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Effect of Foot Exercise on Lower Limb Strength and Balance Among Elderly: Basis for a Health Education Program

Pitoy Frendy Fernando
Adventist University of the Philippines
frendypitoy@gmail.com

ABSTRACT

The primary aim of this study was to determine the effects of foot exercise (*senam kaki diabetes)* on lower limb strength and balance among the elderly. A quasi-experimental interrupted time-series design with control group was utilized. Participants were chosen through purposive sampling technique. Consequently, 60 participants met the criteria set for the study. Simple random sampling was used to divide the participants into experimental and control groups with 30 participants in each group. The result shows that foot exercise was effective in improving lower limb strength and balance of the elderly. Lower limb strength and balance of the participants in the experimental group gradually improved in every week of intervention compared to those in the control group. Further, the result shows that age, sex, and body weight did not affect the lower limb strength and balance of the elderly who underwent foot exercise.

Keywords: Foot Exercise, Lower Limb Strength, Balance, Elderly.

INTRODUCTION

The elderly is a universal complex of biological change process associated with an increased morbidity and mortality risk. It is generally characterized as the decline of functional capacity of every system in the body. Lately, physical factors such as lower limb strength and balance become a concern in elderly life regarding to risk of fall. Less muscle mass will hamper the flexion and extension of the lower limbs that will lead to the presence of abnormalities which leads to more complex problem (Bird et al.2013).

A Global Report of Health Prevention by the World Health Organization (WHO) states that there is frequently a decrease in muscle strength among elderly people that may interfere with balance (WHO, 2018). Further, based on the global survey done by WHO from the 17 control trials for elderly around the world, 100 % of the data showed that those with muscle weakness and impaired balance are five times more likely to fall (WHO, 2018). Furthermore, the WHO reported that from those elderly who experienced fall, 25 % have lower limb problems and 17

% have balance disorders and weakness which are second to the factors that lead to falls or environment-related ones (Turkeli, Elmas, Atay, Kurt, & Sonmez, 2017).

In some countries in Asia, decreasing muscle mass and strength among elderly has been reported. According to cross-sectional studies conducted by Diz, Queiroz, Tavares, and Pereira (2015) in the 80-year-old age group, Japan recorded the highest prevalence value , where 75% were men and 54.3% were women., while the lowest values were recorded in Taiwan with prevalence of 9.4% in men and 4.8% in women. Furthermore, the study shows that the prevalence will increase as time goes by.

In Indonesia, a study was done by Indonesia Family Life Survey among the elderly age 50 years and above. Twenty households in 27 provinces, representing 83% of the Indonesian population, were randomly selected from each urban. The result of the study shows that 24.9% among the elderly had functional disability such as limitations of activities of daily living, gait problems, inadequate standing and balance disorders. Further, the survey showed that 17.3% of those who had experienced fall had functional disability (Pengpid & Peltzer, 2018).

Trombetti et al, (2016) stated that a progressive loss of skeletal muscle mass and function accompanied the aging process. When the quality and quantity of the muscles decrease, debilitating condition will affect the person to decrease the quality of life such loss of strength or power, balance and physical performance. Addison, Marcus, LaStayo, and Ryan (2014) added that while the muscle mass decrease, intermuscular adipose tissue will increase as manifestation of aging with characteristic of a loss of strength, imbalance and mobility dysfunction.

Recently, considerable recent research among health care providers focused on the benefits of physical exercise in improving the functional capacity of frail older adults. Exercise programs that boost resistance, balance, stamina, coordination and other multi-component exercises have had a beneficial influence on certain functional parameters among frail elderly subjects, particularly in lower limb strength and balance (Cadore et al. 2013). Heavy physical exercise is no longer suitable for older people, however, the magnitude and number and associations for low physical activity are more appropriate for muscle strength and balance for older people (Seene & Kaasik, 2012).

Diabetic Foot Exercise or *Senam Kaki Diabetic* is an exercise designed for diabetics. It is an exercise known by the Indonesian public as a cost-effective intervention to increase health outcomes, specially in accelerating blood circulation for diabetic problems. This exercise is known to strengthen the small muscles of the legs. It prevents foot increase the strength of the

calf muscles, deformities, muscles of the thighs and overcome the limits of joint movement (Siddiqi & Sumarliyah, 2014).

Locally, there are no studies about the use of foot exercise *(senam kaki diabetes)* for maintaining muscle strength and balance among the elderly people. Most of the studies using foot exercise (*senam kaki diabetes)* were focused on improving leg blood circulation among diabetics and not for the improvement of lower limb strength and balance among non-diabetics. Through this study, the researcher would like to discover the other benefits of *senam kaki diabetes*, which could either increase lower limb strength and balance among elderly. Furthermore, the researcher would want to know the effectiveness of the use of this exercise in different time periods.

This study aimed to determine the effects of foot exercise on lower limb strengtrh and balance among elderly people.

METHODS

This study used the quasi-experimental interrupted time-series design with control group. A total of 60 elderlies from one institution in Manado, North Sulawesi were utilized as the participants through purposive sampling technique. Random sampling by casting lots was used by the researcher to assign who among the chosen participants who passed the criteria will be utilized as control or experimental group. Each group had 30 participants. The control group did not receive any intervention, while the experimental group received foot exercise as intervention. The inclusion criteria of the participants of the study were as follows: a) the participant must be 60-80 years old; b) does not have any medical condition or health problem such as: ear infection, vertigo and post-stroke patient; and c) must have clearance from his or her attending physician to participate in the study.

The data collection form developed by the researcher was used to record the demographic data of the participants as well as the result of the lower limb strength and balance procedures. Other instruments used were a standard and adjustable chair approximately 40-45 centimeters in height, a newspaper, sheets of paper, pen, stop watch, and body weight scale. To measure the lower limb strength of the participants, Five Times Sit-To-Stand (5TSTS) test by Csuka and McCarty (1985) was utilized. In this test, the participant was asked to sit and then stand for at least five times and the time in seconds was recorded. Those who completed the procedures for 12-15 seconds are categorized as having *risk of fall*; those with greater than 15 seconds are categorized as having *risk of recurrent falls*; while those who completed lower than 12 seconds

are categorized as *normal.* To measure the balance of the participants, functional reach test measurement by Duncan, Weiner, Chandler, and Studenski (1990) was utilized. The Functional Reach Test was used to assess the difference between arm length and maximum forward reach. Those partcipants who obtained a result lower or equal than 18.5 centimeter means that they have limited mobility skills, inability to leave the neighborhood without help, and classified as having *risk of falls*, while those who had a result of more than 18.5 cm are classified as *normal.*

To maintain the confidentiality of the data, the researcher used codes or acronymes instead of the participant's real name. Participants were also told that they can withdraw their participation in this research in any phase or any time that they feel uncomfortable or are not able to continue the participation without losing any of their benefits and priveleges. For the safety of the participant, the researcher collaborated with the resident physician who screened them before the intervention. The participants who were found fit and able to do the intervention were given the clearance by the resident physician to participate in the study. The blood pressure of the participants was monitored before the performance of the lower limb and strength and balance test to prevent fall accident related to postural hypotension effect.

Statistical analysis was performed with the use of Statistical Package for Social Science (SPSS) software. *Mean, Frequencies, and Percentages* were used to determine the demographic profile of the participants and the lower limb strength and balance level among control group and the experimental group before and after first week, second weeks, third weeks, and fourth weeks. *Independent T-test* was used to compare two means group for situation in which each participant is only assigned to only one condition to find out the lower limb strength and balance level. *Dependent T-test* was used to compare two means group for situations in which every participant is in both samples to find out the lower limb strength and balance level. *Analysis of variance (ANOVA)* was used to compare the groups in the same time and to find out the improvement in lower limb strength and balance level during the treatment in four time periods.

RESULT

Lower Limb Strength and Balance of the Participants in the Control Group at Baseline, After the First Week, Second Week, Third Week, and Fourth Week of Intervention

Table 1 presents the descriptive statistics of the lower limb strength and balance of the participants in the control group at baseline after the first week, second week, third week, and

fourth week. The lower limb strength was measured in terms of the number of seconds the participants in the control group did the 5TSTS. The result of the lower limb strength shows that at the base line the participants in the control group (n=30) had a mean of 14.91 seconds (SD = 4.17), which is considered as *risk of fall*. After the first week, the mean decreases to 14.73 seconds (SD = 4.32), which is still considered as *risk of fall.* Two weeks after, the mean increased to 15.01 seconds (SD = 4.47), which is considered still as *risk of recurrent fall*. After the third week, the mean increased to 15.28 seconds (SD = 4.74), and after the fourth week the mean increased to 15.32 seconds (SD = 4.60) which still is considered *risk of recurrent fall*.
On the other hand, the balance was measured in terms of the number of centimeters the participants in the control group referred to the functional reach test. The result of balance among the participants in the control group decreased almost every week but still consider as a *normal*. The mean at baseline was 23.90 cm (SD = 6.20), it continued to decrease to 23.71 cm (SD = 5.76) after the first week. After the second week, the mean increased a little bit to 23.72 cm (SD = 5.83) but decreased again in the third week with a mean of 23.30 cm (SD = 6.26). After the fourth week the mean level decreased to 23.20 cm (SD = 6.35), which is still considered as *normal*.

Table 1. **Lower Limb Strength and Balance of the Participants in the Control at Baseline and After the First Week, Second Week, Third Week, and Fourth Week.**

Variable	Time	N	Mean	SD	Qualitative of Descriptor
Lower Limb Strength	Baseline	30	14.91	4.17	Risk of Fall
	After First Week	30	14.73	4.32	Risk of Fall
	After Second Week	30	15.01	4.47	Risk of Recurent Fall
	After Third Week	30	15.28	4.74	Risk of Recurent Fall
	After Fourth Week	30	15.32	4.60	Risk of Recurent Fall
Balance	Baseline	30	23.90	6.20	Normal
	After First Week	30	23.71	5.76	Normal
	After Second Week	30	23.72	5.83	Normal
	After Third Week	30	23.30	6.26	Normal
	After Fourth Week	30	23.20	6.35	Normal

Note. Lower Limb Strength (< 12 seconds – Normal; 12-15 seconds – Risk of Fall; > 15 seconds – Risk of Recurrent Fall); Balance ($\geq$ 18.5cm – Normal; and < 18.5cm – Risk of Fall).

This result indicates that within four weeks, the lower limb strength and balance function for the elderly participants who did not received the intervention was declining. Decrease in lower

limb strength and balance function are natural body changes related to aging process. Mauk (2018) stated that the elderly in their age will have musculoskeletal changes such as decreased muscle tone, strength, and endurance. Moreover, contractility of muscle fibers will be impaired in attempt to restore the muscle power and functions (Reid et al, 2014).

The result of the study is consistent with the study of Vechin et al (2015) who found out that the participants who did not receive any intervention experienced a decrease in leg muscle strength. According to Lehman (2017), elderlies with long sedentary time and less physical activity will experience difficulty of walking. Moreover, Motalebi, Cheong, Iranagh, and Mohammadi (2018) stated that body functions naturally decrease in old age and affect the atrophy of type II muscle fibers resulting to loss of skeletal muscle strength and balance deficiencies.

Lower Limb Strength and Balance of the Participants in the Experimental Group at Baseline, After the First Week, Second Week, Third Week, and Post Intervention.

Table 2 presents the descriptive statistics of the lower limb strength and balance of the participants in the experimental group at baseline, after the first week, second week, third week, and post intervention. The result shows that there was a gradual improvement of lower limb strength in terms of the number of the seconds the participants of 5TSTS in experimental group for every week of intervention. Mean baseline of treatment was 15.77 seconds (SD = 6.26), which is considered as *risk of recurrent fall*. After the first week of intervention, the mean started to show improvement. From 15.77 seconds at baseline, it decreased to 12.57 seconds (SD = 5.06) which is considered as *risk of fall*. After the second week of intervention, the mean of

Table 2. **Lower Limb Strength and Balance of the Participants in the Experimental Group Before and After the First Week, Second Week, Third Week, and Fourth Week.**

Variable	Time	N	Mean	SD	Qualitative of Descriptor
	Baseline	30	15.77	6.26	Risk of Recurent Fall
Lower	After First Week	30	12.57	5.06	Risk of Fall
Limb	After Second Week	30	10.45	3.52	Normal
Strength	After Third Week	30	9.69	3.21	Normal
	After Fourth Week	30	9.26	3.18	Normal
	Baseline	30	23.34	7.37	Normal
	After First Week	30	26.16	7.02	Normal
Balance	After Second Week	30	28.67	6.84	Normal
	After Third Week	30	31.77	7.46	Normal
	Post Intervention	30	32.82	7.10	Normal

Note. Lower Limb Strength (< 12 seconds – Normal; 12-15 seconds – Risk of Fall; > 15 seconds – Risk of Recurrent Fall); Balance (≥ 18.5 cm – Normal; and < 18.5 cm – Risk of Fall).

lower limb strength was 10.54 seconds (SD = 3.52) this mean translates to *normal* lower limb strength. Moreover, the result shows that after the third week the mean continued to decrease to 9.69 seconds (SD = 3.21), and 9.26 seconds (SD=3.18) at post intervention, which are considered as *normal* lower limb strength for the elderly.

The result of the balance in terms of the number of centimeters of the functional reach test among participants in experimental group shows the same improvement, starting from the first week of intervention. The mean at baseline was 23.34 cm (SD = 7.37). It gradualy increased after receiving the intervention to 26.16 cm (SD = 7.02) after the first week, 28.67 cm (SD = 6.84) after the second week, 31.77 cm (SD = 7.46) after the third week, and 32.82 cm (SD = 7.10) post intervention, which are considered as *normal* balance for the elderly.

The above result showed an increasing lower limb strength and balance function of the elderly participants after they have experienced intervention of foot exercise within a period of four weeks. It implies that elderly with active exercise will increase the function of lower limb strength and balance as the prevention of natural body changes related to aging process. Cruz-Jentift (2014) states that through workout, the intrinsic and extrinsic muscle fibers will improve the power and maintain the function of muscles. It is visible in both variables that those who experienced exercise were improved in lower limb strength from the category of *risk of recurent fall* became *normal*, while balance improve but still in the same category of *normal*.

The result of the study is consistent with the study done by Motalebi, Cheong, Iranagh, and Mohammadi (2018) that there is an improvement of lower limb strength and dynamic balance among the institutional elderly participants after receiving foot exercise training. Another study which supports the findings was conducted by Maritz, Patel, Varughese, and Yecco (2013). They posited that moderate exercise program improved the extremity muscle strength and functional mobility of the participants. Moreover, the findings of the studies supported by the concept of therapeutic exercise which is the interrelatedness of multidimensions of physical function: react, adapt, and develop the response to force the physical stresses upon tissues to prevent the degeneration, degradation, and deformity of the body (Carolyn et al, 2017).

Joshua et al (2014) found out that foot exercise is effective in targeting the key muscles of lower limbs to improve forward limits of stability among the elderly. Foot exercises increase the muscle size by increasing the contractile protein content in type two muscle fibers for quick reaction time and maintenance of balance. Foot exercise increases maximal strength and

induces change in the neural control of lower leg muscles. It increased maximal strength of the ankle plantar flexor muscles and decreased maximal amplitude and fluctuations of central pressure displacements (Penzer, Duchateau & Baudry, 2015).

Difference in Lower Limb Strength and Balance Between the Control and Experimental Group Before the Intervention.

Table 3 shows the mean differences of lower limb strength and balance between the control group and experimental group before the intervention which was analyzed using Independent t-test. The result shows that there is a mean diference of .857 seconds in lower limb strength in terms of the number of seconds the participants did the 5TSTS between control group (mean = 14.91 seconds) and experimental group (mean = 15.77 seconds) before the intervention with a *p* value of .535, which is not significant. Furthermore, the result shows that there is a mean diference of -.563 cm in balance in terms of the number of the centimeters the participants have in the functional reach test between control group (mean = 23.90 cm) and experimental group (mean = 23.34cm) before the intervention with a *p* value of .750, which is not significant.

The result indicates that there is no significant difference between control group and experimental group in lower limb strength and balance before the intervention. As one grows older, decline in body function becomes normal. Elderly will experience decline of muscle mass, contractile muscle fibers, muscle power, knee extensors and knee flexors which makes the elderly to slow down and increase his or her risk to fall. This implies that participants in both groups have the same level of lower limb strength and balance. So sugest: the findings *fail to reject* the null hypothesis which states states *"there is no significant difference in lower limb strength and balance between control group and experimental group before the intervention"*.

Table 3. **Difference in Lower Limb Strength and Balance Between the Control and Experimental Group Before the Intervention**

Variable	Group	Mean	Differences	T	Df	Sig	Qualitative of Descriptor
Lower Limb Strength	Experiment Control	15.77 14.91	.857	.624	58	.535	Not Significant
Balance	Experiment Control	23.34 23.90	-.563	-.320	58	.750	Not Significant

Note: Significant at $p = .05$

The result of this study is consistent with the study conducted by Emilio, Hita-Contreras, Jiménez-Lara, Latorre-Román, and Martínez-Amat (2014) which found out that there is no significant differences in flexibility, balance and risk of fall the participants were observed between baseline control and experimental group for the study of proprioceptive training program on older adults which is focusing on the lower part of the body. Another study conducted by Cho and An (2014) also support the result of this study with their findings that there was no significant differences in homogeneity test for the muscle strength and fall index values between control and experimental group before the fall prevention exercise was given.

Difference in Lower Limb Strength and Balance Between the Control and Experimental Group After the Intervention

Table 4 shows the mean differences of lower limb strength and balance between the control group and experimental group after the intervention which was analyzed using Independent t-test. The result shows that there is a mean diference of -6.06 seconds in lower limb strength in terms of the number of the seconds refered the 5TSTS between control group (mean = 15.32) and experimental group (mean = 9.26) after the intervention with a *p* value of .000, which is significant. Furthermore, the result also shows that there is a mean diference of 9.62 seconds in balance in terms of the number of the centimeters the participants have in the functional reach test between the control group (mean = 23.20) and experimental group (mean = 32.81) after the intervention with a *p* value of .000, which is significant.

The result indicates that there is a significant difference in lower limb strength and balance between the control group and experimental group after the foot exercise intervention. This implies that when the elderly perform the foot exercise, they will have stronger lower limb and better balance function as showed by the mean difference of the experimental and control group. Thus, the null hypothesis that states *"there is no significant difference in lower limb strength and balance between control group and experimental group after the intervention"* is rejected.

The improvement could be attributed to the fact that exercise create repetitive movements of the muscle fibers to produce the new muscle protein for enhancements of neural and muscular function, resulting to the improvement of balance, coordination,

Table 4. **Difference in Lower Limb Strength and Balance Between the Control and Experimental Group after the Intervention**

Variable	Group	Mean	Difference	T	Df	Sig	Qualitative of Descriptor
Lower Limb Strength	Experiment Control	9.26 15.32	-6.06	-5.93	51.57	.000	Significant
Balance	Experiment Control	32.81 23.20	9.62	5.53	58	.000	Significant

Note: Significant at $p = .05$

strength, flexibility, speed, range of movement, and reduce the number of experience falls. According to Le Wine (2014) engaging in exercise is a good way to have a healthy life. In a study published by The American Medical Association as cited in Le Wine (2014) it showed that among the alderly aged 70 to 89 who are engaged in an exercise program, 28% were less likely to become disability and 18% were less likely to become episode of physical disability. This finding is supported by a previous study conducted by Kahle and Tevald (2014), which found out that there is a significant improvement of core muscle strength and balance performance between control and experimental group after the participants experienced home exercise program. Another study conducted by Cadore et al (2014) also support the finding which states that four weeks resistance training improved the balance, muscle strength, and gait ability of the elderly participants. The findings of the study is supported by the Principle of Structural Integrity by Levine which states that integrated healing and optimal restoration of structure function nurses can practice as they assist patients in performing exercise (Masters, 2014).

Difference in Lower Limb Strength and Balance Between Baseline and After Four Week the Intervention in Control and Experimental Group

Table 5 shows the mean differences of lower limb strength and balance between baseline and after the fourth week of intervention in the control group which was analyzed using Dependent t-test. The result shows that there is a mean difference of 0.41 seconds in lower limb strength in terms of the number of the seconds the participants have in the 5TSTS before the first week of intervention (mean = 14.91 seconds) and after the fourth week of intervention (mean = 15.32 seconds) with a p value of .016, which is significant. Furthermore, the result shows that there is a mean diference of 0.70 cm in balance in terms of the number of centimeters refered the functional reach test between baseline of intervention (Mean = 23.9 cm) and after the fourth week of intervention (Mean = 23.2 cm) with a p value of .160, which is not significant.

The result shows that there is a significant difference of lower limb strength between the baseline and after the fourth week of intervention among the control group. As shown in table 1, the participants were at risk of fall at baseline and after the first

Table 5. **Difference in Lower Limb Strength and Balance Between Baseline and After Four Week of the Intervention in Control Group.**

Variable	Group	Mean	Difference	SD	T	Sig	Qualitative of Descriptor
Lower Limb Strength	Pretest	14.91	.41	.88	-2.56	.016	Significant
	4th Week	15.32					
Balance	Pretest	23.9	.70	2.66	1.44	.160	Not Significant
	4th Week	23.2					

Note: Significant at $p = .05$

week and were at risk of recurrent fall after four weeks. This shows that when the elderly will not exercise, their muscles especially in the lower limb tends to become weaker. Thus, the null hypothesis that states *"there is no significant difference in lower limb strength between before firts week and after four week in control group"* is rejected.

On the other hand, the result shows that there is no significant difference of balance between baseline and after the fourth week among the control group. This means that the balance of the participants in the control group at baseline and after the fourth week remains the same. As shown in table 4, the participants' balance was normal at baseline until after the four week. Thus, the null hypothesis that states *"there is no significant difference in balance between before and after the intervention in control group"* is retained.

This finding was supported by the previous study conducted by Cadore et al (2014) which found out that the control group's foot muscle strength and balance was significantly reduced to compared with the participants in the group with combination foot exercise program, wherein the participants are more at risk to fall. Further, the study done by Sosnoff, Finlayson, McAuley, Morrison, and Motl (2014) found out that those who did not exercise for twelve weeks had risk of fall due to decreased lower limb stregth and balance function.

According to Victoria (2018), the elderly with lack of regular exercise will have physical decline with a range of health problems such as reduced coordination and balance, reduced joint flexibility and mobility, reduced bone strength, and reduced muscle mass, strength and

physical endurance. John Hopkins Medicine (2018) also states that older adults who are not physically active can increase the risk of falls and decline the ability to do daily activities.

Table 6 shows the mean differences of lower limb strength and balance between baseline and post intervention in the experimental group which was analyzed using Dependent t-test. The result shows that there is a mean diference of 6.51 seconds in lower limb strength in terms of the number of seconds the participants have in 5TSTS between baseline (mean = 15.77 seconds) and post intervention (mean = 9.26 seconds), which is significant (.000). Further, the result also shows that there is a mean diference of 9.48 cm in balance in terms of the number of the centimeters the participants have in the functional reach test between the baseline (mean = 23.34 cm) and post intervention (mean = 32.82 cm) with a *p* value at .000, which is significant.

Table 6. **Difference in Lower Limb Strength and Balance Between Baseline and After fourth Week the Intervention in Experimental Group.**

Variable	Group	Mean	Difference	SD	T	Sig	Qualitative of Descriptor
Lower Limb Strength	Pretest	15.77	6.51	4.49	7.94	.000	Significant
	4th Week	9.26					
Balance	Pretest	23.34	9.48	3.16	16.44	.000	Significant
	4th Week	32.82					

Note: Significant at $p = .05$

The result shows that there was a significant difference of lower limb strength and balance between baseline and post intervention in experimental group. As shown in table 2, the lower limb strength was at *risk of recurent fall* in the baseline and changed after post intervention to the *normal* category. While balance showed significant improvement from the baseline until the post intervention with *normal* category. This implies that when the elderly exercise, their muscles, specially their lower limbs tend to become strong and balance tends to become stable. Thus, the null hypothesis that states "*There is no significant difference in lower limb strength and balance between baseline and post intervention in experimental group*" is rejected.

The result supports the findings as shown in table 4 which shows that those participants who were engaged in foot exercise have stronger lower limb and better balance function. The result of this study is consistent with the study done by Motalebi, Cheong, Iranagh, and Mohammadi (2018) which found out that there is a significant improvement in lower-limb muscle strength and balance among the elderly after intervention of twelve weeks of progressive

elastic resistance training on lower limb. Another study which support the findings was done by Josephson and Williams (2017) which found out that intervention group with strength training program significantly improved in balance control with a mean of 3.33 point when compared to the control group with mean of .83 point.

The findings is further supported by the concept of Therapeutic Exercise which explains that exercise is a key element in improving or restore the indifidual's function or preventing the dysfunction. Exercise is also intended to remediate impairments of the body structure, to enhance activity and participation, to reduce health-related risk factors, and to optimize overall health status (Lori et al, 2017). The findings is also supported by the Theory of Conservation which explains that if the intervention attends to the conservationof structural integrity, the patients will return to wholeness (health).

Difference in the Gain Score of the Lower Limb Strength and Balance Between Control and Experimental Group.

Table 7 shows the gain score differences of lower limb strength and balance between the control and experimental groups which was analyzed using Iependent t-test. The result shows that there is a mean diference of -6.92 seconds in lower limb strength in terms of the number of the seconds the participants have in the 5TSTS between the

Table 7. **Significant Difference in the Gain Score of the Lower Limb Strength and Balance Between Control and Experimental Group**

Variable	**Group**	**Mean**	**Difference**	**T**	**Df**	**Sig**	**Qualitative of Descriptor**
Lower Limb Strength	Experiment	-6.51	-6.92	-8.28	31.21	.000	Significant
	Control	.41					
Balance	Experiment	9.48	10.18	13.5	58	.000	Significant
	Control	-.70					

Note: Significant at $p = .05$

control group (mean = .41 seconds) and the experimental group (mean = -6.51 seconds) with a *p* value of .000, which is significant. Furthermore, the result also shows that there is a mean diference of 10.18 cm in balance in terms of the number of the centimeters the participants have in the functional reach test between the control group (mean = -.70 cm) and experimental group (mean = 9.48 cm) with a *p* value of .000, which is significant.

The result shows that there is a significant difference in gain scores of lower limb strength and balance between the control and experimental groups. This implies that four weeks of exercise made a significant function improvement of lower limb strength and balance to the elderly participants. In other words, the elderly should be encouraged to have the foot exercise because when they exercise the muscle, especially in the lower limb, will become stronger and will reduce the risk of fall due to lower limb strength and balance function improvement. Thus, the null hypothesis that states *"There is no significant difference in the gain score of the lower limb strength and balance between control and experimental group"* is rejected.

The findings of this study is consistent with the result of the study conducted by Cadore et al (2014) which revealed significant reduction of 31% in the rate of falls for the participants in the exercise program compared with the control group. Static balance, ankle strength, function, and participation were significantly improved in the experimental group compared to the control group after the exercise intervention. However, the finding is not consistent with Alfieri et al (2012) which revealed that the mean differences in isokinetic parameters for ankle strength between the control and experimental group was not significant at $p = 0.28$ after the exercise intervention. However, those in the experimental group had significant improvement in plantar flexion and dorsiflexion bilaterally at $p = 0.02$.

Difference in Lower Limb Strength and Balance Across Four Time Periods Doing Foot Exercise

Table 8 shows the mean differences of lower limb strength and balance across four time periods doing exercise which was analyzed using Pairwise Comparison Test ANOVA. The result shows that there is significant improvement of lower limb strength in terms of the number of the seconds the participants have in the 5TSTS in every week with a decrease in mean level. The mean at baseline was 15.77 seconds. After one week of intervention with foot exercise, there was a decrease of 3.19 seconds (mean = 12.57 seconds) with a *p* value of .000. Two weeks after, the mean has decreased to 5.32 seconds (mean = 10.45 seconds) with a *p* value of .000. Three weeks after the intervention, the mean has decreased to 6.08 seconds (mean = 9.69 seconds) with a *p* value of .000. At post intervention, the mean decreasing to 6.51 seconds (mean = 9.26 seconds) with a *p* value of .000, which is significant.

The result of balance in terms of the number of the centimeters the participants have in the functional reach test also shows significant improvement in every week of intervention. The mean of baseline is 23.34 cm. After one week of intervention with foot exercise, there is an

increase of 2.83 cm (mean = 26.17 cm) with a *p* value of .000. Two weeks after, the mean has decreased to 5.33 cm (mean = 28.67 cm) with a *p* value of .000. Three weeks after the intervention, the mean has decreased to 8.43 cm (mean = 31.77 cm) with a *p* value of .000. And at the post intervention, the mean has decreased to 9.48 cm (mean = 32.82 cm) with a *p* value of .000, which is significant.

Table 8. **Difference in Lower Limb Strength and Balance Across Four Time Periods Doing Foot Exercise**

Variable	Time	Mean	Mean Difference	Std. Error	Sig	Qualitative of Descriptor
	Baseline	**15.77**				
Lower Limb Strength	After 1st Week	12.57	-3.19	.575	.000	Significant
	After 2nd Week	10.45	-5.32	.815	.000	Significant
	After 3rd Week	9.69	-6.08	.809	.000	Significant
	After 4th Week	9.26	-6.51	.820	.000	Significant
	Baseline	**23.34**				
Balance	After 1st Week	26.17	2.83	.375	.000	Significant
	After 2nd Week	28.67	5.33	.504	.000	Significant
	After 3rd Week	31.77	8.43	.569	.000	Significant
	Post Intervention	32.82	9.48	.577	.000	Significant

Note: Significant at *p* = .05

The result shows that there is a significant difference of the mean lower limb strength and mean balance across four time periods of doing foot exercise. This implies that foot exercise gave significant function improvement of lower limb strength and balance after each week of intervention. The result also shows the efficacy of the foot exercise starting from the first week. It means that the foot exercise improved lower limb strength and balance eventhough the participants perform the exercise for just one week only. This implies that the more weeks the elderly would exercise, the better would be their limb strength and balance. Thus, the null hypothesis that states *"There is no significant difference in lower limb strength and balance across four time periods doing foot exercise"* is rejected.

There is a dearth of studies that discussed the efficacy of exercise across time periods, however the study of Vechin et al (2015) support the finding. According to them, there is a significant improvement at *p = .001* in muscle strength after the participants received the exercise program. Another study conducted by Reid et al (2014) found out that after the intervention, participants with high and low intensity exercise have significant improvement in standing balance, usual gait speed, and chair stand performance. Furthermore, the findings showed that

the longer the duration of the study is done, the greater improvement gains are observed. According to Clark (2016), duration of exercise has its relative effectiveness for inducing health and body compositional changes in individuals.

The findings is in line with the Theory of Concervation which explains that by engaging in exercise, the individual conserves his or her structural integrity since the foot exercise is one way of maintaining or restoring the physical body by preventing breakdown or promoting healthy. Moreover, it maintains the self perspective (conservation of personal integrity) and the social relationship (sonservation of social integrity) that eventually lead to wholeness of an individual (Masters, 2014)

Difference in Lower Limb Strength and Balance Across Four Time Periods Doing Foot Exercise When Age is Considered

Table 9. **Comparison of the Mean Lower Limb Strength and Balance Across Four Time Periods When Age is Considered.**

Age	Base Line	Qualitative of Descriptor	1st Week	Qualitative of Descriptor	2nd Week	Qualitative of Descriptor	3nd Week	Qualitative of Descriptor	4th Week	Qualitative of Descriptor
					Mean					
Lower Limb Strength										
65-74yo	13.86	Risk of fall	10.88	Normal	9.19	Normal	8.78	Normal	8.36	Normal
75-80yo	19.59	Risk of recurrent Fall	15.95	Risk of recurrent Fall	12.96	Risk of fall	11.52	Normal	11.07	Normal
Balance										
65-74yo	24.83	Normal	27.90	Normal	30.05	Normal	33.67	Normal	34.62	Normal
75-80yo	20.35	Normal	22.70	Normal	25.90	Normal	27.95	Normal	29.20	Normal

Note. Lower Limb Strength: < 12 seconds – Normal; 12-15 seconds – Risk of Fall; > 15 seconds – Risk of Recurrent Fall; Balance: ≥18.5 cm – Normal; and < 18.5 cm – Risk of Fall. N= 20 for 65-74 yo and 10 for 75-80 yo.

Table 9 shows the multiple comparison of lower limb strength and balance across four time periods doing foot exercise when age is considered which was analyzed using descriptive statistics. The result shows that lower limb strength in terms of the number of the seconds the participants have in the 5TSTS in both age groups are decreasing in every week after intervention of foot exercise. At the baseline, the level of mean was 13.86 seconds for 60-74 years old which is considered as *risk of fall* and 19.59 seconds for 75-80 years old which is considered as *risk of recurent fall*. After the first week of intervention, a decrease was noted. It start decreasing with a mean of 10.88 seconds for 60-74 years old which is considered as *normal* and 15.95 seconds for 75-80 years old which is still considered as *risk of recurent fall*,

second week of intervention with mean of 9.19 seconds for 60-74 years old which considered as *normal* and 12.96 seconds 75-80 years old which is considered as *risk of fall*, third week of intervention with a mean of 8.78 seconds for 60-74 years old and 11.52 seconds for 75-80 years old which is considered as *normal*, and fourth week of intervention with a mean of 8.36 seconds for 60-74 years old and 11.07 seconds for 75-80 years old which is considered as normal.

Table 12 also shows the improvement of balance in terms of the number of the centimeters the participants have in the functional reach test across four time periods when age is considered. The result shows that there was an improvement in balance between the participant for both age group in every week after intervention of foot exercise. Before intervention, the level of mean was 24.83 cm for 60-74 years old and 20.35 cm for 75-80 years old. After the first week of intervention, an increase was noted. It increased from the first week of intervention with a mean of 27.90 cm for 60-74 years old and 22.70 cm for 75-80 years old; second week of intervention with a mean of 30.05 cm for 60-74 years old and 25.90 cm for 75-80 years old; third week of intervention with a mean of 33.67 cm for 65-74 years old and 27.95 cm 75-80 years old; and fourth week of intervention with mean of 34.62 cm for 60-74 years old and 29.20 cm 75-80 years old which are considered as *normal* .

Table 10. **Diferrence in Lower Limb Strength and Balance Across Four Time Periods When Age is Considered.**

Variable	Age	N	F	Sig	Partial Eta Squared	Qualitative of Descriptor
Lower Limb Strength	65–74 Years Old	20	38.758	.000	.671	Significant
	75 -80 Years Old	10	17.748	.001	.664	Significant
Balance	65 – 74 Years Old	20	62.939	.000	.768	Significant
	75 -80 Years Old	10	96.553	.000	.915	Significant

Note: Used ANOVA: Tests of Within-Subjects Effects (Greenhouse-Geisser), significant at $p = .05$

The result indicates that there is an improvement of lower limb strength and balance among participants in both age group after the intervention across four time periods. When it comes to the age group comparison, the level of lower limb strength indicates that younger participants are more strong and balanced than the older participants. This implies that foot exercise is effective in improving the strength and balance to reduce the risk of fall in both groups of age. On other hand, the result also implies that the eldely who are aged 60-74 are more stronge and balance compare to the elderly who age 75-80. According to Milanovic et

al (20113) decrease in muscle mass begins at the age of 50 as much as 15% and estimated to increase to 30% at the age 60 years. The decline will increase to 50% when the elderly reaches the age of 75 and above. Further, the decline of muscle mass will affect the strength which increase 35%-40% number of fall accident.

Furthermore, table 10 shows the significant difference of lower limb strength and balance for groups of age 65-74 years old and 75-80 years old which was analyzed using ANOVA. The result shows that the lower limb strength in terms of the number of the seconds the participants have in 5TSTS across four time periods in groups of age 65-74 years old is significant with a *p* value of .000 (F=38.758), ηp^2=.671 and group of age 75-80 years old is significant with a *p* value of .001 (F=17.748), ηp^2=.664. Furthermore, the result shows that the balance in terms of the number of the centimeters the participants have in the functional reach test across four time periods in group of age 65-74 years old is significant with a *p* value of .000 (F= 62.939), ηp^2=.768 and group of age 75-80 years old is significant with a *p* value of .000 (F= 96.553), ηp^2=.915.

The result indicates that both the younger and older elderly participants have singnificant improvement in lower limb strength and balance across four time periods. It implies that foot exercise can be applied as an intervention for the elderly in both age group since the result showed significant effect. Hence the null hypothesis that states *"There is no significantcant difference in lower limb strength and balance across four time periods doing foot exercise when age is considered"* is rejected.

Furthermore, table 11 shows the significant differences of lower limb strength and balance improvement between age group which was analyzed using Independent t-test. The result shows that there is a mean diference of 3.02 seconds in lower limb strength in terms of the number of the seconds the participants have in the 5TSTS between age of

Table 11. **Difference in the Gain Score of the Lower Limb Strength and Balance According to Age**

Variable	Group	Mean	Difference	T	Df	Sig	Qualitative of Descriptor
Lower Limb Strength	60-74 yo 75-80 yo	-5.50 -8.52	3.02	1.80	28	.082	Not Significant
Balanced	60-74 yo 75-80 yo	9.79 8.85	.95	.77	28	.450	Not Significant

Note: Used independent sample test, significant at p = .05

60-74 years old (mean = -5.50 seconds) and 75-80 years old (mean = -8.52 seconds) with a *p* value of .082 which is not significant. Furthermore, the result shows that there is a mean diference of .95 cm in balance in terms of the number of the centimeters the participants have in the functional reach test between 60-74 years old (mean = 9.79 cm) and 75-80 years old (mean = 8.85 cm) with a *p* value of .450, which is not significant.

The result indicates that there is no significant difference in scores gained in lower limb strength and balance between age groups. However, even if the result shows statistically not significant difference in improvement, the data shows that there is 3.02 seconds and .95 cm mean difference between the age group which is clinically different. This implies that both age groups have the same improvement in function after four weeks of experiencing foot exercise, but it might have clinically affected the efficacy of the exercise when age is conscidered. In other words, the foot exercise can be implemented to both age groups Consistent with the findings is a study conducted by Seco et al (2013) who found out that foot strength, flexibility and balance ability was increased after doing the exercise in both group of 65-74 years old and 75-80 years old. This study found out that participants in younger age were stronger compared to the older participants. A study conducted by Buford et al (2012) found out that elderly with younger age have more femoral muscle mass which is the strongest muscle in body that suported the foot to stand and move. According to Nakano, Otonari, Takara, Carmo and Tanaka (2014) elderly people in their 60s and 70s had similar functional characteristics in physical performance, balance, and muscle strength. However, this started to decline in their 80s caused by aging process which leads to sarcopenia, affecting more than 50% of muscle tissue in body.

Difference in Lower Limb Strength and Balance Across Four Time Periods Doing Foot Exercise When Sex is Considered

Table 12 shows the multiple comparison of lower limb strength and balance across four time periods of doing foot exercise when sex is considered which was analyzed using descriptive statistics. The result show that the lower limb strength in terms of the number of the seconds the participants have in 5TSTS in both age groups decrease every week after intervention of foot exercise. At baseline, the mean was 17.69 seconds for males which is considered as *risk of recurrent fall* and 14.81 seconds for females which is considered as *risk of fall*. It starts decreasing from the first week after intervention with mean of 14.10 seconds for male which is considered as *risk of fall* and

Table 12. **Comparison of the Mean Lower Limb Strength and Balance Across Four Time Periods When Sex is Considered.**

Sex	Mean									
	Base Line	Qualitative of Descriptor	1st Week	Qualitative of Descriptor	2nd Week	Qualitative of Descriptor	3nd Week	Qualitative of Descriptor	4th Week	Qualitative of Descriptor
Lower Limb Strength										
Male	17.65	Risk of fall	14.10	Normal	11.45	Normal	10.62	Normal	10.24	Normal
Female	14.81	Risk of recurrent Fall	11.81	Risk of recurrent Fall	9.95	Risk of fall	9.23	Normal	8.77	Normal
Balance										
Male	25.55	Normal	27.80	Normal	30.40	Normal	32.60	Normal	33.45	Normal
Female	22.23	Normal	25.35	Normal	27.80	Normal	31.35	Normal	32.50	Normal

Note. Lower Limb Strength: < 12 seconds – Normal; 12-15 seconds – Risk of Fall; > 15 seconds – Risk of Recurrent Fall; Balance: ≥ 18.5 cm – Normal; and < 18.5 cm – Risk of Fall. N=10 for male and 20 female).

11.81 seconds for female which is considered as *normal*; second week of intervention with mean of 11.45 seconds for male and 9.95 seconds for femalae which is considered as *normal*; third week of intervention with a mean of 10.62 seconds for male and 9.23 seconds for female which is considered as *normal*, and fourth week of intervention with mean of 10.24 seconds for males and 8.77 seconds for females which is still considered as *normal*.

The result of balance in terms of the number of the centimeters the participants have in the functional reach test also shows improvement across four time periods when sex is considered. The result shows that there is an improvement between participant for both sex groups in every week after intervention of foot exercise. At the baseline, the mean was 25.55 cm for male which and 22.23 cm for female. It started to increase from the first week after intervention with mean of 27.80 cm for male and 25.35 cm for female, second week of intervention with mean of 30.40 cm for male and 27.80 cm for female, third week of intervention with mean of 32.60 cm for male and 31.35 cm for female, and fourth week of intervention with mean of 33.45 cm for male and 32.50 cm for female which is considered as *normal*.

The result indicates that there is an improvement of lower limb strength and balance among participants in both sex group after the intervention across four time periods. When it comes to the sex group comparison, female participants have better lower limb strength than the male participants, while male participants have better balance than female participants. This implies that foot exercise is effective in improving the strength and balance to reduce the risk of fall in both sex groups. On the other side, the result also implies that the female elderly are stronger

compared to the male elderly, while the male elderly have more balance compared to the female elderly. According to Hands, Parker, Larkin, Cantell, and Rose (2016) posit that exercise is very useful in elderly life. It is believed that it can increase every aspect of elderly health outcomes. Through exercise, males and females gain different health benefits according to the level, mode and intensity of the physical activity. Furthermore, table 13 shows the significant improvement of lower limb strength and balance for groups of male and female which was analyzed using ANOVA. The result shows that lower limb strength in terms of the number of the seconds the

Table 13. **Diferrence In Lower Limb Strength And Balance Across Four Time Periods When Sex Is Considered.**

Variable	Sex	N	F	Sig	Partial Eta Squared	Qualitative of Descriptor
Lower Limb Strength	Male	20	20.637	.000	.696	Significant
	Female	10	28.464	.000	.600	Significant
Balance	Male	20	45.621	.000	.835	Significant
	Female	10	78.461	.000	.800	Significant

Tests of Within-Subjects Effects (Greenhouse-Geisser), Significant at $p = .05$

participants have in the 5TSTS across four time periods among male participants is significant with a *p* value of .000 (F= 20.637), ηp^2=.696 and female participants a *p* value of .000 (F= 28.464), ηp^2=.600. Furthermore, the balance in terms of the number of the centimeters the participants have in the functional reach test shows the same result across four time periods. The result shows that male participants are significant with a *p* value of .000 (F= 45.621), ηp^2=.835 and female participants are significant with a *p* value of .000 (F= 78.461), ηp^2=.800. The result indicates that both groups of male and female participants have singnificant inprovement in lower limb strength and balance function across four time periods. It implies that foot exercise can be applied as an intervention in both sex group since the result showed significantly affected. Hence the null hypothesis that states *"There is no significantcant difference in lower limb strength and balance across four time periods doing foot exercise when sex is considered"* is rejected.

Moreover, table 14 shows the significant differences of lower limb strength and balance improvement between groups of sex which was analyzed using Independent t-test. The result shows there is a mean diference of -1.42 seconds in lower limb strength in terms of the number of the seconds refered the 5TSTS between male (mean = -7.45 seconds) and female (mean = -

6.04 seconds) with a *p* value as .426, which is not significant. Further, the result shows that there is a mean diference of -2.37 cm in etween male (mean = 7.90 cm) and female (mean = 10.27 cm) with a *p* value as balance in terms of the number of the centimeters refered the functional reach test significant of .051, which not significant.

The result indicates that there is no significant difference in gain score of lower limb strength and balance between sex groups. However, the result shows that there is a mean difference of -1.42 seconds of lower limb strength and -2.37 cm of balance which clinically have difference between sex groups. This implies that both sex groups have the same improvement in function after four weeks of experiencing foot exercise. In other words, the foot exercise can be implemented to both sex groups.

The finding is consistent with the study of Krist, Dimeo and Keil (2013) which states that there is a significant improvement of mobility and muscle strength of participants among male and female groups after the exercise is implemented. According to Nakano, Otonari, Takara, Carmo and Tanaka (2014) both sex groups have the same improvement and declining of physical performances and balance. Furthermore, the study

Table 14. **Difference in the Gain Score of the Lower Limb Strength and Balance According to Sex**

Variable	Groups	Mean	Difference	T	Df	Sig	Qualitative of Description
Lower Limb Strength	Male Female	-7.45 -6.04	-1.42	-.81	28	.426	Not Significant
Balanced	Male Female	7.90 10.27	-2.37	-2.04	28	.051	Not Significant

Note: Used independent test, significant at $p = .05$

conducted by Psatha et al (2017) showed that the elderly females showed greater average of lower limb strength than males after receiving the exercise program. However, male elderly participants showed more improvement. On the other hand, the study conducted by Melam, Buragadda, Alhusaini, Ibrahim, and Kachanathu, (2014) showed that the male had more balance compared to female elderly in community.

Difference in Lower Limb Strength and Balance Across Four Time Periods of Doing Foot Exercise When Body Weight is Considered

Table 15 shows the multiple comparison of lower limb strength and balance across four time periods of doing foot exercise when body weight is considered which was analyzed using

descriptive statistics. The result shows that lower limb strength in terms of the number of seconds the participants have in 5TSTS in the three groups classification of body weight decreased in every week after the foot exercise intervention. At the baseline, the means are 12.89 seconds for normal body weight which is considered as *riskof fall*, 17.25 seconds for overweight which is considered as *risk of recurrent fall* , and 18.82 seconds for obese which is considered as *risk of recurrent fall*. After first week of intervention, a decrease was noted. It start decreasing with a mean of 10.66 seconds for normal body weight which is considered as *normal*, 12.47 seconds for overweight which is considered as *risk of fall*, and 17.44 seconds for obese which is still considered as *risk of recurrent fall*. After second week of intervention, the means were 9.56 seconds for normal body weight which is considered as *normal*, 9.51 seconds for overweight which is considered as *normal*, and 15.02 seconds for obese which is considered as *risk of recurrent fal*. After the third week of intervention, the means were 8.82 seconds for normal which is considered as *normal*, 9.21 seconds for overweight which is considered as *normal*, and 13.06 seconds for obese which is considered as *risk of fall*. At the post intervention, the means were 8.33 seconds for normal body weight which is considered as *normal*, 8.77 seconds for overweight which is considered as normal, and 12.78 seconds for obese which is still considered as *risk of fall*.

The result of balance in terms of the number of the centimeters the participants have in the functional reach test also shows improvement across four time periods when body weight is considered. The result shows that there was an improvement among the participant in the last three groups classification of body weight in each week after the

Table 15. **Comparison of the Mean Lower Limb Strength and Balance Across Four Time Periods When Body Weight is Considered.**

	Mean									
Sex	**Base Line**	**Qualitative of Descriptor**	**1st Week**	**Qualitative of Descriptor**	**2nd Week**	**Qualitative of Descriptor**	**3nd Week**	**Qualitative of Descriptor**	**4th Week**	**Qualitative of Descriptor**
Lower Limb Strength										
Normal	12.89	Risk of fall	10.66	Normal	9.56	Normal	8.82	Normal	8.33	Normal
Over	17.25	Risk of recurrent Fall	12.47	Risk of fall	9.51	Normal	9.21	Normal	8.77	Normal
Obese	18.82	Risk of recurrent Fall	17.44	Risk of recurrent Fall	15.02	Risk of recurrent Fall	13.06	Risk of fall	12.78	Risk of fall
Balance										
Normal	21.51	Normal	24.67	Normal	26.92	Normal	31.67	Normal	32.63	Normal
Over	25.15	Normal	28.08	Normal	30.92	Normal	32.81	Normal	34.04	Normal
Obese	23	Normal	24.80	Normal	27.00	Normal	29.30	Normal	30.10	Normal

Note. Lower Limb Strength: < 12 seconds – Normal; 12-15 seconds – Risk of Fall; > 15 seconds – Risk of Recurrent Fall; Balance: ≥ 18.5 cm – Normal; and < 18.5 cm – Risk of Fall. N=10 for male and 20 female). N= 12 for normal bodyweight, 13 for overweight, and 5 for obese

foot exercise intervention. At the baseline, the mean was 21.51 cm for normal, 25.15 cm for overweight, and 23 cm for obese which is considered as *normal*. After the first week of intervention, an increase was noted. It started to increase from the first week after intervention with a mean of 24.67 cm for normal, 28.08 cm for overweight, and 24.80 cm for obese which is considered as *normal*. After the second week of intervention the mean were 26.92 cm for normal, 30.92 cm for overweight, and 27 cm for obese which is considered as *normal*. After the third week of intervention the means are 31.67 cm for normal, 32.81 cm for overweight, and 29 cm for obese which is considered as *normal*. At post intervention, the means were 32.63 cm for normal, 34.04 cm for overweight, and 30 cm for obese which is still considered as *normal*.

The result indicates that there is an improvement of lower limb strength and balance among participants in the groups classification of body weight after the intervention program across four time periods. When it comes to the groups of body weight comparison, participants with normal body weight showed more strength followed by participants with overweight and participants with obesity. However, participant who are overweight showed more balance followed by participants with obesity and normal body weight. This implies that the more heavy the participants in terms of the level of BMI, the weaker they are in lower limb strength. The obese elderly tend to be weaker caused by the decreasing of muscle mass the creators of body power while body fat increases. Further, the participants who are in the overweight group shows more balance caused by the amount of muscle mass still enough while the fat mass increase during their age. According to Do Cetin and Nasr (2014) the elderly who look fatter tend to be weaker. The increase of body weight among elderly is caused by accumulative of fat mass. Further, Sakuma and Yamaguchi (2013) state that the fat mass did not regenerating the muscle power, the power created by the muscle mass and is declining during aging as natural changes.

Table 16. **Diferrence in Lower Limb Strength and Balance Across Four Time Periods When Body Weight is Considered.**

Variable	Groups	N	F	Sig	Partial Eta Squared	Qualitative of Descriptor
Lower Limb Strength	Normal	12	18.619	.001	.629	Significant
	Overweight	13	27.417	.000	.696	Significant

	Obese	5	20.941	.002	.840	Significant
	Normal	12	44.083	.000	.800	Significant
Balance	Overweight	13	86.126	.000	.878	Significant
	Obese	5	20.211	.000	.835	Significant

Note: Tests of Within-Subjects Effects (Greenhouse-Geisser), Significant at $p = .05$

Moreover, Table 16 shows the significant improvement of lower limb strength and balance for groups classification of body weight which was analyzed using ANOVA. The result shows that lower limb strength in terms of the number of the seconds the participants have in the 5TSTS across four time periods in all groups classification of body weight is significant. Participants who have normal body weight are significant with a *p* values of .001 (F= 18.619), ηp^2=.629, participants in overweight group are significant with a *p* value of .000 (F= 27.417), ηp^2=.696, and participants in obese group are significant with a *p* value of .002 (F= 20.941), ηp^2=.840. Further, the result also shows that balance in terms of the number of centimeters the participants have in the functional reach test across four time periods are significant in all groups classification of body weight. Participants in normal weight are significant with a *p* value of .000 (F= 44.083), ηp^2=.800, participant in overweight are significant with a *p* value of .000 (F= 86.126), ηp^2=.878, and participants in obese are significant with a *p* value of .000 (F= 20.211), ηp^2=.835.

The result indicates that participants in the group of normal body weight, overweight, and obese have significant improvement in lower limb strength and balance across four time periods after doing exercise. It implies that foot exercise can be applied as an intervention for elderly people in all groups of body weight since the result showed significant effect. Hence, the null hypothesis that states *"There is no significantcant difference in lower limb strength and balance across four time periods doing foot exercise when body weight is considered"* is rejected.

Furthermore, table 17 shows the significant differences of lower limb strength and balance improvement between the groups of body weight which was analyzed using ANOVA. The result shows that there was no significant difference of lower limb gain score between the groups of body weight with a *p* value of.085 (F= 2.70). Further, the result shows that there was a significant difference in the balance gain score between groups of body weight with a *p* value of .032 (F= 3.92).

Table 17. **Difference in Gain Score of Lower Limb Strength and Balance According to Body Weight**

Variable	Group	N	Mean	F	Sig	Qualitative of Description
Lower Limb Strength	Normal	12	-4.56	2.70	.085	Not Significant
	Overweight	13	-8.48			
	Obese	5	-6.04			
Balanced	Normal	12	11.12	3.92	.032	Significant
	Overweight	13	8.88			
	Obese	5	7.10			

Note: Test of ANOVA, Significant at $p = .05$

The result implies that the groups of body weight were the same in improvement of lower limb function after four weeks of experiencing foot exercise. While with regards to balance, the groups had significant difference in improvement. However, even there was a difference in improvement, Table 16 showed that all the groups of body weight still have significant improvement. In other words, the foot exercise still can be implemented to all groups of body weight.

While the result of ANOVA do not indicate which of the three groups differ from one onother, table 18 show the analysis to find out the significant difference on balance among the body weight groups utilizing Turkey Honest Significant Difference (HSD). The result shows that the mean differences score of balance between normal body weight and overweight was 2.232 and not significant with a *p* value of .148, between normal body weight and obese was 4.017 and significant with a *p* value of .037, while between overweight and obese was 1.785 and not significant with a *p* value of .477.

The result indicatess that in the balance score in terms of the number of the centimeters the participants have in the Functional Reach Test, participants with normal body weight are more affected than participants who are overweight and obese, and

Table 18. **Comparison of Balance Between Body Weight Groups**

Variable	(I) BMI	(J) BMI	Mean Difference (I-J)	Std. Error	Sig.	Qualitative of Description
Balance Gain	Normal	Overweight	2.232	1.154	.148	Not Significant
		Obese	4.017	1.534	.037	Significant
	Overweight	Normal	-2.232	1.154	.148	Not Significant
		Obese	1.785	1.517	.477	Not Significant
	Obese	Normal	-4.017	1.534	.037	Significant
		Overweight	-1.785	1.517	.477	Not Significant

Note: Post Hoc Test, Turkey Honest Significant Difference Test. Significant at $p = .05$

participants who are overweight are more affected than obese participants. This implies that the more heavy the participants in terms of body weight, lesser the improvement of balance they will have.

There is a dearth of studies discussing efficacy of foot exercise in different body weight groups. However, the study conducted by Ilich, Inglis, Kelly and McGee (2015) supported the findings that elderly participants with loss of muscle and who are obese manifested physical limitations. Slow in walking speed and difficult of leg stance are the outcomes of the limitation. According to Tomlinson et al (2016), obese and sacropenia have similar risks of functional limitation. Both conditions play a role in limiting physical performance in daily task. Sacropenia and obesity increased mechanical stress to the musculo-skeletal system through carrying the inert mass of adipose tissue and decreasing muscle's function.

Proposed Health Education Program Based on the Result of the Study

The author has taken the initiative to develop a Health Education Program based on the findings of this study. According to World Health Organization, health education is a combination of learning experiences designed to help individuals and communities improve their health, by increasing their knowledge or influencing their attitudes (WHO, 2019).

As one ages, his or her bones tend to shrink in size and density. Muscles generally lose strength so with endurance and flexibility that eventually may lead to a decline in elderly functional capacity and put them at risk of falling. Exercise had been found in this study as an effective intervention in improving the participants' lower limb strength and balance, therefore, this can be considered to be an effective intervention to prevent falls especially among the elderly. This program will target elderlies both in the community and those in the nursing home and their relatives and families as participants.

Literature states that the loss of strength and stamina attributed to aging is in part caused by reduced physical activity. This physical activity program will provide the elderly ages 60 and above the necessary knowledge on the importance of exercise on improving muscle strength, flexibility and balance to reduce their risk for falls. Further, this program will increase their awarenes that engaging in exercise (*senam kaki diabetes*) will help them achieve optimal health thereby experiencing greater sense of well-being.

The goal of the program is to provide knowledge among the elderly and their respective families on how to maintain muscle strength and flexibility and keep them strong thus

improving their quality of life. At the end of the program, the participants are expected to: 1) recognize the physiological changes brought about by aging proces; 2) identify factors that cause elderly to be at risk for fall; 3) explain the benefits of *senam kaki diabetes*; 4) demonstrate how to perform *senam kaki diabetes* consistently; and 5) illustrate how to practice measure balance and lower limb strength with 5TSTS and Functional Reach test.

This program is developed to educate the elderly and their respective families on how to improve muscle strength and flexibility thus reducing the risk of fall. This program has two parts. The first part will be a seminar and the second part will be a workshop. Contact time would be four hours, which will be divided into two hours for the seminar and two hours for the workshop. Further the *senam kaki diabetes*, and the benefit that they will get in engaging to the said exercise will be introduced to them. Furthermore, it will be enphasized to the participants that weakness and poor balance are actually linked to inactivity, rather than age.

The workshop part will be the actual demonstration and return demonstration of *senam kaki diabetes.* The elderly will be divided into groups with five persons per group and will be led by one instructor to make the observation easier. The instructor will lead his or her own group until the participants can do it on their own. At the end of the seminar, the elderly will be given one copy of disc that they can play and review if they forget the steps.

The program activities will be conducted into two parts as follows: seminar will be divided into three topics discussion. A 20-minute lecture-discussion about physiological change brought about by aging process which of subtopics such as: the elderly age, Physical changes brought by aging proces, and effects of the physiological changes in elderly life; 20 minutes lecture-discussion about the risk factors of the problems which consist of subtopics such as: the risk factors of falls, and the triggers of the risk factors; and 50 minutes lecture-discussion about the foot exercise which is *"senam kaki diabetes"* which consist of subtopics such as: background of the exercise, benefits of the exercise, and the procedures of the exercise. At the end of each topic discussion, time for question and answer will be given. The workshop will be divided by 2 parts. The first part will be two hours of foot exercise workshop. The audience will be trained by the instructor about the movements of the exercise. The second part will be two hours of lower limb strength and balance measurement workshop. The audience will be trained about the procedures to measure the lower limb strength and balance. After the program, the evaluation will be given to the participant of the program to ensure that the program is meeting the needs of the participants. The evaluation strategy will be constructed as follows: Attendance of the participants will be given in the begining and at the

end of each seasson to measure the attractiveness of the program. Formulated questionaire will be givent at the end of the program to evaluate the implementation, the approprietness, and effectiveness of the program. The outcomes of the evaluation will be used to measure the overall success of the program. It will be used to supplement the lack of the next program.

CONCLUSION

Based on the findings, it was concluded that the foot exercise was effective in improving lower limb strength and balance among the elderly. The longer the elderly will engage in *senam kaki diabetes,* irrespective of age sex and body weight, the better is their balance and the strength of their lower limb.

The following are the recomendations for nurse educators, nurse practitioners, and nurse researchers based on the findings of this study:

To strengthen the gerontology course offered in the BSN program, integrating and enhancing the importance of foot exercise among elderly both in the community and nursing home should be done. Nurse educator can facilitate the foot exercise to enable and to correctly teach their students how to perform it. They can apply the said example as they care for the elderly clients.

The foot exercise which is *senam kaki diabetes* is recommended for the nursing practitioners to use as a form of health education for elderly clients and their respective families to prevent falls and improve their quality of life. Nurses both in the community and other health care self and other health care providers can talk routinely to their elderly clients the importance of incorporating physical activity in their lives.

Another study can be done using more participants in other settings and utilize elderly ages 60-89 and consider other variables like co-morbidity, quality of life, and different arm position.

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