Hand grip strength related to functional status in older adults in a population of southeastern Mexico.

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Author contributions:

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Abstract:
Background: Manual grip strength is a biological marker associated with aging and body function. A decrease in handgrip strength, especially after the age of 65, is associated with Sarcopenia, risk of falls, compromised physical function, and premature mortality. The study aimed to determine the correlation between handgrip strength and functional status in older adults in Southeastern Mexico. **Methods**: An observational and correlational study was carried out on 65 adults over 60 years of age, participants from INAPM. Handgrip strength was assessed with a Jamar dynamometer, and functional status was assessed using the Barthel scale. Sperman's correlation coefficient was used to analyze the data, and ethical principles were applied in accordance with the *General Health Law in the Matter of Research for Health*. **Results**: According to Spearman's correlation, a negative correlation was observed (rs= -.344, p= .005) between age and functional status; the right and left HGS maintained a positive correlation (rs= .301, p=.015 y rs= .247, p= .047 respectively) with functional status. **Conclusion**: The FPM and functional status showed a positive relationship, which indicates that the greater muscle strength, the greater the independence, while age and functional independence showed a negative relationship; in other words, at older ages, there is less independence and vice versa.
Keywords: Hand strength, Functional Status, Older Adults.

Introduction

Hand grip strength is considered a biological marker of aging related to quality of life and body function. It assesses muscle strength in an easy, simple, and low-cost way [1, 2, 3 ,4]. This indicator decreases as age progresses, and it appears rapidly after 65 years of age. It has been linked to Sarcopenia, risk of falls, compromised physical function, and premature mortality, among other

health indicators [5, 6, 7]. Hand strength compromise has been related to global strength and body muscle mass. It has been reported that hand grip decreases in adults with physical limitations, highlighting activities such as getting up from a chair, climbing stairs, and going outside [8]. It is known that functional independence is linked to the performance of daily life activities, and although it has been identified that strength is required for their execution, there is a variability in the studied population, which means it has not yet been established as an essential element [9, 10].

The factors that diversify accurate conclusions are not only based on differences in gender, race, and age, e.g., in a black male with a lean body mass does not translate into a more significant physical strength and physical function concerning being a white male with less muscle mass [11]. A study conducted in a Mexican population to determine the hand strength values found an average of 25.4 ± 5 Kg. However, these data were obtained from the ages of 20 years and were correlated with different anthropometric variables [12].

Despite advances in understanding health conditions in specific populations, there is still a notable gap in knowledge about possible differences between individuals from diverse backgrounds and conditions. This lack of disaggregated data limits the effectiveness of clinical interventions, particularly in vulnerable populations such as older adults. In this context, manual grip strength has been identified as a key indicator of functional status in the Mexican population, mainly in Southeastern Mexico, where it is still scarce. Due to this, the aim of the study was to establish the correlation between manual grip strength and functional status in an older adult population from Southeastern Mexico. Through this approach, we seek to enrich our understanding of the factors influencing the group's functional health and generate valuable information to guide future interventions and public health policies adapted to the region's particularities. Furthermore, the

findings of this research have the potential to contribute to the identification of the risk factors and improve the preventative strategies in a key population for the social well-being.

Methods

Study design

An observational, cross-sectional, correlational-causal study, with non-probabilistic sampling applied in August and September 2023 in the National Institute of Older Adult Persons (INAPAM), belonging to the municipality of Ciudad del Carmen, Campeche, Mexico. The study variables were hand grip strength and functional status. Grip strength was assessed using the Barthel index. Each variable was evaluated in a single session to determine their relationship.

Participants

The participants of the study consisted of older adults who regularly attended the INAPAM, $\geq$ 60y of age and provided written informed consent, without pathologies that would prevent them from flexing their fingers or performing manual pressure with either hand, without cognitive and sensory impairment that would limit communication and understanding of the indications provided.

Procedures

The study was conducted in two phases. In the first phase, all older adults attended an informational meeting explaining the project's objectives and procedures. Those who signed the informed consent form were divided into groups by sex to facilitate the process during the subsequent phases. In the second phase, the participants were individually admitted to the work area (multi-

purpose room) to start measuring the study variables. Hand grip strength (HGS): Maximum grip strength of the intrinsic hand muscles (lateral, medial compartments, and digital flexors) [13,14]. Maximum grip strength was determined by dynamometry, using a Sammons Preston Jamar dynamometer [20]. Position II, recommended by the American Society of Hand Therapists (ASHT), was used, and the Sarcopenia group study in the Mexican population to guarantee the reliability of the measurement [15]. The procedure was adjusted to the one described by Romero-Dapueto et al. [16], which is done with the subject sitting on a chair with a backrest, shoulders adducted and without rotation, elbow flexed at 90*, forearm and wrist in a neutral position (in extension between 0-30* and with an ulnar deviation of 0*-15*), with both feet flat on the floor and with the back supported by the backrest. The participant performs a maximum grip strength for 3 seconds on the command “press your hand hard,” with a rest of 1 min between each repetition, making two attempts. It was carried out on both limbs, noting each and using the best one for the study. The classification of the study population in terms of decreased FPM was carried out using the cut-off points of the EWGSOP2 (European Working Group on Sarcopenia in Older People), which classifies women with FPM <16kg and men with <27kg as having low levels of muscle strength, muscle quantity/quality and physical performance, this being an indicator of severity.

Functional Status (FS)

Functional status is defined as the ability to carry out the actions required in daily life to maintain onself and subsist independently [17]; FS was measured through the Barthel scale via oral interview in which the sequence dictated by the test was carried out. A total of 65 older adults were assessed, ending with a general closing session.

Statistical analysis

The data was analyzed using the Statistica Package for the Social Sciences (SPSS) program, version 25. The normality test applied was Kolmogorov-Smirnov. To determine the correlation between the variables of interest, EF and FPM, Spearman's correlation was used. The level of statistical significance was p-value of <0.05.

Throughout the research process, ethical principles for research on human subjects were applied, adherence to the guidelines established in the General Health Law on Research for Health, with the approval of the research committee of the participating institution and registered with the scientific committee of the Faculty of Health Sciences with folio F2024E001.

Results

The final sample consisted of 65 older adults (OA), where 75.4% were female and 24.6% male. In terms of marital status, both widowed and married people were represented at 30.8%, while those in a domestic partnership represented the smallest proportion at 1.5%.

In relation to employment status, it was found that 44.6% of the participants were engaged in household chores, followed by retirees, who represented 23.1%. The smallest number corresponded to supermarket packers, with 1.5%.

The results for FPM, age and the sume of the Barthel index can be seen in table 1, which breaks down the measurements of central tendency, including the mean, median, mode, standard deviation (SD), and minimum and maximum values. The minimum age recorded was 60 years, while the maximum was 88 years, with a mean of 70.22 years and a SD of 7.217. Regarding the FPM, the minimun value for the rigth hand was 7 kg and for the left hand 6 kg, with maximum values of 34 kg and 32 kg, respectively. The average for the right hand was 16.20 kg and 16.06 kg for the left

hand. The minimum Barthel index score was 70 and the maximum 100, with a mode and mediam of 95.69.

Table 1.

Results for handgrip strength (HGS), age and the Barthel index score.

Variable	Mean	Median	Mode	Standar desviation	Minimum	Maximum	Normality test
Age	70.22	69.00	67	7.21	60	88	.006
RHGS	16.20	14.00	10	6.62	7	34	.002
LHGS	16.06	14.00	12	6.91	6	32	.003
BI score	95.69	100.00	100	6.11	70	100	.000

RHGS: Right Hand Grip Strength; LHGS: Left Hand Grip Strength

Normality test were carried out on each of the variables, obtaining a p-value of 0.006 for age, 0.002 for the FPM of the right hand, 0.003 for the left hand and 0.000 for the Barthel index. Given that all the values were lower than 0.05, it was concluded that the date did not follow a normal distribution, therefore, it was decided to use non-parametric tests for the correlation analysis.

Table 2 shows the distribution of participants based on the classification of handgrip strength (HGS) according to the criteria of the EWGSOP2. The results reveal a higher prevalence of low

HGS in both hands, being more evident in the left hand. In this sense, 62.5% of men and 71.4% of women presented low HGS in the left hand, compared to 56.3% and 69.4% in the right hand, respectively.

Table 2.

Handgrip strength: EWGSOP2 criteria

EWGSOP2				
	RHGS		LHGS	
	f	%	*f*	%
Male				
Low HGS <27 kg (0-26 kg)	9	56.3	10	62.5
Normal HGS >27 kg (More than 27 kg)	7	43.8	6	37.5
Female				
Low HGS <16 kg (0-15 kg)	34	69.4	35	71.4
Normal HGS >16 kg (More than16 kg)	15	30.6	14	28.6

f: frequency; %: percentage; HGS: Hand Grip Strength; RHGS: Right Hand Grip Strength; LHGS: Left Hand Grip Strength; EWGSOP2: European Working Group on Sarcopenia in Older People

The results of the functional independence assessment showed a high level of independence in most activiteis of dauly living (ADL), difficulties were observed in activities such as using stairs and controlling urine. While 83.1% of the participants were independent in going up and down

stairs, 10.8% required assistance and 6.2% were dependent. Regarding urinary control, 61.5% were continent, 24.6% presented incontinence and 13.8% suffered from incontinence.

Table 3 shows the population's classification according to the functional dependence levels evaluated through the Barthel Index. It is noteworthy that no participant presented total or severe dependence. 50.8% of the sample showed indepedence in activities of daily living (ADL), while 29.2% presented low dependence and 20% moderate dependence.

Table 3

Barthel Index Category

Variables	f	%
Total Dependency	0.0	0.0
Severe Dependency	0.0	0.0
Moderate Dependency	13	20.0
Low Dependency	19	29.2
Independency	33	50.8

f: frequency; %: percentage.

The results of Spearman's correlation analysis (Table 4) revealed a positive correlation between the FMP of both hands and functional independence, indicating that the greater the grip strength, the higher the level of independence. On the other hand, a negative correlation was found between age and functional independence (rs= -.344, p=0.005), which suggests that older age is associated with less autonomy in activities of daily living.

Table 4.

Correlation results

Variables	Participant age	FPMD	FPMI
BI score	-.344**	.301*	.247*
	.005	.015	.047

Note: * The correlation is significant at the 0.05 level (two-tailed), ** The correlation at the 0.01 level (two-tailed). FPMD (RMHG): right manual pressure force; FPMI (LMHG): left manual pressure force.

Discussion

A predominance of females (75.4 %) was found in the sample studied, consistent with existing literature [16,18,19,20,21]. The higher female representation could be attributed to various factors, including a greater willingness of women to participate in research studies, increased seeking of medical attention, and higher life expectancy. However, it is important to consider that some studies, such as that of Hermosilla et al. [22], have reported an exclusively female proportion, suggetsing the need to explore the reasons for these differences in sample composition in greater depth.

Regarding marital status, the results show a relatively even distribution between widowed, married, and single statuses, with a lowe proportion of people in a domestic partnership. These findings are partially consistent with those reported by Villamizar [18], who found a predominance of married people. However, according to Valladares [23], the percentage of cohabiting people

differes from the results obtained in this study and Villamizar's [18]. These discrepancies could be related to cultural, socioeconomic, and demographic factors specific to each population studied.

The age range of the participants in this study was between 60 and 88 years, with a mean of 70.22 years and a standard deviation of 7.217. This age ranfe is consistent with most previous studies [6,18,19,24,25], where the population studied has focused mainly on older adults. However, it is important to highlifht that some studies have included younger populations (16,26), which suggests the need for additional research to explore the differences in results between different age groups. Although the average age found in this study is similar to that reported by other authors, others have been found with a slightly higher average age (83.68 years), which could indicate variations in the characteristics of the population studied [21].

The handgrip strength (HGS) was significantly higher in the right hand (16.20kg) compared to the left (16.06kg), a finding consistent with the existing literature [18,23,24,27]. These results corroborate the influence of laterality on muscle strength, where the dominant hand, generally the right, has a greater grip capacity. The prevalence of right-handedness in our sample is consistent with previous studies, which suggests that the practice and preferential use of one hand contribute to the differential development of the musculature.

The evaluation of handgrip strenght revealed a high prevalence of muscle weakness in both genders, especially in the dominant hand. These results are consistent with previous studies [21] and suggest an association between old age and sarcopenia. Our findings highlight the importance of evaluating muscle strength in older adults and the need to implement interventions to prevent and treat sarcopenia.

The evaluation of functional status using the Barthel index revealed a high prevalence of indepedence in activities such as bathing, personal hygiene, using the toilet, moving from bed to chair, and feeding onself. Howeverm greater dependence was observed in urine control (61.5 continent) and in the use of stairs (83.1% independent). These results suggest that, despite most participants being able to carry out basic activities of daily living, there were specific deficits in some areas. This heterogeneity in function is consistent with the finding of previous studies [21,23,25], which highlight the importance of assesing the needs of older adults individually.

Our research confirms the importance of muscle strength as a determinant of funcional status in older adults. The negative correlation between age and functional independence and the positive correlation between FPM and the Barthel index support the theory that sarcopenia contributes to functional decline [19,23,24,25,26]. In addition, the findings suggest that FPM could be an early marker of fraility and a therapeutic target for improving the quality of life in this population.

Conclusion

This study showed a significant association between FPM and functional status in older adults, measured using the Barthel index. A decrease in FPM was related to a decrease in functional independence. These findings corroborate the importance of muscle strength as a determining factor of functional capacity in this population. Future research shuold explore the effects of specific strength training programs on improving FPM and functional status in older adults with different functional levels or disabilities. This information can be beneficial for planning rehabilitation and therapeutic exercise programs, as well as for the early identification of possible functional deficits related to muscle weakness. Furthermore, it would be interesting to explore

the impact of specific interventions to strengthen the non-dominant in future studies in individuals with a marked laterality.

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