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A Pilot Study to Promote Active Living among Physically Inactive Korean American Women

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Abstract

A 4-week lifestyle program called Women's Active Living for Koreans (WALK) was designed for Korean American women to promote physical activity (PA). In a pilot controlled trial, 40 women were randomized to WALK-regular or WALK-plus. WALK-plus involves joining an online community via a social media app. WALK-plus performed significantly higher numbers of days of muscle-strengthening activities than WALK-regular at post-intervention visit. Both groups increased vigorous activities and walking and decreased sedentary behaviors on weekdays. WALK program showed great potential in improving PA and decreasing sedentary behaviors. Online social networking may have additional effect on PA among this population.

Keywords

physical activity; sedentary behavior; online social networking

Introduction

Metabolic syndrome (MetS), a cluster of risk factors including abdominal obesity, hypertension, dyslipidemia, and insulin resistance, greatly increases the risk of developing cardiovascular disease (CVD) and type 2 diabetes (T2DM) (Ford, 2005). Nearly 33% of

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all U.S. adults are estimated to have MetS (Ervin, 2009). Moreover, MetS risk factors and cardiometabolic disease are a growing health concern among Asians (Gu et al., 2005; Jih et al.; Lim et al., 2011). Compared to non-Hispanic Whites, Asian subgroups including Koreans have significantly higher MetS prevalence for every body mass index (BMI) category (Palaniappan et al., 2011). In addition, MetS prevalence dramatically increases in middle-aged and older women (Ervin, 2009; Kim et al., 2007).

Lifestyle modification such as regular physical activity (PA) and healthy diet reduces the risk of MetS (Yamaoka & Tango, 2012). Physical inactivity, however, is prevalent among Korean Americans (KAs), especially women. More KA women (36%) did not participate in any exercise than KA men (26%) and general women living in California (22%) in a survey conducted in Alameda County, California (Centers for Disease Control and Prevention, 1997). KA women were also less likely to walk in leisure time and perform moderate as well as vigorous PA when compared to non-Hispanic whites according to a 2005 California Health Interview Survey (Maxwell et al., 2012). In a recent Korean community survey conducted in the San Francisco Bay Area, no separate data for KA women were reported, but only 14% of KA men and women met the national guideline of PA, walking at least 150 minutes weekly (Ivey et al., 2016).

No lifestyle intervention focusing on PA has been developed for KA women to reduce their risks for MetS. In existing lifestyle interventions, PA has been an ancillary component of interventions to address hypertension, T2DM, and prediabetes (Choi & Rush, 2012; Han et al., 2010; Islam et al., 2013). Although online social networking has shown its potential in improving adoption and maintenance of PA among diverse women populations (Butryn et al., 2016; Rote et al., 2015), its use has not been tested among KA women. Given that the pervasive use of smartphone and its familiarity among KAs, online social networking may enhance the efficacy of a lifestyle intervention and can be a strategy to be included in lifestyle interventions. Thus, a pilot randomized controlled trial (RCT) was proposed to address this research question: Can a lifestyle intervention including an online social networking component promote PA and reduce sedentary behavior among physically inactive KA women? The purpose of this study was to conduct a pilot RCT to assess the feasibility, acceptability, and potential efficacy of a 4-week lifestyle intervention called the Women’s Active Living for Koreans (WALK) program for physically inactive KA women to promote PA and reduce sedentary behavior.

Methods

Study design and sample

This 4-week pilot study was conducted from August 2018 to December 2018. The study protocol was approved by the University of California, San Francisco Institutional Review Board prior to participant enrollment. The sample size of 40 was conventional for a pilot study, balancing cost against precision. Participants were recruited from a combination of community strategies including study announcements translated in Korean through KA community organizations’ social networks and KA online communities. KakaoTalk, a popular Korean mobile messaging application, was also used for recruitment. A KakaoTalk ID linked to our study mobile phone number was listed in study fliers so that potential participants could add our KakaoTalk ID to their "Kakao Friends" and text or call our research staff through KakaoTalk. Inclusion criteria were: 1) self-identified as KA women; 2) sedentary lifestyle at work and/or during leisure time measured by the Stanford Brief Physical Activity Survey (Taylor-Piliae et al. 2006) as reporting participation of less than 3 times a week of moderate or vigorous PA in the preceding 6 months; 3) 40-69 years of age; 4) reporting being inactive and thinking about becoming more active (contemplation stage) or doing some, but not enough PA (preparation stage) as measured by the Physical Activity Stages of Change (Marcus & Forsyth, 2009); and 5) having a smartphone. Exclusion criteria were: 1) known medical conditions or other physical problems requiring a medically tailored exercise program (e.g., prior myocardial infarction, use of nitroglycerin to treat angina, chronic obstructive pulmonary disease, uncontrolled hypertension, or DM); 2) current participation in a lifestyle program or research study; 3) anticipated travels outside of the U.S. during the next 2 months; and 4) pregnancy.

Community Engagement

A Community Advisory Board (CAB) was formed with 8 bilingual or monolingual KAs including Korean immigrants with diverse backgrounds representing different KA community organizations. The principal investigator of the study who is bilingual presented the purpose and proposed study procedures of the study in Korean at two CAB meetings. CAB members provided their feedback, which was incorporated before recruitment began. After the data collection was done, the study team presented preliminary findings to the CAB and solicited the interpretations of the findings. Each meeting was held at a local KA community organization office and lasted about two hours. Light lunch was served and a $30 prepaid card was provided after the meeting.

Telephone screening

As shown in Figure 1, a total of 54 women contacted the research team via email, telephone call, or KakaoTalk text message. Every communication was done in Korean. During telephone screening, we identified those who were physically inactive at work and/or during leisure time with the Stanford Brief Physical Activity Survey as well as those who were considering being physically active in the future (contemplation stage) or the near future (preparation stage) with Physical Activity Stages of Change. Those who met the eligibility criteria received the information about the study procedures over the phone. Fifty-one women received a link to online consent form using DocuSign via email. Those who provided consent received a document in mail for their fasting blood test at local labs to further check their MetS criteria status.

WALK Intervention Procedures

At the pre-intervention visit, participants completed a self-administered survey, translated in Korean. Blood pressure (BP), body weight, height, and waist circumference (WC) were measured. Either the principal investigator of the study or a trained bilingual research assistant delivered one on one counseling to all participants about MetS and its management focusing on PA, especially fast walking and muscle-strengthening activities (e.g., squat, push-up) and a handout written in Korean. The intervention was based on the Social Cognitive Theory and the Stages of Change Model (Bandura et al., 1980; Marcus et al., 1992). According to the 2008 Physical Activity Guidelines for Americans, 30 minutes a day, 5 days a week, at least 150 minutes a week of moderate-intensity aerobic activities as well as at least 2 days a week of muscle-strengthening activities were recommended. Healthy eating habits were introduced based on MyPlate, the current U.S. dietary recommendation (United States Department of Agriculture). Self-monitoring tools including weekly challenge sheets and Fitbit Zip (Fitbit), an accelerometer, were given to every participant. All women were asked to wear a Fitbit at least 10 hours daily, except for showering, bathing, and swimming. A Fitbit app was installed on their smartphones to upload and transfer wirelessly PA data collected by Fitbit in real-time. They also received weekly challenge sheets as for an activity diary to record PA and a reminder to increase PA, decrease sedentary behavior, and practice healthy eating by lowering sodium, fat, and sugar intakes. After in-person counseling was completed, 40 women were randomly assigned (1:1 allocation) to WALK-plus group or WALK-regular group. Using computer algorithms for a 1-to-1 randomization, a person who is not on the research team prepared a set of sealed, opaque envelopes that contained random allocation.

While the WALK-regular participants individually initiated their 4-week program right after the pre-intervention visit, WALK-plus participants waited to join an online social community with other WALK-plus participants. Since we planned to recruit 40 participants for the study, the first 12 participants who were assigned to the WALK-plus group began together as the first community on a pre-scheduled date. Three weeks later, the second community of 8 participants started the program together. WALK-plus participants were individually invited to join an online social community created by NAVER BAND, a popular social media app among Koreans. They were asked to respond to posts of the weekly research team and other participants and complete weekly homework. Topics of the research team-initiated weekly posts included motivational tips to make exercise as a habit (1st and 2nd week), mental health benefits of exercise (3rd week), and overcoming negative thoughts with positive thoughts (4th week).

The behavior change techniques embedded both in the WALK-plus and the WALK-regular groups were the same, which included information, instruction, self-monitoring, and goal setting (Michie et al. 2011). The only differences between the groups were feedback and reinforcement from the research team and other participants delivered via the online social community for the WALK-plus group. The contents of one on one counseling and handouts were adapted from a 4-week lifestyle program called “My Heart My Mind” which was developed for sedentary middle-aged and older Korean women living in Korea at risk for MetS (Shin et al., 2017).

Measures

The primary outcomes were time spent in PA and sedentary activities for the past 7 days, as measured by a self-reported survey. The survey included the International Physical Activity Questionnaire (IPAQ) short form (Craig et al. 2003) and 2 items on time spent in aerobic activities and number of days spent in muscle-strengthening activities based on the 2008 Physical Activity Guidelines for Americans. According to the IPAQ’s guidelines for data processing analysis, three levels of PA were categorized: high, moderate, and low.

The secondary outcome was the mean number of steps per day for the prior week, as measured by Fitbit. Based on previous studies using pedometers (Choi et al., 2016; Choi & Fukuoka, 2019), the minimum of 1,000 counts was selected and daily steps less than 1,000 counts were excluded from data analysis. Less than 1,000 daily steps were considered as invalid, possibly due to Fitbit not being worn at least 10 hours.

Physical environment for PA including neighborhood/community: The 11-item Behavioral Risk Factor Surveillance module of the Environmental Supports for Physical Activity Questionnaire is used to assess an individual's perception of the PA environment (Kirtland et al., 2003). We adapted it to create one five-item index measuring the use of environmental resources in the community: (a) private or membership-only recreation facilities; (b) walking trails, parks, playground, and sports fields; (c) shopping malls; (d) public recreation centers; and (e) schools that are open to the public. Each item had three response options: 1(yes), 2(no), and 3 (my community does not have these facilities). When the response was either 2 or 3, it was recoded to 0; it was not changed for response 1. The overall use of environmental resources was calculated with the sum of 5 recoded responses.

Social level: Social influence for exercise was assessed with two questions: what proportion of the people whom you meet regularly (at least 1-2 times per month) a) do exercise, and b) encourage you to exercise? Participants responded to each item on a scale with 4 options including *most of them, half of them, less than half, only a few or no one*. All items with four responses were recorded as 10, 7, 4, and 1 so that high scores indicated better social influence for exercise.

Individual level: Seven barriers to exercise (e.g., time, motivation, safe place, health problems, someone to exercise with, not knowing what exercises to perform) were included and adapted from the Exercise Benefits and Barriers Scale (Sechrist et al., 1987). Participants responded to each item on a scale from 1 (strongly agree) to 4 (strongly disagree) and all items with four responses were recoded as either 0 for strongly disagree and disagree or 1 for strongly agree and agree. Sum of recoded responses was calculated for barriers to exercise, so that a high score indicated high barriers. Two-item self-efficacy for exercise was adopted from a survey used for KAs at risk for diabetes (Han et al., 2016). Two items were about their confidence a) to know what exercises are healthy for them; and b) exercise for at least 30 minutes five times each week. They were examined on a scale from 1 (very confident) to 4 (not at all confident) and two items with four responses were recoded as either 0 for '*not at all confident*' and '*not confident*' or 1 for '*confident*' and '*very confident.*' Psychological health of KA women was assessed with the 6-item Kessler Psychological Distress Scale (Kessler et al., 2002).

Dietary habit: Mini dietary assessment index was used to assess KA women's eating habits (Kim et al., 2003). Ten questions included food intake (e.g., calcium, protein, vegetable, fruit, fried or stir-fried, fatty meat) as well as behaviors (e.g., adding salt or soy sauce, eating three meals a day, eating high calorie and high sugar snacks, picky eating). Participants responded to each item on a scale with always (5), sometimes (3), and not likely

(1) and responses of the five unhealthy food intakes and behaviors were reversely coded. The sum of responses was used with high scores indicating healthy eating habits.

We also collected socio-demographic characteristics including age at immigration, years lived in the U.S. (if a participant was an immigrant), marital status, education level, employment, annual household income, and English proficiency.

Since administrator(s) of any group can check who reads or does not read posts in the group with NAVER BAND, our research team, which was the administrator of the two closed groups, examined online social activities by assessing the number of reads, posts, and comments of each WALK-plus participant. All WALK-plus group participants joined closed online communities and nearly everyone (95%) posted at least once during the 4-week study period. During the 4-week study period, the online posting activities included a total of 4 researcher-initiated posts (one per week), 48 participant-initiated posts from 19 participants, and 39 comments form 14 participants. WALK-plus participants uploaded 2.4 posts on average ranging from no post to 8 posts, and 80% of them read more than half of the posts. Participants also completed their weekly homework by uploading posts or leaving comments. For example, women uploaded a photo of places where they walked or exercised for the third week assignment. In addition, 60% completed their weekly homework at least twice. We categorized all WALK-plus group participants (n=20) into two groups depending on their online social activities. Those who read more than half of the posts and submitted their weekly homework at least twice were categorized as the actively engaged (n=12). Those who read less than half of the posts and submitted their weekly homework less than twice were categorized as the minimally engaged (n=8).

Data management

All survey data, blood test results, and physical measurements were managed using REDCap (Research Electronic Data Capture), a secure web-based application for research studies (Harris et al. 2009). School resource email addresses were assigned to link each Fitbit account. Participants in the WALK-plus group joined NAVER BAND with their mobile phone number or personal email address. Data of the closed online community were remotely monitored.

Statistical analysis

Analyses were carried out with Stata/SE (StataCorp, 2017). All tests of significance are evaluated with a two-sided alpha of .05. Multilevel linear regression models were used to test change over time (Hox et al., 2017; Singer & Willett, 2003). Multilevel regression (MLReg) retains all cases even if some assessments of the outcome are missing or participants drop out from the study. This is possible through the use of Full Information Maximum Likelihood (FIML; Enders, 2010; Schafer & Graham., 2002) with the Expectation-Maximization (EM) algorithm (Enders, 2010; Muthén & Shedden, 1999). These parameter estimates are unbiased as long as the missingness is ignorable (missing at random or covariate-dependent missingness; Enders, 2006, 2010; Graham, 2009; McKnight et al., 2007; Schafer & Graham, 2002).

The estimation of change was carried out in two ways (Hox et al., 2017; Singer & Willett, 2003). First, unconditional models with random intercepts at level two were estimated for each outcome to evaluate change from baseline through the fourth assessment (or the second assessment for variables collected only twice). "Unconditional" models identify the best-fitting change trajectory with no predictor except time. Next, differences in change trajectories for the two arms of the study (intercept and slope coefficients) were tested. The conditional effect for the intercept tests whether the outcome differs at baseline as a function of group differences (or other covariates that do not change over time). The conditional effect for the slope coefficient is sometimes called a cross-level interaction and tests whether characteristics that differ across individuals (e.g., being in the WALK-plus compared to the WALK-regular), affect how the outcome changes over time.

Bootstrapping was utilized for outcome measures that did not meet the assumption of normality required for the maximum likelihood estimation. Some measures were skewed, or on very short ordinal scales, or both (Carpenter & Bithell, 2000; Efron, 2000; Wehrens et al., 2000; Wood, 2005; Zhu, 1997). The analyses for the current study employed the nonparametric bias-corrected bootstrap to obtain bootstrapped confidence intervals using 5,000 repetitions (Carpenter & Bithell, 2000). In using bootstrapped confidence intervals, an MLReg coefficient is significant if zero is not in the interval. Post-hoc pairwise comparisons were also conducted for the outcomes that were significant for three groups using the nonparametric bias-corrected bootstrap.

Results

Participant characteristics

Among 41 women who provided informed consent, 40 completed blood tests for fasting lipid profile and glucose. One participant declined to complete the blood test. Out of the 54 who expressed interest in participating, 94% (n=51) were eligible and 74% (n=40) were enrolled. The mean (± SD) age of all the participants was 48.4 ± 6.3 years, and 58% reported limited English proficiency, either not so good or not at all (Table 1). The WALK-plus and WALK-regular groups were generally similar in education, annual household income, employment, marital status, having health insurance, health literacy, having gym membership, prior experience of NAVER BAND, number of MetS risk factors, and BMI. WALK-plus participants immigrated to the U.S. at a younger age ($p = 0.04$) and were less likely to have prior experience of regular PA than WALK-regular participants ($p = 0.03$).

Thirty-seven women (93%) completed the post-intervention visit. The three women who could not attend the post-intervention visit still provided PA data measured by Fitbit; two of them completed post-intervention questionnaires over the phone or by mail.

Main Analysis: Two-group analysis

The WALK-plus group and the WALK-regular group were not statistically different in PA and sedentary behaviors of the past 7 days at pre-intervention visit. The groups did not differ in their time spent in PA (aerobic activity, muscle-strengthening activity, vigorous activity, moderate activity, walking), and sedentary behaviors (sitting on weekdays as well as sitting on weekend). Regardless of group, participants significantly increased their time spent in aerobic activity, muscle-strengthening activity, vigorous activity, and walking, but not moderate activity from pre-intervention visit to post-intervention visit. Both groups also significantly decreased time spent in sitting on weekdays, but not on weekend from pre-intervention visit to post-intervention visit. There was a significant difference between groups in the way they changed in the number of days spent in muscle-strengthening activity; The WALK-plus group increased 1.4 days more than the amount of increase that the WALK-regular group showed from pre-intervention visit to post-intervention visit (Table 2).

Since no baseline step data were measured before participants started the program, the first week's step data were treated as a baseline and both groups' steps were not different at week 1 (Figure 2, 7742 ± 1896 vs. 7765 ± 2234 for WALK-plus group and WALK-regular group). Both groups were not different in changes in their weekly mean steps over time during 4 weeks. The average steps of WALK-plus group and WALK-regular group across 4 weeks were 7458.4015 ± 2195 and 7415 ± 2102, respectively.

Overall, two groups were similar in their characteristics at pre-intervention visit, but not for the proportion of people who encouraged them to exercise (social influence-encouragement). The WALK-plus group had lower social influence-encouragement than the WALK-regular group. Regardless of group, women increased their confidence in knowing what exercise would be good for their health (self-efficacy for exercise knowledge), social influence-encouragement, the use of physical environment, and healthy eating behavior. Both groups also decreased their perceived barriers to exercise and mental distress from pre-intervention visit to post-intervention visit. However, there was no increase in confidence to engage in exercise at least 5 times per week (self-efficacy for exercise) or in the proportion of people who exercise among those with whom the women were acquainted with (social influence for exercise). In addition, there was a significant difference between groups in the way they changed in self-efficacy for exercise knowledge from pre-intervention visit to post-intervention visit (Table 2). The WALK-plus group increased about .5 less than the amount of increase in self-efficacy for exercise knowledge that the WALK-regular group showed from pre-intervention visit to post-intervention visit.

Additional analyses: Comparisons by online social community engagement

To explore the associations between levels of online social community engagement and the outcomes, we conducted comparisons across 3 groups: Actively Engaged WALK-plus, Minimally Engaged WALK-plus, and WALK-regular (Table 3). There was no significant difference among the 3 groups in self-reported PA and sedentary behaviors, except time spent in walking at pre-intervention visit. Time spent in aerobic PA, muscle-strengthening activity, vigorous activity, moderate activity, and sedentary behaviors on weekdays and weekend in the past 7 days were similar among groups when they began the program. However, those who actively engaged in the WALK study's online social community, where only WALK-plus participants were invited, reported that they spent more time in walking than those who minimally engaged (Coefficient = 96.3, BC 98.33% CI: 9.5 to 200.3). Overall, all three groups increased time spent in PA (e.g., aerobic PA, vigorous activity, and walking) and number of days spent in muscle-strengthening activity, and reduced time spent in sedentary behaviors on weekdays from pre-intervention visit to post-intervention visit. There was no significant difference among the three groups in the way they changed over time in PA and sedentary behaviors on weekends; the only change was in sedentary behaviors on weekdays. The Minimally Engaged WALK-plus group significantly reduced more in time spent in sitting on weekdays from pre-intervention visit to post-intervention visit (Coefficient = 1.7, BC 98.33% CI: 0.2 to 3.5).

There was a significant difference in weekly mean steps measured by Fitbit. The Actively Engaged WALK-plus group showed significantly higher weekly mean steps than the Minimally Engaged WALK-plus group at week 1 and this significant difference continued during 4 week (Figure 3). There was no significant difference among groups in the way they changed over time.

Feasibility and Acceptability

Overall, participants used Fitbit at least 70% of the time during the 4-week intervention (19.6 days on average). Since 78% (31 out of 40) used Fitbit at least 70% of the time for 4 weeks, we conclude that use of Fitbit was acceptable and feasible. A majority of women (90%) of the WALK-plus group reported that online social activities were helpful in increasing their PA. Thirty-nine participants completed the usability questions and all of them responded that the WALK program was helpful in increasing PA and they would recommend it to others like them regardless of group assignment. All reported that in-person meetings and the use of Fitbit as a monitoring tool were helpful.

Discussion

The main finding of this study was that PA promotion, especially the number of days one performed muscle strengthening activity, was greater in the WALK-plus group with online social networking when compared to the WALK-regular group. While all participants overall performed muscle activities less than one day at the pre-intervention visit, the WALK-plus group exceeded the recommended number of days for muscle activities, which is 2 days per week (from 0.4 to 3.2 days); the WALK-regular group did not reach that recommended number of days of muscle activities (from 0.3 to 1.7 days) at post-intervention visit. The intensity of the program’s core contents delivered in in-person meetings and self-monitoring tools available for both groups may be too strong to differentiate the unique contribution of online social networking on the primary outcomes except muscle activity.

Those who actively engaged in the online social community were walking more at the beginning of the study than those who minimally participated in the online social community and that difference continued. Less time spent in walking of the minimally engaged indicates that they may need more attention or encouragement through online and/or offline social network or intervention. The PA barriers among the minimally active should be explored further and innovative strategies should be developed for them. Although all three groups increased time spent in PA (e.g., aerobic PA, vigorous activity, and walking) and number of days spent in muscle-strengthening activity, and reduced time spent in sedentary behaviors on weekdays from pre-intervention visit to post-intervention visit, those who minimally engaged in online social community significantly reduced time spent in sitting on weekdays more than those who actively engaged in online social community. Since sedentary behaviors may involve using devices including mobile phones, this finding may reflect the low levels of online social activities among those who minimally engaged in online social community.

Although the proportion of the people whom the WALK-plus group participants meet regularly and who encourage them to exercise was significantly lower than that of the WALK-regular group participants at pre-intervention visit, both the proportions significantly increased from pre-intervention visit to post-intervention visit. However, among the people whom participants meet regularly (acquaintances), the proportion of these acquaintances who exercise did not change for both groups. Since the WALK program did not offer or organize any meeting for participants to exercise together in communities, this fact may explain why there was no change. In addition, it indicates that those who are physically inactive may have social networks composed of the physically inactive. Although family or friends are considered to provide social influences to PA participation in general adult populations, the importance of having a family or friend partners actively participate in the program was found in weight management literature among overweight or obese African Americans (Kumanyika et al., 2009). The potential negative influence of having inactive family and/or friends around women on their PA were also noted among overweight or obese physically inactive women with young children (Choi & Fukuoka, 2019). Having a person whom women actually can emulate in adopting and maintaining PA might be essential for those who are physically inactive. Any efforts to build local social networks to promote PA are needed and should be tested among KA women.

Women in the WALK-plus group and the WALK-regular group improved their confidence in knowing what exercise is healthy for them, but not confidence in performing PA at least 5 times per week. All of the participants were immigrants and the majority of them reported their English proficiencies are limited, either not so good or not at all. Hardships that KA immigrants experience and their negative impact on health promoting behaviors are reported (Chung et al., 2018). Also, given that all women used to be physically inactive, they may feel not competent in performing PA 5 days or more.

This study has several strengths and limitations. Its strengths include community involvement (e.g., the CAB’s inputs, use of community organizations’ offices for data collection, use of local blood test labs) and objective measures of PA collected over 4 weeks. Because the WALK-plus program involved the use of NAVER BAND, the study included KakaoTalk users only. Findings are limited to those who are users of KakaoTalk. However, no one was disqualified for this inclusion criterion. This indicates that KA women in general may have some capacity to use online social media support.

Although the intervention with the online social community did not show full efficacy for all PA and sedentary behaviors over 4 weeks, our study results suggest that online social community could provide benefit for physically inactive KA women to increase their PA levels, especially muscle-strengthening activities. Most WALK-plus participants were highly engaged in the online social community despite the moderate online study activities.

Online social community can be a useful strategy to improve PA and to decrease sedentary behaviors among physically inactive KA women, who do not have any centralized ethnic community centers in the San Francisco Bay Area. Future research should investigate how to build online social communities among KAs and what components should be included to form online communities to promote PA. Furthermore, online social community's long-term effects on PA maintenance should be investigated in future study. To investigate the long-term effects of such an online social community on PA adoption and maintenance, the duration of the future study needs to be extended and a follow-up assessment should be included. In addition, an in-person one on one counseling session at the beginning of the program could be replaced by a group session followed by a short telephone or online session along with text messages tailored to a participant's needs to increase scalability and sustainability of the program. An adequately powered RCT of such an intervention is warranted and feasible.

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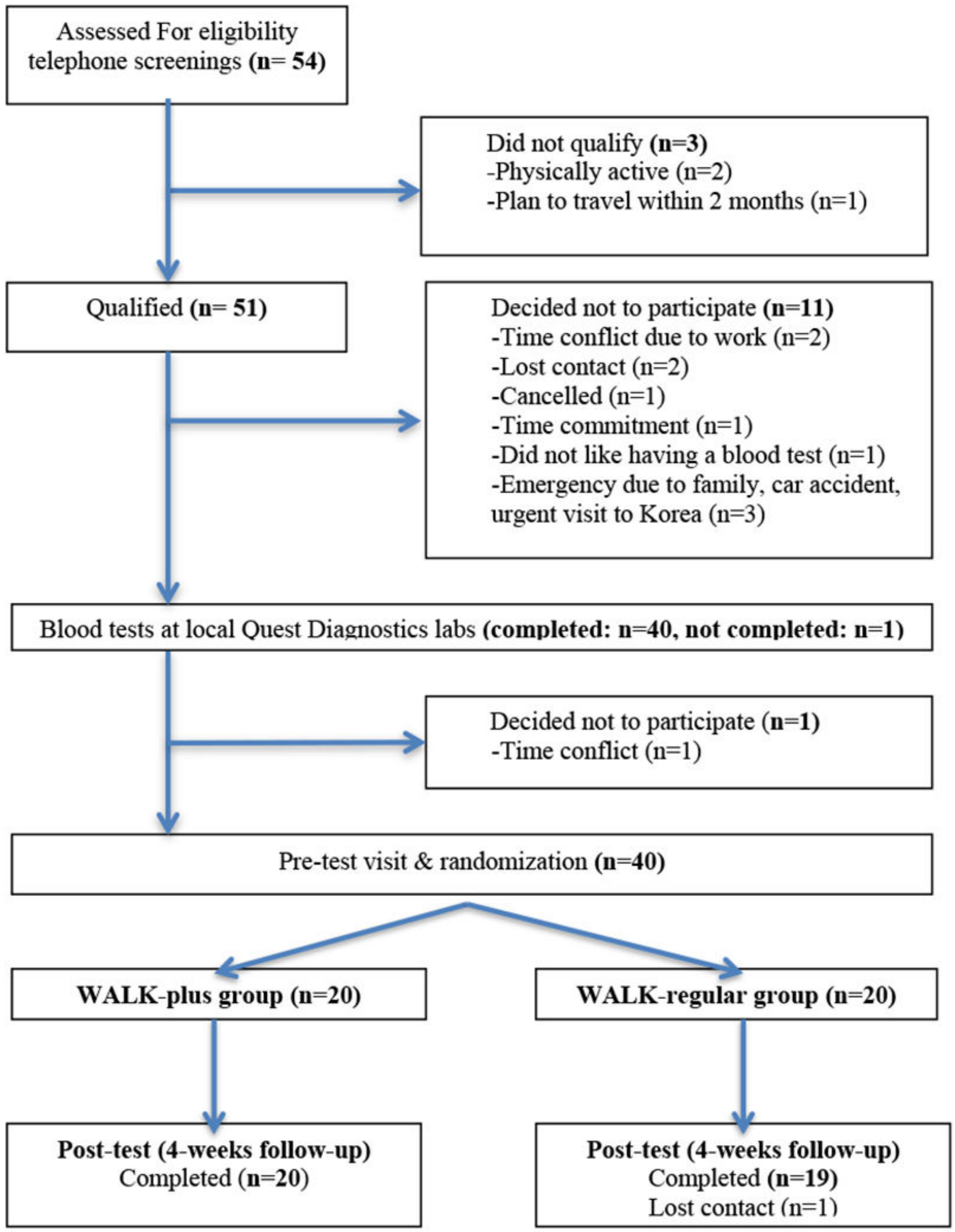

Figure 1.
Flow of the Study Diagram

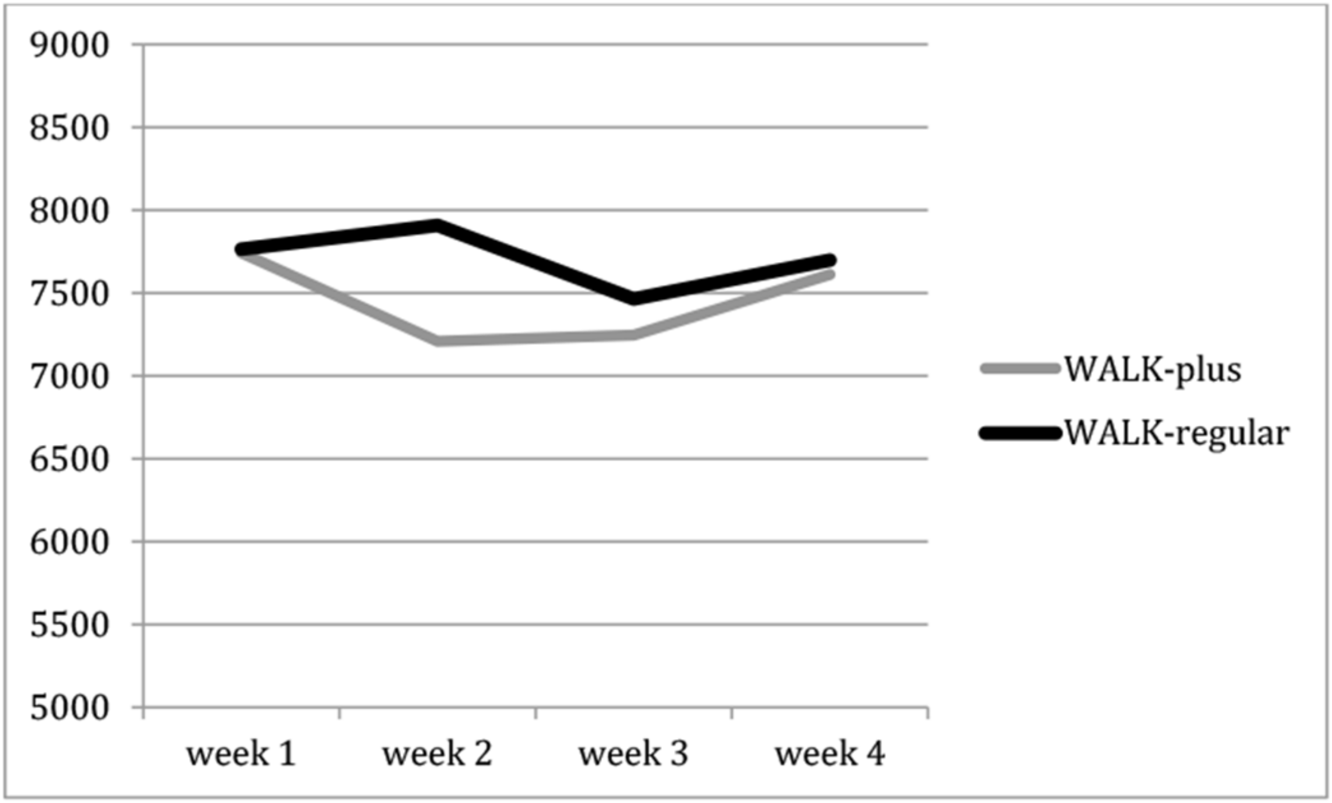

Figure 2.
Two Group Analysis: Weekly Steps

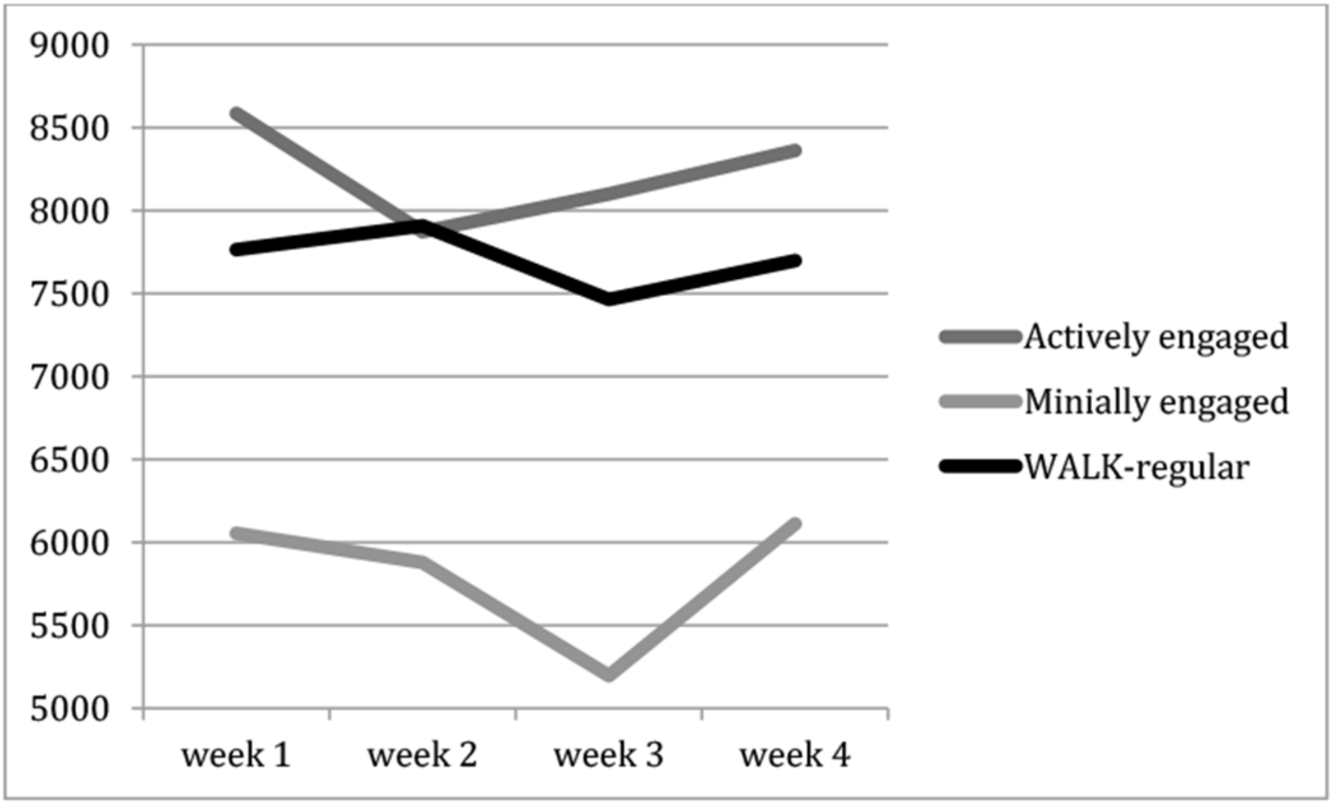

Figure 3.
Additional Group Analysis: Weekly Steps

Table 1.

Baseline Characteristics

Variable	Participants (n=40) mean±SD or %(n)	WALK-plus (n=20) mean±SD or %(n)	WALK-regular (n=20) mean±SD or %(n)	*p*-value[a]
Age (years)	48.8±6.3	48.9±5.6	48.8±7.1	0.94
English proficiency				0.50
Fluent	7.5 (3)	10.0 (2)	5.0 (1)	
Well	30.0 (12)	30.0 (6)	30.0 (6)	
Less than well	62.5 (25)	55.0 (12)	65.0 (13)	
Education				0.11
High school/Some college	10.0 (4)	20.0 (4)	0.0 (0)	
College degree	55.0 (22)	40.0 (8)	70.0 (14)	
Graduate degree	35.0 (14)	40.0 (8)	30.0 (6)	
Annual Household income [1]				0.76
<$25,000	5.1 (2)	5.3 (1)	5.0 (1)	
$25,000-$49,999	2.6 (1)	0 (0)	5.0 (1)	
$50,000-$74,999	10.3 (4)	10.5 (2)	10.0 (2)	
>$75,000	80.0 (32)	84.2 (16)	80.0 (16)	
Employment				0.14
Employed	45.0 (18)	55.0 (11)	35.0 (7)	
Not employed/other	55.0 (22)	45.0 (9)	65.0 (13)	
Marital status				0.25
Married	90.0 (36)	95.0 (19)	85.0 (17)	
Other	10.0 (4)	5.0 (1)	13.0 (3)	
Has any health insurance				1.00
Yes	82.5 (33)	80.1 (16)	85.0 (17)	
No	17.5 (7)	20.0 (4)	15.0 (3)	
Age at immigration	32.0±8.8	29.2±8.1	34.9±8.7	0.04
Years in the US	16.6±9.5	19.4±8.7	13.7±9.6	0.06
Health literacy				0.60
Inadequate	40.0 (16)	35.0 (7)	40.0 (9)	
Adequate	60.0 (24)	65.0 (13)	55.0 (11)	
Has gym membership	17.5 (7)	15.0 (3)	20.0 (4)	0.67
Had been regularly active	42.5 (17)	40.0 (8)	75.0 (15)	0.03
NAVER BAND user	20.0 (8)	20.0 (4)	20.0 (4)	1.00
BMI (kg/m^2)	23.3±2.7	23.1±2.8	23.5±2.6	0.67
WC =>85 cm	57.5 (23)	50.0 (10)	65.0 (13)	0.34
HTN/taking anti-HTN med	17.5 (7)	20.0 (4)	15.0 (3)	0.68
HDL<50 [1]	33.3 (13)	30.0 (6)	36.8 (7)	0.65
Triglyceride =>150 [1]	23.1 (9)	25.0 (5)	21.1 (4)	0.77
Blood sugar=>100 or self-reported T2DM [1]	12.8 (5)	5.0 (1)	21.1 (4)	0.13

Variable	Participants (n=40) mean±SD or %(n)	WALK-plus (n=20) mean±SD or %(n)	WALK-regular (n=20) mean±SD or %(n)	*p*-value[a]
MetS risk [1]				0.39
No risk	25.6 (10)	35.0 (7)	15.8 (3)	
1 or 2 risk factors	51.3 (20)	45.0 (9)	57.9 (11)	
3 or more	23.1 (9)	20.0 (4)	26.3 (5)	

[1] n=39 due to missing data, one participant denied to take a blood test.

[a] *p* value represents the results of *t* tests for continuous measures and chi-square tests for categorical variables. *p* values compare WALK-plus and WALK-regular groups for each variable.

Note: WC=waist circumference; HTN=hypertension; T2DM=Type 2 diabetes mellitus; MetS=metabolic syndrome

Table 2.

Two-group analysis

Variable	WALK-plus (n=20)		WALK-regular (n=19)		Unconditional model	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention		
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Coefficient	BC 95% CI
Single item						
Aerobic activity (m/wk)	41.8 ± 59.5	214.5 ± 158.8	42.6 ± 55.5	192.1 ± 290.9	21.1	−166.1 to 144.8
Muscle activity (d/wk)	0.4 ± 0.6	3.2 ± 2.1	0.3 ± 1.0	1.7 ± 2.2	1.4	0.1 to 2.6
IPAQ						
VA (m/wk)	6.5 ± 16.6	64.9 ± 91.4	18.0 ± 67.0	81.8 ± 111.7	−5.4	−72.2 to 54.7
MA (m/wk)	45.5 ± 94.6	59.3 ± 160.6	41.5 ± 84.6	49.8 ± 81.2	5.5	−80.6 to 104.0
WA (m/wk)	62.8 ± 96.2	239.0 ± 205.2	79.0 ± 86.0	180.3 ± 142.9	75	−50.7 to 212.4
Weekday sitting (h/d)	5.7 ± 3.3	4.6 ± 2.9	4.9 ± 2.5	4.4 ± 3.0	−0.6	−2.0 to 0.9
Weekend sitting (h/d)	4.9 ± 2.9	3.8 ± 3.0	4.6 ± 2.4	4.5 ± 2.1	−1.0	−2.4 to 5.6
Physical environment use[a]	1.3 ± 0.8	2.0 ± 1.1	1.3 ± 0.8	1.8 ± 0.9	0.18	−0.5 to 0.8
Social influence-exercisers[b]	5.1 ± 3.5	6.0 ± 3.1	5.9 ± 2.1	6.2 ± 2.2	0.2	−0.3 to 0.6
Social influence-encouragement[c]	7.3 ± 3.8	8.5 ± 2.8	9.5 ± 1.1	9.5 ± 1.1	0.4	−0.0 to 0.9
Barriers to physical activity[d]	2.3 ± 1.3	1.9 ± 1.5	1.9 ± 1.2	1.5 ± 1.3	0.47	−1.0 to 2.0
Self-efficacy for exercise knowledge[e]	0.9 ± 0.4	1.0 ± 0.0	0.6 ± 0.5	0.9 ± 0.2	−0.47	−0.8 to −0.1
Self-efficacy for exercise[f]	0.3 ± 0.4	0.3 ± 0.5	0.4 ± 0.5	0.4 ± 0.5	−.07	−0.6 to 0.4
Psychological distress[g]	3.9 ± 3.1	2.5 ± 1.5	5.4 ± 4.0	3.5 ± 2.2	0.5	−1.3 to 2.4
Dietary habit[h]	35.4 ± 5.0	36.7 ± 5.9	35.0 ± 6.3	37.6 ± 7.4	−1.3	−4.8 to 2.7

Note: BC 95% CI = non-parametric bootstrapped bias-corrected confidence interval (if zero is not in the interval, the effect is significant).

d = day; h = hour; m = minute; wk = week; VA = vigorous activity; MA = moderate activity; WA = walking; IPAQ = International Physical Activity Questionnaire

[a] 5-items on the use of facilities in community from the Behavioral Risk Factor Surveillance : 0 to 5 (used)

[b] 1-item on social influence regarding exercisers: 1 to 10 (high proportion of the people whom they meet regularly do exercise)

[c] 1-item on social influence regarding encouragement: 1 to 10 (high proportion of the people whom they meet regularly encourage them to exercise

[d] 7-items on barriers to physical activity: 0 to 7 (high barriers)

[e] 1-item on confidence to know what exercises are healthy for them: 0 to 1 (high self-efficacy to know exercise)

[f] 1-item on confidence to exercise for at least 30 minutes five times each week: 0 to 1 (high self-efficacy to perform exercise)

[g] 6-item Kessler Psychological Distress Scale: 0 to 24 (distressed)

[h] 10-item Mini dietary assessment index: 10 to 50 (healthy eating habit)

Table 3.

Three-group analysis

Variable	Actively Engaged (n=12)		Minimally Engaged (n=8)		WALK-regular (n=19)			
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention		
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Chi-square	*P*-value
Single item								
Aerobic activity (m/wk)	27.1 ± 43.0	220.0 ± 175.1	63.8 ± 76.0	206.3 ± 50.2	42.6 ± 55.5	192.1 ± 290.9	0.6	0.76
Muscle activity (d/wk)	0.3 ± 0.7	3.6 ± 2.1	0.5 ± 0.5	2.5 ± 1.9	0.3 ± 1.0	1.7 ± 2.2	6.2	0.05
IPAQ								
VA (m/wk)	8.3 ± 19.9	78.8 ± 106.9	3.8 ± 10.6	44.0 ± 62.4	18.0 ± 67.0	81.8 ± 111.7	0.8	0.68
MA (m/wk)	45.0 ± 105.9	28.8 ± 47.2	46.3 ± 81.6	105.0 ± 250.0	41.5 ± 84.6	49.8 ± 81.2	0.8	0.66
WA (m/wk)	73.8 ± 116.4	305.0 ± 224.4	46.3 ± 57.6	140.0 ± 128.4	79.0 ± 86.0	180.3 ± 142.9	2.6	0.28
Weekday sitting (h/d)	6.0 ± 3.5	5.5 ± 3.8	5.3 ± 2.9	3.1 ± 2.5	4.9 ± 2.5	4.4 ± 3.0	8.5	0.01
Weekend sitting (h/d)	5.1 ± 2.4	4.3 ± 3.1	4.8 ± 3.5	3.0 ± 2.8	4.6 ± 2.4	4.5 ± 2.1	2.5	0.29

Note: Group by time omnibus test for interaction to examine if there is a change over time that differs in any of three groups against any other groups.

d = day; h = hour; m = minute; wk = week; VA = vigorous activity; MA = moderate activity; WA = walking; IPAQ = International Physical Activity Questionnaire