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The use of handgrip strength (HGS) in outpatient care for patients with Alzheimer's Disease

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***Keywords*— hand grip strength, dementia, Alzheimer's disease, elderly.**

***Abstract*—*To evaluate the contribution of handgrip strength (HGS) in outpatient care for elderly patients with Alzheimer's disease (AD). Cross-sectional study, with AD patients, >65 years of age, who underwent cognitive, nutritional and HGS assessment, International Physical Activity Questionnaire (IPAQ-SF) and Disability Assessment in Dementia (DAD). The data were compared to a similar control group (CG) composed of 51 elderly people, with p <0.05. The 43 elderly people with AD exhibited lower HGS scores when compared to the CG (13.4±8.2 vs 17.5±8.0; p=0.008, Mann-Whitney). There was no difference in HGS according to the severity of dementia, cognitive aspects, the IPAQ-SF and in the activities of daily living in the DAD. Higher HGS values were associated with males and younger age. There was a correlation with some anthropometric indicators. HGS was significantly lower in elderly people with AD. In Alzheimer's disease, higher HGS values were associated with males, younger age and some anthropometric indicators*

I. INTRODUCTION

Aging is associated with motor and physical fitness impairment resulting from the loss of the motor unit. In elderly people with dementia, cognitive impairment is associated with a reduction in the ability to perform routine physical activities with a consequent loss of functional capacity [1].

Among the different instruments that assess global muscle strength, the measurement of handgrip strength (HGS) is a relatively convenient, objective and simple functionality measurement; it is sensitive to physiological changes, it is a sarcopenia and fragility marker and is associated with cardiovascular mortality risk [2].

Some studies have shown the decline of HGS associated with dementia in a Japanese community [3], and the authors pointed out that a major reduction in HGS could be considered an indicator of late onset of dementia, from middle age to old age. In another study [4] that investigated reference values in a Brazilian population, HGS showed a negative correlation with age among healthy adults and elderly people. The study in question [4] did not identify HGS values in different clinical situations, but it was able to show the behavior of this indicator. HGS could also be considered an indicator for the prediction of cognitive impairment in obese women [5], and other studies suggest that HGS could be considered an indicator of the muscle strength capacity of overall health status [6].

Despite some evidence in the literature, there are still gaps in the knowledge of the contribution of the use of HGS in nutritional assessment and in its relationship with clinical and lifestyle aspects of elderly people with AD.

Thus, the objective of the study was to evaluate the contribution of handgrip strength (HGS) in outpatient care for elderly patients with Alzheimer's disease (AD).

II. METHOD

Cases

This cross-sectional study included elderly patients in outpatient care with clinical diagnosis of Alzheimer's disease (AD), according to the Diagnostic and Statistical Manual of Mental Disorders [7], the Recommendations of the European Federation of Neurological Societies [8] and the Brazilian Academy of Neurology [9], monitored at the neurology outpatient clinic of PUC-Campinas Hospital. A control group (CG) was formed with similar socio-cultural conditions, without cognitive complaints and without neurological or psychiatric diseases. The Human Research Ethics Committee of the University, protocol no. 1,234,677, approved the study. All participants signed an informed consent term.

Procedures

-*Cognitive evaluation:* The Mini-Mental State Examination (MMSE) [10], the simple memory drawing [11], the verbal fluency test [11] and the clock drawing test were evaluated [11].

-*Clinical dementia rating (CDR)* ***[***12]:–The CDR score was used to classify the degree of severity of dementia as mild, moderate or severe.

-*Anthropometric indicators:* Body mass index (BMI)[13], arm circumference (AC) [14,15], triceps skinfold (TSF)[14,15], arm muscle circumference (AMC)[14,15], subscapular skinfold (SSF)[14,15], calf circumference (CC)[14], waist circumference (WC)[16,17], and the thickness of the adductor pollicis muscle (TAPM)[18,19] were assessed. The procedures and cutoff points standardized in the relevant literature were used.

-*Handgrip strength (HGS):* It is a measure of the amount of force produced by an isometric contraction, applied over the dynamometer's loops, with three measurements, and the scores are subsequently averaged. The data were recorded in kilogram-force (Kgf). The measurement was performed with the individuals sitting with their feet flat on the floor, with adducted shoulder and elbow flexed at 90°, forearm in neutral position and wrist between 0 and 30° extension. A SAEHAN® model SH5002 mechanical dynamometer was used [3,20,21].

-*Mini Nutritional Assessment (MNA):* The Mini Nutritional Assessment (MNA) [22] form was used to assess nutritional status, with patients being classified as eutrophic, with or without malnutrition risk or malnutrition.

-*International Physical Activity Questionnaire- Short Form (IPAQ):* Physical activity was assessed and patients classified as sedentary or active, according to a standardized and validated instrument for the Brazilian population [23].

-*Disability Assessment in Dementia (DAD):* Basic activities of daily living (BADLs) and instrumental activities of daily living (IADLs) were assessed through a questionnaire that evaluates perception by elderly people [24,25].

Statistical analysis

A descriptive analysis was carried out with presentation of measures of position and dispersion for continuous variables. To compare continuous or orderable measurements between 2 groups, the Mann-Whitney test was applied. To verify the relationship between continuous or orderable measurements, Spearman's correlation coefficient was used. The level of significance adopted for the statistical tests was 5% [26,27].

III. RESULTS

The study included 43 patients aged 65 years and over, 65.1% (n=28) being female. A CG was formed with 51 individuals, with an average age of 78.3±7.8 years. There was no significant difference in age and gender between the groups. The elderly with AD were classified as having mild dementia in 16 cases, moderate dementia in 19 cases and severe dementia in 8 cases, according to the CDR.

The exploratory factor analysis [28] was used to summarize the cognitive assessment determined by several tests in a single component. The method of extraction was by principal components. The global measure of sample adequacy by the Kaiser-Meyar-Olkin (KMO) criterion was 0.6205, considered reasonable for the application of the analysis. The sample adequacy measures (MAA) of the four (4) variables, were greater than 0.50, complying with the adequacy criteria (*Cognitive Factor*, Table 1).

The values of the correlation analysis between the mean maximum handgrip strength (HGS) and the anthropometric parameters and the cognitive assessment can be seen in Table 1.

Table 1. Correlation between maximum average HGS and anthropometric parameters and cognitive assessment.

Variables	*Coefficient (r) **	*P-value*
Cognitive Factor	0.09006	0.5658
HGS vs age	-0.45051	0.0024*
HGS vs weight	0.55317	0.0001*
HGS vs height	0.55610	0.0001*
HGS vs body mass index	0.29336	0.0562
HGS vs arm circumference	0.41500	0.0057
HGS vs triceps skin fold	-0.04677	0.7658
HGS vs subscapular skinfold	0.10175	0.5162
HGS vs arm muscle circumference	0.56314	<.0001*
HGS vs waist circumference	0.38548	0.0107*
HGS vs calf circumference	0.39423	0.0089*
HGS vs TAPM	0.25972	0.0967

Cognitive Factor:- exploratory factor analysis [26]

HGS: handgrip strength; TAPM: thickness of the adductor pollicis muscle. Spearman's correlation coefficient. * *p*<0.05.

When comparing the HGS scores, among the elderly with AD and those in the CG, it was observed that significantly, the elderly with AD exhibited lower scores for the HGS-right arm (13.9±8.6 vs 18.0±8.0; Mann-Whitney, *p*=0.006); HGS-left arm (12.9±8.0 vs 17.0±8.2, *p*=0.008), and the HGS-maximum mean between the two arms (13.4±8.2 vs 17.5±8.0, *p*=0.008). *(Data not reported in tables).*

The score values of handgrip strength according to gender, CDR and MNA of the elderly with AD, are shown in Table 2.

Table 2. Descriptive analysis of HGS according to gender, CDR and MNA.

	Handgrip strength		
	Right	Left	Mean
Gender			
Male (n=15)	21.8 (±8.6)	20.3 (±7.8)	21.0 (±8.1)
Female (n=28)	9.7 (±4.8)	9.0 (±4.6)	9.3(±4.6)
p-value	<0.001*	<0.001*	<0.001*
CDR			
Mild (n=16)	16.5 (±10.1)	15.5 (±9.0)	16.0 (±9.5)
Moderate (n=19)	12.2 (±7.1)	11.4 (±7.1)	11.8 (±7.0)
Serious (n=8)	12.7 (±8.1)	11.3 (±7.0)	12.0 (±7.5)
p-value	0.474	0.361	0.461
MNA			
No nutritional risk	17.0 (±10.1)	15.2 (±9.7)	16.1 (±9.8)
With nutritional risk and malnutrition	11.5 (±6.3)	11.1 (±5.8)	11.3 (±6.0)
p-value	0.06	0.198	0.08

HGS: handgrip strength; CDR*:* clinical dementia rating; MNA: mini nutritional assessment. Mann-Whitney Test; **p*<0.05.

There was no significant difference between the HGS scores and the practice of physical activity (IPAQ). There was no significant correlation between HGS and daily living activities in the DAD (Table 3).

Table 3. Descriptive analysis of HGS according to the practice of physical activity and activities of daily living.

	HGS r	HGS l	Maximum average HGS
IPAQ			
Sedentary (n=26)	14.0 ± 8.5	12.9 ± 7.4	13.4 ± 7.8
Active (n=17)	13.8 ± 9.0	12.9 ± 9.0	13.3 ± 8.9
p-value	0.97[a]	0.84[a]	0.88[a]
DAD			
BADL	0.186; *p*=0.23[b]	0.185; *p*=0.23[b]	0.186; *p*=0.23[b]
IADL	0.127; *p*=0.41[b]	0.085; *p*=0.58[b]	0.109; *p*=0.48[b]
ADL	0.160; *p*=030[b]	0.137; *p*=0.37[b]	0.149; *p*=0.33[b]

IPAQ: International Physical Activity Questionnaire; DAD: Disability Assessment for Dementia; HGS: handgrip strength; HGSr: right arm Handgrip strength; HGSl: left arm Handgrip strength; BADL: basic activities of daily living; IADL: instrumental activities of daily living; *ADL: Activities of daily living.* [a] Mann-Whitney; [b] Spearman's correlation; * $p<0.05$.

Discussion

Studies investigating changes in cognition in connection with HGS changes as well as studies that investigated HGS changes, in connection with the cognitive function changes, have been reported in the relevant literature. It is known that with advancing age and with the progression of dementia, the ability to perform activities of daily living and HGS, decrease with time; but these issues still need further clarification, both with regard to HGS, as well as in relation to day-to-day activities.

Our data showed significant differences regarding HGS among patients with AD and patients in the control group and HGS was weaker in patients with AD. In a Korean longitudinal study [5] with elderly women over 65 years of age, HGS was associated with a reduced risk of cognitive impairment in obese women, but not in non-obese women. And in another longitudinal Korean aging study [29], which assessed the relationship between HGS and the cognitive function, a significant bidirectional relationship was observed between these variables; and the authors suggested that this should be better elucidated in further investigations. HGS could also be used in the assessment of cognitive status, and the strength capacity and cognitive function could parallel each other [30], where the functionality loss in one factor, could predict the loss of functionality in the other, as shown in that study conducted with elderly Americans [30]. No difference was observed in our investigation between HGS and physical activity and daily living activities.

Other studies in the relevant literature [31,32] showed that cognitive decline would be associated with a specific pattern of functional losses, which started with impairment in the performance of advanced activities of daily living, followed by losses in instrumental activities of daily living towards basic activities of daily living. And in a longitudinal observational study [33] with elderly inpatients over 70 years of age, HGS was associated with basic activities of daily living and with instrumental activities of daily living, and the authors suggested that HGS be further explored as a predictive marker in elderly patients.

Study Limitations

The small sample size and the type of study (cross-sectional), were considered the main limitations of this study. It is noteworthy, however, that the Service where the study was conducted, serves a representative population of a large metropolitan region and, thus, the population of patients with AD, assessed here, reflects a considerable group of patients with this disease, who are routinely and rigorously monitored in an outpatient clinical neurology service.

IV. CONCLUSION

HGS was significantly lower in elderly people with AD. In Alzheimer's disease, higher HGS values were associated with males, younger age and some nutritional indicators.

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