UC San Diego

UC San Diego Previously Published Works

Title

Physical activity maintenance among Spanish-speaking Latinas in a randomized controlled trial of an Internet-based intervention.

Permalink

https://escholarship.org/uc/item/4kq4b29v

Journal

Journal of behavioral medicine, 40(3)

ISSN

0160-7715

Authors

Hartman, Sheri J
Dunsiger, Shira I
Bock, Beth C
et al.

Publication Date

2017-06-01

DOI

10.1007/s10865-016-9800-4

Peer reviewed

eScholarship.org Powered by the California Digital Library
University of California

J Behav Med (2017) 40:392–402
DOI 10.1007/s10865-016-9800-4

Physical activity maintenance among Spanish-speaking Latinas in a randomized controlled trial of an Internet-based intervention

Sheri J. Hartman[1] · Shira I. Dunsiger[2,3] · Beth C. Bock[2,3] · Britta A. Larsen[1] · Sarah Linke[1] · Dori Pekmezi[4] · Becky Marquez[1] · Kim M. Gans[5] · Andrea S. Mendoza-Vasconez[1] · Bess H. Marcus[1]

Received: June 19, 2016 / Accepted: September 30, 2016 / Published online: October 17, 2016
© Springer Science+Business Media New York 2016

Abstract 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. 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) 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. 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

✉ Sheri J. Hartman
sjhartman@ucsd.edu

Shira I. Dunsiger
SDunsiger@Lifespan.org

Beth C. Bock
Bbock@Lifespan.org

Britta A. Larsen
blarsen@ucsd.edu

Sarah Linke
slinke@ucsd.edu

Dori Pekmezi
dpekmezi@uab.edu

Becky Marquez
bemarquez@ucsd.edu

Kim M. Gans
kim_gans@brown.edu

Andrea S. Mendoza-Vasconez
asm017@ucsd.edu

Bess H. Marcus
bmarcus@ucsd.edu

[1] Department of Family Medicine and Public Health, University of California, San Diego, 3855 Health Sciences Dr., La Jolla, CA 92093-0901, USA

[2] Department of Psychiatry and Human Behavior, Centers for Behavioral and Preventive Medicine, Miriam Hospital, Providence, RI, USA

[3] Warren Alpert Medical School at Brown University, Providence, RI, USA

[4] Department of Health Behavior, School of Public Health at University of Alabama at Birmingham, Birmingham, AL, USA

[5] Department of Behavioral and Social Sciences and the Institute for Community Health Promotion, School of Public Health, Brown University, Providence, RI, USA

(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. 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

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

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, 2015; Moore et 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 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). The majority of Latinos (83 %) use the Internet regularly (Lopez et al., 2013; Pew Research Center, 2014). 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 et al., 2011). To address this disparity, our research team developed and tested an Internet-based physical activity intervention for Latinas (Marcus et al., 2015a, b) 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 et al., 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 et al., 2015; Hartman et al., 2011; Larsen et al., 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 mea-

sured by assessing MVPA 6 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., 2015a, b, 2016). 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 min 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 et al., 2015; Gao et al., 2016; Marcus et al., 2013; Pekmezi et al., 2009, 2016). 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., 2015a, b). 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-min 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 Fig. 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

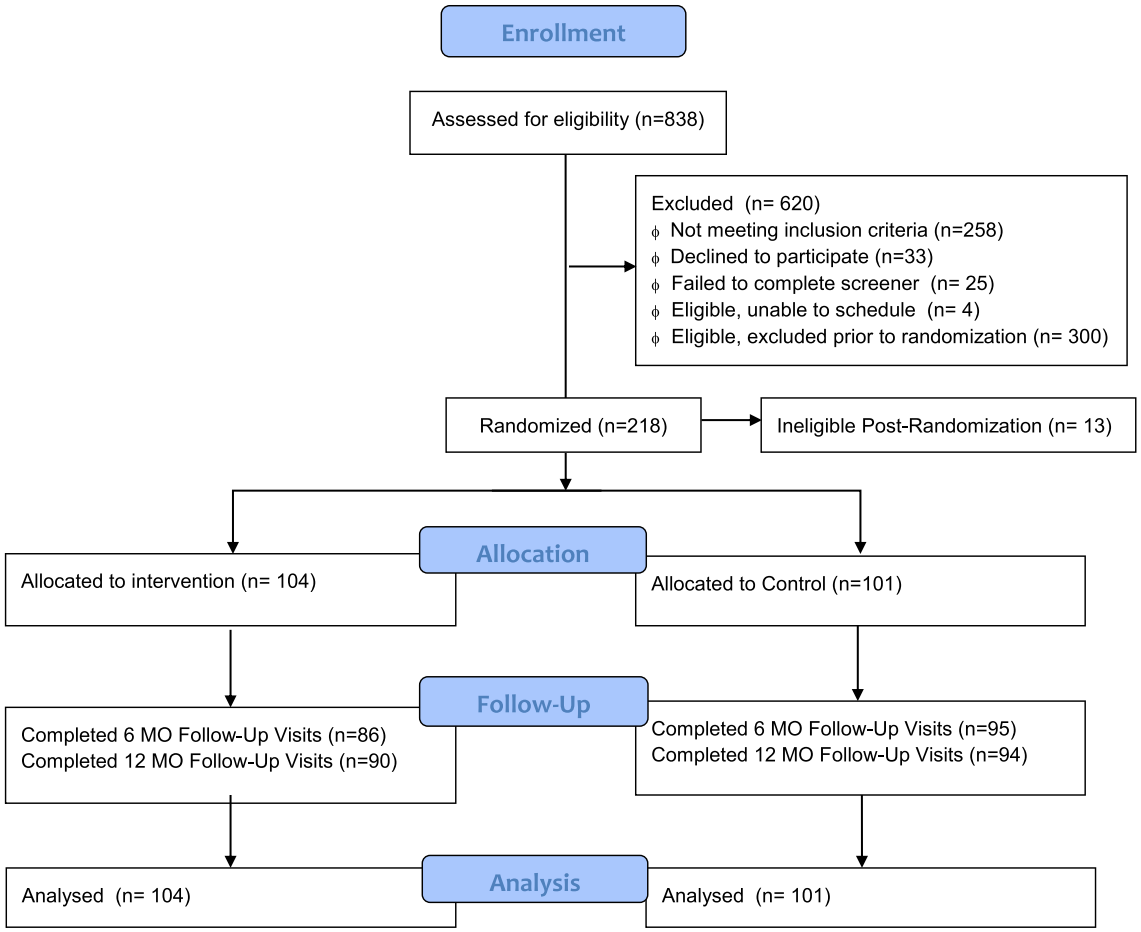

Fig. 1 CONSORT diagram

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 Ph.D. 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 min 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 15–20 min 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 min 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 6 and 12 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 min at a moderate intensity pace (3–4 miles per hour) just prior to completing the 7-Day PAR at baseline, 6 and 12 months. Accelerometer-measured physical activity (ActiGraph 3X+) served as an additional primary outcome measure (Kelly et al., 2013). Accelerometer data was collected at 30 Hz and processed with 60-second epochs. Participants wore the accelerometer on the left hip for the 7 days during waking hours only, overlapping with the 7-Day PAR at baseline, 6 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 et al., 1996). The Spanish Short Test of Functional Health Literacy in Adults (STOFHLA), is a brief (7-min) measure designed to evaluate adult literacy in the health care setting (Nurss et al., 1998; Parker et al., 1995). 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 et al., 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 et al., 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; intraclass correlation $r = 0.84$) (Marcus et al., 1992). The 40-item Processes of Change assessed 2 main subscales: behavioral and cognitive processes (alphas ranged from .62 to .96) (Marcus et al., 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 et al., 1998). Valid wear time was classified as 5 days of at least 600 min of wear time each day or at least 3000 min of wear time over 5 days. To be counted in the total minutes/week of activity, activity had to occur in ≥10-min 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 6 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 $\alpha = 0.05$.

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 to 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 Fig. 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 Fig. 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 min per week (SD = 14.95) to 108.62 min per week (SD = 107.19) over 12 months, compared to Control participants who reported increases from 8.54 min per week (SD = 14.64) to 75.85 min 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 min/week, while those in the Control Group increased MVPA by 12.8 min/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 ($p > .05$). 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 min per week (SE = 86.41) of MVPA accumulated in 10 min bouts compared to 55.51 min 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 min per week), which was similar, and not

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]	86.50 %	77.00 %	81.90 %
BMI (kg/m^2)[a]	29.1 (5.8)	28.6 (4.5)	28.8 (5.2)
White	45.20 %	58.40 %	51.70 %
Mexican	82.70 %	86.10 %	84.40 %
Annual Household Income <$30,000	69.30 %	63.50 %	66.40 %
Married	50.00 %	57.40 %	53.70 %
Some college or more education	55.40 %	66.40 %	60.80 %
Language Spoken in the Home			
Only Spanish	40.40 %	34.70 %	37.60 %
More Spanish than English	30.80 %	32.70 %	31.70 %
Both Equally	15.40 %	23.80 %	19.50 %
More English than Spanish	11.50 %	5.00 %	8.30 %
Only English	1.90 %	4.00 %	2.90 %
Health Literacy (scores of 23–36 "functional")	34.8 (2.7)	37.3 (22.8)	36.0 (16.1)
Self- Efficacy[b]	2.27 (0.75)	2.40 (0.82)	2.34 (0.79)
Processes of change			
Cognitive processes	2.42 (0.85)	2.49 (0.79)	2.45 (0.82)
Behavioral processes	1.98 (0.64)	2.00 (0.58)	1.99 (0.61)
Social support[c]			
Friends Participation Score	15.17 (7.30)	14.67 (5.59)	14.93 (6.52)
Family Participation Score	17.59 (7.43)	17.96 (7.81)	17.77 (7.60)
Rewards and Punishments	3.50 (1.06)	3.36 (0.86)	3.43 (0.96)
Environment (NEWS)			
Residential Density	250.14 (92.43)	228.95 (71.97)	239.70 (83.46)
Land-use mix-Diversity[d]	2.87 (0.88)	2.91 (0.92)	2.89 (0.90)
Land-use mix-access[a]	3.34 (0.72)	3.27 (0.74)	3.31 (0.73)
Street Connectivity[a]	3.16 (0.70)	3.03 (0.80)	3.09 (0.75)
Infrastructure and safety[a]	2.86 (0.63)	2.98 (0.62)	2.91 (0.63)
Aesthetic	2.74 (0.81)	2.74 (0.86)	2.74 (0.83)
Traffic hazards	2.29 (0.76)	2.17 (0.756)	2.23 (0.76)
Crime[a]	1.86 (0.83)	1.62 (0.77)	1.74 (0.81)

[a] N = 204; [b] N = 200; [c] N = 202; [d] N = 130

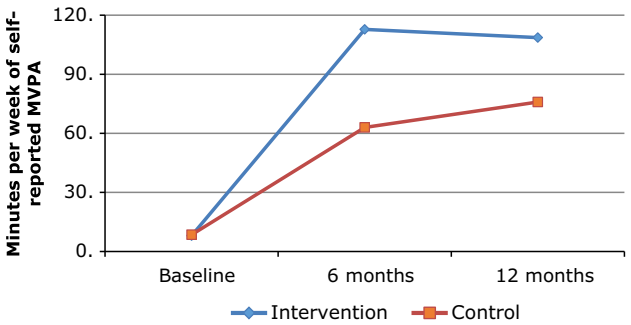

Fig. 2 Unadjusted mean minutes per Week of Self-Reported Moderate to Vigorous Physical Activity at Baseline, 6-Months, and 12-Months

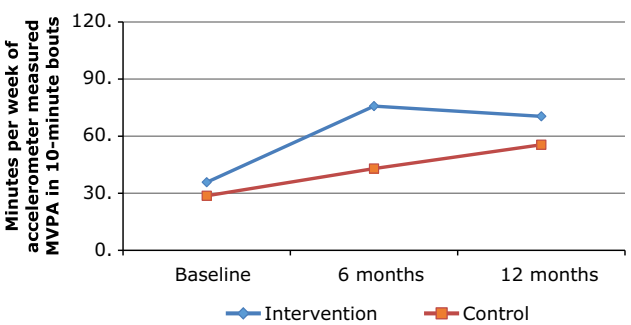

Fig. 3 Unadjusted mean minutes per week of accelerometer measured moderate to vigorous physical activity in 10-min bouts at baseline, 6-months, and 12-months

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) versus 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 to .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., 2015a, b). 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 et al., 2013, 2014). 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., 2010). However, Franzini and colleagues also found that despite the greater access, the Latino neighborhoods had lower perceived safety, worse sidewalk 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 et al., 2011; Burke et al., 2008; Darker et al., 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.

Acknowledgments We would like to thank Michael Getz and Illumina Interactive Learning, as well as Raul Fortunet, Karla Nuñez, Rachelle Edgar, Madison Noble, Daniah Tanori, David Bakal, Emily Berliant, and Dr. Veronica Villarreal at the University of California, San Diego for their valuable research assistance and contributions to this study.

Compliance with ethical standards

Conflict of interest Sheri J. Hartman, Shira I. Dunsiger, Beth C. Bock, Britta A. Larsen, Sarah Linke, Dori Pekmezi, Becky Marquez, Kim M. Gans, Andrea S. Mendoza-Vasconez, and Bess H. Marcus declares that they have no conflict of interest.

Human and animal rights and Informed consent 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

was obtained from all patients for being included in the study. All study protocols and forms were approved by the institutional review board of the University of California, San Diego.

References

Anderson-Bill, E. S., Winett, R. A., & Wojcik, J. R. (2011). Social cognitive determinants of nutrition and physical activity among web-health users enrolling in an online intervention: the influence of social support, self-efficacy, outcome expectations, and self-regulation. *Journal of Medical Internet Research*. doi:10.2196/jmir.1551

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. *Prentice Hall series in social learning theory* (Vol. 1).

Benitez, T. J., Dodgson, J. E., Coe, K., & Keller, C. (2015). Utility of acculturation in physical activity research in Latina adults: An integrative review of literature. *Health Education & Behavior*. doi:10.1177/1090198115601042

Blair, S. N., Haskell, W. L., Ho, P., Paffenbarger, R. S., Vranizan, K. M., Farquhar, J. W. et al. (1985). Assessment of habitual physical activity by a seven-day recall in a community survey and controlled experiments. *American Journal of Epidemiology, 122*, 794–804.

Burke, V., Beilin, L. J., Cutt, H. E., Mansour, J., & Mori, T. A. (2008). Moderators and mediators of behaviour change in a lifestyle program for treated hypertensives: A randomized controlled trial (ADAPT). *Health Education Research, 23*, 583–591. doi:10.1093/her/cym047

Cadmus-Bertram, L. A., Marcus, B. H., Patterson, R. E., Parker, B. A., & Morey, B. L. (2015). Randomized trial of a fitbit-based physical activity intervention for women. *American Journal of Preventive Medicine, 49*, 414–418. doi:10.1016/j.amepre.2015.01.020

Centers for Disease Control and Prevention. (2015). *The benefits of physical activity*. Retrieved from https://www.cdc.gov/physicalactivity/basics/pa-health/

Cerin, E., Saelens, B. E., Sallis, J. F., & Frank, L. D. (2006). Neighborhood environment walkability scale: Validity and development of a short form. *Medicine and Science in Sports and Exercise, 38*, 1682–1691. doi:10.1249/01.mss.0000227639.83607.4d

Colby, S. L., & Ortman, J. M. (2015). *Projections of the size and composition of the U. S. population: 2014 to 2060*. Current Population Reports.

Darker, C. D., French, D. P., Eves, F. F., & Sniehotta, F. F. (2010). An intervention to promote walking amongst the general population based on an "extended" theory of planned behaviour: A waiting list randomised controlled trial. *Psychology & Health, 25*, 71–88. doi:10.1080/08870440902893716

Davies, C. A., Spence, J. C., Vandelanotte, C., Caperchione, C. M., & Mummery, W. K. (2012). Meta-analysis of internet-delivered interventions to increase physical activity levels. *International Journal of Behavioral Nutrition and Physical Activity, 9*, 1–13. doi:10.1186/1479-5868-9-52

Dominguez, K., Penman-Aguilar, A., Chang, M.-H., Moonesinghe, R., & Ted, C. et al. (2015). Vital signs: Leading causes of death, prevalence of diseases and risk factors, and use of health services among Hispanics in the United States—2009–2013. *MMWR. Morbidity and Mortality Weekly Report, 64*, 453–458. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/25950251

Foster, C., Richards, J., Thorogood, M., & Hillsdon, M. (2013). Remote and web 2.0 interventions for promoting physical activity. *The Cochrane Database of Systematic Reviews, 9*, CD010395. doi:10.1002/14651858.CD010395.pub2

Franzini, L., Taylor, W., Elliott, M. N., Cuccaro, P., Tortolero, S. R., Janice Gilliland, M., et al. (2010). Neighborhood characteristics favorable to outdoor physical activity: Disparities by socioeconomic and racial/ethnic composition. *Health Place, 16*, 267–274. doi:10.1016/j.healthplace.2009.10.009

Freedson, P. S., Melanson, E., & Sirard, J. (1998). Calibration of the computer science and applications, Inc. accelerometer. *Medicine & Science in Sports & Exercise, 30*, 777–781.

Gao, S., Stone, R. A., Hough, L. J., Haibach, J. P., Marcus, B. H., Ciccolo, J. T., et al. (2016). Physical activity counseling in overweight and obese primary care patients: Outcomes of the VA-STRIDE randomized controlled trial. *Preventive Medicine Reports, 3*, 113–120. doi:10.1016/j.pmedr.2015.12.007

Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., Lee, I.-M., et al. (2011). American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Medicine and Science in Sports and Exercise, 43*, 1334–1359. doi:10.1249/MSS.0b013e318213fefb

Hartman, S. J., Dunsiger, S. I., Pekmezi, D. W., Barbera, B., Neighbors, C. J., Marquez, B., et al. (2011). Impact of baseline BMI upon the success of Latina participants enrolled in a 6-month physical activity intervention. *Journal of Obesity, 2011*, 921916. doi:10.1155/2011/921916

Haskell, W. L., Lee, I. M., Pate, R. R., Powell, K. E., Blair, S. N., Franklin, B. A., et al. (2007). Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation, 116*, 1081–1093. doi:10.1161/circulationaha.107.185649

Joseph, R. P., Durant, N. H., Benitez, T. J., & Pekmezi, D. W. (2014). Internet-based physical activity interventions. *American Journal of Lifestyle Medicine 8*, 42–68. doi:10.1177/1559827613498059

Kelly, L. A., McMillan, D. G., Anderson, A., Fippinger, M., Fillerup, G., & Rider, J. (2013). Validity of actigraphs uniaxial and triaxial accelerometers for assessment of physical activity in adults in laboratory conditions. *BMC Medical Physics, 13*, 5. doi:10.1186/1756-6649-13-5

Kendzierski, D., & DeCarlo, K. J. (1991). Physical Activity Enjoyment Scale: Two validation studies. *Journal of Sport & Exercise Psychology*, 50–65. Retrieved from http://psycnet.apa.org/psycinfo/1991-20212-001

Larsen, B. A., Noble, M. L., Murray, K. E., & Marcus, B. H. (2014). Physical activity in Latino men and women: Facilitators, barriers, and interventions. *American Journal of Lifestyle Medicine*. doi:10.1177/1559827614521758

Larsen, B. A., Pekmezi, D., Marquez, B., Benitez, T. J., & Marcus, B. H. (2013). Physical activity in Latinas: Social and environmental influences. *Women's Health (London, England), 9*, 201–210. doi:10.2217/whe.13.9

Lopez, M. H., Gonzalez-Barrera, A., & Patten, E. (2013). *Closing the digital divide: Latinos and technology adoption*. Pew Research Center. Retrieved from http://www.pewhispanic.org/2013/03/07/closing-the-digital-divide-latinos-and-technology-adoption/

Magoc, D., Tomaka, J., & Bridges-Arzaga, A. (2011). Using the web to increase physical activity in college students. *American Journal of Health Behavior, 35*, 142–154.

Marcus, B. H., Dunsiger, S. I., Pekmezi, D. W., Larsen, B. A., Bock, B. C., Gans, K. M., et al. (2013). The Seamos Saludables study: A randomized controlled physical activity trial of Latinas. *American Journal of Preventive Medicine, 45*, 598–605. doi:10.1016/j.amepre.2013.07.006

Marcus, B. H., Dunsiger, S. I., Pekmezi, D., Larsen, B. A., Marquez, B., Bock, B. C., et al. (2015a). Twelve-month physical activity outcomes in Latinas in the Seamos Saludables trial. *American Journal of Preventive Medicine, 48*, 179–182. doi:10.1016/j.amepre.2014.08.032

Marcus, B. H., Hartman, S. J., Pekmezi, D., Dunsiger, S. I., Linke, S., Marquez, B., et al. (2015b). Using interactive Internet technology to promote physical activity in Latinas: Rationale, design, and baseline findings of Pasos Hacia La Salud. *Contemporary Clinical Trials*. doi:10.1016/j.cct.2015.08.004

Marcus, B. H., Hartmand, S., Larsen, B. A., Pekmezi, D., Dunsiger, S., Linke, S., et al. (2016). Pasos Hacia La Salud: A randomized controlled trial of an Internet-delivered physical activity intervention for Latinas. *International Journal of Behavioral Nutrition and Physical Activity*. doi:10.1186/s12966-016-0385-7

Marcus, B. H., Rossi, J. S., Selby, V. C., Niaura, R. S., & Abrams, D. B. (1992a). The stages and processes of exercise adoption and maintenance in a worksite sample. *Health Psychology : Official Journal of the Division of Health Psychology, American Psychological Association, 11*, 386–395. doi:10.1037/0278-6133.11.6.386

Marcus, B. H., Selby, V. C., Niaura, R. S., & Rossi, J. S. (1992b). Self-efficacy and the stages of exercise behavior change. *Research Quarterly for Exercise and Sport, 63*, 60–66. doi:10.1080/02701367.1992.10607557

Mateo, F., Granado-Font, E., Ferre-Grau, C., & Montana-Carreras, X. (2015). Mobile phone apps to promote weight loss and increase physical activity: A Systematic review and meta-analysis. *Journal of Medical Internet Research, 17*, e253. doi:10.2196/jmir.4836

Moore, S. C., Lee, I., Weiderpass, E., & Al, E. (2016). Association of leisure-time physical activity with risk of 26 types of cancer in 1.44 million adults. *JAMA Internal Medicine*. doi:10.1001/jamainternmed.2016.1548

National Health Interview Survey. (2015). Early Release of Selected Estimates Based on Data From the National Health Interview Survey, January–September 2015: Leisure-Time Physical Activity. *CDC/NCHS*. Retrieved from http://www.cdc.gov/nchs/data/nhis/earlyrelease/earlyrelease201602_07.pdf

Norris, A. E., Ford, K., & Bova, C. A. (1996). Psychometrics of a brief acculturation scale for hispanics in a probability sample of urban hispanic adolescents and young adults. *Hispanic Journal of Behavioral Sciences, 18*, 29–38. doi:10.1177/07399863960181004

Nurss, J., Parker, R., Williams, M., & Baker, D. (1998). *Directions for administration and scoring and technical data, short test of functional health literacy in adults (S-TOFHLA-English & S-TOFHLA-Spanish)*. Center for the Study of Adult Literacy.

Owen, N., Glanz, K., Sallis, J. F., & Kelder, S. H. (2006). Evidence-based approaches to dissemination and diffusion of physical activity interventions. *American Journal of Preventive Medicine, 31*, S35–44. doi:10.1016/j.amepre.2006.06.008

Parker, R. M., Baker, D. W., Williams, M. V., & Nurss, J. R. (1995). The test of functional health literacy in adults: A new instrument for measuring patients' literacy skills. *Journal of General Internal Medicine, 10*, 537–541.

Pekmezi, D., Ainsworth, C., Joseph, R., Bray, M. S., Kvale, E., Isaac, S., et al. (2016). Rationale, design, and baseline findings from HIPP: A randomized controlled trial testing a home-based, individually-tailored physical activity print intervention for African American women in the Deep South. *Contemporary Clinical Trials, 47*, 340–348. doi:10.1016/j.cct.2016.02.009

Pekmezi, D. W., Neighbors, C. J., Lee, C. S., Gans, K. M., Bock, B. C., Morrow, K. M., et al. (2009). A Culturally adapted physical activity intervention for latinas a randomized controlled trial. *American Journal of Preventive Medicine, 37*, 495. doi:10.1016/j.amepre.2009.08.023

Pew Research Center. (2014). *Internet user demographics*. Retrieved from http://www.pewinternet.org/data-trend/internet-use/latest-stats/

Prochaska, J. O., & Diclemente, C. C. (1986). Toward a comprehensive model of change. In W. R. Miller & N. Heather (Eds.), *Treating addictive behaviors: Processes of change* (pp. 3–27). Boston, MA: Springer US.

Sallis, J. F., Grossman, R. M., Pinski, R. B., Patterson, T. L., & Nader, P. R. (1987). The development of scales to measure social support for diet and exercise behaviors. *Preventive Medicine, 16*, 825–836. doi:10.1016/0091-7435(87)90022-3

Sallis, J. F., Haskell, W. L., Wood, P. D., Fortmann, S. P., Rogers, T., Blair, S. N., & Paffenbarger, R. S. (1985). Physical activity assessment methodology in the Five-City Project. *American Journal of Epidemiology*, *121*, 91–106. Retrieved from http://aje.oxfordjournals.org/content/121/1/91.abstract

Services, U. S. D. of H. and H. (2008). *Physical activity guidelines for Americans*. Hyattsville, MD: US Department of Health and Human Services.

van den Berg, M. H., Schoones, J. W., & Vliet Vlieland, T. P. M. (2007). Internet-based physical activity interventions: a systematic review of the literature. *Journal of Medical Internet Research, 9*, e26. doi:10.2196/jmir.9.3.e26

Vandelanotte, C., Spathonis, K. M., Eakin, E. G., & Owen, N. (2007). Website-delivered physical activity interventions a review of the literature. *American Journal of Preventive Medicine, 33*, 54–64. doi:10.1016/j.amepre.2007.02.041

Vermeesch, A. L., & Stommel, M. (2014). Physical activity and acculturation among U.S. Latinas of childbearing age. *Western Journal of Nursing Research, 36*, 495–511. doi:10.1177/0193945913507341