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Original Research

Absolute and relative handgrip strength as indicators of cognitive impairment: Evidence from the Mexican cognitive aging study

Miguel Ángel Perez-Sousa [a,b], Alejandro Cuevas [c], Miguel Germán Borda [c,d,e], Mikel Izquierdo [f,g], Robinson Ramírez-Vélez [f,g,h,*]

[a] Department of Physical Education, Faculty of Education, University of Córdoba, 14071 Cordoba, Spain
[b] Epidemiology of Physical Activity and Fitness Across Lifespan Research Group, University of Seville, 41004 Seville, Spain
[c] Semillero de Neurociencias y Envejecimiento, Clínica Universidad de Navarra, Pamplona, Spain
[d] Department of Neurology, Clínica Universidad de Navarra, Pamplona, Spain
[e] Centre for Age-Related Medicine (SESAM), Stavanger University Hospital, Stavanger, Norway
[f] Navarrabiomed, IdiSNA, Complejo Hospitalario de Navarra (CHN), Universidad Pública de Navarra (UPNA), Pamplona, Spain
[g] CIBER of Frailty and Healthy Aging (CIBERFES), Instituto de Salud Carlos III, Madrid, Spain
[h] Facultad de Ciencias de la Educación, Unidad Central del Valle del Cauca (UCEVA), Túlua, Colombia

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ABSTRACT

Aim: Handgrip strength (HGS) is a simple, noninvasive measure that may help with the early detection and risk assessment of cognitive decline in middle-aged and older adults. This study aimed to explore the relationship between both absolute and relative measures of HGS and cognitive impairment in a nationally representative sample of Mexican adults aged 55 and older.
Methods: This secondary cross-sectional study included 1870 participants (58.4% women; mean age = 68.1 ± 8.7 years) from the Mexican Cognitive Aging Study (Mex-Cog). Data from individuals aged ≥ 55 years included socioeconomic, lifestyle, anthropometric, and biomarker information. HGS was assessed using a dynamometer in absolute values (kg) and relative indices (HGS/height, HGS/height^2, HGS/weight, and HGS/BMI). Quartiles (Q) were created, with Q4 representing the highest performance. Cognitive impairment was defined as an MMSE score of < 24 points. Associations were examined using sex-stratified binary logistic regression adjusted for age, education level, and population density.
Results: Women in the lowest quartile of absolute handgrip strength had significantly higher odds of cognitive impairment than those in the highest quartile (odds ratio [OR] = 2.24, 95% CI 1.04–4.80, $p = 0.039$). In men, significant associations were found for the second quartile of HGS normalised by height and height^2. Overall, absolute HGS and HGS/height^2 showed the strongest and most consistent significant association with cognitive impairment.
Conclusions: Lower absolute and relative HGS values were strongly associated with a higher likelihood of cognitive impairment in Mexican adults. Due to its low cost, accessibility, and reproducibility, HGS may represent a practical biomarker for the early detection and tracking of cognitive decline, particularly in low-resource settings.

1. Introduction

Cognitive impairment is a significant public health concern, particularly among older adults. Dementia affects approximately 697 out of every 10,000 individuals in this population, while mild cognitive impairment (MCI) affects an estimated 1560 to 1820 per 10,000 individuals aged 60 years and older [1]. Beyond its high prevalence, dementia leads to profound personal, social, and economic consequences, including loss of independence, increased caregiver burden, higher rates of hospitalisation, and substantial healthcare costs.

Sarcopenia is an age-related condition characterized by the loss of muscle mass and strength and has been associated with significant functional decline, mortality, and other adverse health outcomes [2]. A strong correlation between sarcopenia and cognitive impairment has

* Corresponding author.
E-mail address: robin640@hotmail.com (R. Ramírez-Vélez).

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been reported, with sarcopenia increasing the risk of Alzheimer's disease (AD) and other dementias by 197 % and 68 %, respectively [3]. Loss of lean muscle mass has been associated with brain atrophy in Alzheimer's disease, which suggests a possible common underlying mechanism [4]. Individual decreases in muscle function are associated with an increased incidence of AD [5]. Physical exercise has been shown to have a neuroprotective role via the skeletal muscle, which secretes myokines and other molecules [6], which could partially explain the effects of sarcopenia.

In this context, measuring handgrip strength (HGS) using a handheld dynamometer is a convenient, easy, and rapid method to assess the functional state of muscles and the presence of sarcopenia [7]. It can also indicate nutritional status and is inversely correlated with all-cause mortality [8]. Given the strong influence of body size on absolute muscle strength, different scaling methods for HGS have been proposed to allow for meaningful comparisons across individuals. Relative and allometric indices, such as HGS/height, HGS/height^2, HGS/weight, and HGS/body mass index (BMI), account for anthropometric variability and geometric scaling of muscle force. The use of height^2 as a denominator follows allometric principles, assuming that muscle strength scales to body cross-sectional area rather than total mass [9,10]. Relative indices (e.g., HGS/weight, HGS/BMI) further reflect functional strength and muscle quality, which have been linked to adverse outcomes such as frailty, disability, and accelerated cognitive decline, particularly as cognitive impairment significantly progresses with aging [11–14]. Therefore, evaluating these scaling methods may provide a more accurate understanding of the relationship between muscle strength and cognitive impairment in older adults, particularly in population-based cohorts. Although substantial evidence supports this association, data on middle-aged populations in Latin America remain limited as no large-scale studies have been conducted to represent the region's general population [15,16]. Investigating this transitional age group is particularly relevant, as it represents a critical window for early detection and intervention before cognitive decline significantly progresses [17,18]. Therefore, this study aimed to examine the association between both absolute and relative measures of HGS and cognitive impairment in a nationally representative sample of Mexican adults aged 55 years and older.

2. Materials and methods

2.1. Subjects

This secondary cross-sectional analysis was based on data from the Mexican Health and Aging Study (MHAS) (https://www.mhasweb.org), a longitudinal, nationally representative study of adults aged ≥ 50 years residing in both urban and rural areas of Mexico. Urban and rural classifications followed the definitions of the Instituto Nacional de Estadística y Geografía (INEGI), which categorizes localities by population size: urban areas include localities with ≥2500 inhabitants, and rural areas include those with <2500 inhabitants. The primary objective of MHAS is to prospectively evaluate the impact of diseases, disabilities, and health conditions on the aging process in the Mexican population [19]. To date, this study has completed six waves of data collection (2001, 2003, 2012, 2015, 2018, and 2021).

The Mexican Cognitive Aging Study (Mex-Cog) analysed in the present work is a subsample of the MHAS. Participants were selected using the same multistage stratified probability sampling design as MHAS, measuring that the Mex-Cog sample remains representative of the non-institutionalised Mexican population aged 50 years and older. The sampling weights provided by the MHAS were applied to preserve the national representativeness. For this analysis, we used data from the 2016 Mex-Cog wave, developed as part of the Harmonized Cognitive Assessment Protocol (HCAP) initiative, which includes detailed assessments of cognitive function and physical performance [20]. The Mex-Cog subsample included 2265 participants who completed standardised assessments of sociodemographic characteristics, cognitive function, and muscular fitness (*Supplemental Figure 1*). Participants were eligible for inclusion if they (1) were aged ≥55 years at the time of the 2016 survey, (2) completed the handgrip strength assessment, and (3) had valid Mini-Mental State Examination (MMSE) data. Individuals with missing data for any of the main study variables (HGS, cognitive function, or sociodemographic covariates) were excluded. After defining the analytical sample, cognitive function was evaluated using the validated instruments described below.

2.2. Cognitive assessment

Cognitive performance was evaluated using an adapted and abbreviated version of the MMSE included in the 2016 Mexican Cognitive Aging Ancillary Study (Mex-Cog), an add-on to the Mexican Health and Aging Study (MHAS). This 10-item version, harmonized with the international Harmonized Cognitive Assessment Protocol (HCAP), has been validated for use in the Mexican population [21,22]. The instrument assesses orientation, attention, calculation, memory, and language with a total score ranging from 0 to 28 points.

A cut-off score of <24 was used to define cognitive impairment, in accordance with the validation study of the adapted Spanish MMSE for the Mexican population, [22] which identified 23–24 as the optimal threshold for distinguishing impaired from non-impaired individuals. This cutoff has been consistently applied in subsequent analyses of MHAS and Mex-Cog data to ensure comparability across studies.

2.3. HGS measurement

HGS was assessed using a Smedley BASELINE spring-type dynamometer (Fabrication Enterprises, White Plains, NY, USA), which is a validated instrument for measuring isometric grip strength. The device was calibrated before each testing session, and an adjustable handle was set individually to accommodate each participant's hand size. Participants were seated upright with the elbow flexed at 90°, forearm in a neutral position, and wrist between 0° and 30° extension [23]. They were instructed to perform maximum voluntary contractions for 3–5 s, receiving standardised verbal encouragement. Each hand was tested twice with a 1-minute rest interval between trials to minimise fatigue. The highest value (kg) for both hands was recorded and used in the analyses. To evaluate relative HGS, absolute HGS was normalised as follows: HGS normalised by height (HGS/height), HGS normalised by weight (HGS/body weight), HGS normalised by body mass index (HGS/BMI), and HGS normalised by height^2 (HGS/height^2). These scaling methods were applied to account for anthropometric variability and geometric differences in muscle mass and mechanical load. The height^2 denominator follows allometric principles, assuming that muscle force scales to the body cross-sectional area rather than mass [24,25]. Relative indices such as HGS/weight and HGS/BMI reflect functional strength and muscle quality, respectively [11,12].

2.4. Anthropometric measurements

Trained personnel collected anthropometric data using standardised MHAS field protocols. Body weight was measured to the nearest 0.1 kg using a calibrated digital scale, with participants wearing light clothing and no shoes. Height was measured to the nearest 0.1 cm using a portable stadiometer while participants stood upright without shoes, with heels, buttocks, and upper back in contact with the measuring surface. BMI was calculated as the weight in kilograms divided by the height in meters squared (kg/m^2). Waist-to-height ratio (WHtR) was calculated as waist circumference (cm) divided by height (cm) and was included as an indicator of central adiposity.

2.5. Confounding variables

Sociodemographic characteristics, including sex, age, years of schooling, and place of residence, were obtained using items from the MHAS questionnaire.

2.6. Statistical analysis

All statistical analyses were performed using SPSS version 26 (IBM Corp., 2019). IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp. Binary logistic regression analysis was conducted to assess the association between cognitive impairment and quartiles of HGS, using the last quartile as a reference. Cognitive impairment was analysed as a dichotomous variable, defined by MMSE scores <24 (impaired) and ≥24 (normal cognition). This cut-off has been widely employed in population-based studies of older adults, including Latin American cohorts, to identify possible cognitive impairment while maintaining diagnostic sensitivity and specificity [26,27]. Subsequently, sex-stratified analysis was performed. For this purpose, sex was recorded as male or female and age was treated as a continuous variable (in years). Years of schooling were self-reported and categorised as *low education* (<6 years), *medium education* (6–11 years), or *high education* (≥12 years), following the established MHAS criteria. Place of residence was classified as *urban* or *rural* according to INEGI's official definitions. These sociodemographic variables were previously identified as risk factors for cognitive impairment in the Mexican population and were included as covariates in multivariable logistic regression analyses. Results from the regression analyses are presented as odds ratios (ORs) with 95 % confidence intervals (CIs). The level of statistical significance was set at two-sided $P < 0.05$.

3. Results

Table 1 presents the participants' descriptive characteristics. The mean age was 68.4 ± 7.8 for participants without cognitive impairment and 68.1 ± 8.9 for participants with cognitive impairment. Most participants resided in urban areas, with populations exceeding 100,000 inhabitants (60.4 % in the non-impairment group and 55.7 % in the impairment group), whereas a smaller proportion lived in rural areas, with fewer than 2500 inhabitants (16.4 % non-impairment and 20.6 % with impairment). Regarding anthropometric results, women presented a higher BMI than men (27.2 ± 4.2 in non-impairment group and 28.8 ± 5.4 in impairment group). Across all measures of HGS, participants with cognitive impairment showed substantially lower values than those without impairment. Mean absolute HGS was markedly reduced in the impaired group (18.5 [6.9] vs 29.6 [8.6] kg), and similar differences were observed for HGS normalized by body weight, height, BMI, and allometric scaling (heigth^2).

Table 1
Descriptive characteristics of participants according to cognitive status (non-impaired vs. impaired).

Variable	Non impairment (n = 1496)	Impairment (n = 374)
Age, years	68.4 (7.8)	68.1 (8.9)
Sex, female	912 (60.9)	180 (48.1)
Population = 100,000+	716 (55.7 %)	353 (60.4 %)
Population = 15,000 - 99,999	199 (15.5 %)	82 (14.1 %)
Population = 2500 - 14,999	106 (8.2 %)	53 (9.1 %)
Population <2500	265 (20.6 %)	96 (16.4 %)
Years school	7.2 (4.7)	4.6 (4.1)
BMI (kg/m^2)	27.7 (4.2)	28.8 (5.4)
WHtR	0.61 (0.1)	0.64 (0.1)
Absolute handgrip (kg)	29.6 (8.6)	18.5 (6.9)
Normalized handgrip by body weight (kg/kg)	0.27 (0.07)	0.18 (0.07)
Normalized handgrip by height (kg/m)	0.18 (0.05)	0.12 (0.04)
Normalized handgrip by BMI (kg/BMI)	1.08 (0.33)	0.66 (0.27)
Normalized handgrip heigth^2 (kg/m^2)	11.1 (2.9)	8.11 (2.69)
MMSE score	23.1 (4.9)	19.1 (4.9)

Note: HGS = Handgrip strength (kg); BMI = Body Mass Index; WHtR = Waist-to-Height Ratio MMSE = Mini-Mental State Examination. Continuous variables are presented as mean (SD); categorical variables as n (%). Population size categories: Urban (> 100,000 inhabitants); Semi-urban (15,000–99,999); Small town (2500–14,999); Rural (< 2500).

Table 2 presents the distribution of cognitive impairment across quartiles of HGS, expressed as absolute values and normalized by anthropometric measures, stratified by sex. Among men, cognitive impairment was more frequent in lower quartiles of HGS across all scaling methods. Using absolute HGS, a smaller proportion of non-impaired men were classified in the lowest quartile (Q1, 4.6%) compared with impaired men (10.8%), whereas the highest quartile (Q4) included a substantially greater proportion of non-impaired men (71.1%) than impaired men (44.9%). For HGS adjusted by weight, height, BMI, and height^2, impaired men were consistently over-represented in Q1–Q2 and underrepresented in Q4 relative to non-impaired men, indicating a stepwise inverse association between HGS and cognitive impairment. Among women, similar but more pronounced patterns were observed. For absolute HGS, 42.3% of cognitively impaired women were in Q1 compared with 23.9% of non-impaired women, while only 3.5% of impaired women were in Q4 versus 10.0% of non-impaired women. Across all normalized measures, impaired women were disproportionately represented in the lowest quartiles and markedly less frequent in the highest quartile compared with non-impaired women.

Table 3 presents the associations between quartiles of HGS and cognitive impairment. Among men, lower absolute HGS was associated with higher odds of cognitive impairment, with a statistically significant association observed in the third quartile (Q3: OR, 1.74; 95% CI, 1.09–2.77; $p = 0.020$). When HGS was normalized by height, men in the second quartile showed significantly increased odds of cognitive impairment compared with those in Q4 (OR, 2.68; 95% CI, 1.28–5.63; $p = 0.009$), whereas associations in Q1 and Q3 did not reach statistical significance. A similar pattern was observed for allometrically scaled HGS, with higher odds in Q2 (OR, 2.18; 95% CI, 1.18–4.03; $p = 0.013$) and Q3 (OR, 1.64; 95% CI, 1.02–2.62; $p = 0.041$). No significant associations were observed when HGS was normalized by body weight or BMI. Among women, lower absolute HGS was associated with cognitive impairment only in the lowest quartile (Q1: OR, 2.24; 95% CI, 1.04–4.80; $p = 0.039$). No statistically significant associations were identified across quartiles for handgrip strength normalized by weight, height, BMI, or allometric scaling, as all confidence intervals included unity. Overall, absolute HGS and height-based scaling methods showed the strongest associations with cognitive impairment, with more consistent associations observed in men than in women.

4. Discussion

We found a clear inverse relationship between HGS and cognitive impairment; participants with lower HGS, whether measured in absolute terms or adjusted for height, had significantly higher odds of cognitive impairment, even after adjusting for age, sex, education, and place of residence. Among the relative indices, HGS normalised by height^2 showed the strongest and most consistent association in men, indicating that scaling HGS to body size enhanced its predictive value for cognitive performance.

Our findings align with prior evidence from European, Asian, and North American cohorts, showing that lower muscular strength predicts poorer cognitive function and greater odds of dementia [28,29]. This study extends these results by using a nationally representative Mexican sample and incorporating both the absolute and relative indices of HGS. Previous Latin American studies were mostly localised and used unadjusted strength measures, limiting their generalisability. Thus, our results fill an important gap in regional evidence and support HGS as a simple, low-cost indicator for identifying individuals at risk of cognitive

Table 2
Distribution of cognitive impairment (MMSE) across quartiles of handgrip strength (absolute and relative) by sex.

		Male				Female			
		Impairment ($n = 194$)		No impairment ($n = 584$)		Impairment ($n = 180$)		No impairment ($n = 912$)	
		n	%	n	%	n	%	n	%
Absolute handgrip	Q1	9	4.6	63	10.8	43	23.9	386	42.3
	Q2	12	6.2	86	14.7	61	33.9	290	31.8
	Q3	35	18.0	173	29.6	58	32.2	204	22.4
	Q4	138	71.1	262	44.9	18	10.0	32	3.5
Normalized handgrip by body weight	Q1	17	8.8	69	11.8	55	30.6	326	35.7
	Q2	16	8.2	89	15.2	57	31.7	306	33.6
	Q3	49	25.3	171	29.3	45	25.0	203	22.3
	Q4	112	57.7	255	43.7	23	12.8	77	8.4
Normalized handgrip by height	Q1	13	6.7	69	11.8	43	23.9	342	37.5
	Q2	10	5.2	97	16.6	61	33.9	299	32.8
	Q3	39	20.1	162	27.7	51	28.3	217	23.8
	Q4	132	68.0	256	43.8	25	13.9	54	5.9
Normalized handgrip by BMI	Q1	9	4.6	48	8.2	48	26.7	363	39.8
	Q2	11	5.7	71	12.2	63	35.0	322	35.3
	Q3	44	22.7	181	31.0	50	27.8	193	21.2
	Q4	130	67.0	284	48.6	19	10.6	34	3.7
Normalized handgrip by height^2	Q1	17	8.8	81	13.9	46	25.6	323	35.4
	Q2	17	8.8	113	19.3	51	28.3	287	31.5
	Q3	37	19.1	166	28.4	53	29.4	212	23.2
	Q4	123	63.4	224	38.4	30	16.7	90	9.9

Note: BMI, body mass index. HGS was normalized by height, height^2, body weight, and body mass index (BMI).
BMI = Body Mass Index.

Table 3
Association between cognitive impairment and quartiles of handgrip strength (HGS) according to different scaling methods.

	Male				Female			
Absolute HGS	ORs	Lower 95% CI	Upper 95% CI	p	ORs	Lower 95% CI	Upper 95% CI	p
Q1	1.62	0.74	3.58	0.230	2.24	1.04	4.80	0.039
Q2	1.76	0.88	3.53	0.111	1.67	0.80	3.50	0.173
Q3	1.74	1.09	2.77	0.020	1.64	0.78	3.45	0.196
Normalized handgrip by body weight								
Q1	0.83	0.44	1.58	0.573	1.05	0.56	1.98	0.875
Q2	1.81	0.96	3.42	0.067	1.24	0.66	2.33	0.499
Q3	1.25	0.80	1.94	0.332	0.99	0.52	1.90	0.976
Normalized handgrip by height								
Q1	1.17	0.59	2.35	0.656	1.71	0.89	3.30	0.108
Q2	2.68	1.28	5.63	0.009	1.43	0.77	2.67	0.262
Q3	1.49	0.94	2.37	0.094	1.47	0.77	2.79	0.242
Normalized handgrip by BMI								
Q1	1.24	0.55	2.78	0.606	1.90	0.91	3.99	0.090
Q2	1.32	0.64	2.73	0.446	1.70	0.83	3.51	0.149
Q3	1.18	0.76	1.83	0.473	1.46	0.69	3.07	0.319
Normalized handgrip by height^2								
Q1	1.15	0.61	2.16	0.674	1.15	0.64	2.08	0.644
Q2	2.18	1.18	4.03	0.013	1.20	0.68	2.14	0.531
Q3	1.64	1.02	2.62	0.041	0.97	0.54	1.74	0.927

Note: Regression taking the last quartile as a reference (Q4); ORs, odds ratio; confidence interval at 95 %; BMI, body mass index.

decline in low- and middle-income settings [28]. The consistency of our findings with those of previous longitudinal studies strengthens the plausibility of a causal link between muscle weakness and cognitive decline. For instance, a 2021 meta-analysis of 15 cohort studies showed that individuals with low baseline grip strength had nearly twice the risk of cognitive decline and 1.5 times the risk of dementia compared with those with stronger grip strength. Similarly, analyses from the UK Biobank (~190,000 adults) revealed that each 5-kg reduction in HGS increased dementia risk by nearly 20 % [28], while U.S. data indicated a 10–18 % increase in cognitive impairment per 5-kg decrement [29].

Several mechanisms may explain this relationship. Muscle weakness may accelerate cognitive decline by promoting chronic inflammation, oxidative stress, and decreased secretion of neurotrophic factors such as brain-derived neurotrophic factor (BDNF), which supports neuronal survival and plasticity [28,30]. Alternatively, lower HGS might serve as an early marker of neurodegeneration or cerebrovascular problems, indicating decreased nervous system integrity and a higher burden of white matter lesions [28]. Because of these connections and their ease of measurement, HGS is increasingly seen as a practical clinical biomarker for cognitive health [29].

Relative measures of HGS provide additional value by adjusting for differences in body size and composition, thus better reflecting muscle quality and metabolic health [11]. This method is especially useful in population-based studies where variations in body measurements can affect associations with cognition. In our sex-specific analyses, the relevance of scaling varied by sex; in men, HGS adjusted by height^2 had the strongest link to cognitive impairment, while in women, absolute HGS showed clearer trends. These differences likely resulted from sex-specific variations in body composition, fat distribution, and hormonal effects on muscle function.

We also observed that rural residents generally had higher HGS values than urban participants, which is consistent with previous findings that physically demanding rural lifestyles contribute to greater muscular strength [31].

This urban–rural contrast underscores the significance of contextual factors such as occupation and physical activity in interpreting population-level differences in muscle function and cognition. Few studies have explored the relationship between relative HGS and cognitive impairment. Our results indicate that normalising strength using anthropometric measures produces stronger and more valid associations, reducing the confounding influence of body mass and enhancing risk classification. This methodological improvement can increase the accuracy of future epidemiological studies on sarcopenia, frailty, and cognitive decline.

Despite its strengths, this study had several limitations. The cross-sectional design prevents causal inference, and longitudinal analyses are needed to clarify the directionality of associations. The MMSE, although widely used, may lack sensitivity to early or domain-specific cognitive changes, especially in populations with low educational attainment, despite our statistical adjustments for education. Self-reported sociodemographic and lifestyle data may also introduce recall bias. Furthermore, we lacked data on clinical and biological variables, such as medication use, nutrition, and neuroimaging markers, which could help elucidate the underlying mechanisms. Finally, comorbidities such as diabetes, hypertension, and cardiovascular disease, although available in the broader MHAS dataset, were not included in this analysis, possibly introducing residual confounding.

Nonetheless, this study had several strengths. It used a large, nationally representative Mexican sample, including both urban and rural participants, and examined both the absolute and relative HGS measures. Incorporating scaling indices and sex-stratified analyses offers a more nuanced understanding of the muscle–cognition relationship and addresses the limitations common in previous studies.

5. Conclusion

This study provides new evidence linking muscle strength to cognitive function in the Latin American population. Among relative indices, normalization by height and allometric scaling yielded significant associations in men, suggesting that adjustment for body size may enhance the ability of HGS to capture clinically relevant variation in muscle function related to cognitive health. In contrast, normalization by body weight or body mass index did not materially strengthen these associations, particularly among women, in whom relative indices largely attenuated the observed relationships. As it is simple and affordable, HGS testing could be a practical screening tool for early cognitive decline in low-resource areas. However, because not all relationships were statistically significant, further long-term studies with larger and more varied samples are necessary to confirm these results and assess the prognostic usefulness of relative strength measures in clinical and epidemiological settings.

Data statement

All data were obtained from the Mexican Health and Aging Study (MHAS) database: https://www.mhasweb.org/Home/index.aspx.

Ethics declarations

The study was approved by the Institutional Review Boards of the University of Texas Medical Branch, the Instituto Nacional de Estadística y Geografía, and the Secretaría de Salud Pública of Mexico. This study adhered to the ethical principles outlined in the Declaration of Helsinki. All participants provided written informed consent by Good Clinical Practice guidelines before enrollment.

Generative AI and AI-assisted technologies

While preparing this work, the authors used Grammarly to check for grammatical errors, improve clarity and conciseness, ensure appropriate tone, and verify the originality of the content. After using this tool/service, the authors reviewed and edited the content as needed and is responsible for the publication's content.

CRediT authorship contribution statement

Miguel Ángel Perez-Sousa: Conceptualization, Funding acquisition, Investigation, Methodology, Validation, Visualization, Writing – review & editing. **Alejandro Cuevas:** Writing – review & editing, Writing – original draft, Methodology. **Miguel Germán Borda:** Writing – review & editing, Writing – original draft, Supervision. **Mikel Izquierdo:** Writing – review & editing, Writing – original draft, Conceptualization. **Robinson Ramírez-Vélez:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Miguel German Borda reports financial support was provided by Norwegian Health Association. Miguel German Borda reports a relationship with The Norwegian Public Health Association that includes: funding grants. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jarlif.2025.100058.

References

[1] Cao Q, Tan CC, Xu W, Hu H, Cao XP, Dong Q, et al. Prevalence of dementia: a systematic review and meta-analysis. Zhu LQ, editor. J Alzheimer's Dis 2020;73(3):1157–66. February 4.
[2] Yuan S, Larsson SC. Epidemiology of sarcopenia: Prevalence, risk factors, and consequences. Metabolism 2023;144:155533. July.
[3] Amini N, Ibn Hach M, Lapauw L, Dupont J, Vercauteren L, Verschueren S, et al. Meta-analysis on the interrelationship between sarcopenia and mild cognitive impairment, Alzheimer's disease, and other forms of dementia. J Cachexia Sarcopenia Muscle 2024;15(4):1240–53. August.
[4] Waite SJ, Maitland S, Thomas A, Yarnall AJ. Sarcopenia and frailty in individuals with dementia: a systematic review. Arch Gerontol Geriatr 2021;92:104268. January.
[5] Beeri MS, Leugrans SE, Delbono O, Bennett DA, Buchman AS. Sarcopenia is associated with incident Alzheimer's dementia, mild cognitive impairment, and cognitive decline. J Am Geriatr Soc 2021;69(7):1826–35. July.
[6] Pedersen BK. Physical activity and muscle–brain crosstalk. Nat Rev Endocrinol 2019;15(7):383–92. July.
[7] Vaishya R, Misra A, Vaish A, Ursino N, D'Ambrosi R. Hand grip strength as a proposed new vital sign of health: a narrative review of evidences. J Health Popul Nutr 2024;43(1):7. January 9.
[8] Norman K, Stobäus N, Gonzalez MC, Schulzke JD, Pirlich M. Hand grip strength: Outcome predictor and marker of nutritional status. Clin Nutr 2011;30(2):135–42. April.
[9] Tomkinson GR, Lang JJ, Rubín L, et al. International norms for adult handgrip strength: a systematic review of data on 2.4 million adults aged 20 to 100+ years from 69 countries and regions. J Sport Health Sci Published online December 2024; 6. https://doi.org/10.1016/j.jshs.2024.101014.

[10] Nevill AM, Tomkinson GR, Lang JJ, Wutz W, Myers TD. How should adult handgrip strength be normalized? Allometry reveals new insights and associated reference curves. Med Sci Sports Exerc 2022;54(1):162–8. https://doi.org/10.1249/MSS.0000000000002771.

[11] Lee WJ, Peng LN, Chiou ST, Chen LK. Relative handgrip strength is a simple indicator of cardiometabolic risk among middle-aged and older people: a nationwide population-based study in Taiwan. PLoS One 2018;11(8):e0160876.

[12] Bahat G, Yilmaz O, Tufan A, Kilic C, Aydin K, Karan MA. Cut-off values of muscle strength and physical performance in Turkish older adults: sex-specific thresholds for sarcopenia diagnosis. Eur Geriatr Med 2021;12:125–34.

[13] Buchman AS, Wilson RS, Boyle PA, Bienias JL, Bennett DA. Grip strength and the risk of incident Alzheimer's disease. Neuroepidemiology 2007;29(1–2):66–73.

[14] Sternäng O, Reynolds CA, Finkel D, Ernsth-Bravell M, Pedersen NL, Aslan AKD. Grip strength and cognitive abilities: associations in old age. J Gerontol B Psychol Sci Soc Sci 2016;71(5):841–8.

[15] Parra MA, Baez S, Allegri R, Nitrini R, Lopera F, Slachevsky A, et al. Dementia in Latin America: Assessing the present and envisioning the future. Neurology 2018; 90(5):222–31.

[16] Custodio N, Wheelock A, Thumala D, Slachevsky A. Dementia in Latin America: epidemiological evidence and implications for public policy. Front Public Health 2020;8:83.

[17] Prince M, Wimo A, Guerchet M, Ali GC, Wu YT, Prina M. World alzheimer report 2015: the global impact of dementia. London, UK: Alzheimer's Disease International (ADI); 2015.

[18] Rodríguez-Gómez O, Abdelnour C, Acosta D, et al. Latin America and the Caribbean Consortium on Dementia (LAC-CD): Harmonizing research and fostering capacity building across Latin America and the Caribbean. Alzheimer's Dement 2023;19(3):1020–33.

[19] Wong R, Michaels-Obregón A, Palloni A. The Mexican Health and Aging Study (MHAS): 2012–2015 longitudinal data for Mexico and the U.S. Salud Pública Méx 2017;59(3):300–8.

[20] Mejía-Arango S, Samper-Ternent R, Michaels-Obregón A, Wong R. Cognitive aging in Mexico: Findings from the Mexican Cognitive Aging Study (Mex-Cog). J Aging Health 2022;34(5–6):708–20.

[21] Villaseñor-Cabrera T, Guàrdia-Olmos J, Jiménez-Maldonado M, et al. Sensitivity and specificity of the Mini-Mental State Examination in the Mexican population. Qual Quant 2010;44:1105–12. https://doi.org/10.1007/s11135-009-9263-6.

[22] de Beaman SR, PE Beaman, Garcia-Peña C, Villa MA, Heres J, Córdova A, et al. Validation of a modified version of the mini-mental state examination (MMSE) in Spanish. Aging Neuropsychol Cogn 2004;11(1):1–11. https://doi.org/10.1076/anec.11.1.1.29366.

[23] Roberts HC, Denison HJ, Martin HJ, Patel HP, Syddall H, Cooper C, et al. A review of the measurement of grip strength in clinical and epidemiological studies: towards a standardized approach. Age Ageing 2011;40(4):423–9.

[24] Jaric S. Role of body size in the relation between muscle strength and movement performance. Exerc Sport Sci Rev 2003;31(1):8–12.

[25] Nevill AM, Holder RL. Scaling, normalizing, and per ratio standards: an allometric modeling approach. J Appl Physiol 1995;79(3):1027–31.

[26] Mejía-Arango S, Gutiérrez LM. Prevalence and incidence rates of dementia and cognitive impairment no dementia in the Mexican population: Data from the Mexican Health and Aging Study. J Aging Health 2011;23(7):1050–74.

[27] Crum RM, Anthony JC, Bassett SS, Folstein MF. Population-based norms for the Mini-Mental State Examination by age and educational level. JAMA 1993;269(18): 2386–91.

[28] Duchowny KA, Ackley SF, Brenowitz WD, Wang J, Zimmerman SC, Caunca MR, et al. Associations between handgrip strength and dementia risk, cognition, and neuroimaging outcomes in the UK Biobank cohort study. JAMA Netw Open 2022;5 (6):e2218314. June 23.

[29] McGrath R, Robinson-Lane SG, Cook S, Clark BC, Herrmann S, O'Connor ML, et al. Handgrip strength is associated with poorer cognitive functioning in aging Americans. J Alzheimer's Dis 2019;70(4):1187–96. August 20.

[30] Han X, Ashraf M, Tipparaju SM, Xuan W. Muscle–brain crosstalk in cognitive impairment. Front Aging Neurosci 2023;15:1221653. https://doi.org/10.3389/fnagi.2023.1221653. July 27.

[31] Sampaio RAC, Sampaio PYS, Yamada M, Ogita M, Arai H. Urban–rural differences in physical performance and health status among older Japanese community-dwelling women. J Clin Gerontol Geriatr 2012;3(4):127–31. https://doi.org/10.1016/j.jcgg.2012.09.003.