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Effect of a Randomized Controlled Trial Walking Program on Walking, Stress, Depressive Symptoms and Cardiovascular Biomarkers in Elderly Korean Immigrants

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Purpose: Despite well-known benefits of walking on cardiovascular health, no structured walking exercise program has been formally tested on elderly Korean immigrants (EKIs). This pilot randomized controlled trial study assessed the effect of a walking program on walking behavior (pedometer steps count), stress (cortisol), depressive symptoms (CESD-10), and cardiovascular disease biomarkers (hs-CRP and fibrinogen) via venipuncture in EKIs. **Methods:** Seventy EKIs recruited from a Korean community were randomly assigned to a 12-week walking group or control group in a 3:2 ratio. The working program included a pedometer, buddy, monthly coffee card, weekly call for goal setting, and physical activity consultation. Walking group EKIs maintained the Centers for Disease Control and Prevention recommended exercise guidelines and good mental health status over 12 weeks. **Results:** There was no significant difference in the outcomes between control and walking groups. **Conclusion:** Social networking with Koreans in the senior center and church from a well-established Korean community might have positive effects on mental health.

Key Words: *Depression; Older adults; Serum biomarkers; Stress; Walking*

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death in the United States and other developed countries. Racial/ethnic minority groups in the U.S. have the highest prevalence of CVD risk factors and CVD mortality [1]. Elderly Korean immigrants (EKIs) are one of the fastest growing minority groups in the U.S. [2]. EKIs have a high prevalence of CVD risk factors such as physical inactivity and depression [3-5].

Depression is particularly prevalent in this population, which is important because depression accentuates the inflammatory responses such as serum high sensitivity C-reactive protein (hs-CRP) and fibrinogen, precipitating CVD events [6,7]. EKIs seem to have elevated stress due to socio-environmental changes (e.g., language barriers, changes in socioeconomic status, feelings of loneliness and a sense of not belonging) and social isolation from immigration, which appear to influence the high prevalence of depression in this minority population [4,8].

With increasing immigration and higher numbers of aging Korean immigrants, the prevalence of CVD is expected to increase among EKIs. Regular physical activity has a significant influence on CVD risk factors [9-11]. A study reported that minority individuals tend to be less physically active than the national recommendations suggest [12]. Walking is a commonly used exercise among Koreans and is accessible to most individuals with little risk of injury [3]. Regular walking is associated with lower levels of hemostatic and inflammatory markers [13,14]. Despite its

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proven benefits, physical activity is uncommon among EKIs which is surprising because walking is part of daily life in Korea [4,15]. However, after immigration, EKIs typically become sedentary because automobiles replace walking for the majority of daily activities. Immigration-acquired sedentary western lifestyle is one important and treatable factor contributing to the high prevalence of CVD risk factors among EKIs [5].

According to the Theory of Reasoned Action, written and verbal messages about the benefits of walking and its effect on health outcomes have beneficial influence on one's attitude toward walking and subjective perception on the behavior [16]. The Theory of Reasoned Action and other research findings have confirmed a link between social support and positive health outcomes [16-18]. Adults with larger social support systems had higher levels of self-esteem and exercise behavior than those with lower social support [19]. Pedometers have been found to be effective instruments to promote physical activity [20-22]. We implemented a culturally-appropriate program (use of culturally-appropriate exercise: walking, walking with a buddy, pedometer recording, physical activity education and counseling by a Korean) to promote cardiovascular health among EKIs. Despite well-known benefits of walking to improve cardiovascular health, no structured walking exercise program has been formally tested in EKIs. The purpose of this pilot study was to assess the effect of a walking program on walking behavior (steps count), stress (cortisol) and depressive symptoms as well as CVD biomarkers (hs-CRP, fibrinogen). We hypothesized that the walking exercise program would result in (a) increased steps count, (b) decreased stress (cortisol) level, (c) decreased depressive symptoms (Center for Epidemiological Studies Depression Scale-10 [CESD-10]) and (d) decreased CVD biomarkers (serum hs-CRP, fibrinogen).

METHODS

1. Sample and data collection

In this pilot randomized controlled walking intervention study, a sample of 70 EKIs were recruited from locations that are likely to have a substantial percentage of EKIs such as a Korean senior center and a Korean church via assistance of the senior center and Korean church key personnel. Korean senior centers, which are Korean communities for elders, provide elders with a Congregate Meal Program and a place for social gathering twice per week. Korean churches also play an important role for social networking. Inclusion criteria for subjects include: (1) age ≥ 60 years old, (2) capacity to ambulate independently (do not use other' s assistance or walking assistance devices when walking), (3) having somebody to walk with as a buddy when assigned in an experimental group. People with chronic disease or disability that may limit their physical activity level, taking immunosuppressants or blood thinners such as Heparin, Coumadin, Lovenox and Plavix, and having severe needle phobia and/or a known bleeding disorder were excluded from this study.

Data collection was done at the Korean senior center and a Korean church and the investigator met with key personnel prior to the study. The key personnel announced the study and asked interested people to come forward or contact via email or call later for participation. Recruitment was also done via word of mouth from the signed participant to his (her) friend. Data were collected from June, 2011 to September, 2011 by the research team. When we reached the target number of voluntary participants (70), we stopped recruitment. This study was approved by a University Human Subjects Review Committee. Informed consent in the Korean language was obtained from each participant and participants were randomly allocated into an experimental and a control group in a 3:2 ratio. Considering the well-known benefits of walking, participants were divided into a 3:2 ratio to benefit more participants from walking.

2. Exercise intervention

Each participant in the experimental group was given a pedometer with a handout on the benefits of physical activity to positively influence their attitudes and perceptions toward walking behavior and was instructed to wear the pedometer from morning to bedtime. Instructions on how to use a pedometer, goal setting (10,000 steps per day), and walking with a buddy were given. Use of a buddy system addressed the issue of social isolation previously identified in EKIs. The research team gave a bi-weekly call to experimental group regarding goal setting for steps and daily step recording on a log as a reminder. A coupon for coffee/tea with buddy ($6) was mailed out monthly to each participant in the experimental group. The walking program lasted for 12 weeks.

People in the control group were asked to walk on their own from baseline to 12 weeks after giving instructions on the benefits of physical activity. All outcome data were collected before and after 12-weeks of walking in both groups.

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3. Instruments

Instruments used to collect data in this study included demographic questionnaire, daily step log, Center for Epidemiological Studies Depression Scale-10 (CESD-10), blood samples for stress hormone (cortisol) and cardiovascular biomarkers (serum high sensitivity c-reactive protein [hs-CRP], fibrinogen). Demographic characteristics of the participants were assessed with commonly used self-reported questions (i.e., age, gender, education, marital status, health status).

4. Daily step log

Walking was measured with daily steps count on a pedometer (Accusplit AE120). The Accusplit AE 120 pedometer has been shown to be a valid and reliable step count measure [21,23]. Participants in an exercise group were instructed to wear the pedometer snugly to the body and to keep it upright in a vertical plane, perpendicular to the ground to accurately assess physical activity from waking up to before going to bed. They were asked to record the number of steps taken each day on a provided calendar.

5. Center for Epidemiological Studies Depression Scale-10 (CESD-10)

Depression was measured with the 10-item CESD-10 [24]. The CESD-10 showed good predictive validity when compared to the full-length 20-item version of the CESD (kappa = .97, $p < .001$) [25]. The Korean version of CESD-10, which showed good reliability with Cronbach alpha of 0.80, was used in a self-report format in this study [26]. The CESD-10 has four possible responses in a Likert format, where "0" is "rarely or none of the time (< 1 day)", and "3" is "almost or all of the time (5-7 days)". Scores range from 0 to 30 with higher scores reflecting greater levels of depressive symptoms. A cut point of 10 or higher was considered having depressive symptoms [25]. The CESD-10 has four separate factors: depressive affect, somatic symptoms, positive affect, and interpersonal relations [27].

6. Blood samples: serum biomarkers

Blood samples from all participants were collected in sodium citrate Vacutainers (Becton Dickinson) and immediately refrigerated. Serum was separated from whole blood by centrifugation, flash frozen, and stored at -70°C within 4 hours of collection. Commercially available enzyme linked immunosorbent assay (ELISA) kits were used to measure serum concentrations of C-reactive protein (CRP), fibrinogen, and cortisol. CRP and fibrinogen were measured using two-antibody sandwich ELISAs from GenWay (San Diego, CA). Cortisol was assayed using a competition ELISA from Enzo Life Sciences (Plymouth Meeting, PA). Reagent and microtiter plate preparations were completed according to manufacturers' instructions included in the respective kits. For CRP, serum samples were diluted 1:100 prior to analysis. Assays were completed in duplicate or triplicate, normalized to total serum protein concentration by Bradford analysis, and reported as serum average ± SEM.

7. Data analysis

The IBM Statistical Package for Social Sciences version 19 (SPSS, Chicago, IL) was used for data analysis. Descriptive statistics were performed to assess demographic characteristics of the participants and steps count. Paired t-tests were used to assess within-group differences on steps count, stress, depressive symptoms, and CVD biomarkers from baseline to 12 weeks of walking exercise program. Independent t-tests were used to assess between group differences of stress, depressive symptoms and CVD biomarkers at baseline and end of 12 weeks of walking program. In terms of steps counted, further analysis was done dividing the mean scores of the total 12 weeks steps into two groups (< 7,000 steps/day, ≥ 7,000 steps/day) based on the Tudor-Locke et al. [28]'s guidelines (7,000 to 10,000 steps/day = 30 minutes/day of moderate-to-vigorous physical activity).

RESULTS

The dominant participants of both walking and control groups were female, married, and reported exercising ≥ 3/week in the past week prior to study. More EKIs in the walking exercise group reported to be healthy in general compared to those in control group (54.6% vs. 45.8%)(Table 1). Two participants in walking exercise program dropped out: one had a health issue and the other did not want to commit to daily wearing of pedometer and recording of step counts.

1. Steps count

There was a significant difference in the steps count of walking group from week 1 (Mean = 40,527, SD = 20,948) to week 12 (Mean = 53,731, SD = 20,369), supporting the hypothesis (a), increased steps count (t = -4.24, $p = < .01$). Weekly mean steps were between 50,000 (7,143 steps/

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day) to 60,000 (8,571 steps/day) steps for 10 weeks from week 2 to week 12 (Figure 1). When the mean scores of the total 12 weeks steps count (range: 20,345-85,370) were divided into two groups (≥7,000 steps vs <7,000 steps), EKIs who had ≥7,000 steps/day (n=20, 52.6%) were younger in age (69.8 [2.19]), healthier (60% vs. 55.5%) and had fewer health burdens in their daily lives (41.2% vs. 35.3%) than those with <7,000 steps/day (n=18 [47.4%]).

Table 1. Demographic Characteristics of Elderly Korean Immigrants (n= 68)

Variables	Exercise (n=44)	Control (n=24)
Age		
Range (Mean, SD)	63-87 (75.2, 6.02)	60-84 (71.3, 6.35)
Gender		
Male	20 (45.5%)	10 (41.7%)
Female	24 (54.5%)	14 (58.3%)
Education		
<High school	7 (15.9%)	8 (33.3%)
High school	25 (56.8%)	7 (29.2%)
>High school	12 (27.3%)	9 (37.5%)
Marital status		
Married	28 (63.6%)	17 (70.8%)
Widow(er)	9 (20.5%)	5 (20.8%)
Separated	1 (2.3%)	1(4.2%)
Divorce	6 (13.6%)	1 (4.2%)
Health status (self-report)		
Very unhealthy	4 (9.1%)	3 (12.5%)
Not healthy	16 (36.3%)	10 (41.7%)
Healthy	20 (45.5%)	11 (45.8%)
Very healthy	4 (9.1%)	0
Exercise behavior (self-report)		
<1/week	2 (4.5%)	2 (8.3%)
1-2/week	15 (34.1%)	6 (25.0%)
≥3/week	27 (61.4%)	16 (66.7%)

2. Stress (cortisol) and depressive symptoms (CESD-10)

There were no significant differences in mean scores of cortisol and depressive symptoms from baseline to end of week 12 in both walking group and control group and thus hypotheses (b) and (c) were not supported. There were no significant differences in between-group comparisons of both cortisol and depressive symptoms at baseline and 12 week (Table 2). Mean stress and depressive symptom scores were in a normal range in both walking and control groups.

3. CVD biomarkers (hs-CRP, fibrinogen)

There were no significant differences in mean scores of hs-CRP and

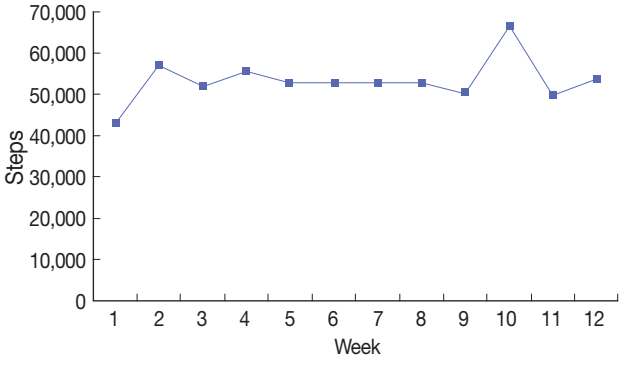

Figure 1. Steps count of a walking group.

Table 2. Between- and Within-group Comparisons of Depressive Symptoms, Stress, and CVD Biomarkers (hs-CRP, fibrinogen)

Variables	Walking mean (SD)	Control mean (SD)	Between-group (walking-control) comparison (t, *p*)
Depression (CESD-10)			
Baseline	8.65 (4.96)	8.32 (4.04)	(t=0.27, *p*=.79)
12-week	7.84 (4.79)	7.90 (4.78)	(t=-0.05, *p*=.96)
Within-group (baseline -12 week) comparison (t, *p*)	(t=1.06, *p*=.30)	(t=0.49, *p*=.63)	-
Stress (cortisol)			
Baseline	3.53 (3.74)	4.90 (5.04)	(t=-1.22, *p*=.23)
12- week	3.94 (2.91)	3.86 (2.99)	(t=0.10, *p*=.92)
Within-group (baseline -12 week) comparison (t, *p*)	(t=-0.34, *p*=.74)	(t=0.94, *p*=.36)	-
hs-CRP			
Baseline	1.73 (1.82)	1.73 (3.43)	(t=<0.01, *p*=.99)
12-week	1.22 (1.19)	1.75 (3.03)	(t=-0.78, *p*=.44)
Within-group (baseline -12 week) comparison (t, *p*)	(t=2.09, *p*=.05)	(t=-0.01, *p*=.99)	-
Fibrinogen			
Baseline	325.85 (181.34)	215.50 (69.32)	(t=0.34, *p*<.01)
12-week	367.85 (181.34)	196.05 (68.99)	(t=4.07, *p*<.01)
Within-group (baseline -12 week) comparison (t, *p*)	(t=-0.70, *p*=.49)	(t=1.36, *p*=.19)	-

CVD=Cardiovascular disease; hs-CRP=high sensitivity C-reactive protein; CESD-10=Center for Epidemiological Studies Depression Scale-10.
normal range of CESD: 0-9, cortisol: 3-15 mcg/dL, hs-CRP: 0.07-5.25mg/L, fibrinogen: 200-400 mg/dL.

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fibrinogen from baseline to end of week 12, and thus hypothesis (d) was not supported. In between-group comparisons, both walking and control groups had significantly different mean scores in fibrinogen at baseline and end of week 12 (both $p < .01$). However, there was no significant difference in between-group comparisons of hs-CRP (Table 2). Mean scores of CVD biomarkers were in a normal range in both walking and control groups.

DISCUSSION

The majority of EKIs in this study appeared to be in good health, which might have influenced the study outcomes in this study. More than 60% of EKIs in both walking and control groups reported to be exercising ≥ 3/week prior to joining this walking exercise program.

1. Walking

The walking program seemed to have a significant effect on improving walking behavior of walking group from week 1 to week 12. EKIs had a steady walking behavior in steps count from week 2 to week 12, reporting steps between 50,000-60,000 per week (7,143-8,571 steps/day). The steps count is higher than other U.S. adult population age ≥ 18 (5,117 steps/day) [29,30]. According to the Centers for Disease Control and Prevention (CDC) guideline [29], older adults are recommended to have at least 2 hours and 30 minutes of moderate-intensity aerobic exercise every week and muscle-strengthening activities on two or more days a week. A review study indicates that 7,000 to 10,000 steps/day is equivalent to accumulating 30 minutes/day of moderate-to-vigorous physical activity in healthy older adults [28].

Unlike other study findings on physical inactivity in EKIs [3-5,15], many participants in this study were physically active. The steps count reveals that EKIs in this study meet the CDC recommendations of 2 hours and 30 minutes of moderate-intensity aerobic exercise every week. Although many people responded to exercising more than ≥ 3 in the past week, this walking program seems to be well-accepted by EKIs. In fact, the two groups (exercising ≥ 3/week, < 3/week in the past week) had no difference in the amount of walking.

Participants recruited from two Korean community sites as well as knowing who are in the walking groups seemed to have a synergistic effect by encouraging walking with each other after senior center meetings or church activities. This research supports the link between social support and positive health outcomes proposed by the Theory of Reasoned Action and other researchers [16-18]. Long-term follow-up of walking behavior after the structured walking exercise might be considered in future studies. More comprehensive baseline physical activity measurement including type of physical activity and duration besides frequency might be useful to see the intervention effect.

When the mean scores of the total 12 weeks steps count were divided into two groups, EKIs who had ≥ 7,000 steps/day (n = 20, 52.6%, range: 7,196-12,196 steps/day) were younger in age (69.8 [2.19]) and healthier (60% vs. 55.5%) than those with < 7,000 steps/day (n = 18, 47.4%, range: 2,906-6,918 steps/day). Other researchers also reported a positive effect of feeling to be younger and better health status on physical activity [29,31]. Although a pedometer itself can be an intervention, no steps count in control group limits assessment of the intervention effect. Future studies might consider incorporating muscle strengthening exercise to walking and steps count in control group.

Major barriers encountered during walking intervention included the pedometer not working and health issues. Although studies reported good reliability of the pedometer [21,23], five people in this study reported a mal-functioning pedometer. Health status was another major barrier for walking. Some EKIs had to slow down the pace of walking because of knee joint pain, shingles and general sickness. Although the majority of participants reported to be healthy in general, aging itself seemed to make them vulnerable for health issues.

2. Stress and depressive symptoms

Although the walking program had no reported effect on monitored stress level or depressive symptoms in this study, these were not significant issues in the participating EKIs. Unlike other findings of high prevalence of depression in EKIs in previous studies by the corresponding author and other researchers [4,8,32], the mean scores of both stress and depressive symptoms were within normal range. EKIs in this study were regular participants of a Korean senior center and a Korean catholic church (Silver College for seniors), and so were functionally independent and motivated. The Korean senior center has a meal program twice a week and Korean elders can enjoy several fun activities such as chess, table tennis, Karaoke, dancing, and education sessions in Korean along with a lunch with other Korean seniors. The Silver College is the church's program for seniors to get life-long education through several diverse classes, for example, dancing, calligraphy, singing, health education,

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painting and English conversation. Those who obtained certain credits will graduate with a certificate given by a pastor of the church.

It is well known that depression is prevalent in people with loneliness and social isolation [5,33]. Depression was highly prevalent in EKIs because of social isolation from language barriers and loneliness [4,32]. Social networking with Koreans in the Senior Center and church from a well-established Korean community might have positive effects on mental health, as supported by serum cortisol level. Researchers reported that people with a positive affect and optimism had lower cortisol levels in the awaking period [34,35]. Those who are regular participants of the organization with regular exercise may not have as much stress or have been able to relieve experienced stress through networking and exercise. According to the successful aging theory [36], social engagement and regular physical activity are important components of a successful aging process.

3. CVD biomarkers

Like stress and depressive symptoms outcomes, serum hs-CRP and fibrinogen were not significant issues in this study. Although walking had no significant effect on decreasing CVD biomarkers, EKIs in this study had a normal range of CVD biomarkers from the beginning. Fibrinogen level was statistically different in both walking and control groups at baseline and end of week 12 but that was not clinically significant. This study supports other study findings on the positive relationships between depression and elevated hs-CRP and fibrinogen levels [6, 7]. Social isolation and loneliness were positively associated with hs-CRP and fibrinogen levels in older adults [37]. Since depression was not a significant issue, CVD biomarkers were not significant. Studies indicated active social engagement as a consistent predictor of low CVD risk factors such as hs-CRP and fibrinogen levels and decreased CVD mortality risk in older adults [38,39]. In a longitudinal study of a 5,925 cohort of people ages from 52-74 years from British towns followed - up for 13.7 years (1992-2006), social engagement had a protective effect on CVD mortality independent of known cardiovascular risk factors, disease, disability, and socioeconomic conditions [39].

Regular physical activity decreases CVD risk by mediating anti-inflammatory effects [40,41]. For example, in the Third National Health and Nutrition Examination Survey with 3,638 apparently healthy people age ≥ 40, people with more frequent physical activity had a lower odds of having an elevated C-reactive protein and fibrinogen level [40]. The majority of findings are based on Caucasian populations and this study is a good supplement for the findings in EKIs.

Although several studies indicated that CVD risk factors are highly prevalent in EKIs [3-5,15], participants in this study had relatively good mental, physical activity behavior, and CVD biomarkers. Regular physical activity and active social engagement seem to have significant influence on depressive symptoms and CVD risk factors in EKIs, like in other study findings [9,11]. However, caution needs to be taken when interpreting the current study findings because of the limitations in study methodology such as convenient sampling, no comparison of steps measures in control group, and inaccurate pedometer.

CONCLUSION

Regular physical activity and active social engagement seems to be critical for mental and cardiovascular health, which are major components of successful aging and also important components for public health nurses to encourage and educate older adults. Although some participants were well aware of the benefits of exercise, as well as participating in some exercise prior to joining this exercise program, they seemed to have benefited from this structured walking program. Overall, this walking program was well-accepted by EKIs. For example, EKIs maintained the CDC recommended walking guideline from week 2 to the end of the intervention. Some participants asked the investigator to lead a walking group after the program ended, and those who did not participate this time asked to open another program next year. Future studies might consider incorporating long-term follow-up, strength exercise, step measures in control group, and expansion of selection sites.

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