Original article

MUSCLE STRENGTH AND KNEE FUNCTIONALITY OF ELDERLY WOMEN PRACTICING WATER AEROBICS

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ABSTRACT: The objective in this study was to relate the lower limb muscle strength with the knee functionality of elderly women practicing water aerobics. A cross-sectional study was developed between June and September 2016 in the city of Maringá, state of Paraná, Brazil. The sample consisted of 147 elderly women practicing water aerobics. The 30-second chair stand test and the Cincinnati questionnaire were used. It was observed that the elderly women presented low levels of lower limb muscle strength [Md = 13 (Q1 = 11; Q3 = 16)]. A significant (p = 0.001) and moderate (r = 0.68) correlation was found between lower limb muscle strength and knee functionality. The moderate correlation between the lower limb muscle strength and knee functionality of the elderly women suggests an important association between these variables.
DESCRIPTORS: Motor activity; Aging; Physical aptitude; Health promotion; Gerontology.

FORÇA MUSCULAR E FUNCIONALIDADE DO JOELHO DE IDOSAS PRATICANTES DE HIDROGINÁSTICA

RESUMO: Este estudo teve como objetivo relacionar a força muscular de membros inferiores com a funcionalidade do joelho de idosas praticantes de hidroginástica. Trata-se se de um estudo transversal realizado entre junho e setembro de 2016 na cidade de Maringá no Paraná. A amostra foi composta por 147 idosas praticantes de hidroginástica. Foi utilizado o teste de levantar e sentar da cadeira por 30 segundos e o questionário Cincinnati. Observou-se que as idosas apresentaram nível fraco de força muscular de membro inferior [Md = 13 (Q1 = 11; Q3 = 16)]. Verificou-se correlação significativa (p = 0,001) e moderada (r = 0,68) entre a força muscular de membros inferiores e a funcionalidade do joelho. A correlação moderada entre a força muscular de membros inferiores e a funcionalidade do joelho das idosas sugere uma importante associação entre essas variáveis.
DESCRITORES: Atividade motora; Envelhecimento; Aptidão física; Promoção da saúde; Gerontologia.

FUERZA MUSCULAR Y FUNCIONALIDAD DE LA RODILLA DE ANCIANAS PRACTICANTES DE AQUAGYM

RESUMEN: El objetivo de este estudio fue relacionar la fuerza muscular de miembros inferiores con la funcionalidad de la rodilla de ancianas practicantes de aquagym. Se trata de un estudio trasversal desarrollado entre junio y septiembre de 2016 en la ciudad de Maringá, estado de Paraná, Brasil. La muestra incluyó a 147 ancianas practicantes de aquagym. Fue utilizado la prueba 30-second chair stand y el cuestionario Cincinnati. Se observó que las ancianas presentaron nivel débil de fuerza muscular de miembro inferior [Md = 13 (Q1 = 11; Q3 = 16)]. Fue verificada correlación significativa (p = 0,001) y moderada (r = 0,68) entre la fuerza muscular de miembros inferiores y la funcionalidad de la rodilla. La correlación moderada entre la fuerza muscular de miembros inferiores y la funcionalidad de la rodilla de las ancianas sugiere una asociación importante entre esas variables.
DESCRIPTORES: Actividad motora; Envejecimiento; Aptitud física; Promoción de la salud; Gerontología.

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INTRODUCTION

Human aging is a process characterized by different physiological, morphological, psychological and social changes that naturally happen in the organism. It can be conceptualized as a dynamic, universal, progressive and individual process[1]. Advanced age triggers cellular, muscle and functional changes, reducing the capacity to maintain homeostasis and, consequently, causing greater disposition to illnesses[2].

Among the different changes that happen as a result of the aging process, those that affect the locomotive system stand out, mainly due to their relation with frailty and functionality, such as the decrease in lean mass, called sarcopenia[3]. The loss of lean mass is related to the loss of strength in aging. Nevertheless, some authors[4-5] propose another name to define the specific loss of strength, called dynapenia[6]. The same authors report that the loss of muscle mass explains only 10% of the loss of strength and disability found in elderly individuals. In a study[7] involving 56 elderly, with an average age of 62.5±5.4 years, a relation was also appointed between muscle mass and muscle strength in the physical performance of elderly individuals, but the muscle strength is a better predictor of physical performance than muscle strength.

The reduction in the lower limb strength affects the functional mobility, increasing the propensity to falls and influencing the walk, an indicator of the risk for autonomy and independence loss in these individuals[8]. Muscle strength is known to be very important in an elderly person's life, as it is required for daily activities[9]. The accomplishment of countless daily tasks largely depends on the lower limb muscle strength[10-11].

When the elderly presents inappropriate functional capacity, he starts to experience difficulties to accomplish those activities, often due to knee pains, as a consequence of weakened lower limb muscles[12-13]. In view of these premises, the importance of physical exercises in this phase of life is highlighted as an important prevention and treatment measure of the locomotive system and of other chronic-degenerative conditions[14].

Physical exercises promote safety in the accomplishment of the Activities of Daily Living (ADLs), guaranteeing functional performance and, consequently, greater independence and autonomy. In a study[15] involving 44 community dwellers, with an average age of 88.75±4.05 years, the importance of physical exercise was emphasized, which during the aging process offer a range of beneficial effects for the functional independence, entailing improvements in the quality of life and ADLs. Among many modalities and practices appropriate for the elderly, one particular practice is focused on, which is water aerobics.

A large number of elderly women practice water aerobics to remain active[16], due to the practicality and the advantages the physical properties of the water promote, helping with joint movements, flexibility gain, low impact and gain of muscle strength, among other benefits[17]. Therefore, the objective in this study was to relate the lower limb muscle strength with the knee functionality in elderly women practicing water aerobics.

METHOD

The non-probabilistic convenience sample consisted of 147 elderly women practicing water aerobics at health clubs in the city of Maringá, state of Paraná (PR), which offered this modality. The data were collected with the authorization of the nine health clubs that offer this modality in the city of Maringá-PR between June and August 2016.

Female elderly aged 60 years or older were included, who had exclusively practiced water aerobics two times per week for at least three months. Elderly women who practiced more than one exercise modality (besides water aerobics) and who suffered from auditory and visual impairments that made it impossible to apply the questionnaires were excluded. The women with knee and/or hip prosthesis and using a walking aid were also excluded.

As a measure, a sociodemographic questionnaire was used which the authors themselves had

elaborated, including questions like age, age range (60 to 70 years, 71 years or older), monthly income in minimum wages (MW) (R$ 880.00, according to MW for 2016), education level, race, retirement, employment situation, marital situation, length of practice of water aerobics, weekly attendance, medication used, perceived health, motives leading to the practice of water aerobics, smoking, presence of pains during water aerobics practice.

For the knee functionality, the Cincinnati questionnaire was applied, validated in Portuguese, which is divided in eight questions and scores different items related to pain, instability and movement capacity. A normal knee corresponds to 100 points. Thus, the extent to which the affected knee makes it difficult for the patient to accomplish routine activities can be verified when the total score is closer to 0, while scores closer to 100 indicate a normal knee without limitations(18).

The 30-second chair stand test (CST) was also applied, acquired from the functional assessment protocol for elderly by Rikli and Jones, validated for the Brazilian population, which is intended to assess the lower limb muscle strength and resistance. The test was executed on a chair of 43 centimeters high, without upper limb support, with backrest, standing against the wall. In the test, the subject starts sitting down with the feet on the floor and the arms crossed against the chest. Upon the evaluator's command, the participant stands up to the fully standing position and then returns to the sitting position. The elderly were encouraged to complete this action as many times as possible within 30 seconds and the score corresponds to the total number of correct executions. The test was executed three times, considering only the best result(19).

A quantitative and observational study with a cross-sectional design was undertaken. This study received approval from the Ethics Committee for Research involving Human Beings at the *Centro Universitário de Maringá*, registered under opinion number 1.769.637. Initially, the elderly were informed about the justification and objectives of the study, and the women who accepted signed the free and informed consent form. The research tools were collected at the health clubs always before the elderly women's water aerobics training, at previously checked times.

To analyze the data, frequency and percentage were used for the categorical variables. For the numerical variables, initially, the normality of the data was verified using the Kolmogorov-Smirnov test. As the data did not present normal distribution, Medians (Md) and Quartiles (Q1; Q3) were used to characterize the results. To compare the lower limb muscle strength and knee functionality in function of the age range (up to 70 years and more than 70 years), Mann-Whitney's U-test was used. To verify the correlation between the lower limb muscle strength and knee functionality, Spearman's correlation coefficient was used. Significance was set at $p<0.05$.

RESULTS

The mean age of the elderly was 69.4 ± 6.9 years. The analysis of the sample characteristics showed that 88 (59.9%) were between 60 and 70 years of age, 128 (87.1%) were white, 116 (78.9%) were retired, 123 (83.7%) gained a monthly income of more than two minimum wages and 132 (89.8%) were professionally active. It was also observed that 74 elderly (50.3%) were married (Table 1).

Table 1 – Frequency distribution of the sociodemographic profile of elderly women practicing water aerobics. Maringá, PR, Brazil, 2016 (continues)

VARIABLES	N	%
Marital status		
Married	74	50.3
Not married	73	49.7
Age range		
60 to 70 years	88	59.9
71 to 80 years	52	35.3
Older than 80 years of age	7	4.8

Monthly income		
Up to 2 minimum wages	24	16.3
2 to 3 minimum wages	56	38.1
More than 3 minimum wages	67	45.6
Education		
Illiterate	9	6.1
Unfinished Primary	27	18.4
Finished Primary	41	27.9
Finished Secondary/Higher	70	47.6
Race		
White	128	87.1
Caucasian/Black	14	9.5
Asiatic	5	3.4
Retirement		
Yes	116	78.9
No	31	21.1
Employment Situation		
Active	132	89.8
Not-active	15	10.2

What the health and exercise profile of the elderly women practicing water aerobics is concerned (Table 2), it was verified that most of them had practiced water aerobics for more than five years (n=72/49%), regularly took three or more medicines (n=55/37.4%) and did not feel pain while practicing water aerobics (n=137/93.2%). As for the lower limb muscle strength, only nine (6.1%) elderly obtained very good scores on the CST. Concerning the number of repetitions on this test, the elderly women presented weak muscle strength [Md = 13 (Q1 = 11; Q3 = 16)].

Table 2 – Frequency distribution of health and exercise profile in elderly women practicing water aerobics. Maringá, PR, Brazil, 2016

VARIABLES	**N**	**%**
Length of exercise practice		
3 months to 1 year	15	10.2
1.1 to 3 years	26	17.7
3.1 to 5 years	34	23.1
More than 5 years	72	49
Medication use		
Does not use	14	9.5
1 medicine	27	18.4
2 medicines	51	34.7
3 or more medicines	55	37.4
Feels knee pain during practice		
No	137	93.2
Yes	10	6.8
Chair Stand Test (Lower limb muscle strength)		
Very weak	48	32.7
Weak	36	24.5
Regular	35	23.8
Good	19	12.9
Very Good	9	6.1

What the knee functionality is concerned, it was also verified that the elderly women's functionality was good [Md = 87 (Q1 = 74; Q3 = 96)].

When comparing the muscle strength and knee functionality of the elderly women practicing water aerobics in function of the age range (Figure 1), a significant difference was found in muscle strength (p = 0.001) as well as in knee functionality (p = 0.003), evidencing that that the elderly women in the age range of up to 70 years presented better knee functionality (Md = 88.0) and lower limb muscle strength (Md = 14.5) than the elderly over 70 years of age (Md = 83 and 12, respectively).

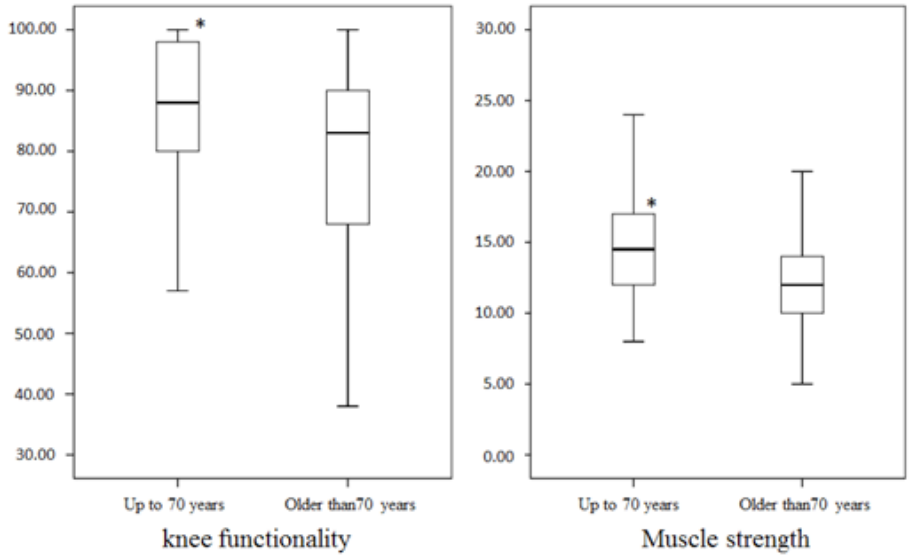

Figure 1 – Comparison of muscle strength and knee functionality of elderly women practicing water aerobics in function of the age range. *Significant difference (p<0.05) – Mann-Whitney's U-test. Maringá, PR, Brazil, 2016.

A significant (p=0.001) and moderate (r=0.68) correlation was found between lower limb muscle strength (CST test) and knee functionality (Cincinatti questionnaire), indicating that, the greater the muscle strength, the better the knee functionality, or vice-versa (Figure 2).

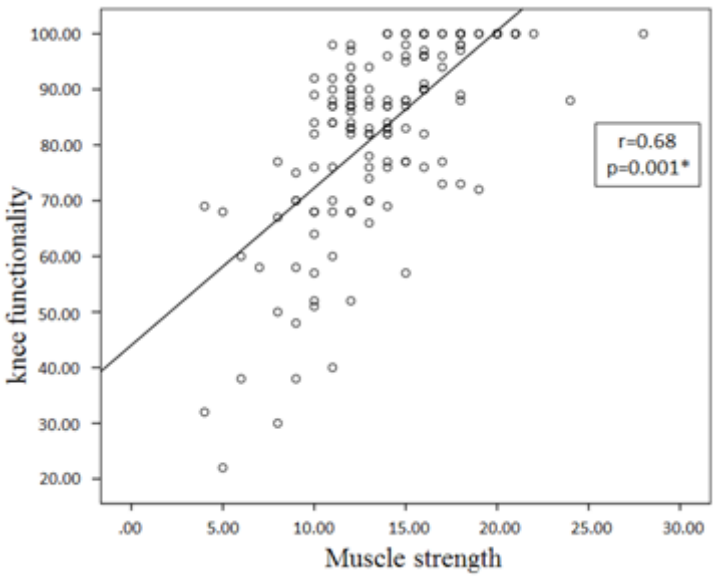

Figure 2 – Correlation between muscle strength and knee functionality of elderly women practicing water aerobics. *Significant Correlation (p<0.05) – Spearman Correlation. Maringá, PR, Brazil, 2016.

DISCUSSION

In this study, it was identified that most of the elderly women presented weak or very weak muscle strength on the 30-second chair stand test. The lower limb muscle strength was moderately correlated with the elderly women's knee functionality.

Assessing the muscle strength and function in the aging process is fundamental due to its relation with the elderly's autonomy, considering that the execution of daily activities requires certain levels of strength[20]. In his study, the same author concludes that maintaining good strength levels is necessary for the satisfactory performance of daily tasks, these being professional or daily activities, and for the maintenance of a good quality of life independently of the age.

The muscle strength, which can be defined as the ability of the muscle to create tension and its quality in a certain movement, peaks around the age of 30 years, after which the muscle decline starts. After the age of 60 years, the loss of muscle strength is aggravated and is responsible for the considerable motor deficits observed in individuals of this age range[21-22]. The decline in muscle strength is more enhanced as from the age of 60 years[23], mainly in women and specifically in the lower limbs, being associated with the decrease in the level of physical activity, besides nutritional, hormonal, endocrine and neurological factors[24].

Moreover, the research participants were expected to present significantly better strength levels than what was found, due to the fact that most of the elderly had practiced water aerobics for at least three months. In a study[25] involving 16 women in Foz do Iguaçu, it is appointed that the improvement in the elderly persons' amount of strength happens relatively quickly and can be identified on average in two months.

In another study[26], executed in Fortaleza, 26 elderly women who attended the *Serviço Social do Comércio*, between 60 and 80 years of age, report that, during water aerobics, one needs to defeat the resistance of the water, and that the exercises performed in this midst demand more strength than when executed on the floor. Nevertheless, the resistance depends on the speed and the shape of the part being moved in order to exert some degree of muscle tension. The choice of the test applied offers the advantage that it requires continuous movement, similar to what is required in the modality, so that the data obtained can contribute to a more precise estimate of the lower limb strength.

The results found in the comparison between the different age ranges support the findings in the literature. A statistically significant difference was verified between the elderly aged between 60 and 70 years and 71 years or older, indicating that the elder elderly women had less muscle strength than the younger ones. The downward trend of the averages with age is confirmed in function of the loss of strength and muscle mass. In a study[27] involving 59 elderly, being one group practicing water aerobics and another practicing aerobics for at least six months, no significant differences were found in the lower limb strength levels when the same 30-second chair stand test was performed in both age ranges.

Other authors(28) also found significant results for the lower limb strength of 21 elderly women submitted to water aerobics twice a week during 72 weeks in Florianópolis. In another study[29] developed in Ipatinga, including 26 elderly women with a mean age of 71±5.7 years, who used the same test to assess the lower limb strength of elderly women practicing water aerobics, the results reached in the sample were higher than the reference data in another study[9] developed in Ceará, which used the CST in 30 women practicing water aerobics and 30 women in the control group. The women in the first group practiced water aerobics twice a week for three months. The practitioners' post-test indicated increased lower limb strength when compared to the pre-test in the same group, and also when compared to the post-test of the control group.

In this study, the elderly women presented good knee functionality despite the change in the lower limb muscle strength, in view of the relation between the muscles involves in the knee joint. The knee extensor and flexor muscles stabilize the joint and the decreased strength of these muscle groups reduces the capacity to protect that joint[3].

As age advances, the elasticity and stability of the muscles, tendons and ligaments worsen, the transverse area of the muscles decreases due to the muscle atrophy and the muscle mass is reduced

in proportion to the body weight, causing a drop in muscle strength[20]. Background studies provide evidence that, when preserved, the strength of the knee extensor muscles is associated with a better performance in the activities of daily living and even with a greater prevention of falls[4].

This study is important because the knee functionality is essential for the elderly to perform the activities of daily living, which improve the quality of life. Besides its physiological benefits, regular exercise is considered a practice and space that promotes elderly health. This evidences that the health professionals should act in an interdisciplinary manner, based on these results, to propose strategies and health actions.

The limitations in this study are the sample, which included only female elderly, a fact that impeded the gender comparison of the lower limb strength and knee functionality; only elderly from the city of Maringá, state of Paraná, which does not represent the elderly population practicing water aerobics in general, but from a single location.

CONCLUSION

The findings in this study indicate the frailty of elderly women practicing water aerobics in terms of muscle strength. The moderate correlation between the lower limb muscle strength and the knee functionality of these women suggests an important association between these variables and indicates, in turn, the need to intensify the work of the muscle groups acting in that joint.

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