



Research Article

Effects of Nordic Walking on Body Composition, Muscle Strength, and Lipid Profile in Elderly Women

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SUMMARY

Purpose: The purpose of this study was to investigate the effects of Nordic walking on body composition, muscle strength, and lipid profile in elderly women.**Method:** Sixty-seven women were assigned to the Nordic walking group ($n = 21$), the normal walking group ($n = 21$), and the control group ($n = 25$). Nordic walking and normal walking were performed three times a week for 12 weeks. Body weight, body mass index, total body water, skeletal muscle mass, percent body fat, grip strength, sit to stand, arm curl, total cholesterol, triglyceride, high-density lipoprotein cholesterol, and low-density lipoprotein cholesterol were measured before and after the program. A Chi-square test, one way analysis of variance, paired t test and repeated-measure two-factor analysis were used with the SAS program for data analysis.**Results:** There was a significant difference in the weight ($F = 8.07, p < .001$), grip strength ($F = 10.30, p < .001$), sit to stand ($F = 16.84, p < .001$), arm curl ($F = 41.16, p < .001$), and total cholesterol ($F = 5.14, p = .009$) measurements between the groups. In addition, arm curl was significantly increased in the Nordic walking group compared to the normal walking group and the control group.**Conclusion:** The results indicate that Nordic walking was more effective than normal walking in improving upper extremity strength.

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Introduction

Since aging has become a social issue, people are interested in the elderly's quality of life. According to the Korea National Statistical Office (KNSO, 2009), the life expectancy of a child is 77 years for men and 83.8 years for women. Life expectancy has been increasing since 1970 because the death rate for elderly aged 65 or older has decreased (KNSO, 2009). In addition, according to the 2010 Population and Housing Census, the population of elderly aged over 65 was 5.42 million, 1.06 million more than in 2005 (KNSO, 2010). This finding confirms that the elderly population is increasing. Various welfare policies for the elderly have been implemented. Many attempts to maintain and improve the health of the elderly are being made especially through health promotion programs at health centers. However, interest in healthy and

successful aging and demand for the best quality of life are growing because 90.9% of Korean elderly suffer from chronic diseases (Kim, 2006). In particular, among many health problems, obesity, the main cause of diabetes, hypertension, and other cardiovascular diseases, reduces physical strength and negatively affects health (Park & Kim, 2004).

According to the 2009 Korean National Health and Nutrition Examination Survey, among those aged 60 years and over, 32.2% of men and 41.4% of women were obese. Among those aged 70 years and over, 19.9% of men and 38.1% of women were obese. In women, the 60–69 years age group had the highest rate of obesity. Walking for exercise and low-impact aerobic exercises are recommended for elderly who are obese or have a low level of physical strength. In addition, walking is an easy exercise to practice. Many positive effects such as body composition and lipid profile changes have been reported for all age groups (Colak & Ozelik, 2004; Kim et al., 2010; So & Choi, 2007). According to the Korean National Institute of Health, the practice rate of walking as exercise was 46.1% in 2009. The rate for men was higher than that for women (47.8% vs. 44.2%). The practice rate for exercise walking was the highest for

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men age 65 years and more. Among women, middle-aged women (the 19–64-year age group) showed the highest rate (Ministry of Health and Welfare & Korea Centers for Disease Control and Prevention, 2010).

Aging slows down the function of the entire body in the elderly; the elderly experience weakness and decline in percent body fat and bone density. Due to these problems, the elderly experience limits in their physical activity ability and are prone to injuries (Chung, Lee, Park, & Jin, 2008).

It is impossible to prevent the decline of physical strength completely in elderly, but appropriate physical activities and regular exercise can slow down the speed of decline. (Daley & Spinks, 2000). The World Health Organization (WHO) provides physical activity guidelines, as the practice rate of physical activities has been accelerating since people's interest in health increased (WHO, 2000). The elderly in particular are very interested in health and practicing healthy behaviors because they receive benefits from exercise programs (Park & Oh, 2005). Therefore, we need to develop and apply exercise programs that increase the practice rate without much physical demand (Kim & Jang, 2011).

Recently, the positive effects of exercise walking have been reported to the public, which interested many people in Nordic walking. Nordic walking helps people use not only the lower body but also all the muscles of the upper body. Nordic walking also increases caloric output and oxygen consumption more than any other walking exercise.

Nordic walking is a form of walking that involves walking while holding poles similar to ski poles. While walking, people use their arms, shoulders, chest, and other upper body muscles. Thus, Nordic walking increases caloric output and oxygen consumption compared to normal walking (Evans, Potteiger, Bray, & Tuttle, 1994). This form of walking requires the use of many muscles to increase walking speed with poles, which increases gross-motor activity and metabolism. Nordic walking is safe because of the effects of walking on all fours are well-known as a rhythmic exercise while maintaining balance (Cha, 2010). Nordic walking helps people remain stable while walking and improves their breathing efficiency. In addition, some studies show that Nordic walking reduces the load on the lower body (Bohne & Abendroth-Smith, 2007), although some studies do not support the hypothesis (Hansen, Henriksen, Larsen, & Alkjaer, 2008).

Therefore, Nordic walking is well-known as a useful exercise that provides stability to people who are old or have orthopedic problems and physical balance problems to improve their physical activity (Church, Earnest, & Morss, 2002). In particular, Nordic walking uses not only lower body movements but also upper body movements. This decreases the load that occurs while walking and could help to increase muscle strength (Willson, Torry, Decker, Kemozer, & Steadman, 2001). According to Kim and Cho's (2010) study, Nordic walking decreases movement of the ankle and knee joints and helps with efficient forward walking movement.

Many researchers have studied the effect of Nordic walking, including obese women who had fat loss (Cha, 2010; Kim & Choi, 2006) and elderly with osteoarthritis of the knee who gained benefits such as fat loss after Nordic walking and underwater exercise (Kim & Roh, 2009). Also, only one study to date (Song, 2012) examines body composition, gait capacity, cardiovascular function and activities of daily living by comparing Nordic walking and normal walking.

In addition, studies have compared Nordic walking to normal walking to check efficiency (Kim & Cho, 2010) and body cooperation (Shin & Kim, 2011). Only Kim and Choi, who worked with obese middle-aged women, found a positive effect. In addition, most

participants in Nordic walking studies were obese middle-aged women in rehabilitation programs (Kim & Choi, 2006; Wendlova, 2008). These studies have been conducted in kinematics and sports biomechanics settings. No study to date has been conducted in nursing.

We investigated the change in body composition due to Nordic walking and normal walking and changes in strength due to Nordic walking and normal walking. This study demonstrates the need to develop safe and efficient exercise programs for the elderly that incorporate Nordic walking in their daily lives.

Purpose

The purpose of this study is to compare the effects of Nordic walking program to those of a normal walking program on the body composition, muscle strength and lipid profile of women who are over 65 years of age.

Methods

Study design

This study uses a quasi-experimental nonequivalent control group pretest-posttest design to compare the effects of Nordic walking and normal walking on the body composition, muscle strength, and lipid profile of women over 65 years old over 12 weeks.

Setting and samples

Participants were women over 65 years old who wanted to participate in health promotion programs at health centers. They were assigned randomly to the Nordic walking group or the normal walking group according to the order in which they applied to participate in the program. The control group consisted of elderly who attended elder's college and did not participate in other health promotion programs. In total, 21 people were in the Nordic walking group, 21 people were in the normal walking group, and 25 people were in the control group. No one dropped out during this study. We set up an effect size of .80 at a power of .80 and an α level of .05. We created the selection criteria based on the formula that each group needed 15 subjects (Rosner, 2000). The selection criteria were as follows: The person (a) agreed to participate in this study; (b) was able to communicate and perform physical activity; (c) had not done any exercise continuously for the last 6 months.

Data collection

The data collection period was from February to May 2012. Before we began collecting data, the study was approved by the critical trial judge committee from D university S Oriental Medicine Hospital (institutional review board No. 2011-01). Data was collected to measure general characteristics, body composition (body mass index [BMI], total body water, skeletal muscle mass, body fat percentages), muscle strength, and lipid profile (total cholesterol, triglyceride, high density lipoprotein [HDL] cholesterol, low density lipoprotein [LDL] cholesterol) before participants started the Nordic walking and normal walking programs. Body composition and physical fitness were evaluated by a researcher who was an exercise specialist. The researcher used senior fitness test items from a senior fitness test manual (Rikli & Jones, 2001).

Intervention

Walking program

The Nordic walking and normal walking program was created after three professors from the exercise prescription department were consulted. The program was based on the fact that Nordic walking and normal walking improved cardiovascular disease condition, body composition, and physical fitness in Lim's study (2008), where elderly participants practiced exercise walking 3 or 4 times a week, 30–50 minutes each time for 12 weeks. After modifying the Nordic walking technique from Kim's study (2010), we applied the protocol to this exercise program for Nordic walking and normal walking.

The Nordic walking and normal walking exercise program consisted of warm-up exercise, main exercise, and cool-down exercise for 12 weeks, 3 times a week, 60 minutes each time. The use of poles was the only difference between the Nordic walking and normal walking programs. The detailed program is shown in Table 1. The Nordic walking poles were assembled and I-shaped with a minimum length of 79 cm and a maximum length of 135 cm. To soften the stress of Nordic walking, screw shaped rubber was attached at the bottom of poles. Each piece of rubber weighed 267 g.

During the warm-up exercise period, the Nordic walking group did isometric exercises with poles, and the normal walking group did isometric exercises that did not harm their knees. The warm-up exercise period lasted for 10 minutes. Using the perceived exertion rating (American College of Sports Medicine, 2006), we gradually increased the subjects' exercise intensity. The intensity was 11–12 (easy) during the 1st week as the adaption period, 13–14 (a little hard) from the 2nd to 6th week, and 15–16 (hard) from the 7th to 12th week. The cool-down exercises involved dynamic stretching for 15 minutes. Participants used Nordic poles (BTN-2, HI-TRECK, Korea), and we set the length of each pole to reach the participant's umbilical level when standing in bare feet and without the rubber at the bottom of the poles. Since the participants were elderly, we let them set the pressure intensity individually so that they could practice exercise walking safely depending on their muscle strength and physical strength. This program was implemented by a collaborator who majored in physical education and has a first-class physical director agent license. The setting was at a park with a 400-meter track in G metropolitan city. The Nordic walking group and the normal walking group practiced exercise walking on different days of the week. When it was impossible to implement this program due to the weather, we changed the setting from the park to the gym (Figure 1).

Instruments

Body composition

Body weight, height, total body water, skeletal muscle mass, and percent body fat were measured with the Inbody 520 (Biospace, Seoul, Korea), and BMI was calculated by dividing the person's body weight (kg) by the square of the person's height (m²). The Inbody 520 measures total body water by using a multi-frequency technique that separates total body water into intracellular water and



Figure 1. Nordic walking.

extracellular water. This tool analyzes muscles, fat, and skeletal muscle mass, elements that are the most changed through exercise. The Inbody 520 displays skeletal muscle mass separately from soft lean mass. For obesity, we measured the percent body fat, an indicator of the percentage of body fat to body weight.

Muscle strength

Grip strength was measured with a dynamometer. This tool measures the coordination between the thumb and the other four fingers and general maximum strength. Participants made their second joint of fingers a right angle and controlled the width. Participants did not let the dynamometer reach their body with their arms dangling. The left and right rotations and each side's highest measurement were recorded on a chart. The figures were rounded off to the nearest kilogram.

Lower extremity muscle strength was measured with the sit to stand test. Number of full stands that can be completed in 30 seconds with arms folded across chest was checked. Upper extremity muscle strength was measured with the arm curl test. Number of bicep curls that can be completed in 30 seconds holding a hand weight of 2 kg dumbbell was checked (Rikli & Jones, 2001).

Lipid profile

Total cholesterol, triglyceride, and HDL cholesterol were measured with enzymatic and colorimetry test methods with an analysis instrument, the ADVIA 1650 (Bayer, Tokyo, Japan), on empty stomach. Low density lipoprotein (LDL) cholesterol was measured with the elimination enzymatic assay test methods with an analysis instrument, the ADVIA 1650 on empty stomach.

Data analysis

Data analysis was implemented through the SAS (version 9.2; SAS Institute, Cary, NC, USA). General characteristics of the participants in the three groups were investigated with the Chi-square test and one way analysis of variance by homogeneity test. Paired *t* test was used to for comparison of differences between the before and after test values in each group. Repeated measure two-factor analysis was used to determine the difference in the change in

Table 1 Nordic Walking and Walking Exercise Program

Order	Intensity	Duration (min)
Warm-up	Stretching	10
Main exercise	Week 1: 11–12 RPE	35
	Week 2–6: 13–14 RPE	
	Week 7–12: 15–16 RPE	
Cool-down	Stretching	15

Note. RPE = rating of perceived exertion.

body composition, muscle strength, and lipid profile among the groups and over time.

Results

Homogeneity test of participants

There was no significant difference among the average ages of the participants in the three groups. The average age were 67.8 years old in the Nordic walking group, 68.2 years old in the normal walking group, and 68.0 years old in the control group. The education levels, especially the elementary school and middle school graduation rates, of the three groups were similar. In addition, most of the participants had living spouses so there was no significant difference between these groups.

For body composition, there was no significant difference in average height, weight, BMI, total body water, skeletal muscle mass, and percent body fat in the three groups.

For muscle strength, there was no significant difference in grip strength, sit to stand, and arm curl with a dumbbell.

For the lipid profile, there was no significant difference in total cholesterol, triglyceride, HDL cholesterol, and LDL cholesterol in the three groups (Table 2).

Body composition

The Nordic walking group showed a decrease in body weight from 59.6 kg before the intervention to 58.6 kg after the intervention ($p < .001$). The normal walking group also showed a decrease in body weight from 57.2 kg before the intervention to 56.4 kg after the intervention ($p = .002$). However, the control group did not show any significant change in body weight: 60.7 kg before to 60.8 kg after 12 weeks. Body weight did not differ significantly among the three groups ($p = .182$), but there were significant differences over time (before vs. after; $p < .001$) and a significant interaction between group and time ($p < .001$). The Nordic walking group and normal walking group showed a significant decrease in body weight compared to the control group.

For BMI, the Nordic walking group showed a significant decrease from 24.5 kg/m² before the intervention to 24.0 kg/m² after the intervention. The normal walking group did not show any significant changes: 23.2 kg/m² before the intervention and

23.0 kg/m² after the intervention. The control group also did not show any significant changes: 25.0 kg/m² before to 24.9 kg/m² after 12 weeks. The BMI did not differ significantly among the three groups ($p = .064$), but there were significant differences over time (before vs. after; $p = .002$), and no interaction between group and time ($p = .066$).

In terms of total body water, the Nordic walking group did not show any significant changes from 28.8L before the intervention to 28.8L after the intervention. The normal walking group also did not show any significant changes, from 28.8L before the intervention to 29.2L after the intervention. Only the control group showed a significant change, from 29.1L before to 29.7L after 12 weeks. Total body water did not differ significantly among the three groups ($p = .872$); there were no significant differences over time ($p = .314$), or significant interaction between group and time ($p = .769$).

In terms of skeletal muscle mass, the Nordic walking group showed a significant change from 20.6 kg before the intervention to 21.4 kg after the intervention ($p < .001$). The normal walking group showed a significant change from 20.3 kg before the intervention to 21.2 kg after the intervention ($p < .001$). However, the control group did not show any significant changes: 20.9 kg before to 21.4 kg after 12 weeks. The skeletal muscle mass did not differ significantly among the three groups ($p = .853$), but there were significant differences over time (before vs. after; $p < .001$), and no significant interaction between group and time ($p = .108$).

In terms of percent body fat, the Nordic walking group showed a significant decrease from 34.2% before the intervention to 32.9% after the intervention ($p = .008$). The normal walking group showed a significant decrease from 31.9% before the intervention to 30.7% after the intervention ($p = .005$). However, the control group did not show any significant changes: 34.7% before to 34.1% after 12 weeks. The percent body fat did not differ significantly among the three groups ($p = .131$), but there were significant differences over time (before vs. after; $p < .001$), and no interaction between group and time ($p = .201$; Table 3).

Muscle strength

In terms of grip strength, the Nordic walking group showed a significant change from 22.0 kg before the intervention to 24.6 kg after the intervention ($p < .001$). The normal walking group

Table 2 Homogeneity Test of General Characteristics and Research Variables ($N = 67$)

Characteristics	Division	Nordic ^a	Normal ^a	Control ^a	χ^2/F	p
		$M \pm SD$ or n (%)	$M \pm SD$ or n (%)	$M \pm SD$ or n (%)		
Age (yr)		67.8 \pm 2.5	68.2 \pm 2.6	68.0 \pm 2.5	0.15	.858
Education	Elementary school	7 (33.3)	8 (38.1)	7 (28.0)	2.08 ^b	.722
	Middle school	7 (33.3)	8 (38.1)	7 (28.0)		
	\geq High school	7 (33.3)	5 (23.8)	11 (44.0)		
Partner	Yes	18 (85.7)	18 (85.7)	23 (92.0)	0.59 ^b	.745
	No	3 (14.3)	3 (14.3)	2 (8.0)		
Height (cm)		156.2 \pm 4.6	157.2 \pm 5.0	156.0 \pm 4.4	0.47	.625
Weight (kg)		59.6 \pm 5.2	57.2 \pm 8.8	60.7 \pm 6.9	1.41	.251
Body mass index (kg/m ²)		24.5 \pm 1.7	23.2 \pm 2.9	25.0 \pm 2.9	2.87	.064
Total body water (L)		28.8 \pm 2.0	28.8 \pm 4.3	29.1 \pm 2.9	0.05	.954
Skeletal muscle mass (kg)		20.6 \pm 1.6	20.3 \pm 2.6	20.9 \pm 1.5	0.49	.618
Percent body fat (%)		34.2 \pm 4.1	31.9 \pm 6.2	34.7 \pm 5.7	1.73	.185
Grip strength (kg)		22.0 \pm 4.1	22.7 \pm 3.6	22.9 \pm 4.5	0.30	.738
Sit to stand (no. of times)		16.0 \pm 2.5	16.6 \pm 3.2	17.1 \pm 3.5	0.62	.541
Arm curl (no. of times)		22.9 \pm 2.6	23.5 \pm 3.1	22.1 \pm 3.4	1.13	.330
Total cholesterol (mmol/L)		5.2 \pm 0.8	5.2 \pm 0.7	5.7 \pm 0.8	3.01	.056
Triglyceride (mmol/L)		1.4 \pm 0.5	1.3 \pm 0.4	1.6 \pm 0.5	3.06	.054
HDL cholesterol (mmol/L)		1.3 \pm 0.2	1.5 \pm 0.4	1.3 \pm 0.3	2.76	.071
LDL cholesterol (mmol/L)		3.7 \pm 0.8	3.4 \pm 0.8	3.9 \pm 0.9	2.11	.130

^a Nordic refers to the Nordic walking group ($n = 21$); Normal refers to the normal walking group ($n = 21$); Control refers to the control group ($n = 25$).

^b Chi-square test.

Table 3 Comparisons of Body Composition among the Three Groups (*N* = 67)

Body composition	Groups ^a	Before	After	<i>t</i> (<i>p</i>)	<i>F</i> (<i>p</i>)		
		<i>M</i> ± <i>SD</i>	<i>M</i> ± <i>SD</i>		Group	Time	Group × time
Weight (kg)	Nordic (a)	59.6 ± 5.2	58.6 ± 5.2	−5.45 (<.001)	1.75 (.182)	19.38 (<.001)	8.07 (<.001) a, b < c
	Normal (b)	57.2 ± 8.8	56.4 ± 8.9	−3.55 (.002)			
	Control (c)	60.7 ± 6.9	60.8 ± 7.1	0.45 (.659)			
Body mass index (kg/m ²)	Nordic	24.5 ± 1.7	24.0 ± 1.8	5.38 (<.001)	2.87 (.064)	10.56 (.002)	2.84 (.066)
	Normal	23.2 ± 2.9	23.0 ± 3.1	−1.17 (.257)			
	Control	25.0 ± 2.9	24.9 ± 3.1	−0.59 (.562)			
Total body water (L)	Nordic	28.8 ± 2.0	28.8 ± 2.4	−0.06 (.954)	0.14 (.872)	1.03 (.314)	0.26 (.769)
	Normal	28.8 ± 4.3	29.2 ± 4.4	0.50 (.626)			
	Control	29.1 ± 2.9	29.7 ± 2.8	4.47 (<.001)			
Skeletal muscle mass (kg)	Nordic	20.6 ± 1.6	21.4 ± 1.6	6.82 (<.001)	0.16 (.853)	40.51 (<.001)	2.31 (.108)
	Normal	20.3 ± 2.6	21.2 ± 2.9	4.00 (<.001)			
	Control	20.9 ± 1.5	21.4 ± 1.7	1.95 (.064)			
Percent body fat (%)	Nordic	34.2 ± 4.1	32.9 ± 4.4	−2.97 (.008)	2.10 (.131)	20.98 (<.001)	1.65 (.201)
	Normal	31.9 ± 6.2	30.7 ± 5.6	−3.15 (.005)			
	Control	34.7 ± 5.7	34.1 ± 5.9	−1.69 (.104)			

^a Nordic refers to Nordic walking group (*n* = 21); Normal refers to normal walking group (*n* = 21); Control refers to control group (*n* = 25).

showed a significant change from 22.7 kg before the intervention to 25.2 kg after the intervention. The control group did not show significant changes: 22.9 kg before to 21.5 kg after 12 weeks. The grip strength did not differ significantly among the three groups (*p* = .298), but there were significant differences over time (before vs. after; *p* = .012), and significant interaction between group and time (*p* < .001). The Nordic walking group and the normal walking group showed a significant change compared to the control group.

In sit to stand, lower extremity muscle strength, the Nordic walking group showed a significant change, from 16.0 before the intervention to 19.7 after the intervention (*p* < .001). The normal walking group showed a significant change, from 16.6 before the intervention to 21.1 after the intervention (*p* < .001). However, the control group did not show any significant changes: 17.1 before to 17.6 after 12 weeks. The sit to stand did not differ significantly among the three groups (*p* = .201), but there were significant differences over time (before vs. after; *p* < .001), and a significant interaction between group and time (*p* < .001). The Nordic walking group and the normal walking group showed a significant change compared to the control group.

In arm curl, upper extremity muscle strength, the Nordic walking group showed significant change from 22.9 before the intervention to 27.4 after the intervention (*p* < .001). The normal walking group showed a significant change, from 23.5 before the intervention to 26.1 after the intervention. However, the control group did not show any significant changes: 22.1 before to 22.6 after 12 weeks. The arm curl differed significantly among the three groups (*p* = .011), and there were also significant differences over time (before vs. after; *p* < .001), and a significant interaction between group and time (*p* < .001). The Nordic walking group was more significantly improved than the normal walking group in arm curl when we compared these groups (Table 4).

Lipid profile

In total cholesterol levels, the Nordic walking group showed a significant decrease from 5.2 mmol/L before the intervention to 4.9 mmol/L after the intervention (*p* = .001). The normal walking group showed a significant decrease from 5.2 mmol/L before the intervention to 5.0 mmol/L after the intervention (*p* = .011). However, the control group did not show significant changes, from 5.7 mmol/L before to 5.7 mmol/L after 12 weeks. Total cholesterol differed significantly among the three groups (*p* = .005); there were also significant differences over time (before vs. after; *p* = .004), and a significant interaction between group and time (*p* = .009). The Nordic walking group and the normal walking group showed a significant change compared to the control group.

In triglyceride levels, the Nordic walking group showed a significant decrease, from 1.4 mmol/L before the intervention to 1.3 mmol/L after the intervention. The normal walking group did not show any significant changes, from 1.3 mmol/L before the intervention to 1.2 mmol/L after the intervention. The control group did not show any significant changes, from 1.6 mmol/L before to 1.5 mmol/L after 12 weeks. The triglyceride levels differed significantly among the three groups (*p* = .041); there were also significant differences over time (before vs. after; *p* = .003), but no interaction between group and time (*p* = .951).

In HDL cholesterol levels, the Nordic walking group showed a significant increase, from 1.3 mmol/L before the intervention to 1.5 mmol/L after the intervention. The normal walking group did not show any significant changes, from 1.5 mmol/L before the intervention to 1.7 mmol/L after the intervention. The control group did not show any significant changes, from 1.3 mmol/L before to 1.3 mmol/L after 12 weeks. The HDL cholesterol levels differed significantly among the three groups (*p* = .017); there were significant

Table 4 Comparisons of Muscle Strength among the Three Groups (*N* = 67)

Muscle Strength	Groups ^a	Before	After	<i>t</i> (<i>p</i>)	<i>F</i> (<i>p</i>)		
		<i>M</i> ± <i>SD</i>	<i>M</i> ± <i>SD</i>		Group	Time	Group × time
Grip strength (kg)	Nordic (a)	22.0 ± 4.1	24.6 ± 3.9	8.36 (<.001)	1.23 (.298)	6.67 (.012)	10.30 (<.001) a, b > c
	Normal (b)	22.7 ± 3.6	25.2 ± 3.8	6.60 (<.001)			
	Control (c)	22.9 ± 4.5	21.5 ± 5.5	−1.33 (.200)			
Sit to stand (no. of times)	Nordic (a)	16.1 ± 2.5	19.7 ± 2.4	6.00 (<.001)	1.64 (.201)	84.68 (<.001)	16.84 (<.001) a, b > c
	Normal (b)	16.6 ± 3.2	21.1 ± 4.0	11.61 (<.001)			
	Control (c)	17.1 ± 3.5	17.6 ± 2.6	1.05 (.306)			
Arm curl (no. of times)	Nordic (a)	22.9 ± 2.6	27.4 ± 3.0	14.61 (<.001)	4.80 (.011)	175.57 (<.001)	41.16 (<.001) a > b, c
	Normal (b)	23.5 ± 3.1	26.1 ± 4.1	6.76 (<.001)			
	Control (c)	22.1 ± 3.4	22.6 ± 4.0	1.96 (.062)			

^a Nordic refers to Nordic walking group (*n* = 21); Normal refers to normal walking group (*n* = 21); Control refers to control group (*n* = 25).

differences over time (before vs. after; $p = .005$), but no interaction between group and time ($p = .068$).

In LDL cholesterol levels, the Nordic walking group did not show any significant changes: from 3.7 mmol/L before the intervention to 3.4 mmol/L after the intervention. The normal walking group did not show any significant changes: from 3.4 mmol/L before the intervention to 3.5 mmol/L after the intervention. The control group did not show any significant changes: from 3.9 mmol/L before to 3.9 mmol/L after 12 weeks. The LDL cholesterol levels did not differ significantly among the three groups ($p = .072$); there were no significant differences over time (before vs. after; $p = .224$), and no interaction between group and time ($p = .272$; Table 5).

Discussion

In this study, the three groups showed significant differences in body weight after intervention. The Nordic walking group and the normal walking group showed more body weight change compared to the control group. In addition, for BMI, only the Nordic walking group showed a significant decrease; for skeletal muscle mass and percent body fat, the Nordic walking group and the normal walking group showed significant changes. In Song's (2012) study with similar age and BMI ranges, only percent body fat showed interaction of group and time in body composition. Nordic walking showed 30–70% more energy output efficiency than the normal walking and was recommended for elderly because of its low possibility of injuries due to the low load on knee and joint (Lars, Jan, Lis, & Claus, 2006). The BMI of the participants in the study is overweight according to the WHO (2000) standards. However, this study showed changes in weight but no significant changes in percent body fat. According to Song's study that showed changes of percent body fat in participants with similar cases, Nordic walking was the exercise that helped obesity management.

Kim and Choi's study (2006) showed changes in body composition such as body weight, body fat, abdominal fat percentage, and BMI. Also, the Nordic walking group showed a significant difference in body fat, lean body mass, and body weight compared to the control group (Cha, 2010). In this study, we concluded that Nordic walking is efficient for managing obesity even though the participants and the study design were different. In addition, after the obese participants who were 61 years, on average, with impaired glucose tolerance and diabetes practiced Nordic walking, they showed not only an improvement in blood sugar levels but also a significant difference in BMI (Fritz et al., 2011). Therefore, we confirmed the need (as noted by the 2009 Korean National Health and Nutrition Examination Survey) to manage obesity for elderly women aged from 60 to 69, and showed that a Nordic walking program to be beneficial as a obesity management program.

In muscle strength, the Nordic walking group and the normal walking group showed an increase in muscle strength in grip strength, sit to stand, and arm curl. In particular, the Nordic walking group showed a significant increase in upper extremity muscle strength compared to the other groups. Cha's (2010) study, which demonstrated the benefits of Nordic walking for grip strength, muscular endurance, and cardiovascular endurance, supports this study results. In this study Nordic walking showed significant interaction of group and time and in muscle strength, but there was no significant interaction in Song's (2012) study.

We found the Nordic walking group showing significant increase in upper extremity muscle strength than the normal walking group, a remarkable outcome because the participants in this study had never experienced a continuous exercise program.

This study demonstrates that Nordic walking can energize upper body muscles by using poles and give stability while walking. Thus, Nordic walking is a suitable exercise for the elderly.

In terms of blood lipid levels, the Nordic walking group and the normal walking group showed a significant decrease in total cholesterol compared to that of the control group. Blood lipid did not show any interaction in other lipid profile except total cholesterol, but there were significant differences in triglyceride and HDL cholesterol in the Nordic walking group.

In Sun, Yang, and Kim's study (1997), 8 weeks of exercise did not lead to a difference in the participants' total cholesterol, but at least 12 weeks of exercise led to a decrease. In particular, a long period of aerobic exercise could bring about a decrease in total cholesterol even though exercise did not decrease body weight in the study by Kannel, Castelli, and Gordon (1979). In this study, only total cholesterol in blood lipid showed a significant difference in the three groups after 12 weeks of exercise. In addition, results from Kim and Choi's (2006) study supported this study: the Nordic walking group and the normal walking group showed a significant decrease in total cholesterol and triglyceride, and the Nordic walking group showed a significant increase in HDL cholesterol. However, a change in blood lipid can be different because blood lipid can be affected by the subject's diet and individual difference (Kim & Choi).

In this study, we note the differences in triglyceride and HDL cholesterol levels in the Nordic walking group, suggesting that Nordic walking is more efficient in decreasing blood lipid than normal walking and other activities. However, the blood lipid change could be small.

In advanced research on Nordic walking effects, Nordic walking has been categorized as a good exercise because it decreases the exercise tolerance rate and improves momentum for walking forward (Kim & Cho, 2010). In addition, Nordic walking is helpful for muscle strength because this form of exercise decreases exercise

Table 5 Comparisons of Lipid Profile among the Three Groups ($N = 67$)

Lipid profile	Group ^a	Before	After	$t(p)$	$F(p)$		
		$M \pm SD$	$M \pm SD$		Group	Time	Group \times time
Total cholesterol (mmol/L)	Nordic (a)	5.2 \pm 0.8	4.9 \pm 0.8	-3.82 (.001)	5.79 (.005)	9.04 (.004)	5.14 (.009) a, b < c
	Normal (b)	5.2 \pm 0.7	5.0 \pm 0.6	-2.81 (.011)			
	Control (c)	5.7 \pm 0.8	5.7 \pm 0.8	0.62 (.544)			
Triglyceride (mmol/L)	Nordic	1.4 \pm 0.5	1.3 \pm 0.4	-3.07 (.006)	3.35 (.041)	9.49 (.003)	0.05 (.951)
	Normal	1.3 \pm 0.4	1.2 \pm 0.4	-1.98 (.062)			
	Control	1.6 \pm 0.5	1.5 \pm 0.5	-1.55 (.135)			
HDL cholesterol (mmol/L)	Nordic	1.3 \pm 0.2	1.5 \pm 0.3	3.72 (.001)	4.38 (.017)	8.33 (.005)	2.80 (.068)
	Normal	1.5 \pm 0.4	1.7 \pm 0.5	1.79 (.089)			
	Control	1.3 \pm 0.3	1.3 \pm 0.4	-0.10 (.923)			
LDL cholesterol (mmol/L)	Nordic	3.7 \pm 0.8	3.4 \pm 0.6	-1.92 (.070)	2.74 (.072)	1.51 (.224)	1.33 (.272)
	Normal	3.4 \pm 0.8	3.5 \pm 0.9	0.18 (.860)			
	Control	3.9 \pm 0.9	3.9 \pm 0.7	-0.57 (.571)			

Note. HDL = high-density lipoprotein; LDL = low-density lipoprotein.

^a Nordic refers to Nordic walking group ($n = 21$); Normal refers to normal walking group ($n = 21$); Control refers to control group ($n = 25$).

tolerance so that it decreases the pain of walking and increases the time spent walking (Templeton, Booth, & O'Kelly, 1996; Willson, et al., 2001). Therefore, Nordic walking could be applied to elderly with arthritis and chronic disease.

Limitations

This study has several limitations. The sample was small, and all the participants were females. The efficiency of Nordic walking could be underestimated because there was no big changes in variables since participants were elderly and the study period was only 3 months. We did not consider the participants' nutritional intake, and the tests were conducted on different dates. In addition, we did not exclude environmental effects such as the Hawthorne effect of Nordic walking and normal walking.

Implications for nursing

Nordic walking increases upper body muscles more than normal walking does because Nordic walking uses poles. In addition, Nordic walking is a more appropriate exercise for the elderly because it requires the use of poles in both hands which potentially decreases the possibility of injuries. Nordic walking does not cause the monotony that normal walking can, and using a pole improves the speed and power of walking. In addition, Nordic walking is less boring because of the rhythm. Therefore, Nordic walking is a useful health promotion program for the elderly.

Conclusions

In this study, we confirmed changes in body composition, muscle strength, and blood lipid after three groups (Nordic walking, normal walking, and control) practiced 3 times a week, for 60 minutes each time, during the 12-week study period. We demonstrated that the Nordic walking and the normal walking groups showed significant differences in decreases in body weight, muscle strength, and total cholesterol. In particular, the Nordic walking group showed more improvement in upper extremity muscle strength because this exercise requires poles whereas normal walking does not.

Further studies could examine participants with arthritis and chronic disease regarding the medical effect of Nordic walking used as a rehabilitation method. A long-term follow-up study and replication study with comprehensive expansion of participants should be conducted.

Conflict of interest

The authors declare no conflicts of interest.

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