

A Comparative Study on Cycling in Relation to the Physical Balance, Muscle Strength, Self-esteem and Depression of Elderly Women

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Abstract

The purpose of this study was to provide basic data for development of nursing intervention to maintain and enhance healthy life by comparing the effect of the use of bicycle on balance (i.e. dynamic, static balance), muscle strength of upper and lower limbs, self-esteem, and depression of elderly women. A descriptive comparative study verifying difference by grasping balance, muscle strength, self-esteem, and depression intended for elderly women on the use of bicycle. For this study, data were collected for 4 weeks from July 29, 2013 to August 23, 2013 from 69 elderly women in total living in M city of G province, specifically 34 elderly women who used bicycle 3 times a week for 1 year and 35 elderly women who did not use bicycle. The elderly women using a bicycle showed that 25.61 and 7.66 seconds for a point of static and dynamic balance respectively, 17.38 and 14.15 times for the number of times for muscle strength of upper and lower limbs, respectively, and 5.44 and 32.82 points for depression and self-esteem, respectively, meanwhile the elderly women not using a bicycle showed that 15.51 and 8.65 seconds for a point of static and dynamic balance, respectively, 14.09 and 10.66 times for the number of times for muscle strength of upper and lower limbs, respectively, and 5.44 and 32.82 points for depression and self-esteem, respectively. An average difference between the two groups showed a significant difference statistically in balance-dynamic balance ($t=1.836$, $p=.022$), upper limb strength ($t=3.623$, $p=.001$), lower limb strength ($t=5.202$, $p<.001$), and depression ($t=-2.697$, $p=.009$). As the use of bicycle leads to enhanced dynamic balance, reinforced muscle strength in upper and lower limbs, and lowered depression, elderly women are encouraged to use a bicycle for improved their physical and mental strength.

Keywords: Aged, Cycling, Depression, Extrimities, Muscle Strength, Postural Balance, Women

1. Introduction

The population of age 64 or older accounts for more than 7% of the total population of Korea as of 2000, making the nation an aged society. As of 2014, the share of the elderly in the total population accounts for 12.7% and continues an upward trend. The National Statistical Office forecasts that the share will increase to 14.0% in 2017 and hover above 20.8% in 2026, making Korea a super-aged society¹. As the later years in one's life take up an increasingly

longer period in an individual's life, physical, emotional and social issues related to an aging population can occur. Among these, one of the most serious issues is decreased health resulting from undermined physical functions and diseases¹. In the later years of one's life, an individual undergoes various anatomical, physiological and behavioral changes, including a change in the muscular system which decreased muscle power, as well undermined sense in balance and flexibility².

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One of the most important factors to have a healthy later life is not simply to extend one's life expectancy but to improve one's functional independence³. The purpose of improving health among the elderly is to prevent the undermining of physical stamina and therefore delaying the period during which the elderly would have to rely on others⁴.

For the elderly, sports can delay the undermining of physical stamina, help maintain strength and improve flexibility in the joints. This in turn not only helps physically but also relieves anxiety and depression, leading to an improved quality of life⁵⁻⁹. Muscle strength, durability, sense of balance and flexibility increase to help prevent any imbalance in walking, falls or fractures¹⁰. It also helps improve physical stamina, increase social interaction and promote physical and mental health to ensure that a healthier life can be lived in later years^{7, 11, 12}.

While various sport mediation studies have been conducted using the elderly as subjects, bicycling in particular can be said to be enjoyable regardless of age and gender and be helpful in improving physical stamina, muscle strength in the lower body¹³. Moreover, cycling maintains and strengthens cardiovascular functions of the body, reduces body fat, stabilizes blood pressure, reduces glucose levels and is also more fun than walking or running. Because of this, the elderly who are not used to exercise, women, those with weak lower body, joints or lower back and patients of osteoporosis can also take up biking without risk¹⁴.

Usually those in their teens or in their 60s or older cycle^{15, 16}. As for the elderly, they can gain techniques, take up social and cultural activities, interact with others and gain joy, happiness and a sense of achievement. It is also suggested as one of the best cardio exercises that is fit for preventing aging and metabolic diseases¹⁷.

Menopausal women who had participated in cycling for a long time were reported to have a higher muscle composition and greater lower body muscle strength¹⁸. For the elderly exposed to a higher risk of falls due to decreased muscle strength and flexibility, cycling can help prevent this and in turn reduce the risk of fractures due to falls. Moreover, it can bring positive effects to quality of life as well¹⁵. Cycling can also help stabilize emotions, build a positive physical image and reduce stress and depression¹⁹.

According to Lee²⁰, regular exercise can reduce the incidence of depression by 30%. Kang¹⁵ reports that cycling not only reduces depression and emotional stress but also helps change one's mood and increase self-esteem.

As such, this study compares the balance, muscle strength, self-esteem and depression of elderly women who cycle and elderly who don't, as well as identify the correlation between variables in order to present a basic data set on the development of nursing mediation programs for local elderly women through cycling programs that can improve their physical and mental health.

1.1 Purpose of the Study

- 1) To understand the characteristics of elderly women who cycle.
- 2) To identify how the sense of balance (static, dynamic), muscle strength (upper body, lower body), self esteem and depression differ between elderly women who cycle and those who don't.
- 3) To compare the difference in the sense of balance (static, dynamic), muscle strength (upper body, lower body), self esteem and depression among elderly women who cycle and those who don't.
- 4) To analyze the relation between characteristics of elderly women who cycle and their sense of balance, muscle strength, self-esteem and depression.

2. Methods

2.1 Research Design

This study is a descriptive study conducted to compare the relation between variables and the difference in the degree of the sense of balance (static, dynamic), muscle strength (upper body, lower body), self-esteem and depression as a result of cycling.

2.2 Subjects

A total of 69 elderly women who lived in city M of G province, of which 34 cycled 3 times or more per week and 35 did not cycle were explained to about the purpose of the study. Those who agreed to the purpose and participation were selected as study subjects.

2.3 Ethical Considerations

Data was collected after gaining approval from the Institutional Review Board of G University (KNU_IRB_2013_9). In order to protect the rights of study subjects, the purpose and significance of the study were explained to the subjects. Those who agreed signed an

agreement form and if they did not wish to continue the study at any moment, they were allowed to leave the study. It was explained that the collected data would be used only for study purposes and confidentiality would be upheld.

2.4 Instruments

2.4.1 Balance (Static and Dynamic Balance)

For an evaluation of static balance, the time of standing on one foot was measured. The subject was told to look ahead with both hands on her hip. At the call of the test conductor, she stood on one foot, her predominant foot. The time until the lifted foot reached the ground was measured using a timer (148 TIMER, China). After one time of practice, the test was conducted for 2 times and the longer time measured was selected for the record in seconds. The reliability in the study by Giorgetti, Harris and Jette²¹ was .85.

To evaluate dynamic sense of balance, the time it took for walking 2.45m was measured. The back was stretched straight and the subject had her hands on her thighs. She would sit in the center of a chair and at the call of the test conductor, would get up from the chair and run to a spot 2.45 m away, turn and run back as fast as she can. The total time it took for her to return was measured using a timer (148 TIMER, China). The test was conducted 2 times and the record for the shorter time was selected and recorded in seconds. The reliability for testing-retesting in this category was 0.95 in the study by Rikli and Jones²².

2.4.2 Muscle Strength (Upper Body and Lower Body)

To evaluate the muscle strength in the upper body, dumbbell lifting was used. The subject was asked to straighten her back, have her feet touch the ground and seated on a chair so that there is no discomfort in lifting and lowering a dumbbell. For men a dumbbell of 3kg and for women a dumbbell of 2kg was held in the hand with the palm facing upwards. The upper arm and elbow was attached to the sides while the elbow was bended and then stretched as much as possible. This counted as one repeat. The number of repeats done in 30 seconds was measured and recorded. The reliability for the test-retest of this category in the study by Rikli and Jones²² was 0.81. To evaluate the lower body muscle strength, the number of times one could get up from the chair and sit

down again was measured. The back was straightened and the subject was seated at the center of the chair. The arms were overlapped in the shape of an X. At the call of the test conductor, the subject sat down on the chair and rose up for 30 seconds. The number of repeats done within the 30 seconds was measured. The reliability for the test-retest of this category in the study by Rikli and Jones²² was 0.89.

2.4.3 Self-esteem

To measure self-esteem, the tool developed by Rosenberg²³ and translated by Jon²⁴ was used. This tool consists of a total of 10 questions of which 5 are positive questions and 5 are negative questions. A 5 point Likert scale was used with 'not at all' being 1 point and 'very much so' being 5 points. A higher score indicates a higher self-esteem. Cronbach's α coefficient at the time of the tool's development was 0.85 and was 0.78 in this study.

2.4.4 Depression

To measure depression, the GDS Short Form developed by Sheikh and Yesavage²⁵ which was translated and standardized by Kee²⁶ to create a Geriatric Depression Scale Short Form Korea Version (heretofore referred to as GDSSF-K) was used. This tool consists of 15 questions that can be answered with a Yes or No. For questions number 2, 7, 8, 11 and 12, a yes was given 1 point while for the remaining questions a no was given 1 point to calculate the total score. A higher total score indicates a more severe depression. Usually points lower than 5 indicate normal, 5~9 points indicate a slight depression, 10 points or more indicate a medium to severe depression²⁵. At the time of standardization of the tool, Cronbach's α coefficient was .88 while it was 0.83 in this study.

2.5 Data Collection

Data was collected using a questionnaire which was distributed from July 29 to August 23, 2013 at 6 senior citizens' centers in City M, G province with the approval of the local community head. Given that the subjects were elderly, 3 trained study assistants and 3 researchers read the questionnaire to the subjects, heard their answers and marked the most relevant answer on the questionnaire for them. Then the sense of balance and muscle strength were measured. It took 20-30 minutes per subject.

2.6 Data Analysis

The collected data was analyzed to calculate the frequency, percentage and mean for the general characteristics of elderly women, their disease-related characteristics and cycling-related characteristics using the SPSS/WIN 18.0 program. For balance (static, dynamic), muscle strength (upper body, lower body), self-esteem and depression, the mean and standard deviation were calculated. The average difference between elderly women who cycled and those who didn't was put to an Independent t-test, while the correlation between cycling elderly women's characteristics and their balance (static, dynamic) muscle strength (upper body, lower body), self-esteem and depression was analyzed using Pearson's correlation coefficients.

3. Result

3.1 General Characteristics

The general characteristics of elderly women are as seen in Table 1. Average age was 73.28, with the subjects' age ranging from 65 to 90 and 60.9% had a religion. In terms of living arrangements, 50.7% lived alone, 33.3% lived with their spouses, 13.0% lived with their children, and 2.9% each lived with their father or grandchildren. In terms of economic status, 58.0% was middle but those who answered 'low' amounted to 42.0%. In terms of education, 58.0% had no formal education. Those who had been married were 98.6%, of which 49.3% had experienced their spouse's death. The share of respondents who do not smoke and who do not drink alcohol was 98.6% and 88.4%, respectively. 40.6% of the respondents said they secured their living allowances on their own, while 23.2% said they received it from their children, 20.3% said they received it from children and supplied it themselves, and 13.0% said they received government subsidies. Those who regularly exercised accounted for 56.5%.

3.2 Disease-Related Characteristics of Female Elderly

The disease-related characteristics of female elderly are as seen in Table 2. Those who have a disease take up 82.6%, with 30.4% of them having 2 diseases, followed by 1 disease (27.5%), and 3 or more (24.6%). Of the diseases, the breakdown was high blood pressure (44.9%), diabetes (26.15%), arthritis (15.9%), osteoporosis (15.9%), back pain or neural pain (11.6%) and heart disease (11.6%).

Table 1. General characteristics of female elderly (N=69)

Characteristics	Divisions	Frequency
Age	65~74 years	39(56.5)
	75 years or older	30(43.5)
Religion	Yes	42(60.9)
	No	29(39.1)
Living arrangements	Alone	35(50.7)
	With spouse	23(33.3)
	With children	9(13.0)
	Others	2(2.9)
Economic status	High	0(0.0)
	Middle	40(58.0)
	Low	29(42.0)
	None	40(58.0)
Education	Elementary school	26(37.7)
	Middle school	1(1.4)
	High school	2(2.9)
	Unmarried	1(1.4)
Marital status	Married	33(47.8)
	Separated	1(1.4)
	Dead spouse	34(49.3)
Smoking	Yes	1(1.4)
	No	68(98.6)
Drinking	Yes	8(11.6)
	No	61(88.4)
Living allowances	Oneself	28(40.6)
	Oneself and children	14(20.3)
	Children	16(23.2)
	National subsidies	9(13.0)
Exercise	Public officer pension	2(2.9)
	Yes	30(43.5)
	No	39(56.5)

Other diseases included hyperlipidemia, thyroid disease, stroke and inflammation in the respiratory system. 75.4% of the respondents were on medication.

3.3 Characteristics of Female Elderly Who Cycle

The characteristics of female elderly who cycle are as seen in Table 3. Average period of cycling was 14.71 years, with

Table 2. Disease-related characteristics of female elderly (N=69)

Characteristics	Divisions	Frequency (%)
Disease	Yes	57(82.6)
	No	12(17.4)
	0	12(17.4)
Number of diseases	1	19(27.5)
	2	21(30.4)
	3 or more	17(24.6)
Medication	Yes	52(75.4)
	No	17(24.6)
Hypertension	Yes	31(44.9)
	No	38(55.1)
Hyperlipidemia	Yes	6(8.7)
	No	63(91.3)
Diabetes	Yes	18(26.1)
	No	51(73.9)
Arthritis	Yes	11(15.9)
	No	58(84.1)
Osteoporosis	Yes	11(15.9)
	No	58(84.1)
Lower back pain, neural pain	Yes	8(11.6)
	No	61(88.4)

Table 3. Characteristics of those who cycled (N=34)

Characteristics	Divisions	Frequency	M ± SD
Cycling history (years)	1~5	8(23.5)	14.71 ± 12.46 (2~57 years)
	6~10	12(35.3)	
	11~20	7(20.6)	
	≥21	7(20.6)	
	3	3(8.8)	
Sessions per week (number)	4	1(2.9)	
	5	2(5.9)	
	6	3(8.8)	
	7	25(73.5)	
	30	23(67.6)	
Times per session (min.)	40	1(2.9)	
	45	1(2.9)	
	60	9(26.5)	

6~10 years forming the majority. Average weekly number of cycling sessions was 6.35 With the share divided among 7 days (73.5%), 6 days (8.8%) and 3 days (8.8%). The average time cycled per session was 38.68 minutes, with response being 30 minutes (67.6%) and 60 minutes (26.5%).

3.4 Sense of Balance (Static, Dynamic), Muscle Strength (Upper Body, Lower Body), Self-esteem and Depression in Elderly Women Who Cycled and Who Didn't

The sense of balance (static, dynamic), muscle strength (upper body, lower body), self-esteem and depression in elderly women who cycled and who didn't are as shown in Table 4. Of the elderly women who cycled, their balance-static balance was 25.61seconds, dynamic balance was 7.66 seconds, muscle strength-upper body 17.38 times, lower body 14.15 times, self-esteem was 32.82 points, and depression was 5.44points. For elderly women who did not cycle, balance-static balance was 15.51 seconds, dynamic balance was 8.65 seconds, muscle strength-upper body was 14.09 times, lower body was 10.66 times, self-esteem was 32.20 points, and depression was 7.91 points.

3.5 The Difference in Balance (Static, Dynamic), Muscle Strength (Upper Body, Lower Body), Self-esteem and Depression in Relation to Cycling

The differences in mean among variables in relation to cycling are as seen in Table 5. There was statistically

Table 4. Degree of balance, muscle strength, self-esteem and depression in elderly women in relation to whether they cycle or not

Variables		Those who cycled M(SD)	Those who did not cycle M(SD)	Range
Balance (sec.)	Static	25.61(22.96)	15.51(2.73)	
	Dynamic	7.66(1.70)	8.65(1.81)	
Muscle strength (number)	Upper	17.38(4.29)	14.09(3.18)	
	Lower	14.15(3.09)	10.66(2.46)	
Self-esteem		32.82(6.78)	32.20(6.86)	10~50
Depression		5.44(3.28)	7.91(4.29)	0~15

Table 5. Difference in balance, muscle strength, self-esteem and depression in relation to cycling

Variables		Cyclist M $\pm$ SD	Non-cyclist M $\pm$ SD	t or F (p)
Balance	Static	25.61 $\pm$ 22.96	15.51 $\pm$ 22.73	1.836(.071)
	Dynamic	7.66 $\pm$ 1.70	8.65 $\pm$ 1.81	-2.343(.022)
Muscle strength	Upper	17.38 $\pm$ 4.29	14.09 $\pm$ 3.18	3.623(.001)
	Lower	14.15 $\pm$ 3.09	10.66 $\pm$ 2.46	5.202(<.001)
Self-esteem		32.82 $\pm$ 6.78	32.20 $\pm$ 6.86	-2.697(.705)
Depression		5.44 $\pm$ 3.28	7.91 $\pm$ 4.29	0.380(.009)

significant difference in balance–dynamic balance ($t=1.836, p=.022$), muscle strength–upper muscle strength ($t=3.623, p=.001$), lower muscle strength ($t=5.202, p<.001$) and depression ($t=-2.697, p=.009$). That is, elderly women who cycled had a shorter dynamic balance, better upper and lower body muscle strength and a lower depression score.

3.6 Relation between General Characteristics of Elderly Women Who Cycled and their Balance, Muscle Strength, Self-esteem and Depression

The relation between general characteristics of elderly women who cycled and their balance, muscle strength, self-esteem and depression are as seen in Table 6. The history of cycling and dynamic balance had an inverse correlation ($r=-.406, p=.017$), while the number of sessions and self-esteem had a positive correlation ($r=.378, p=.027$). In other words, the longer the subject had cycled, the shorter they were able to maintain dynamic balance

and the more cycling sessions that they took, the higher their self-esteem.

4. Discussion

This study compares the balance (static, dynamic), muscle strength (upper body, lower body), self-esteem and depression of elderly women who cycle and elderly who don't, as well as identify the correlation between variables in order to present a basic data set on the development of nursing mediation programs for local elderly women through cycling programs that can improve their physical and mental health.

The difference between those who cycled and those who didn't in terms of balance (static, dynamic balance), muscle strength (upper body, lower body), self-esteem and depression shows that the duration that they were able to stand on one foot which is an indicator of static balance was 25.61 seconds for cyclists and 15.51 seconds for non-cyclists, but the difference was not statistically significant ($t=1.836, p=.071$). This is in contrast with

Table 6. Relation between general characteristics of elderly women who cycled and their balance, muscle strength, self-esteem and depression

Variables	Static balance	Dynamic balance	Upper body muscle strength	Lower body muscle strength	Self-esteem	Depression
	r(p)	r(p)	r(p)	r(p)	r(p)	r(p)
History of cycling	-.168(.342)	-.406(.017)	.170(.338)	.158(.372)	.084(.637)	-.280(.109)
Number of cycling sessions per week	.056(.754)	-.051(.776)	.163(.357)	.163(.356)	.378(.027)	-.147(.407)
Duration per session	-.137(.438)	.104(.557)	.044(.807)	.034(.847)	.280(.108)	-.049(.785)

the statistically significant results in the study on elderly women with dementia and their ergometer exercise for 10 weeks, conducted by Hong, Park and Hwang²⁷ or the study on elderly women who underwent artificial joint replacement surgery and were prescribed bicycle exercise, conducted by Park²⁸. Meanwhile in the study conducted on elderly women for 12 weeks on their walking exercise, Kim²⁹ showed that there was no statistical significance either. The dynamic balance for cyclist elderly women was 7.66 seconds and for non-cyclists 8.65 seconds, with statistical significance ($t=-2.343$, $p=.022$). This is similar to the results of a study on cycling by Hong et al.²⁷ where the dynamic balance was also significantly decreased. There was also a similar result in the study by Choi and Kim³⁰ even though it did not specify cycling as the form of exercise, and in the study by Lee et al.³¹ that used complex exercise programs. In all these studies, there was a significant difference in dynamic balance. Therefore, we can conclude that cycling is a good method of exercise that improves physical activities³³ and helps maintain bodily functions required for balance in everyday life, thereby preventing injury from any falls³³. It is also meaningful in that cycling offers a method of going about alone in daily life without any risks or reliance on others. However, additional repeated studies are required due to the inconsistency found in static balance. Dynamic balance was discovered to have improved not only through cycling but also through various other exercise programs.

Upper body muscle strength in cyclist elderly women was 17.38 times and for non-cyclists was 14.09. Cyclists had better upper muscle strength, with the difference showing statistical significance ($t=3.623$, $p=.001$). This is similar to the results gained by Hong, Park and Hwang²⁷ where it increased from 13.43 before the ergometer exercise to 14.18 after with statistical significance. The lower body muscle strength for cyclist elderly women was 14.15 while it was 10.66 for non-cyclists, with statistical significance for the difference ($t=5.202$, $p<.001$). This is in line with the results of Park²⁸ where lower body muscle strength showed significant difference before and after cycling exercise when done by elderly women who had joint replacement surgery or who had dementia. Menopausal women who had been cycling for a long time had higher muscular ratio and muscle strength in their lower bodies compared to those who had not taken up cycling in the study by Sung³⁴ and thus supports this study. Muscle strength is an important component for health and physical stamina. Recently muscle exercise has

been recommended to the elderly as well³⁵ because the decrease in muscle strength that come with advanced age can be kept to a minimum through regular cardiovascular exercise (cycling).

Self-esteem for cyclists was 32.82 points and for non-cyclists 32.20 points but with no statistical significance ($t=-2.697$, $p=.705$) but the self-esteem of cyclists appeared to be slightly higher. This is in contrast with the results of the study by Kim and Chen³⁶. In that study, elderly women who had taken up dance sport showed a significantly higher self-esteem compared to those who had not participated in dance sports. But given the type of the exercise, self-esteem increased more in activities where movements and rhythm were learned rather than where physical stamina was worked on. Therefore, a mediation method using music and rhythm seems to be suggested.

Depression in cyclist elderly women was 5.44 points while it was 7.91 points for non-cyclists, showing that cyclist elderly women had a lower level of depression ($t=.380$, $p=.009$). This is similar to the result in the study by Park³⁷ where those who had participated in sport activities such as badminton or aqua aerobics showed a lower level of depression. Cardiovascular rhythm exercise was reported to increase quality of life among the elderly in a study by Kim and Park³⁸ and thus supports this study. In the study by Lim and Lee³⁹ it has been reported that the elderly acquires new skills, engages in social cultural activities, interaction with others and gain a sense of happiness and achievement through cycling. Such results can be assumed to be partly due to exposure to sunlight in outdoor activities where vitamin D that is created within the body stimulates the secretion of serotonin in the brain, improving mental health. Therefore, activities such as cycling should be recommended to ease depression.

In the correlation between balance (static, dynamic), muscle strength (upper body, lower body), self-esteem and depression with cycling, the history of cycling and dynamic balance showed to have an inverse correlation ($r=-.406$, $p=.017$). This indicates that the longer they had cycled the time they were able to maintain dynamic balance for was shorter. It suggests that as one ages, one's tendons and joints become stiff due to calcification or fabrication, the length of muscles get shortened and the range of joint movement is reduced. Meanwhile eye sight decreases as well as hearing capability and balance, which all combine to make it difficult for the elderly to maintain balance⁴⁰. Therefore cycling can be effective in improving a sense of balance and preventing any falls. There

was a positive correlation between the number of cycling sessions per week and self-esteem ($r=.378$, $p=.027$). That is, the higher the number of sessions, the higher the self-esteem, which is a result that is partially in line with the studies of Roh⁴¹, Kwon and Kim⁴², Kim²⁹, Kim and Yoon⁴³, and Kim and Chen³⁶. Cycling can be said to be an exercise that helps stabilize one's emotions and improve one's self-esteem¹⁹.

5. Conclusion

This study identified the relation between elderly women's use of bicycles and the difference in their sense of balance (static, dynamic balance), muscle strength (upper body, lower body), self-esteem and depression. By doing so, the study aims to provide a basic set of data that can be used for the development of nursing mediation programs that can promote more cycling among elderly women. The study results show that cyclist elderly women had a shorter dynamic balance time compared to non-cyclists, while their upper and lower body's muscle strength was stronger and their depression lower. In terms of the correlation with cycling, the longer they had been cycling their time for dynamic balance was shorter and the more sessions there were for cycling per week, the higher their self-esteem.

Based on this study that shows elderly women who cycle to have an improved sense of dynamic balance, improved muscle strength (upper body, lower body) and a decreased depression, cycling should be proactively recommended to elderly women as it helps improve a sense of balance and thus prevent falls, and improve physical and mental stamina.

Based on the findings of this study, cycling is suggested as a method for nursing mediation for the elderly who have reduced lower body muscle strength or who are depressed. Since consistency is lacking in the findings regarding the category of dynamic balance, follow-up studies should be conducted. It is also suggested that continued studies on the effect of cycling for local community elderly women be conducted with other variables.

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