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Impact of Physical Activities on Frailty in Community-Dwelling Older Women

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Abstract

Aims: The aim of the study was to determine whether increased physical activities (PA) affect frailty for old women, 75 years and older (OO), compared to 60–74 years old (YO).

Methods: This crosssectional study measured 19 frailty indicators (muscle strength and endurance, balance, gait characteristics, and function), using 46 community-dwelling women. PA were divided into three levels by caloric expenditure per week (<2,000 kcal/week, 2,000–3,999 kcal/week, >4,000 kcal/week).

Results: As PA level increased, a gap (=difference) between OO and YO narrowed for step length and function, but for quadriceps strength and endurance, a gap widened.

Conclusions: Frailty progresses with aging but older women who engage in a high level of physical activity (>4,000 kcal/week) can increase mobility and functional capacity, but not for muscle strength and endurance. Starting regular resistance training activities early in the aging process is critical to improve or maintain muscle quality to offset age-related frailty.

Introduction

Prevalence of frailty increases with advanced age (Fried et al., 2001), but aging and frailty are different. Aging cannot be avoided but frailty, at least some aspects of it, can be reduced or even reversed with appropriate interventions. Frailty, according to Fried and colleagues (2001), is a syndrome in which function declines with increased vulnerability characterized by weakness and decreased physiologic reserve. Naturally, frailty is associated with advanced age. Frailty is defined and measured in many ways (Bouillon et al, 2013; Gobbens et al., 2010) because we have not reached consensus for a conceptual definition of frailty (de Vries et al., 2011). This leads to limited effective interventions to prevent or treat frailty. A general suggestion for reducing frailty is to increase physical activities (PA). A study (de Labra et al, 2015) found that exercise-based interventions are effective in slowing the progression of frailty. Another study about exercise concluded that frail older adults should

start with aerobic activity such as walking and add resistance exercise as an intervention for frailty (Liu et al., 2011). The CDC recommends that adults 150 minutes of moderate activity per week (The Centers for Disease Control, 2016), which converts to about 7,000 to 8,000 steps a day. Regarding the effects of PA, a study (Jeoung 2015) revealed that an increase in physical performance factors such as 6-minute walk, 30-sec arm curl test, chair sit and reach test, and grip strength are strongly associated with decreased frailty in elderly women. Frailty, therefore, is known to be associated with decreased walking speed, muscle strength, and flexibility in addition to increased age. For example, slow walking speed is one of phenotypes of frailty (Fried et al, 2001). Walking speed of less than .08 m/s was considered frail in a study (Castell et al., 2013). In another study (Bandeem-Roche et al., 2006) 0.65m/s for women with height <159cm and 0.76m/s for women with height >159 were used for frailty definition. Muscle weakness is also one of frailty phenotypes (Fried et al, 2001). The five-time sit-to-stand test showed lower limb muscle strength is correlated with frailty (Batista et al., 2012). One study found that especially lower knee extensor muscle strength is associated with increased risk of mobility loss (another frailty indicator) in older adults (Visser et al., 2005). Flexibility is measured by range of motion (ROM). Consistent reduction in peak hip extension is associated with compensatory increases in anterior pelvic tilt, indicating a reduced hip flexion ROM in the elderly population. Reduced peak hip extension and increased anterior pelvic tilt can lead to smaller step lengths and thus decreased gait velocity in elderly adults compared with young adults (Kerrigan et al., 1998). However, interventions using PA to prevent frailty need to consider age in order to identify effective methods. For example, the most beneficial number of walking steps and intensity of resistance training for an 85 years old woman and a 65 years older woman should be different. The aim of this study was to understand how much and which types of PA older adults are doing and how these PA are related to frailty levels for different age groups. The knowledge may lead to the determination of practical and age suitable interventions to prevent the progression of frailty. We investigated whether the levels of physical activities influence frailty in a similar or different way for two age groups of women: Young-Old (YO) aged 60–74 years and Old-Old (OO) aged 75–90 years. We focused only on women because women tend to be frailer than men of a similar age (Naumann Mutagh et al., 2004; Gu et al., 2015, World Health Organization 2016) and the types of activities they engage in are also different from those of men (Goggin et al., 2001; Moschny et al., 2011; Sun et al., 2013). In this study, frailty measurements are muscle strength and endurance, balance and mobility, gait characteristics and physical function.

Based on past studies, we assumed that lower PA levels are associated with advanced age and advanced frailty. In addition to testing these two assumptions, we formed three research questions.

1. Do PA levels affect frailty in YO and OO similarly or differently?
2. What portion of PA is explained by walking steps?
3. In which physical activities do YO and OO with high and low PA levels participate?

Methods

Study design:

This is a cross-sectional exploratory study.

Participants:

We recruited participants from among individuals who participated in a study of virtual home-based exercise at a university (Tomita et al., 2016). Since the study was a randomized controlled trial, about half of the participants were doing light to moderate resistance exercise at home, three sessions per week, 30–45 minutes per session for three to six months. The benefits of this recruitment approach were that (a) participants had a common health problem: a higher risk of falling due to falls in the past two years; and (b) we could access people who had various levels of physical activity, including people who were very advanced in age, yet doing home-based exercise. Responding to a flyer for our study, 46 women volunteered. They were community-dwelling older women (60+ years old) who had a fall in the past two years, without cognitive impairment, and were able to visit a university for assessments. Of the 46 participants, 28 were doing home-based strengthening and balance exercise (60.9%) and the rest were not. Participants were divided into three levels of physical activity using caloric expenditure/week: low (< 2,000 kcal/week), medium (2,000 – 3,999 kcal/week) and high (≥ 4,000 kcal/week). For both YO and OO, the number of people who were participating in the strengthening exercises were similar across the three PA groups ($p=.405$, and $p=.313$, respectively).

Measures:

PA were measured using the Community Healthy Activities Model Program for Seniors (CHAMPS) (Stewart et al., 2001), which is an instrument specially designed for evaluating older adults' physical activity level. The CHAMPS has 41 items of minimal, light, moderate and vigorous physical activities to which respondents report their weekly duration and frequency of participation in a typical week over the last four weeks. Caloric expenditure per week for all exercise-related activities was calculated. First, duration (from <1 hour to >9 hours) for each activity was recoded from 0.5 to 6. Second, the new duration variable is multiplied by corresponding MET value (e. g., 3 for “Do heavy work around the house”) to create a weighted duration variable. Then, caloric expenditure per week will be calculated for each activity by multiplying weighted duration by 3.5, by 60 to convert METs per minutes to METS per hour and by (weight in kg/200). According to American College of Sports Medicine formula, $\text{kcal per min} = \text{METs} \times 3.5 \times (\text{body weight in kg}/200)$. The sum of caloric expenditure of 27 items becomes caloric expenditure per week.

The psychometric properties of the CHAMPS are good for people with high to medium PA but not for low PA levels (Hekler et al., 2012).

Outcome measures to indicate frailty used in this study were average grip strength, lower extremity muscle strength and endurance, balance and mobility (balance confidence and Timed Up & Go), gait characteristics (walking speed and step length), and function (Activities of Daily Living).

Maximal voluntary isometric grip strength was measured using a dynamometer. Two trials with each hand were performed. The average for the two trials for the right and left hands were used.

For the strength of the lower extremities, maximal voluntary isometric strength of the knee flexor/extensors, hip flexor/extensors and ab/adductors were measured unilaterally using a strain gauge and a standard exercise bench. A plantar/dorsiflexion device with strain gauge was used to measure ankle plantarflexion and dorsiflexion maximal isometric strength. The strain gauge quantifies the maximal isometric force of muscle contractions in kilograms. Two trials were performed with each leg/muscle group, with the highest force used for the analysis. Participants were instructed to exert maximal isometric muscle force for 2–3 seconds in various positions depending on the muscle group being tested. Knee flexion (hamstrings), and extension (quadriceps) endurance were measured by performing a maximal voluntary isometric contraction for 90 seconds or until fatigue. Endurance was calculated as the area under the fatigue curve. Participants were instructed not to perform a Valsalva maneuver during these tests. In this study, the interrater and test-retest reliability for the standard exercise bench and strain gauge ranged from fair to excellent (Intrarater Correlation Coefficient, ICC, =.74 - .96) and between good and excellent (ICC =.75 - .995), respectively. Test-retest reliability for the plantar/dorsi-flexion force device was excellent (ICC = .91 - .96).

Mobility was measured using the Activities-specific Balance Confidence (ABC) scale (Powell et al., 1995) and the Timed Up and Go (TUG) (Podsiadlo et al., 1991). The ABC is a self-report questionnaire developed to measure balance impairment using 16 items scaled from 0 (no confidence) to 100% (complete confidence). The sum of 16 items is divided by 16 for the final percentage. Healthy older people without a chronic condition have been reported to score 90% or above, and 80% and above are considered high functioning (Mayers et al., 1998). High test-retest reliability for the overall scores ($r=0.92$) and most of the individual items were reported in samples of community-dwelling older adults (Powell et al., 1995).

The TUG measures the time that a person takes to rise from a chair, walk 3 meters, walk back and sit in the chair at a self-selected normal speed. Community-dwelling women between 65 and 85 years of age who take 12 seconds or less are considered mobile (Bischoffe et al., 2003). If one takes 14 seconds or longer, then the person has a high risk for falls (Shumway-Cook et al., 2000). The TUG has excellent interrater reliability (ICC=.99) (Ng et al., 2005). It has high sensitivity (87%) and specificity (87%) to identify older adults who are prone to falls (Shumway-Cook et al., 2000).

For gait characteristics, temporal gait parameters were acquired using motion capture techniques, by tracking retro-reflective markers affixed to both shoes. Participants ambulated along a walkway at a self-selected pace, and gait velocity was monitored with photoelectric cells. Gait variables exported from Visual 3D software included gait speed (m/s) and step length (cm). The average of three trials for the above measures were used for analyses.

For functional status, Activities of Daily Living (ADLs) were assessed using the Functional Independence Measure (FIM) (Keith et al., 1987). The FIM™ contains 18 items that are composed of 13 motor tasks (eating, grooming, bathing, upper and lower body dressing, toileting, bladder and bowel management, bed to chair transfer, toilet transfer, shower transfer, locomotion and stairs) and 5 cognitive tasks. Tasks are rated on a 7-point ordinal scale ranging from 1 (completely dependent) to 7 (completely independent). The FIM has been mainly utilized for rehabilitation purposes and scores have been validated for people with stroke, various levels of spinal cord injury, traumatic brain injury, and multiple sclerosis (Kegelmeyer 2013). Only FIM Motor was used in this study.

Procedure:

All participants were assessed in the same order for all measures at a university. First, demographic characteristics were collected. Functional information was gathered through a one-on-one interview, then gait characteristics were collected in a biomechanics lab. After that, muscle strength and endurance data were collected in a rehabilitation physiology lab, and finally CHAMPS was administered via personal interviews. A pedometer had been provided to participants four weeks prior to these assessments and step counts were collected at the time of assessments.

Statistical analysis:

Age groups were YO (60–74 years old) and OO (75–90 years old). Physical activity groups were low (< 2,000 kcal/week), medium (2,000 – 3,999 kcal/week) and high (≥ 4,000 kcal/week), as measured by all exercise related activities in the CHAMPS. To answer research question (RQ) 1 and test two assumptions at once, we used Generalized Linear Model (GML) and examined the main effect of age and PA, and interaction terms between age groups and PA levels (high vs. low). If the interaction was significant, the two groups had an opposite or very different directional slopes. To reduce the number of muscle tests, we conducted factor analysis, resulting in one component for both muscle strength and endurance. Loadings for eight tests for strength ranged from .718 to .900. We reported different muscle groups such as quadriceps, hamstring, hip extension, and ankle dorsiflexion. The values were adjusted for one's body weight. TUG, walking speed, and step length were adjusted for one's height because height affects one's walking steps, therefore also walking speed (Jerome et al., 2015). Using height as a covariate in ANCOVA for three PA groups, predicted values were used in the GML. To analyze the time took for the TUG, usually an adjustment to one's height is not performed, but considering the wide range of 45 cm, we adjusted the TUG time to one's height in this study. To answer RQ2, we examined variances of caloric expenditure that were accounted for by variances of walking steps. Finally, for RQ3, we illustrated percentages of participants who engaged in high and low levels of various PAs using radar charts.

Results

Sample characteristics

The two age groups were equivalent for all demographic characteristics. The mean age of YO was 66.9 (SD=4.4) years and for OO, it was 79.5 years (SD=3.7). For the total sample,

the mean age was 72.4 (SD=7.5), 89.1% were White, 6.5% were Black, and 4.6% were other. Regarding education, 2.2% had less than 12 years, 26.1% had a high school diploma, 13.0% had a 2-year college degree, 32.6% had a BA or BS, 21.7% had a master's degree, and 4.3% had a doctorate. Living status showed 58.7% lived alone and the rest lived with someone else. Percentages of participants who were participating in the virtual home exercise were also similar for the two age groups. Participants were comprised of 26 YO (56.5%) and 20 OO (43.5%). The three physical activity (PA) groups across both age groups consisted of low (n=16, 34.8%), medium (n=16, 34.8%), and high (n=14, 30.4%) PA groups.

Assumptions and RQ1

First, we examined main effects of age and PA. Age had a significant effect ($p < .05$) on 7 of 12 frailty indicators, including grip strength, quadriceps strength, hip extension strength, TUG, walking speed, step length, and ADLs. For balance confidence, an age effect did not exist ($p=.948$). PA had a significant effect on 5 of 12 frailty indicators, including ankle plantar flexor strength, quadriceps endurance, walking speed, step length, and ADLs. In Table 1, the column for Age effect and PA effect summarizes these findings. As for interaction effects, quadriceps strength and endurance, walking step length and ADLs were significant (Table 1, the last column).

To answer RQ1, we examined the interaction between these two main effects. We found two different interaction patterns: As a PA level increases, there is a widened difference (i.e. gap) between OO and YO for muscle strength and endurance, but there is a narrowed gap between these two groups for mobility and function. For quadriceps strength and endurance, YO strength increased as the PA level increased while OO did not change much, resulting in a wider gap between YO and OO for high PA, compared to those for low PA (See Figure 1a). Although not statistically significant, all other strength measures including hamstrings, hip extension, and ankle DF and hamstring endurance had a similar trend. In contrast, an opposite pattern was observed for step length and ADLs. OO had increases in both step length and ADLs as PA levels increased while YO did not change much, resulting in a smaller difference between YO and OO for high PA, compared to those for low PA (See Figure 1b). This same trend was seen for balance confidence, TUG, walking speed, and grip strength.

RQ2

For OO, variances of PA that are accounted for by variances of walking steps were the highest for high PA (46.7%) and the lowest for low PA (8.4%). Therefore, an increase in PA level was positively correlated with an increase in the number of steps walked. For YO, it was not the case. The difference between the two age groups was obvious only for high PA (Figure 2).

RQ3

Of 27 activities presented in the CHAMPS assessment, there were 21 physical activities that at least one participant engaged in. Radar charts summarize participation in 13 most frequent physical activities for low and high PA levels in Figures 3a (YO) and 3b (OO). The charts present between 0% (the center) and 100% (the most outside) of participants who engaged

in each PA. METs are shown in parenthesis for each PA. Light intensity are presented on the right side of the radar charts and higher intensity activities are shown on the left side.

Almost all participants engaged in light housework (75%–100%) and about 75% did light gardening. Many did stretching exercise (52.5% – 75.5%), or walked leisurely for exercise or pleasure (57.5% - 75.5%). Except for OO with low PA level, many walked to do errands (50%–75.5%). For YO, the pattern of activities were similar for both PA levels (Figure 3a), but for OO, high PA had much higher percentages of participation in four activities (Figure 3b): Walk to do errands (64.3% vs. 2.5% for low PA), walk fast (75% vs. 10% for low PA), heavy housework (75% vs. 30% for low PA), and heavy gardening (100% vs. 2.0% for low PA).

Discussion

This exploratory cross-sectional study examined the interplay between aging and PA levels and how they affect frailty for older women. Aging was strongly related to frailty as Fried and colleagues stated (2001). OO was frailer than YO for all 12 frailty indicators. Of them, 7 indicators were statistically significant (grip strength, quad strength, hip extension strength, TUG, walking speed, step length, and ADLs). Similarly, PA levels were also related to frailty. High PA was associated with less frailty than low PA for all indicators; five were statistically significant (Ankle PF strength, quadriceps endurance, walking speed, step length, and ADLs). Therefore, our assumptions of age and PA level being associated with frailty were correct for many frailty indicators. With a larger sample size, most other indicators would likely become significant. Important findings were that these two factors (age and PA) together had different effects on different frailty indicators. For muscle strength and endurance, high PA tends to have a wider gap between YO and OO than low PA, with the exception of ankle plantarflexion. Among older women with high PA, OO shows weaker strength and endurance than YO. In contrast, for mobility (step length) and function (ADLs), high PA shows a smaller difference between YO and OO than low PA level. OO has greater mobility and function with high PA than YO does. This result may be because the higher PA OO group walked a great number of steps during activities, including walking to do errands, heavy housework and gardening, as well as fast walking, while these activities were rarely done by the low PA OO group. Activity variations were not observed for YO between low and high PA. Therefore, we conclude that effects of PA are different for YO and OO on different frailty indicators. We emphasize the importance of moving and walking for OO to prevent frailty. This may not have to be structured exercise if it is difficult for OO, but can be frequent vigorous physical activities such as vacuuming, cleaning windows, lifting a bag of mulch, weeding, and raking leaves. However, they need to be higher intensity. Fried and colleagues (2001) point out that low PA is a frailty phenotype. We agree that whether people are frail or not, they may not be physically active. Based on their physical activity type, OO with high PA in this study appears to be making an effort to be active. People have some control over physical activities; therefore, OO should intentionally commit to moving actively to reduce frailty. Further, these efforts are beneficial for increasing balance confidence. Only OO with low PA had less than 80% (=cutoff for moderate and high balance confidence), but medium and high PA OO had high confidence, which was equal or better than YO. This high balance confidence is important to be physically active, because if older

adults are not afraid of losing balance, they can be physically active, and this in turn, will lead to even higher confidence levels.

It is not surprising that the OO had low quadriceps strength and endurance than the YO as muscle mass is known to decrease with age. Even most OO with high PA did not participate in resistance type activities or those of a higher intensity (METs >4.0), which could help to maintain strength and endurance. No participants engaged in activities such as dance, riding a bicycle, moderate to heavy strength training, and participation in sports. Although it is good to be physically active, it is important for people of advanced age to make it a priority to engage in higher intensity and resistance type activities regularly. The earlier in the aging process that this begins, the better. These activities could build up a reserve of muscle strength and endurance so that in the even of an illness or disability, the reductions in functional activities and ADLs due to muscle atrophy would not be as debilitating. In addition, although we did not measure lean muscle mass in this study, we can assume that it was lower in the OO than the YO since sarcopenia typically occurs faster after about age 75. The primary treatment for sarcopenia is resistance training and avoiding a sedentary lifestyle. Goodpaster et al, (2006). showed that maintaining or gaining muscle mass does not prevent aging-associated declines in muscle strength. They postulate that the decline in strength may also be due to a decline in muscle quality, which is defined as the loss of strength per unit muscle mass. If the muscle quality is more affected than the muscle mass, this could explain our result of the wider gap between the YO and OO with high PA for strength and endurance, but not for ADLs and step length. Individuals can appear to have high PA levels by walking a high number of steps; however, if the intensity of the activity is not high enough, there would still be an impact on muscle mass and quality. With reduced muscle quality, there would be reduced neural impute to the muscle, so higher strength would not be able to be generated. Thus, the muscle would not be as “usable” for higher intensity activities, especially those that require higher levels of strength and endurance. With resistance training, neural drive would increase before muscle hypertrophy and usability. Therefore, resistance training is a crucial aspect of being physical active.

This study shows that high PA may not overcome the aging effect as indicated by some of the frailty indicators such as grip strength, TUG, walking speed and step length. One study found that a shorter step length is associated with aging (Laufer, 2005). In our study, OO always had a shorter step length than YO within the same PA groups.

One exception of PA effects on muscle strength was identified for plantar flexion (PF) of the ankle. PF occurs when the dorsum of the foot lengthens in line with the leg or points downward. To strengthen the plantar flexors, a common approach is to stand upright and rise up onto one's toes and back down. The reason that OO with high PA had stronger ankle plantar flexors was probably because of their active involvement in heavy housework (e.g. cleaning windows and reaching a shelf in a higher place) and heavy gardening (e.g. pruning, mulching, and planting), as well as walking fast and walking uphill. This is the reason for the recommendation to make an effort to do frequent and vigorous activities of daily living.

We recognize limitations for this exploratory study. First, although patterns of PA effectiveness on frailty for YO and OO were traced, due to a small sample size, some frailty

indicators fell short of statistical significance. With a larger sample size, we may be able to detect a clearer pattern with confidence. Second, to measure physical activities with the CHAMPS questionnaire, we relied on participants' self-report of a typical week based on their past four weeks. In two studies, the CHAMPS' test-retest reliability was acceptable ($ICC=.74$ and $.64$) (Harada, et al., 2001; Hekler et al., 2012), but a recall bias exists just like other self-report questionnaires, which may be considered to be over-reported for some items such as walking and housework. In one study, the correlations between the scores of CHAMPS and accelerometry were negative ($r_s=-.012$) for sedentary, and for other PA levels from low-light to high-light and above, it had small correlations ($r_s=.20$ – $r=.3q8$) (Hekler et al., 2012). An accelerometer can be used for estimating energy expenditure, but this is less accurate than a portable metabolic system, especially for frail elderly with soft and short steps. The concurrent validity of a portable metabolic system and the CHAMPS should be established in the future. Finally, a longitudinal study is highly recommended as the changes that occur may be attributed to frequent and vigorous daily activities as opposed to scheduled and structured exercise for men and women of advanced age.

Conclusion

Frailty progresses with aging, but older women who engage in high level of physical activity (>4000 kcal./week) can moderate this relationship. With higher levels of physical activity, the gap between OO and YO women for mobility and functional capacity were reduced; however, the opposite was seen for strength and endurance. Frequent and vigorous engagement in daily activities and brisk walking are beneficial to improve functional status, but they cannot overcome aging effect in muscle strength and endurance. Starting regular resistance training early in the aging process is critical to improve or maintain muscle quality to offset age-related frailty.

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Figure 1a.

Quadiceps strength and endurance for YO and OO for low, medium, and high PA
 Vertical unit: kg for quad strength and 1/100 kg for quad endurance

Figure 1.b.

ADL and step length for YO and OO for low, medium, and high PA
 Vertical unit: points for ADL and cm for step length

Figure 2.
Variances of PA accounted for by variances of walking steps for YO and OO.

Note: In parenthesis are METs

(a)

Note: In parenthesis are METs

Figure 3.

(a) Percent of the number of Young-Old with low or high PA levels who engage in different physical activities. (b) Percent of the number of Old-Old with low or high PA levels who engaged in different physical activities.

Table 1

Measures of frailty indicators for age and physical activity groups (N=46)

	Low PA M (SD)	Medium PA M (SD)	High PA M (SD)	Age effect & PA effect	Parameter estimates Age * PA (high/low)
Grip strength (kg) Young Old Old Old	24.8 (6.5) 18.1 (4.1)	25.9 (6.2) 18.5 (3.5)	26.2 (4.6) 22.0 (3.7)	18.091 (<.001) *** 2.255 (.324)	0.455 (.500)
Strength Quadriceps (kg) Young Old Old Old	12.0 (4.8) 12.3 (5.1)	15.7 (5.7) 11.0 (4.0)	18.4 (4.5) 11.5 (1.9)	7.877 (.005) ** 2.758 (.252)	4.549 (.033) *
Strength Hamstring (kg) Young Old Old Old	4.7 (2.2) 4.7 (3.1)	5.6 (2.4) 3.3 (2.0)	7.6 (2.7) 5.4 (3.9)	3.117 (.077) 5.064 (.079)	1.398 (.237)
Strength Hip Extension (kg) Young Old Old Old	7.8 (3.3) 6.3 (3.3)	10.1 (5.1) 6.6 (2.4)	10.6 (3.7) 8.6 (2.8)	5.033 (.025) * 3.745 (.154)	.042 (.838)
Strength Ankle PF (kg) Young Old Old Old	10.9 (4.3) 9.3 (2.4)	10.2 (5.8) 7.7 (3.9)	14.7 (5.7) 14.2 (1.4)	1.458 (.227) 12.136 (.002) **	3.666 (.056)
Endurance Quadriceps (kg) Young Old Old Old	677 (272) 777 (267)	937 (391) 675 (326)	1153(330) 899 (332)	2.266 (.132) 6.862 (.032) *	4.549 (.033) *
Endurance Hamstring (kg) Young Old Old Old	196 (60) 217 (232)	262 (132) 142 (117)	371 (221) 293 (199)	1.423 (.233) 5.328 (.070)	0.653 (.419)
Balance confidence Young Old Old Old	82.4 (13.1) 79.7 (14.3)	84.4(20.6) 85.6 (6.9)	88.1 (7.8) 90.3 (4.0)	0.004 (.948) 3.172 (.205)	.278 (.598)
TUG (seconds) Young Old Old Old	9.1 (2.3) 15.6 (9.6)	8.7 (1.8) 11.7 (3.5)	8.6 (2.4) 9.5 (2.8)	6.739 (.009) ** 4.238 (.129)	2.807 (.094)
Walking Speed (m/s) Young Old Old Old	1.14 (0.19) 0.82 (0.17)	1.19(0.21) 1.03(0.33)	1.31(0.18) 1.12(0.10)	12.935 (<.001) *** 9.355 (.009) **	3.298 (.069)
Step Length (cm) Young Old Old Old	62.4 (5.7) * 48.7 (8.1)	60.1 (5.9) 53.4 (9.6)	66.2 (8.8) 63.8 (8.1)	5.727 (.017) * 11.493 (.003) **	4.389 (.036) *
ADL -motor Young Old Old Old	88.9 (2.2) 85.8 (3.2)	89.3 (1.8) 88.0 (1.8)	89.1 (2.0) 89.5 (1.3)	4.413 (.036) * 6.814 (.033) *	4.916 (.027) *

*
p .05,**
p .01.***
p .001