

HAND GRIP STRENGTH AND QUALITY OF LIFE IN OLDER ADULTS PRACTICING PILATES METHOD EXERCISES: A CROSS-SECTIONAL STUDY

FORÇA DE PREENSÃO MANUAL E QUALIDADE DE VIDA EM PESSOAS IDOSAS PRATICANTES DE EXERCÍCIOS DO MÉTODO PILATES: UM ESTUDO TRANSVERSAL

Amanda Tami Kuroda Colevate¹, José Roberto Andrade do Nascimento Júnior², Eduardo Quadros da Silva¹, Priscila Ester de Lima Cruz¹, Daniel Vicentini de Oliveira¹

¹Cesumar University, Maringá-PR, Brazil.

²Federal University of Vale do São Francisco, Petrolina-PE, Brazil.

ABSTRACT

This cross-sectional study assessed the quality of life and hand grip strength in 71 older adults practicing Pilates method exercises. The WHOQOL-Bref, WHOQOL-Old, and handgrip dynamometer tests were utilized. Data were analyzed using the Kolmogorov-Smirnov test, skewness and kurtosis coefficients, bootstrap procedure, Pearson correlation, and t-test ($p < 0.05$). No significant correlations ($p > 0.05$) were found between handgrip strength and the domains and facets of quality of life. However, positive and significant correlations ($p < 0.05$) were observed among the domains and aspects of quality of life. There was no significant difference ($p > 0.05$) in comparing the quality of life domains and facets among older adults practicing Pilates based on the degree of handgrip strength. Although handgrip strength did not show significant correlations with the various domains and aspects of quality of life in older individuals practicing Pilates, positive associations were observed among these different aspects.

Keywords: Aging. Motor activity. Quality of life. Hand strength.

RESUMO

Este estudo transversal teve o objetivo de avaliar a qualidade de vida e força de preensão manual em 71 pessoas idosas que praticam exercícios do Método Pilates. Foi utilizado o WHOQOL-Bref, o WHOQOL-Old e o teste de preensão manual com dinamômetro. Os dados foram analisados pelo teste de Kolmogorov-Smirnov, coeficientes de assimetria e curtose, procedimento de bootstrap, correlação de Pearson e teste t ($p < 0,05$). Não foram encontradas correlações significativas ($p > 0,05$) entre a força de preensão manual e os domínios e facetas da qualidade de vida. No entanto, foram encontradas correlações positivas e importantes ($p < 0,05$) entre os domínios e facetas da qualidade de vida. Não foi encontrada diferença significativa ($p > 0,05$) na comparação dos domínios e facetas da qualidade de vida entre idosos praticantes de Pilates com base no grau de força de preensão manual. Embora a força de preensão manual não tenha mostrado correlações significativas com os vários domínios e facetas da qualidade de vida em pessoas idosas que praticam Pilates, foram observadas associações positivas entre esses diferentes aspectos.

Palavras-chave: Envelhecimento. Atividade motora. Qualidade de vida. Força da mão.

Introduction

The aging process involves physical, physiological, and psychosocial changes¹. The complexity of this process is exacerbated by social inequality in health, which directly influences the losses, risks, and vulnerabilities older adults face². In the physical context, changes resulting from aging often lead to loss of functionality, especially regarding muscle strength³. This loss increases the risk of falls, fractures, and chronic diseases and significantly impacts older adults' quality of life (QoL)^{4,5}.

Studies have shown that various factors, including physical condition and muscle strength⁶⁻⁸, influence the quality of life in old age. Therefore, maintaining muscle strength is crucial to ensure good QoL in old age.

Muscle strength, a fundamental component of health-related physical fitness, is crucial in older adults' daily activities and QoL⁹. Hand grip strength, a reliable indicator of overall functional capacity, is correlated with strength in other body parts, further validating its

significance⁴. With advancing age, the progressive loss of muscle strength estimated by hand grip strength can result in poorer health-related QoL¹⁰.

Hand grip strength in older adults has been considered an important indicator of health and functionality, potentially impacting QoL during this phase¹⁰. This association can be attributed to the importance of muscle strength for performing daily activities and maintaining functional independence. The potential of this parameter to improve health and well-being in old age is highlighted¹¹.

Additionally, engaging in physical exercises like the Pilates Method may be essential in preserving muscle strength and improving older adults' QoL. With its principles of concentration, centralization, and control, this method has been widely recognized for its benefits for physical and mental health⁷.

The justification for conducting this research lies in the need to fill an existing gap in the literature regarding the relationship between hand grip strength and QoL in older adults who practice Pilates Method exercises. Although there is a general recognition of Pilates's benefits for physical and mental health, few studies^{12,13} investigate these effects in older adults, especially concerning the relationship between muscle strength and QoL in this population. Therefore, this study aimed to assess the QoL and hand grip strength in older adults practicing Pilates method exercises.

Methods

This is an observational and cross-sectional study, approved by the Ethics Committee on Research with Human Beings of the Cesumar University (Unicesumar) through opinion number 2.305.312, built by the Reporting of Observational Studies in Epidemiology (STROBE).

The sample, intentionally and conveniently selected, consisted of 71 older adults of both sexes, practitioners of Pilates Method exercises, in seven clinics/gyms/studios in Maringá, Paraná. Older adults using walking aids (cane, walker, among others) and wheelchair users were excluded from the research; older adults with visual, auditory, and cognitive impairments disabling them from taking the test and completing the questionnaires were also excluded.

For the characterization of older adults, a sociodemographic questionnaire was used, with questions regarding age, sex, race, education, smoking, retirement, self-perception of health, occupational status, income in the minimum wage, marital status, number of medications used, presence of diseases, history of falls in the last six months, time of practice, and weekly frequency of Pilates Method exercise practice.

The World Health Organization Quality of Life Bref (WHOQOL-bref) and the World Health Organization Quality of Life Old (WHOQOL-Old) assessed QoL. The WHOQOL-bref is an abbreviated version of the World Health Organization's quality of life assessment questionnaire. It consists of 26 questions, two of which refer to individual perceptions of QoL and health, and the rest are subdivided into physical, psychological, social relationships, and environmental domains. Each domain scores from four to 20 points, with higher scores indicating better QoL in the evaluated domain¹⁴.

The WHOQOL-Old is an additional questionnaire used alongside the WHOQOL-bref to investigate the QoL in older adults, including relevant aspects not covered by instruments designed initially for non-older populations. It comprises 24 facets, attributed to six domains: sensory functioning, autonomy, past, present, and future activities, social participation, death and dying, and intimacy. Each item presents four questions. Each facet scores four to 20 points, with higher scores indicating a better QoL in the evaluated facet^{15,16}.

Handgrip strength was evaluated using a digital manual dynamometer, adopting the unit of measurement in kilograms (kg). The older adult remained seated in a chair with the arm of

the dominant limb adducted and in neutral rotation, with the elbow flexed at 90° and forearm and wrist in neutral rotation. The grip was self-adjusted, according to the older adult's report of greater comfort, and after observing the correct position of the device, whose rod will be positioned between the second phalanges of the fingers (index, middle, and ring). At the evaluator's voice command, the older adult exerted maximum force to bring the two rods of the device closer together. Three measurements were collected with a one-minute rest interval between them, using the highest value obtained¹⁷. The measurement methodology was based on the instructions described in the manufacturer's manual. The reference values used to assess handgrip strength were less than 27 kg/f for men and less than 16 kg/f for women. These values are considered below average and indicate weakness, serving as an important criterion for identifying potential impairments in muscle strength among the individuals assessed¹⁷.

Firstly, a detailed search was conducted to identify establishments offering Pilates apparatus exercises, including studios, clinics, and gyms. Seven locations were selected. Researchers contacted these establishments to explain the objectives and methodology of the study. All seven locations agreed, and visits were scheduled for the days and times when older adults would be present.

During these visits, researchers informed older adults about the procedures and details of the research. Those who agreed to participate signed the Informed Consent Form. Data collection lasted an average of 20 minutes per person between July and October 2023.

Data analysis was performed using SPSS 25.0 software, employing descriptive and inferential statistical approaches. Frequency and percentage were used as descriptive measures for categorical variables. Data normality was assessed using the Kolmogorov-Smirnov test, and skewness and kurtosis coefficients were used for numerical variables. Additionally, bootstrapping procedures (1000 resamples; 95% CI BCa) were conducted to enhance result reliability, correct potential deviations from a standard sample distribution, account for differences in group sizes, and provide a 95% confidence interval for means¹⁸. Mean and standard deviation were used as measures of central tendency and dispersion. Pearson correlation was employed to investigate the relationship between handgrip strength and the domains and facets of older adults' QoL. Independent samples t-test was used to compare the QoL domains and facets based on handgrip strength. A significance level of $p < 0.05$ was adopted.

Results

Seventy-one older adults practicing Pilates participated in the study, including females ($n = 57$) and males ($n = 14$), with ages ranging from 60 to 93 years ($M = 71.52$; $SD = 7.68$). Data from Table 1 reveal the predominance of older adults under 80 years old (81.7%), with a partner (54.9%), with completed high school or higher education (70.4%), of white ethnicity (78.9%), retired (84.5%), not currently employed (60.6%), and with a monthly income of more than three minimum wages (62.0%).

Table 1. Sociodemographic Profile of Older Adults Practicing Pilates Participating in the Research. Maringá, 2023.

VARIABLES	<i>f</i>	%
Gender		
Female	57	80.3
Male	14	19.7
Age Group		
60 to 69 years	32	45.1
70 to 79 years	26	36.6
80 years or older	13	18.3
Marital Status		
With partner	39	54.9
Without partner	32	45.1
Education		
No schooling	2	2.8
Incomplete primary education	11	15.5
Complete primary education	8	11.3
Complete secondary education	15	21.1
Complete higher education	35	49.3
Race/Ethnicity		
White	56	78.9
Black/Brown	4	5.6
Others	11	15.5
Monthly Income		
1 to 2 MW	7	9.8
2.1 to 3 MW	20	28.2
More than 3 MW	44	62.0
Retirement		
Yes	60	84.5
No	11	15.5
Occupational Status		
Employed	28	39.4
Unemployed	43	60.6

Note: MW: minimum wage.

Source: Authors.

According to the results from Table 2, the majority of older adults reported perceiving themselves to be in good health (67.6%), using between one and three medications regularly (54.9%), having some NCDs (53.5%), practicing Pilates for more than a year (73.2%), with a weekly frequency of two or more times (95.8%), and not engaging in any other exercise (59.2%). Finally, it is noted that 94.4% of older adults exhibited an average degree of handgrip strength, while 5.6% exhibited a below-normal degree.

Table 2. Health and Pilates Practice Profile of Older Adults Participants in the Research. Maringá, 2023.

VARIABLES	<i>f</i>	%
-----------	----------	---

Health Perception		
Good	48	67.6
Fair	23	32.4
Medication Use		
None	7	9.9
1 to 3	39	54.9
More than 3	25	35.2
Presence of NCDs		
No	33	46.5
Yes	38	53.5
Length of Pilates Practice		
Less than one year	19	26.8
1.1 to 4 years	28	39.4
More than four years	24	33.8
Weekly Frequency of Pilates Practice		
Once	10	14.1
Twice or more	61	95.8
Engagement in Other Exercises		
Yes	29	40.8
No	42	59.2
Hand Grip Strength		
Below	4	5.6
Normal	67	94.4

NCDs: Non-Communicable Diseases.

Source: Authors.

It can be observed from Table 3 that, overall, older adults exhibited a typical result in handgrip strength ($M = 26.53$; $SD = 7.89$). Regarding the QoL domains, higher scores were observed in the self-assessment domain ($M = 16.34$; $SD = 2.51$), followed by the psychological ($M = 15.83$; $SD = 2.25$), physical ($M = 15.76$; $SD = 2.56$), social relationships ($M = 15.72$; $SD = 2.11$), and environmental ($M = 15.38$; $SD = 2.48$) domains. Finally, the highest means in QoL facets were in the sensory functioning facet ($M = 74.73$; $SD = 19.60$), past, present, and future activities facet ($M = 71.92$; $SD = 13.48$), and intimacy facet ($M = 71.65$; $SD = 20.37$).

Table 3. Descriptive statistics and correlations between handgrip strength and the domains and facets of quality of life of older adults Pilates practitioners.

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. Handgrip strength	-	0.12	0.12	0.05	0.07	0.01	0.05	0.16	0.10	0.09	-0.01	0.22
2. Physical domain		-	0.72*	0.56*	0.65	0.79*	0.42	0.46*	0.49*	0.54*	0.25*	0.33
					*		*					*
3. Psychological domain			-	0.67*	0.68	0.69*	0.41	0.34*	0.61*	0.65*	0.32*	0.44
					*		*					*
4. Social relations domain				-	0.53	0.53*	0.27	0.19	0.54*	0.63*	0.24*	0.49
					*		*					*
5. Environmental domain					-	0.60*	0.35	0.57*	0.69*	0.55*	0.09	0.42
							*					*
6. Self-evaluation domain						-	0.35	0.30*	0.50*	0.48*	0.26*	0.20
							*					*
7. Sensory functioning							-	0.28*	0.26*	0.24*	0.41*	0.20
8. Autonomy								-	0.48*	0.38*	-0.05	0.38
												*
9. PPFA									-	0.78*	0.16	0.38
												*

10. Social participation										-	0.19	0.39
11. Death and Dying											-	0.17
12. Intimacy												
Mean	26.53	15.76	15.83	15.38	15.7	16.34	74.7	67.08	71.92	69.80	69.28	71.6
					2		3					5
Standard Deviation	7.89	2.56	2.24	2.48	2.11	2.51	19.6	19.97	13.48	15.49	23.40	20.3
							0					7

Note: Pearson correlation - * $p < 0.05$. PPAF: Past, present, and future activities.

Source: Authors.

When analyzing the correlations between handgrip strength and the domains and facets of older adults' QoL (Table 3), no significant correlations ($p > 0.05$) were found between handgrip strength and the domains and facets of QoL. However, important ($p < 0.05$) and positive correlations were found among the domains and aspects of QoL.

No significant difference ($p > 0.05$) was found in the comparison of the domains and facets of QoL among older adults practicing Pilates based on the degree of handgrip strength (Table 4).

Table 4. Comparison of domains and facets of quality of life among older adults Pilates practitioners, according to the degree of manual grip strength.

VARIABLES	Manual grip strength		<i>p</i>
	Below normal	Normal	
	(<i>n</i> =4)	(<i>n</i> =67)	
	M (SD)	M (SD)	
Domains of Quality of Life			
Physical	14.86 (3.96)	15.82 (2.49)	0.469
Psychological	14.17 (3.05)	15.93 (2.18)	0.128
Social relations	16.00 (2.88)	15.34 (2.47)	0.610
Environment	15.12 (1.65)	15.76 (2.14)	0.562
Self-assessment	16.00 (2.83)	16.36 (2.51)	0.784
Facets of Quality of Life			
Sensory functioning	92.19 (5.98)	73.69 (19.66)	0.066
Autonomy	73.44 (21.27)	66.70 (16.80)	0.444
PPAF	62.50 (16.13)	72.48 (13.24)	0.152
Social participation	56.25 (21.65)	70.61 (14.88)	0.071
Death and Dying	84.37 (13.01)	68.38 (23.63)	0.186
Intimacy	82.81 (13.86)	70.99 (20.58)	0.262

Note: *Significant difference: $p < 0.05$ - Independent t-test. PPAF: Past, present, and future activities.

Source: Authors.

Discussion

The main findings of this study indicate that older individuals who practice Pilates Method exercises have normal levels of handgrip strength and better QoL in the self-assessment domain and the sensory functioning facet but worse QoL in the psychological domain and the intimacy facet. Furthermore, no relationship was found between handgrip strength and QoL.

The finding that older individuals practicing Pilates Method exercises have normal handgrip strength can be justified by several factors. One of them is that Pilates is an exercise modality that emphasizes muscular strengthening throughout the body, including the hands and forearms¹⁹. During Pilates sessions, practitioners perform various exercises to strengthen muscles in the core, lower limbs, and upper limbs^{20,21}. This can increase overall muscle strength, including the ability to perform a firm and practical handgrip.

Pilates Method promotes body awareness, motor control, and postural stability²². Many Pilates exercises require concentration, precise movement control, and coordination among different muscle groups²³. Regularly practicing these exercises can improve neuromuscular coordination and the ability to perform exact and controlled movements, including handgrip.

A study by Aibar-Almazán et al.²⁴ examined the effects of a Pilates program on older adults and observed significant improvements in handgrip strength post-intervention. The results indicated that Pilates can effectively enhance muscular strength in older adults, including handgrip strength, which is crucial for functionality and independence in this population.

Older adults have better QoL in the self-assessment and sensory functioning domains. Pilates is an exercise modality that promotes a holistic approach to well-being, focusing on physical and mental health²⁵. During Pilates sessions, practitioners are encouraged to develop body awareness, respiratory control, and mental focus, leading to greater self-awareness and self-confidence. These psychological aspects may contribute to better self-assessment of QoL among older adults, positively influencing their perception of their health and well-being. This finding is consistent with the prospective longitudinal study with intervention by Gandolfi et al.²⁶, which evaluated the effects of Pilates on QoL in older women and obtained significant results in QoL scores compared to the control group.

Additionally, Pilates improves posture, balance, and coordination and promotes muscular strength and flexibility. These physical benefits can translate into greater comfort and ease in daily activities^{25,27,28}, contributing to a better perception of sensory functioning. For example, older adults who practice Pilates may experience less pain, stiffness, and physical discomfort, which can improve their ability to perform daily tasks such as walking, getting up, and doing household chores^{29,30}. This result is also discussed in the systematic review by Denham-Jones et al.³¹, as the authors sought to assess the effectiveness of Pilates in reducing pain and physical disability, as well as improving functionality and quality of life in older adults, showing significant effects of the method on disability, physical function, QoL, and pain in the back, neck, and knee of older individuals.

Similarly, the social aspect of Pilates can also significantly improve QoL for older adults. Pilates classes provide an opportunity for social interaction, which can reduce social isolation and promote a sense of belonging and connection with others. Participation in a group setting can also increase motivation and commitment to regular exercise, which can have long-term positive effects on physical and mental health³²⁻³⁴.

The present study observed that older adults have worse QoL in the psychological and intimacy domains. One possible explanation is that while Pilates is widely recognized for its physical benefits, such as improved strength, flexibility, and balance³⁵, it may not be as effective in addressing specific psychological issues such as anxiety, depression, or self-esteem. However, in the study by Farzane and Jahromi³⁶, it was demonstrated that Pilates training in older women led to a significant decrease in anxiety and depression, suggesting that Pilates can be a practical approach to modulating these psychological problems.

Another possibility is that older adults starting Pilates may have unrealistic expectations about the expected outcomes, especially regarding the psychological aspects of QoL. They may expect Pilates to improve not only their physical health but also their mental health and emotional well-being. If these expectations are not met, it could lead to a negative perception of QoL in the psychological and intimacy domains. Additionally, it is essential to consider that older adults who pursue Pilates may be dealing with specific health challenges, such as chronic pain, injuries, or mobility issues, which can negatively impact their QoL in various aspects, including psychological and intimacy domains^{37,38}.

Similarly, the lack of social interaction during Pilates sessions can contribute to the negative perception of QoL in the psychological and intimacy domains. Unlike activities such as group classes or group therapies, where participants have the opportunity to interact and

share experiences, Pilates sessions may be more focused on individual work, which can lead to loneliness and social isolation for some older adults.

We did not find a relationship between handgrip strength and QoL. One possible explanation is that although handgrip strength is an essential indicator of physical health and functionality³⁹, it may not directly determine QoL in all aspects. While handgrip strength may influence certain daily activities and the ability to perform physical tasks⁴⁰, other factors such as mental health, social relationships, autonomy, and emotional well-being also play a significant role in overall QoL perception⁴¹.

In contrast to the findings in our study, the article by Park et al.¹¹ concluded that handgrip strength is associated with the presence of osteoporosis and low health-related quality of life. At the same time, Halaweh¹⁰ demonstrated in their study that maintaining handgrip strength can improve the QoL of older adults aged 60.

Furthermore, Pilates's benefits for QoL may be more closely related to other physical aspects, such as flexibility, balance, posture, and motor control^{29,42}, rather than solely handgrip strength. Pilates is renowned for promoting overall muscular function, body awareness, and emotional well-being, contributing to a more positive perception of QoL^{23,25,31}, regardless of handgrip strength.

The research has some limitations. Firstly, due to its cross-sectional nature, the study does not allow for establishing cause-and-effect relationships between handgrip strength and QoL. While it provides a snapshot of the measured variables, it is impossible to determine whether handgrip strength directly influences the perception of QoL over time. Additionally, the sample used is limited in representativeness. Thus, the results must be more generalizable to the older population practicing Pilates. A more diverse sample regarding age, gender, and health conditions could provide more comprehensive insights into the relationship between these variables.

Another relevant point is that the study did not control for other relevant variables that could influence handgrip strength and participants' QoL. Factors such as pre-existing medical conditions and psychosocial aspects were not controlled or explored, which could impact the findings.

Therefore, while it offers valuable information on handgrip strength and QoL among older adult Pilates practitioners, it is essential to interpret the results considering these potential methodological and sampling limitations. Future studies with longitudinal approaches and more representative samples could provide more robust evidence of this relationship.

Conclusion

It is concluded that most older adults practicing Pilates method exercises exhibited good hand grip strength. The highest QoL scores were in self-assessment, followed by the psychological, physical, social relationships, and environmental domains. The QoL facets with the best performances were sensory functioning, past, present, and future activities, and intimacy. Hand grip strength did not correlate with the domains and facets of QoL.

Furthermore, Pilates exercises may benefit the QoL of older individuals in other ways, emphasizing the importance of holistic and integrated approaches in caring for and promoting the health of this population. Therefore, movement professionals should consider strategies that address physical, emotional, social, and environmental aspects to enhance QoL among older adults.

References

1. López-Otín C, Blasco MA, Partridge L, Serrano M, Kroemer G. Hallmarks of aging: An expanding universe. *Cell*. 2023 Jan 19;186(2):243-278. DOI: <https://doi.org/10.1016/j.cell.2022.11.001>.
2. Dziechciaż M, Filip R. Biological psychological and social determinants of old age: bio-psycho-social aspects of human aging. *Ann Agric Environ Med*. 2014;21(4):835-8. DOI: <https://doi.org/10.5604/12321966.1129943>.
3. Curi VS, Haas AN, Alves-Vilaça J, Fernandes HM. Effects of 16-weeks of Pilates on functional autonomy and life satisfaction among elderly women. *J Bodyw Mov Ther*. 2018 Apr;22(2):424-429. DOI: <https://doi.org/10.1016/j.jbmt.2017.06.014>.
4. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, Cooper C, Landi F, Rolland Y, Sayer AA, Schneider SM, Sieber CC, Topinkova E, Vandewoude M, Visser M, Zamboni M; Writing Group for the European Working Group on Sarcopenia in Older People 2 (EWGSOP2), and the Extended Group for EWGSOP2. Sarcopenia: revised European consensus on definition and diagnosis. *Age Ageing*. 2019 Jan 1;48(1):16-31. DOI: <https://doi.org/10.1093/ageing/afy169>.
5. Bhasin S, Travison TG, Manini TM, Patel S, Pencina KM, Fielding RA, Magaziner JM, Newman AB, Kiel DP, Cooper C, Guralnik JM, Cauley JA, Arai H, Clark BC, Landi F, Schaap LA, Pereira SL, Rooks D, Woo J, Woodhouse LJ, Binder E, Brown T, Shardell M, Xue QL, D'Agostino RB Sr, Orwig D, Gorsicki G, Correa-De-Araujo R, Cawthon PM. Sarcopenia Definition: The Position Statements of the Sarcopenia Definition and Outcomes Consortium. *J Am Geriatr Soc*. 2020 Jul;68(7):1410-1418. DOI: <https://doi.org/10.1111/jgs.16372>.
6. Oliveira DV, Peres PM, Moreira CR, Pereira DA, Silva NA, Silva SE, Nascimento Júnior JR. Quality of life and functional capacity of physically active elderly people: possible relationships. *Rev Aten Saúde*. 2022;20(71):12-19. DOI: <https://doi.org/10.13037/ras.vol20n71.8138>.
7. Marques NR, Bezerra MAC, Dias JMD, Dias RC. Associação entre força de preensão manual e qualidade de vida de idosos. *Rev Bras Geriatr Gerontol*. 2019;22(6). DOI: <https://doi.org/10.1590/1981-22562019022.190169>.
8. Silva FR, Santana PC, Silva CA. Determinantes da qualidade de vida de idosos: Um estudo exploratório. *Rev Bras Geriatr Gerontol*. 2020;23(1). DOI: <https://doi.org/10.1590/1981-22562020023.190141>.
9. Bohannon RW. Grip Strength: An Indispensable Biomarker For Older Adults. *Clin Interv Aging*. 2019 Oct 1;14:1681-1691. DOI: <https://doi.org/10.2147/CIA.S194543>.
10. Halaweh H. Correlation between Health-Related Quality of Life and Hand Grip Strength among Older Adults. *Exp Aging Res*. 2020 Mar-Apr;46(2):178-191. DOI: <https://doi.org/10.1080/0361073X.2020.1716157>.
11. Park HJ, Han B, Chang SY, Kang SH, Lee DW, Kang S. Hand Grip Strength, Osteoporosis, and Quality of Life in Middle-Aged and Older Adults. *Medicina (Kaunas)*. 2023 Dec 11;59(12):2148. DOI: <https://doi.org/10.3390/medicina59122148>.
12. Patti, A., Bianco, A., Paoli, A., Messina, G., Montalto, M. A., Bellafore, M., & Battaglia, G. (2019). Effects of Pilates exercise programs in people with chronic low back pain: a systematic review. *Medicine*, 98(8), e14723. DOI: <https://doi.org/10.1097/MD.00000000000014723>
13. Gomes, M. M., Pinheiro, M. H. S., Moreira, D. A., Marinho, P. E. B., Cabral, C. M. N., & Pimenta, F. M. (2020). Effects of Pilates method on muscle strength, physical performance, and quality of life of elderly: A systematic review. *Fisioterapia e Pesquisa*, 27(3), 337-346. DOI: <https://doi.org/10.1590/1809-2950/17345527032020>.
14. Fleck MP, Louzada S, Xavier M, Chachamovich E, Vieira G, Santos L, Pinzon V. Aplicação da versão em português do instrumento abreviado de avaliação da qualidade de vida "WHOQOL-bref. *Rev Saúde Pública*. 2000;34(2):178-183. DOI: <https://doi.org/10.1590/S0034-89102000000200012>
15. Fleck MP, Chachamovich E, Trentini CM. Projeto WHOQOL-OLD: método e resultados de grupos focais no Brasil. *Rev Saúde Pública*. 2003;37:793-799. DOI: <https://doi.org/10.1590/S0034-89102003000600016>
16. Fleck MP, Chachamovich E, Trentini C. Development and validation of the Portuguese version of the WHOQOL-OLD module. *Rev Saúde Pública*. 2006;40(5). DOI: <https://doi.org/10.1590/S0034-89102006000600007>.
17. Hillman TE, Nunes QM, Hornby ST, Stanga Z, Neal KR, Rowlands BJ, Allison SP, Lobo DN. A practical posture for hand grip dynamometry in the clinical setting. *Clin Nutr*. 2005 Apr;24(2):224-8. DOI: <https://doi.org/10.1016/j.clnu.2004.09.013>.
18. Haukoos JS, Lewis RJ. Advanced statistics: bootstrapping confidence intervals for statistics with "difficult" distributions. *Acad Emerg Med*. 2005 Apr;12(4):360-5. DOI: <https://doi.org/10.1197/j.aem.2004.11.018>.
19. Silva LL, Mendes da Silva KB, Sousa L, Pinhata Rocha C. Is the Pilates method efficient to cause changes in the body composition of healthy individuals? A systematic review. *J Bodyw Mov Ther*. 2022 Oct;32:51-59. DOI: <https://doi.org/10.1016/j.jbmt.2022.04.005>.
20. Kim YS, Lee N. Effects of applied swan pilates motions on upper body muscle activities. *J Bodyw Mov Ther*. 2021 Apr;26:290-293. DOI: <https://doi.org/10.1016/j.jbmt.2020.12.031>.

21. Bertoli J, Bezerra ES, Winters-Stone KM, Alberto Gobbo L, Freitas IF Júnior. Mat Pilates improves lower and upper body strength and flexibility in breast cancer survivors undergoing hormone therapy: a randomized controlled trial (HAPiMat study). *Disabil Rehabil.* 2023 Feb;45(3):494-503. DOI: <https://doi.org/10.1080/09638288.2022.2032410>.
22. Meikis L, Wicker P, Donath L. Effects of Pilates Training on Physiological and Psychological Health Parameters in Healthy Older Adults and in Older Adults With Clinical Conditions Over 55 Years: A Meta-Analytical Review. *Front Neurol.* 2021 Oct 25;12:724218. DOI: <https://doi.org/10.3389/fneur.2021.724218>.
23. Silva CFF, Paula AC, Alexandre FM, Brun G, Farias NO, Oliveira V, Vagetti GC. Papel do método Pilates na cognição e autoimagem de idosos: Revisão sistemática. *Res, Soc Dev.* 2021;10(4). DOI: <https://doi.org/10.33448/rsd-v10i4.14209>.
24. Aibar-Almazán A, Martínez-Amat A, Cruz-Díaz D, Jesús de la Torre-Cruz M, Jiménez-García JD, Zagalaz-Anula N, et al.. The Influence of Pilates Exercises on Body Composition, Muscle Strength, and Gait Speed in Community-Dwelling Older Women: A Randomized Controlled Trial. *J Strength Cond Res.* 2022 Aug 1;36(8):2298-2305. DOI: <https://doi.org/10.1519/JSC.0000000000003790>.
25. Parveen A, Kalra S, Jain S. Effects of Pilates on health and well-being of women: a systematic review. *Bull Fac Phys Ther.* 2023;17. DOI: <https://doi.org/10.1186/s43161-023-00128-9>.
26. Gandolfi NRS, Corrente JE, De Vitta A, Gollino L, Mazeto GMFDS. The influence of the Pilates method on quality of life and bone remodelling in older women: a controlled study. *Qual Life Res.* 2020 Feb;29(2):381-389. DOI: <https://doi.org/10.1007/s11136-019-02293-8>.
27. Noghani N, Sheikhoosini R, Babakhani F. Pilates Exercises Improves Anticipatory Muscular Activation in Elderly Women: A RCT Study. *Phys Occup Ther Geriatr.* 2022;41(2):246-261. DOI: <https://doi.org/10.1080/02703181.2022.2119322>.
28. Yu Z, Yin Y, Wang J, Zhang X, Cai H, Peng F. Efficacy of Pilates on Pain, Functional Disorders and Quality of Life in Patients with Chronic Low Back Pain: A Systematic Review and Meta-Analysis. *Int J Environ Res Public Health.* 2023 Feb 6;20(4):2850. DOI: <https://doi.org/10.3390/ijerph20042850>.
29. Pereira MJ, Mendes R, Mendes RS, Martins F, Gomes R, Gama J, Dias G, Castro MA. Benefits of Pilates in the Elderly Population: A Systematic Review and Meta-Analysis. *Eur J Investig Health Psychol Educ.* 2022 Feb 22;12(3):236-268. DOI: <https://doi.org/10.3390/ejihpe12030018>.
30. Sampaio T, Encarnação S, Santos O, Narciso D, Oliveira JP, Teixeira JE, Forte P, Morais JE, Vasques C, Monteiro AM. The Effectiveness of Pilates Training Interventions on Older Adults' Balance: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Healthcare (Basel).* 2023 Dec 1;11(23):3083. DOI: <https://doi.org/10.3390/healthcare11233083>.
31. Denham-Jones L, Gaskell L, Spence N, Pigott T. A systematic review of the effectiveness of Pilates on pain, disability, physical function, and quality of life in older adults with chronic musculoskeletal conditions. *Musculoskeletal Care.* 2022 Mar;20(1):10-30. DOI: <https://doi.org/10.1002/msc.1563>.
32. Komatsu H, Yagasaki K, Saito Y, Oguma Y. Regular group exercise contributes to balanced health in older adults in Japan: a qualitative study. *BMC Geriatr.* 2017 Aug 22;17(1):190. DOI: <https://doi.org/10.1186/s12877-017-0584-3>.
33. Rodrigues F, Jacinto M, Couto N, Monteiro D, Monteiro AM, Forte P, Antunes R. Motivational Correlates, Satisfaction with Life, and Physical Activity in Older Adults: A Structural Equation Analysis. *Medicina (Kaunas).* 2023 Mar 17;59(3):599. DOI: <https://doi.org/10.3390/medicina59030599>.
34. Royse LA, Baker BS, Warne-Griggs MD, Miller K, Weitzel KJ, Ball SD, Duren DL. "It's not time for us to sit down yet": how group exercise programs can motivate physical activity and overcome barriers in inactive older adults. *Int J Qual Stud Health Well-being.* 2023 Dec;18(1):2216034. DOI: <https://doi.org/10.1080/17482631.2023.2216034>.
35. Carrasco-Poyatos M, Ramos-Campo DJ, Rubio-Arias JA. Pilates versus resistance training on trunk strength and balance adaptations in older women: a randomized controlled trial. *PeerJ.* 2019 Nov 14;7:e7948. DOI: <https://doi.org/10.7717/peerj.7948>.
36. Farzane A, Koushkie Jahromi M. The effect of pilates training on hormonal and psychophysical function in older women. *J Sports Med Phys Fitness.* 2022 Jan;62(1):110-121. DOI: <https://doi.org/10.23736/S0022-4707.21.12089-4>.
37. Oliveira NTB, Ricci NA, Dos Santos Franco YR, Salvador EMES, Almeida ICB, Cabral CMN. Effectiveness of the Pilates method versus aerobic exercises in the treatment of older adults with chronic low back pain: a randomized controlled trial protocol. *BMC Musculoskelet Disord.* 2019 May 24;20(1):250. DOI: <https://doi.org/10.1186/s12891-019-2642-9>.
38. Lim EJ, Hyun EJ. The Impacts of Pilates and Yoga on Health-Promoting Behaviors and Subjective Health Status. *Int J Environ Res Public Health.* 2021 Apr 6;18(7):3802. DOI: <https://doi.org/10.3390/ijerph18073802>.
39. McGrath RP, Kraemer WJ, Snih SA, Peterson MD. Handgrip Strength and Health in Aging Adults. *Sports Med.* 2018;48:1993–2000. DOI: <https://doi.org/10.1007/s40279-018-0952-y>.

40. Lee SH, Gong HS. Measurement and Interpretation of Handgrip Strength for Research on Sarcopenia and Osteoporosis. *J Bone Metab.* 2020 May;27(2):85-96. DOI: <https://doi.org/10.11005/jbm.2020.27.2.85> .
41. Gonnord T, Clarys D, Boucard G, Esnard C. Positive impact of social relationships fostered by physical and/or cognitive group activity on older people's quality of life: PRISMA systematic review. *Front Psychol.* 2023 Sep 12;14:1166072. DOI: <https://doi.org/10.3389/fpsyg.2023.1166072> .
42. Gou Y, Lei H, Zeng Y, Tao J, Kong W, Wu J. The effect of Pilates exercise training for scoliosis on improving spinal deformity and quality of life: Meta-analysis of randomized controlled trials. *Medicine (Baltimore).* 2021 Oct 1;100(39):e27254. DOI: <https://doi.org/10.1097/MD.00000000000027254> .

CRedit author statement

Amanda Tami Kuroda Colevate: Conceptualization, Data curation, Investigation, Writing – original draft.

José Roberto Andrade do Nascimento Júnior: Formal analysis, Methodology.

Eduardo Quadros da Silva: Writing – original draft.

Author 4: Writing – original draft.

Author 5: Project administration, Supervision, Validation, Visualization, Writing – review & editing.

ORCID:

Amanda Tami Kuroda Colevate: <https://orcid.org/0000-0002-6487-2954>

José Roberto Andrade do Nascimento Júnior: <https://orcid.org/0000-0003-3836-6967> .

Eduardo Quadros da Silva: <https://orcid.org/0000-0002-5041-993X> .

Priscila Ester de Lima Cruz: <https://orcid.org/0000-0003-2958-4786> .

Daniel Vicentini de Oliveira: <https://orcid.org/0000-0002-0272-9773> .

Editor: Carlos Herold Junior.

Received on July 07, 2024.

Reviewed on Sep 24, 2024.

Accepted on Sep 25, 2024.

Corresponding authors: Daniel Vicentini de Oliveira. E-mail: d.vicentini@hotmail.com