of Spanish-speaking Latina women engaged in one health-promoting activity (aerobic MVPA) will adopt another behavior (MSA) with great potential to enhance well-being and prevent disease. Future interventions that address both aerobic MVPA and MSA together will provide a more comprehensive approach for reaching the full PA guidelines and will help further reduce PA-related health disparities in Latinas.

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ORCID iD

Tanya J. Benitez https://orcid.org/0000-0003-2691-2019

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