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Physical Activity Maintenance among Spanish-Speaking Latinas in a Randomized Controlled Trial of an Internet-based Intervention

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Abstract

Background—Spanish-speaking Latinas have some of the lowest rates of meeting physical activity guidelines in the U.S. and are at high risk for many related chronic diseases. The purpose of the current study was to examine the maintenance of a culturally and individually-tailored Internet-based physical activity intervention for Spanish-speaking Latinas.

Methods—Inactive Latinas ($N = 205$) were randomly assigned to a 6-month Tailored Physical Activity Internet Intervention or a Wellness Contact Control Internet Group, with a 6-month follow-up. Maintenance was measured by assessing group differences in minutes per week of self-reported and accelerometer measured moderate to vigorous physical activity (MVPA) at 12 months after baseline and changes in MVPA between the end of the active intervention (month 6)

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Conflict of Interest: The authors declare that they have no conflict of interest.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

Informed consent was obtained from all individual participants included in the study. All study protocols and forms were approved by the institutional review board of the University of California, San Diego.

Availability of data and materials

The dataset is available upon request to the corresponding author.

and the end of the study (month 12). Potential moderators of the intervention were also examined. Data were collected between 2011 and 2014, and were analyzed in 2015 at the University of California, San Diego.

Results—The Intervention Group engaged in significantly more minutes of MVPA per week than the Control Group at the end of the maintenance period for both self-reported (mean diff=30.68, SE=11.27, p=.007) and accelerometer measured (mean diff= 11.47, se=3.19, p=.01) MVPA. There were no significant between- or within-group changes in MVPA from month 6 to 12. Greater intervention effects were seen for those with lower BMI (BMI × intervention = −6.67, SE=2.88, p=.02) and lower perceived places to walk to in their neighborhood (access × intervention = −43.25, SE=19.07, p=.02), with a trend for less family support (social support × intervention=−3.49, SE=2.05, p=.08). Acculturation, health literacy, and physical activity related psychosocial variables were not significant moderators of the intervention effect during the maintenance period.

Conclusions—Findings from the current study support the efficacy of an Internet-delivered individually tailored intervention for maintenance of MVPA gains over time.

Keywords

Physical activity maintenance; Spanish-speaking Latinas; Internet; Technology; Behavioral Intervention; Public Health

Background

Regular physical activity confers numerous health benefits, including reduced rates of cardiovascular disease, type 2 diabetes, depression, and certain types of cancer (Centers for Disease Control and Prevention, n.d.; Moore, Lee, Weiderpass, & Al, 2016). Despite this, participation in regular physical activity is low. While about half of U.S. adults do not meet the physical activity guidelines for aerobic activity, these rates are worse in Latinos in the U.S. (Colby & Ortman, 2015; Dominguez et al., 2015; National Health Interview Survey, 2015). Among Latinos, rates of meeting physical activity guidelines are even lower among Latinas who prefer to speak Spanish than Latinas who are U.S. born and speak English (Vermeesch & Stommel, 2014). Interventions that can effectively increase physical activity and maintain those changes over time among Spanish-speaking Latinas are needed to address this growing public health concern.

To promote physical activity an increasing number of studies have developed and tested Internet-delivered interventions as a method of reaching broad populations (Davies, Spence, Vandelanotte, Caperchione, & Mummery, 2012; Foster, Richards, Thorogood, & Hillsdon, 2013; Joseph, Durant, Benitez, & Pekmezi, 2014; Mateo, Granado-Font, Ferre-Grau, & Montana-Carreras, 2015; van den Berg, Schoones, & Vliet Vlieland, 2007; Vandelanotte, Spathonis, Eakin, & Owen, 2007). The majority of Latinos (83%) use the Internet regularly (Pew Research Center, 2014; Lopez, Gonzalez-Barrera, & Patten, 2013). Internet-delivered interventions, whether accessed via home computer, mobile phone or mobile phone apps, have the potential to reach large numbers of people while providing 24-hour access to intervention materials and support. Internet-delivered interventions have demonstrated

promising results for physical activity promotion (Davies et al., 2012; Foster et al., 2013; Joseph et al., 2014; Mateo et al., 2015; van den Berg et al., 2007; Vandelanotte et al., 2007). For example, in a recent review of 72 studies using Internet interventions to promote physical activity in adults (Joseph et al., 2014), most studies (61.9%) reported significant increases in physical activity. These findings are consistent with results from earlier reviews (van den Berg et al., 2007; Vandelanotte et al., 2007) and meta-analyses (Davies et al., 2012). However, these encouraging results are somewhat limited in that we were unable to identify any Internet-based physical activity intervention studies focused on racial/ethnic minority groups and have identified only one study to date with a majority (78%) Latino sample (Magoc, Tomaka, & Bridges-Arzaga, 2011). To address this disparity, our research team developed and tested an internet-based physical activity intervention for Latinas (Marcus et al., 2015) which found encouraging results after the six-month active intervention phase (Marcus et al., 2016).

While this and other Internet-based interventions have produced significant short-term improvements in physical activity, long-term maintenance is needed for continued health benefits of physical activity (Garber et al., 2011). Thus it is also important to establish whether these interventions produce enduring increases in physical activity at longer term follow up. Only a small proportion of Internet-delivered physical activity interventions have included assessments longer than 3 months post-intervention to evaluate longer-term impacts of their intervention (Joseph et al., 2014). Understanding the effects of interventions on longer-term outcomes will help inform the translation of evidence-based interventions into practice (Owen, Glanz, Sallis, & Kelder, 2006), and provide valuable insight regarding the factors that are associated with physical activity maintenance.

In addition to determining whether or not an intervention is effective, determining who benefits from it is essential. A variety of individual- and environmental-level variables, such as acculturation, social support, body mass index (BMI), and neighborhood environment, have been identified as moderators of moderate to vigorous physical activity (MVPA) in previous studies with Latinos (Benitez, Dodgson, Coe, & Keller, 2015; Hartman et al., 2011; Larsen, Pekmezi, Marquez, Benitez, & Marcus, 2013). It is important to explore whether certain individuals would benefit more or less from specific interventions, and to determine whether individuals who report environmental barriers to activity can still benefit from interventions that are predominantly psychosocial in nature.

The purpose of this paper was to examine maintenance of physical activity gains of a culturally and linguistically adapted, individually-tailored Internet-based physical activity intervention for Latinas. Maintenance was measured by assessing MVPA six months after the end of the active intervention phase (12 months after baseline) and exploring changes in MVPA between the end of the active intervention (month 6) and end of the study (month 12). We hypothesized that the Intervention Group would maintain the gains in both self-reported and accelerometer measured MVPA achieved by month 6 at month 12, and that the Intervention Group would report significantly more minutes of self-reported and accelerometer measured MVPA than the control at month 12. Additionally, we sought to examine potential moderators of the intervention effects on self-reported MVPA in order to

determine if the intervention was equally effective across subgroups who often report low MVPA and higher risk of chronic disease.

Methods

Study Design and sample

The Pasos Hacia La Salud study (N=205) was a 6-month randomized controlled trial with a maintenance phase from 6 to 12 months (Marcus et al., 2016; Marcus et al., 2015). The study compared an Internet-based Spanish-language, culturally and individually tailored physical activity intervention with a Spanish-language wellness contact control Internet group. Data were collected at the University of California, San Diego between 2011 and 2014, and were analyzed in 2015. The primary dependent variable upon which the study was powered was minutes per week of MVPA as measured by 7-Day Physical Activity Recall interview (7-Day PAR). Minutes per week of MVPA were measured objectively by accelerometer and served as an additional primary outcome.

Eligible participants were women who self-identified as Hispanic or Latina (or of a group defined as Hispanic/Latina by the Census Bureau), were able to read Spanish fluently (defined as scoring above the “Inadequate” range on the STOFHLA), and self-reported insufficient physical activity (defined as reporting less than 60 minutes per week of MVPA on the 7-Day PAR in an effort to target women most at need for intervention and for consistency with previous studies (Cadmus-Bertram, Marcus, Patterson, Parker, & Morey, 2015; Gao et al., 2016; Marcus et al., 2013; D. Pekmezi et al., 2016; D. W. Pekmezi et al., 2009). Participants also had to be 18-65 years of age with a BMI <45 kg/m^2 and have regular access to an Internet-connected computer through home, work, or their community (e.g., public library, community center, neighbor’s house). Exclusion criteria included having a medical condition or taking medication that would make unsupervised physical activity unsafe, currently pregnant or planning to be pregnant in the next year; and planning to move from the area within the next year. The protocol was approved by the institutional review board of the University of California, San Diego.

Protocol

A detailed description of the study protocol and participant recruitment has previously been published (Marcus et al., 2015). Briefly, participants were recruited through several methods including paid ads on Craigslist.org, participant referrals, advertising in local Spanish language newspapers, and mailed and emailed study information through primary care doctor offices. Potential participants were screened over the phone for eligibility, then attended an orientation session and provided written informed consent. Participants returned for a measurement visit during which height and weight were measured and an ActiGraph GT3X+ accelerometer was distributed with instructions to wear it during waking hours for seven consecutive days. One week following the measurement visit, participants returned with the accelerometer for a randomization visit. Prior to randomization participants completed a 10-minute treadmill walk intended to demonstrate moderate intensity physical activity in order to guide the 7-Day PAR. Participants wore a chest strap heart rate monitor during the walk and completed it in the presence of two research staff members with up-to-

date CPR/AED-training. After all measures were completed, participants were randomly assigned to one of two groups: Tailored Physical Activity Internet Intervention or Wellness Contact Control Internet Group. Group assignment was determined using a permuted block randomization procedure, with small random sized blocks. Randomization was stratified by Transtheoretical Model stage of change to ensure an equal distribution of treatment assigned across levels of motivational readiness for physical activity.

A total of 838 individuals expressed interest in participation. Of these, 258 did not meet inclusion criteria, 333 declined to participate, 25 failed to complete the screener, and 4 were unable to be scheduled for an orientation. A total of 205 eligible women were randomly assigned to the Intervention (n=104) and Control (n=101) groups and included for analyses (see Figure 1).

Tailored Physical Activity Internet Intervention (Intervention Group)

The intervention was based on Social Cognitive Theory (Bandura, 1986) and the Transtheoretical Model (Prochaska & DiClemente, 1986) and emphasized behavioral strategies for increasing activity, including goal-setting, self-monitoring, problem solving barriers, increasing social support, and rewarding oneself for meeting physical activity goals. Participants received access to a study website that included the following features: 1) self-monitoring of minutes of activity and steps; 2) goal setting with graphs to compare goals to reported activity; 3) a message board to foster social support between participants; 4) “ask the expert” where participants could anonymously ask questions to a PhD level researcher; and 5) online resources such as maps to create walking routes and free exercise videos.

In addition, participants completed questionnaires that generated individually tailored physical activity reports. These reports included information regarding: 1) current stage of motivational readiness for physical activity; 2) current self-efficacy; 3) cognitive and behavioral strategies associated with physical activity (processes of change); 4) how the participant compares to individuals who are physically active and meeting national guidelines of 150 minutes per week of MVPA (normative feedback); 5) how the participant compares to her prior responses (progress feedback – provided after the first month); and 6) useful facts about physical activity, such as health benefits, stretching, and heart rate monitoring. In addition, they received an online manual that was matched to their motivational readiness for physical activity. The Intervention Group received email prompts to access the intervention website weekly during month 1, bi-weekly during months 2 and 3, monthly during months 4-6, and every other month during months 7-12. Prompts to complete the tailoring questionnaire occurred monthly throughout the 12 months. They also received 2 brief phone calls during the active intervention phase and one brief call at 9 months during the maintenance phase to review progress and problem solve around activity goals. Calls typically took 15 to 20 minutes and were conducted by the study staff member who completed that participant’s randomization visit.

Wellness Contact Control Internet Group (Control Group)

The Wellness Contact Control Internet Group received access to a Spanish language website with information on health topics other than physical activity. The web-based content

focused on diet and other factors associated with cardiovascular disease risk and included information from a series on heart health developed for Latinos by the National Heart Lung and Blood Institute. Control Group participants also completed online questionnaires on wellness topics (other than physical activity) on the same schedule as the Intervention arm.

During the maintenance phase they also received a brief phone call at 9 months to keep the contact between the two arms as similar as possible. On this call staff made sure they had received the study emails and answered any questions. Calls typically lasted about 5-10 minutes and were conducted by the study staff member who completed that participant's randomization visit.

Cohort Retention

To increase the retention of participants we utilized bilingual/bicultural staff and provided flexible scheduling of visits (i.e., nights, weekends). Reimbursement was provided for travel and childcare and participants were provided monetary compensation: $25 for attending six and twelve month assessments plus a $50 bonus for attending both visits, as well as $10 each month for filling out the online questionnaires. For full details on cohort retention please see Marcus et al 2016.

Measures

The primary outcomes for the current analysis were physical activity at 12 months (end of the maintenance phase) and change in physical activity from month 6 to month 12, measured by self-report and accelerometer. Self-reported physical activity was measured by the 7-Day PAR (Blair et al., 1985; Sallis et al., 1985). The 7-Day PAR is an interviewer-administered instrument that provides details about the types of activities engaged in and an estimate of weekly minutes of physical activity engaged in during the previous week. In an attempt to enhance the accuracy of self-reporting, participants walked on a treadmill for 10 minutes at a moderate intensity pace (3-4 miles per hour) just prior to completing the 7-Day PAR at baseline, 6 months, and 12 months. Accelerometer-measured physical activity (ActiGraph 3X+) served as an additional primary outcome measure (Melanson, Freedson, & Jr, 1995). Accelerometer data was collected at 30Hz and processed with 60 second epochs. Participants wore the accelerometer on the left hip for the seven days during waking hours only, overlapping with the 7-Day PAR at baseline, 6 months, and 12 months.

Demographics were assessed at baseline with a brief questionnaire assessing age, education, income, occupation, race, ethnicity, history of residence, and marital status. The Brief Acculturation Scale (BrAS) is a four-item measure that asks about language use across different life contexts (i.e., at home, with friends) with higher scores indicating a higher level of acculturation (Norris, Ford, & Bova, 1996). The Spanish Short Test of Functional Health Literacy in Adults (STOFHLA), is a brief (7-minute) measure designed to evaluate adult literacy in the health care setting (Nurss, Parker, Williams, & Baker, 1998). The STOFHLA provides three categories of literacy based on the 36-point score: inadequate (0–16), adequate (17–22) and functional (23–36). Environment was assessed using the Neighborhood Environment Walkability Scale, Abbreviated (NEWS-A), which includes 54

items (Cerin, Saelens, Sallis, & Frank, 2006) assessing various aspects of the built environment related to walking, neighborhood aesthetics, and traffic.

Psychosocial measures were assessed at baseline, 6 and 12 months. Social support for physical activity was measured using the Social Support for Exercise (SSE) scale (Sallis, Grossman, Pinski, Patterson, & Nader, 1987). The 13-question measure has three subscales: Family Participation, Family Rewards and Punishment, and Friends Participation (alphas range from 0.61 to 0.91). The Physical Activity Enjoyment Scale (PACES) assessed the level of personal satisfaction derived from physical activity participation (alpha = 0.96) (Kendzierski & DeCarlo, 1991). Physical activity stage of change was measured with a 4-item scale (Kappa = 0.78; intra-class correlation r = 0.84) (Marcus, Selby, Niaura, & Rossi, 1992). The 40-item Processes of Change assessed 2 main subscales: behavioral and cognitive processes (alphas ranged from .62 to .96) (Marcus, Rossi, Selby, Niaura, & Abrams, 1992). Self-efficacy for physical activity was measured with a 5-item instrument (alpha = .82) (Marcus et al., 1992).

All measures were available and used in Spanish.

Statistical Analyses

Using a series of longitudinal mixed effects models (one for self-reported outcomes and another for objectively measured outcomes), we tested the effect of Intervention vs. Control on mean minutes/week of MVPA over 12 months. Interest was in testing the maintenance period by examining the effects at 12 months (Intervention vs. Control, adjusting for baseline) and differences from 6 to 12 months (adjusting for baseline). Models included subject-specific random intercepts, and standard errors were adjusted for repeated measurements (repeating outcomes within participant over time). Analysis was based on the intent to treat sample and thus included all 205 participants randomized at baseline. Mixed effects models estimate regression coefficients using a likelihood based approach and thus do not directly impute missing data (but still make use of all available outcomes). As there were no between-group differences in baseline characteristics, no additional covariates were included in the final models. Identical analyses were completed with 7-Day PAR and accelerometer data. The association between self-reported and objectively measured MVPA was determined using Spearman rank order correlations. Accelerometer data was processed using the ActiLife software, with a cut point of 1952 to establish the minimum threshold for moderate intensity activity (Freedson, Melanson, & Sirard, 1998). Valid wear time was classified as five days of at least 600 minutes of wear time each day or at least 3000 minutes of wear time over five days. To be counted in the total minutes/week of activity, activity had to occur in ≥10-minute bouts, consistent with the 7-Day PAR interview. All analyses of accelerometer data were adjusted for wear time.

Subsequently, between group differences in the percentage of participants meeting American College of Sports Medicine (ACSM) guidelines for physical activity(Services, 2008) (at least 150 min/week of MVPA) were tested using logistic regression models (one for self-reported outcomes and another for objectively measured outcomes). Both unadjusted and adjusted proportions are presented.

Moderators of the intervention effects on MVPA at 12 months (self-reported) were tested using a similar analytic approach to that described previously. To be consistent with the original aims of the grant, interest was in the moderators of the treatment effect on self-reported MVPA (which was considered the primary aim of the study, although objectively measured outcomes were also collected). The study was originally powered on self-reported physical activity, as physical activity guidelines are based on self-reported physical activity(Haskell et al., 2007) and at the time of the grant proposal there was a lack of accelerometer data with Latina populations to use to power this study. We chose not to run the moderator analyses with the accelerometer data as we are not sufficiently powered and would be prone to Type II error. In this case, models included the main effect of the posited moderator, as well as the interaction between Intervention and the moderator. A variable was considered to be a moderator if the interaction was statistically different than zero. Posited moderators were identified a priori and included baseline acculturation, BMI, health literacy, neighborhood walkability and psychosocial measures (a total of six constructs). With the exception of environmental access and social support, total scores were used as moderators. In the case of social support, all 3 subscales were examined separately, as were each of the subscales of environmental access. Unstandardized betas are presented and all analyses were carried out in SAS 9.3 and significance level was set at α=0.05.

Results

Participants were 205 Latinas who predominantly identified as having a Mexican background (84%), being first generation in the U.S. (81%), and speaking only Spanish or more Spanish than English in the home (69%). The average age was 39-years-old, and about two-thirds reported less than $30,000 annual household income (see Table 1). BMI was on average in the overweight category (m=28.8 kg/m^2) and ranged from 17.37-43.12 kg/m^2. On average, participants scored in the “functional” range on health literacy, with only 1% of participants scoring in the “adequate” range. Of the 205 participants randomized, 184 (84%) provided primary outcome data at 12 months (see Figure 1). Those who did not provide 12-month data were not significantly different in any baseline characteristics from those who did.

Changes in MVPA

Unadjusted means of weekly minutes of self-reported MVPA over time are presented in Figure 2. As expected, the largest gains in MVPA were seen during the active intervention period from baseline to 6 months. Significant intervention effect remained at the end of the maintenance phase with the intervention group reporting significantly greater MVPA at 12 months than the control group (mean diff=30.68, SE=11.27, p=.007). Participants in the Intervention Group increased their self-reported MVPA from 8.01 minutes per week (SD=14.95) to 108.62 minutes per week (SD=107.19) over 12 months, compared to Control participants who reported increases from 8.54 minutes per week (SD=14.64) to 75.85 minutes per week (SD=89.75) over 12 months.

MVPA gains during the initial 6 months were largely maintained during the maintenance follow-up period. Between month 6 and 12, individuals in the Intervention Group reduced

their MVPA by 4.2 minutes/week, while those in the Control Group increased MVPA by 12.8 minutes/week. There were no significant between- or within-group changes in MVPA from month 6 to 12.

Of the 205 participants, 157 provided sufficient accelerometer data at 12 months. There were no significant differences between those with and without 12-month objective outcomes with respect to baseline demographics (p's>.05). At 12 months, there was a significant difference between groups (mean diff= 11.47, se=3.19, p=.01) with Intervention participants engaging in a mean of 70.38 minutes per week (SE=86.41) of MVPA accumulated in 10 minute bouts compared to 55.51 minutes per week (SE=74.55) among Controls. Figure 3 depicts unadjusted accelerometer measured MVPA over time. Similar to self-reported outcomes, the largest gains in accelerometer measured MVPA were seen during the first 6 months. The self-reported and accelerometer measured MVPA at 12 months were significantly correlated (rho=0.497, p<.001).

At 12-months, 29% of Intervention participants met ACSM guidelines for physical activity (self-reported MVPA≥ 150 minutes per week), which was similar, and not statistically different, to the number meeting guidelines at 6 months (31%). The number meeting guidelines in the Control increased from 12% at 6 months to 19% at 12 months. The odds of meeting these guidelines did not significantly differ between the groups at 12 months (OR=1.72, 95% CI: .86-3.41, p=0.09). When meeting guidelines was defined based on objectively measured outcomes, 16% of Intervention participants met criteria at 12 months (an increase from 13% at 6 months) vs. 13% of Control participants (an increase from 9% at 6 months). The odds of meeting these guidelines did not significantly differ between the groups at 12 months (OR=1.31, 95% CI: .54-3.17, p=0.56).

Moderators of the Intervention Effect

We examined several potential baseline variables as moderators of the intervention effect on 12-month self-reported MVPA. Acculturation was not a significant moderator of the intervention effect (b=12.23, se=40.20, p=.76), nor was health literacy (b=3.56, se=3.72, p=.34). BMI had a significant moderating effect on the intervention, with a smaller intervention effect seen in those with a higher BMI at baseline (BMI × intervention = −6.67, SE=2.88, p=.02). With regard to neighborhood walkability, there were greater intervention effects among those who reported not having many places they could walk to from their house (access × intervention = −43.25, SE=19.07, p=.02). No other NEWS scales were significant moderators (b's ranged from −22.20 to 18.73, p's ranged from .19-.75). For social support, there was a trend for more of an intervention effect among those reporting less family participation at baseline (social support × intervention=−3.49, SE=2.05, p=.08), but no significant effects associated with other subscales (b=−1.18, se=2.25,p=.60 for participation friends and b=−6.88, se=15.74, p=.66 for rewards and punishments). Self-efficacy (b=−21.03, se=18.62, p=.25) and behavioral (b=−36.72, se=23.27, p=0.11) and cognitive processes (b=−18.63, se=17.62, p=.29) were not significant moderators of the intervention effect.

Discussion

The purpose of this study was to evaluate the maintenance phase of an Internet-based, culturally and linguistically adapted physical activity intervention. As hypothesized, the intervention was successful in helping Spanish-speaking Latinas maintain significant gains in MVPA for an additional 6 months following the end of the active intervention period. At the 12-month follow-up, participants in the intervention arm were still significantly more active than they had been at baseline and were more active than those in the control arm. While the Intervention arm did not increase minutes of MVPA during the maintenance phase from 6 to 12 months, there was also no significant loss of time spent in MVPA. These results are especially encouraging as, although the overall estimates of minutes spent in accelerometer measured MVPA was lower than self-report, the pattern of results was the same. With minimal contact throughout the maintenance phase this Internet-based intervention was able to maintain the significant increases in MVPA that were achieved over the first 6 months. This intervention holds promise for promoting sustained engagement in physical activity among previously inactive Spanish-speaking Latinas.

Our results are consistent with a print based version of the current study, which showed that the print-based, culturally and linguistically adapted physical activity program was effective in maintaining physical activity 6 months after the end of the 6-month intervention (Marcus et al., 2015). Other Internet-based research studies have had varied success in maintaining behavior change. One review of the literature found that only 6 out of 16 studies with a post-intervention follow-up demonstrated maintenance of activity levels (Joseph et al., 2014). It is also important to note that none of the 16 studies that assessed maintenance reported having greater than 20% of participants who identified as Latino. Maintenance of physical activity gains is essential for MVPA interventions to have a public health impact. This is the first published study we are aware of to show this maintenance in Latinas using a web-based intervention.

We did not find that acculturation or health literacy level moderated the effects of the intervention. This intervention had been culturally and linguistically adapted for Spanish-speaking Latinas, and in particular those with lower levels of acculturation. Importantly, the lack of moderating effects suggests that this intervention was not less effective for Latinas with lower acculturation or health literacy. However, the range of values regarding these variables was somewhat restricted. Additional work with more diverse populations of Latinas is needed to fully examine the impact of acculturation and health literacy on internet-delivered interventions. We also did not find that self-efficacy or behavioral and cognitive processes moderated the intervention effect; in other words, the effect of intervention compared to control on PA outcomes did not depend on baseline scores on these constructs. As these were constructs addressed frequently and early on in the intervention, baseline scores may not have impacted the intervention effects.

Several factors did moderate the intervention results. Women with a higher BMI at baseline were less successful in the Intervention Group, suggesting that more may be needed to help this high-risk group increase their activity levels. The intervention may have been more effective for individuals reporting lower family participation in MVPA at baseline. These

individuals may have found study materials and support from study staff and the online forum particularly helpful in the absence of existing support from their families. The intervention was more effective for those who perceived lower access to places to walk in their neighborhood at baseline. Research on the impact of environmental influences on physical activity in Latinas has been mixed (Larsen, Noble, Murray, & Marcus, 2014; Larsen et al., 2013). There is some evidence that lack of access to parks and recreation facilities is associated with less leisure time activity among Latinas, and that Latinas are less likely to have access to facilities than non-Latina Whites (Larsen et al., 2013). In contrast, other research has shown that non-White neighborhoods and higher poverty neighborhoods have greater land-use-mix, providing more walkability destination (Franzini et al Health & Place, 2010). However, Franzini and colleagues also found that despite the greater access, the Latino neighborhoods had lower perceived safety, worse side-walk conditions, and less comfort with the physical environment. Given the potential for individuals to perceive having fewer places to walk to (whether actual, perceived, or due to safety concerns) in predominantly minority communities, it is promising that the current intervention was more effective for those reporting fewer places to walk to in their neighborhood. This suggests that even in the face of real or perceived environmental barriers psychosocial interventions can be effective. This is important as environmental-level changes are not always immediately possible, unlike targeting perceptions about the environment.

The overall success of the intervention in the present study may speak to the strength and appropriateness of the intervention content and delivery channel for maintenance of behavior change. That activity increases that were maintained in this study are especially encouraging given the extremely low levels of MVPA at baseline. Culturally and linguistically adapted materials, tools for self-monitoring, an online forum for communicating with other participants, and having continued access to the website for the full 12 months may have contributed to the success of the maintenance phase. These findings also support the importance of using theoretically grounded intervention content that targets constructs known to predict behavior change (Anderson-Bill, Winett, & Wojcik, 2011; Burke, Beilin, Cutt, Mansour, & Mori, 2008; Darker, French, Eves, & Sniehotta, 2010).

Several limitations should be noted. While the intervention was successful in maintaining the gains in physical activity, the period of maintenance was relatively short (6 months after the end of the active intervention phase). Future studies should examine longer maintenance of physical activity in Latinas. Additionally, participants still received intervention material during the maintenance phase, thus it may not be seen as true maintenance. Another limitation was that the study was originally powered using self-reported physical activity data; however, we still found significant results with objectively measured physical activity. The accelerometer data from this sample can now be used to power future trials with Spanish-speaking Latinas. At 12 months, less than a third of participants were meeting physical activity guidelines, suggesting more is needed to help women reach higher minutes of MVPA. The study was also limited by our sample that comprised relatively healthy, educated, predominantly Mexican-American women with access to the Internet, which may limit the generalizability of the findings. Future studies should explore the efficacy of this intervention among more diverse Latino populations.

Conclusions

The current study supports the efficacy of an Internet-delivered individually tailored intervention for maintenance of MVPA gains over time. With the high rates of inactivity and related diseases among Latinos in the U.S. (Dominguez et al., 2015) and the narrowing of the digital divide, disseminable public health interventions that utilize eHealth/mHealth components that can increase and maintain MVPA are needed. Future research that utilizes other intervention channels with potential for broad reach, such as mobile technology, could complement and enhance an Internet-based intervention to support long-term engagement in physical activity in Latinos. Also, future studies that focus that measure changes in health outcomes and studies with even longer follow-up are needed as continued maintenance of physical activity is important for improving health outcomes.

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List of abbreviations

MVPA	moderate to vigorous physical activity
BMI	body mass index
7-Day PAR	7-Day Physical Activity Recall interview
ACSM	American College of Sports Medicine
BrAS	Brief Acculturation Scale
STOFHLA	Short Test of Functional Health Literacy in Adults

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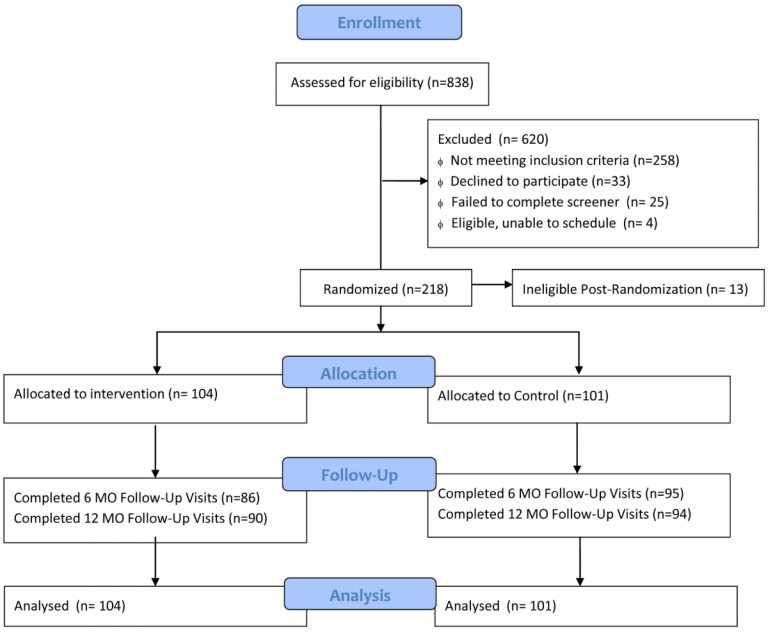

Figure 1.
CONSORT Diagram

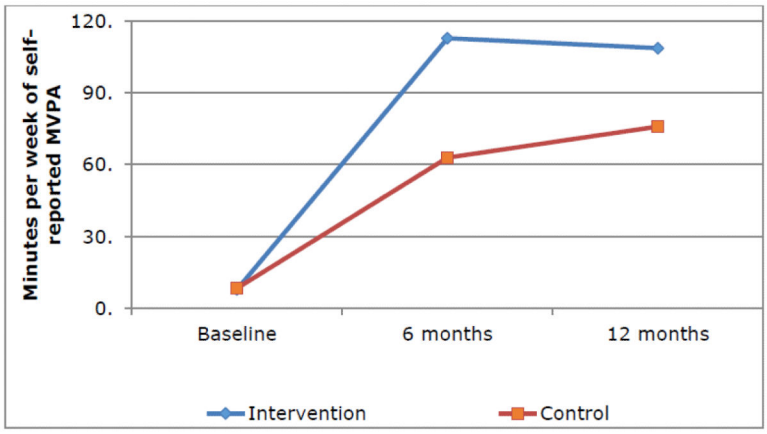

Figure 2.
Unadjusted Mean Minutes per Week of Self-Reported Moderate to Vigorous Physical Activity at Baseline, 6-Months, and 12-Months.

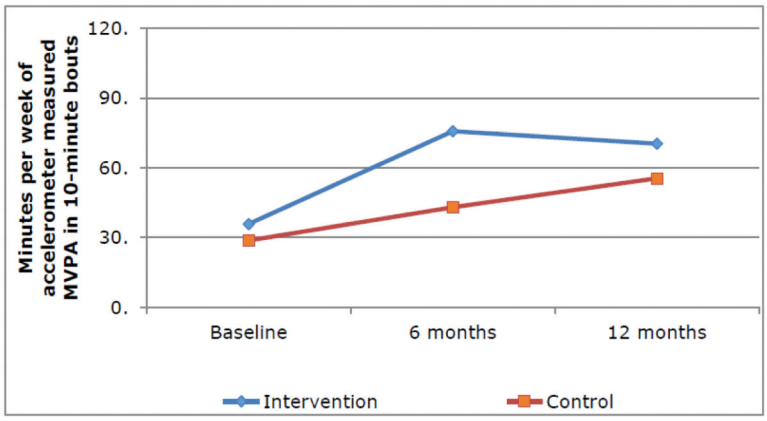

Figure 3.

Unadjusted Mean Minutes per Week of Accelerometer Measured Moderate to Vigorous Physical Activity in 10-Minute Bouts at Baseline, 6-Months, and 12-Months.

Table 1

Demographic Characteristics

Characteristics	Intervention (Mean and SD or %) (N=104)	Control (Mean and SD or %) (N=101)	Overall (M and SD or %) (N=205)
Hispanic	100%	100%	100%
Age	38.8 (10.6)	39.6 (10.4)	39.2 (10.5)
First Generation in U.S.[a]	86.5%	77.0%	81.9%
BMI (kg/m2)[a]	29.1 (5.8)	28.6 (4.5)	28.8 (5.2)
White	45.2%	58.4%	51.7%
Mexican	82.7%	86.1%	84.4%
Annual Household Income	69.3%	63.5%	66.4%
<$30,000	50.0%	57.4%	53.7%
Married	55.4%	66.4%	60.8%
Some college or more education	40.4%	34.7%	37.6%
Language Spoken in the Home	30.8%	32.7%	31.7%
Only Spanish	15.4%	23.8%	19.5%
More Spanish than English	11.5%	5.0%	8.3%
Both Equally	1.9%	4.0%	2.9%
More English than Spanish	34.8 (2.7)	37.3 (22.8)	36.0 (16.1)
Only English			
Health Literacy (scores of 23-36 “functional”)			
Self- Efficacy [b]	2.27(0.75)	2.40(0.82)	2.34(0.79)
Processes of Change	2.42(0.85)	2.49(0.79)	2.45(0.82)
Cognitive Processes	1.98(0.64)	2.00(0.58)	1.99(0.61)
Behavioral Processes			
Social Support[c]	15.17(7.30)	14.67(5.59)	14.93(6.52)
Friends Participation Score	17.59(7.43)	17.96(7.81)	17.77(7.60)
Family Participation Score	3.50(1.06)	3.36(0.86)	3.43(0.96)
Rewards and Punishments			
Environment (NEWS)	250.14(92.43)	228.95(71.97)	239.70(83.46)
Residential Density	2.87(0.88)	2.91(0.92)	2.89(0.90)
Land-use mix- Diversity[d]	3.34(0.72)	3.27(0.74)	3.31(0.73)
Land-use mix - Access[a]	3.16(0.70)	3.03(0.80)	3.09(0.75)
Street Connectivity[a]	2.86(0.63)	2.98(0.62)	2.91(0.63)
Infrastructure & safety[a]	2.74(0.81)	2.74(0.86)	2.74(0.83)
Aesthetic	2.29(0.76)	2.17(0.756)	2.23(0.76)
Traffic hazards	1.86(0.83)	1.62(0.77)	1.74(0.81)
Crime[a]			

[a] N=204;

[b] N=200;

[c] N=202;

[d] N=130