HANDGRIP STRENGTH AND SOME RELATED FACTORS AMONG OLDER PATIENTS WITH OSTEOPOROSIS

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SUMMARY

Objectives: *To assess handgrip strength (HGS), lower limb strength, and some related factors among older people with osteoporosis.* ***Subjects and Methods****: A cross-sectional study on 141 older patients with osteoporosis examined and treated at National Geriatric Hospital from June to October 2022. HGS was measured using the handgrip strength dynamometer, and lower limb strength was assessed by the 5-time chair stand test. General information, characteristics of osteoporosis, and geriatric syndromes were collected.* ***Results:*** *56% of individuals had impaired HGS, and 24.8% of participants had impaired lower limb strength. The older age group was significantly associated with lower handgrip strength (p<0.05). Those with HGS impairment had lower mean BMI (p<0.05). The co-incidence of lumbar spondylosis and diabetes significantly differed between the two groups (p< 0.05). Participants who experienced pain and lumbar spine malformation had a higher rate of impaired HGS (p<0.05). Declining cognitive function increases 5.7 times the risk of HGS decline. The risk of deterioration in HGS was increased in participants with low physical activity levels (OR=3.9), sleep disturbance (OR=3.8), depression (OR=3.7), frailty syndrome (OR=3.5), risk of fall (OR=3.4) and malnutrition (OR=2.2).* ***Conclusion:*** *Half of the subjects had reduced HGS and a quarter of the subjects had reduced lower limb muscle strength. Age, BMI, diabetes, lumbar spondylosis or other joints, living status, and geriatric syndromes were significantly associated with impaired HGS.*

Keywords*: handgrip strength, lower limb strength, elderly, osteoporosis.*

1. INTRODUCTION

Osteoporosis is a “silent disease"- with no typical symptoms, so you may not realize you have it until a low-trauma fracture occurs. Although osteoporosis affects people of all ages and genders, it is more prevalent in Caucasians, women, and the older. These effects create a cycle of impairment, with fractures leading to deterioration in physical function and reduced physical capacity, putting them at a greater risk for further fractures and the possibility of more physical restrictions [1].

The contribution of associated factors in physical function varies between studies. A previous study showed that significant associations include advanced age, females, and pain density [2]. Handgrip dynamometers are typically used to assess maximum isometric handgrip strength (HGS) with excellent inter-tester and test-retest reliability. Low HGS is frequently a sign of poor upper extremity strength and lower extremity function. Weak muscle strength is typically seen in older persons as reduced mobility and an increase in dependency on their activities of daily living and it is a predictor of mortality and body function. In addition, HGS is regarded as a reliable measure of

physical decline and potential outcomes among the older adult population [3].

Exploring the HGS and its associated factors among older patients with osteoporosis can develop interventions to promote activities as much as possible. However, data about HGS are lacking regarding the older population with osteoporosis.

Thus, the aims of this study were to assess HGS and some related factors among older people with osteoporosis examined and treated at the National Geriatric Hospital.

2. SUBJECTS AND METHODS

2.1. Subjects

Patients aged 60 years old and older were diagnosed with osteoporosis according to WHO criteria, were examined and treated at the National Geriatric Hospital from June to October 2022, and had the physical and cognitive abilities to do a face-to-face interview.

Exclusion criteria: patients with severe acute conditions such as ketoacidosis coma, hyperosmolar coma, coma due to cerebrovascular accident, exacerbation of heart failure decompensation, liver failure, exacerbation of chronic obstructive pulmonary disease.

2.2. Study design

- A cross-sectional descriptive study

- The sample was selected according to the convenience sampling method

- According to the formula, the smallest sample size is n = 135 patients. In fact, 141 patients participated in this study.

2.3. Variables

- General information: age, gender, educational level, weight, height, body mass index (BMI).
- Comorbidities characteristics
- Osteoporosis characteristics: T-score, diagnosed duration, symptoms of osteoporosis, treatment
- **Handgrip strength (HGS)**: The HSG of both hands was measured using the handgrip strength dynamometer (Jamar TM Hidraulic Hand Dynamometer 5030 J1, USA). Participants sat comfortably with their hands at their sides in a neutral position. The inner lever of the dynamometer was adjusted to fit the hand, and the respondents were instructed to squeeze the dynamometer as hard as possible for a few seconds. Test each hand twice and record the best effort rating of each on the participant's handout and on the aggregate form.

  Low HGS was defined as < 28 kg for males and < 18 kg for females [4].
- **Lower limb strength:** The 5-time chair stand test measures how quickly a patient transfers five times from sitting to standing and back to a sitting position. A stopwatch and a standard-height chair with a straight back are among the tools required for the test. The test-taker is instructed to sit on the chair with their backrest. The test-taker is also instructed to cross their arms over their chest. The test-taker should then be encouraged to perform five sit-to-stands as quickly as they can at the count of go,

without putting their back or leg on the chair in between repetitions. Individuals with times for 5 repetitions of this test ≥ 12 seconds following can be considered to have performed poorer than average [4].

- **Characteristics of some geriatric syndromes:** Physical activity level was assessed according to the International Physical Activity Questionnaire-Short Form (IPAQ-SF). Polypharmacy was assessed by asking patients and families/ caregivers, viewing prescriptions, and referring to medical records. Nutrition status was evaluated using the Mini Nutritional Assessment - Short Form (MNA-SF). Depression was performed using the Geriatric Depression Scale (GDS-15). Sleep disturbance was screened by the Pittsburgh Sleep Quality Index (PSQI). Cognitive impairment was assessed by the Mini-Mental State Examination (MMSE). The risk of falls was assessed by asking the 21-item fall risk index. Frailty syndromes were assessed by the Clinical Frailty Scale (CFS).

2.4. Tools and data collection method

Data were collected by using a research questionnaire through interviews, diagnosis tests, and medical records at the National Geriatric Hospital.

2.5. Data processing and data analysis

Data coding, entry into REDCap, and analysis were done using Statistical Package for Social Science (SPSS) software (version 22.0). Descriptive statistics were adopted to examine characteristic data: frequency, percentage, and mean with standard deviation. T-test, Chi-square, and Binary logistic regression were performed to evaluate the factors affecting physical function in osteoporosis patients. Statistical significance was accepted at the 95% confidence level ($p < 0.05$).

3. RESULTS

3.1. General characteristics

In the total 141 older patients with osteoporosis, the mean age of the patient was 73.1 ± 8.6 years with a minimum of 60 and a maximum of 97. Participants were divided into 3 groups: 60 – 69 years old (35.5%), 70 – 79 years old (39.9%), and 80 years old and over (25.5%). The majority of study participants were females, accounting for 94.3%. The mean BMI was 21.9±3.0 kg/m^2. The percentage of underweight and overweight were 13.5% and 37.6%, respectively.

3.2. Handgrip and lower limb strength in older patients with osteoporosis

Table 1. HGS and lower limb strength measurements in older osteoporosis patients

Test		Normal *n (%)*	Impaired *n (%)*	Mean ± SD
Handgrip strength (HGS)	Male	4 (50.0)	4 (50.0)	27.9 ± 4.7 (kg)
	Female	58 (43.6)	75 (56.4)	16.1 ± 5.1 (kg)
	Total	62 (44.0)	79 (56.0)	16.7 ± 5.7 (kg)
Lower limb strength (5XSTS)		106 (75.2)	35 (24.8)	16.4 ± 6.8 (s)

Male patients with low HGS accounted for 50% of the total number of males. Females having impaired upper limb strength had a higher rate compared to those having normal upper limb strength (56.4% and 43.6%, respectively). In total, 56% of individuals had impaired HGS. The mean time to accomplish the five-time sit-to-stand test was 16.4 ± 6.8 seconds. Over three-four participants got normal, while 24.8% of the total sample was estimated as impaired lower limb strength.

3.3. Association between HGS and general characteristics

Table 2. Association between HGS and general characteristics (n=141)

Characteristics		Normal HGS		Impaired HGS		p-value
		n	%	n	%	
Age	60 – 69	30	48.4	20	35.3	**< 0.05**
	70 – 79	23	37.1	32	40.5	
	≥ 80	9	14.5	27	34.2	
Gender	Male	4	6.5	4	5.1	> 0.05
	Female	58	93.5	75	94.9	
BMI	< 18.5	4	6.5	15	19.0	> 0.05
	18.5 – 22.9	30	48.4	39	49.4	
	≥ 23	28	45.2	25	31.6	
Lumbar spondylosis or other joints	Yes	7	11.3	20	25.3	**< 0.05**
	No	55	88.7	59	74.7	
Diabetes	Yes	6	9.7	19	24.1	**< 0.05**
	No	56	90.3	60	75.9	
Living status	Family	62	100.0	70	88.6	**< 0.05**
	Alone	0	0.0	9	11.4	
		Mean ± SD				
Age (year)		70.1 ± 7.1		75.5 ± 9.1		**< 0.05**
BMI (kg/m^2)		22.6 ± 2.7		21.4 ± 3.1		**< 0.05**

The overall older age group was significantly associated with lower handgrip strength ($p<0.05$). The mean age in those with HGS decline was higher, and statistically significant ($p<0.05$). The percentage of people living alone with impairment of upper extremity strength was higher (11.4% vs 0.0%) and people living with family had less strength impairment (100.0% vs 86.4%) were statistically significant ($p< 0.05$). Those with HGS impairment had lower mean BMI ($p< 0.05$). The co-incidence of lumbar spondylosis and

diabetes was significantly different between the two groups (p< 0.05).

3.4. Association between HGS and characteristics of osteoporosis

Table 2. The association between HGS and characteristics of osteoporosis

Characteristics		Normal HGS		Impaired HGS		p-value
		n	%	n	%	
Diagnosed duration (year)	Newly	34	54.8	36	45.6	> 0.05
	<5	17	27.4	32	40.6	
	5 – 10	11	17.7	11	13.9	
Symptoms	Pain (back, …)	52	83.9	76	96.2	**< 0.05**
	Loss of height	27	43.5	35	44.3	> 0.05
	Spine malformations	8	12.9	22	27.8	**< 0.05**
	Bone fractures after minor injuries	3	4.8	3	3.8	> 0.05
	No symptoms	4	6.5	2	2.5	> 0.05
Treatment	Yes	35	56.5	37	46.8	> 0.05
	No	27	43.5	42	53.2	
Mean ± SD	T-score of hip	-1.4 ± 1.3		-1.6 ± 0.9		> 0.05
	T-score of spine	-3.3 ± 0.7		-3.4 ± 0.8		> 0.05

Participants who experienced pain and lumbar spine malformation had a higher rate of loss of upper limb strength (83.9% vs. 96.2% and 12.9% vs. 27.8%, respectively) (p<0.05). There is no statistically significant relationship between HGS and diagnosed duration, treatment or not, and BMD in osteoporosis patients (p>0.05).

3.5. Association between HGS and geriatric syndromes

Table 3. The association between HGS and geriatric syndromes (n=141)

Geriatric syndromes	OR	95%CI
Cognitive impairment	**5.7**	2.2 – 14.9
Low physical activity level	**3.9**	1.9 – 8.1
Sleep disturbance	**3.8**	1.7 – 8.4
Depression	**3.7**	1.7 – 7.8
Frailty syndrome	**3.5**	1.5 – 8.4
Risk of fall	**3.4**	1.7 – 6.8
Malnutrition	**2.2**	1.1 – 4.3
Polypharmacy	1.6	0.8 – 3.2

Cognition was an important factor in HGS impairment. Declining cognitive function increased 5.7 times the risk of HGS decline, 95%CI 2.2 – 14.9 (p< 0.05). The risk of deterioration in HGS was increased in participants with low physical activity levels (OR=3.9), participants with sleep disturbance (OR=3.8), participants with depression (OR=3.7), participants with frailty syndrome (OR=3.5), risk of fall (OR=3.4) and malnutrition participants (OR=2.2).

4. DISCUSSION

Our results highlighted characteristics of HGS, lower limb strength, and some related factors with impaired HGS among older patients with osteoporosis at the National Geriatric Hospital. The mean handgrip strength in osteoporosis was 16.7 ± 5.7 kg. The

prevalence of impaired HGS was 56.0%. The mean grip in our study was significantly lower than the study by Yixuan, with 24.17 ± 9.20 kg [5]. This difference is due to the women/men ratio disparity of this study compared to our study, with the female/male ratio being 1.7 compared to 16.6, respectively. Many authors identified that muscle strength was negatively associated with osteoporosis, and reduction in grip strength was associated with an increased risk of osteoporosis [5].

The mean time to accomplish the five-time sit-to-stand test was 16.4 ± 6.8 seconds. Over three-four participants were normal, while 24.8% of the total sample was estimated as impaired lower limb strength. The studies by Khazzani et al., and Dai et al. showed that low 5XTST performance was associated with low BMD, and a high risk of falls and fractures [6].[7].

Many studies among older adults identified that HGS declined gradually with age [4],[8]. A study showed that individuals aged >75 years increased the risk of having low handgrip strength by 2.3-fold [9]. It was well understood that the aging process leads to degenerative changes, and reduction in muscle mass makes HGS decline. Our study found out that the mean age in those with HGS decline was higher and for people in the age group of 80 or older, the risk of HGS decline can increase 3.1 times. These results were consistent with the study among women with low bone mass, with the tendency of handgrip strength decreased with age [10].

Our results demonstrated an association of decreased grip strength with diabetes and lumbar spondylosis but not with comorbidities. Our finding was consistent with the study by Uman et al. conducted in older people aged ≥ 60 years, there was a significant relationship between type II diabetes and low handgrip strength (OR, 2.3; 95% 1.2 – 4.7) [11]. On the other hand, the study by Lino et al. found no association between low grip strength and diabetes [12]. Maybe the differences in subject, sample size, and study method can explain this occurrence

Participants who experienced pain and lumbar spine malformation had a higher rate of loss of upper limb strength (83.9% vs. 96.2% and 12.9% vs. 27.8%, respectively) ($p< 0.05$). Severe vertebral deformities were associated with substantial pain and disability [13]. However, to our knowledge, no studies have investigated the relationship between lumbar spine deformity and hand muscle strength. Therefore, in the future, more research is needed to evaluate this issue.

Cognition impairment was a risk factor for HGS impairment. Declining cognitive function increased 5.7 times the risk of HGS decline, 95% CI 2.2 – 14.9 ($p< 0.05$). The result was consistent with the population-based study in Korean adults that decreasing handgrip strength was associated with a decline in cognitive function [14]. Physical activity directly stimulates skeletal muscle and subsequently leads to improved muscle mass and higher HGS. Higher physical activity level was associated with greater HGS [15]. We found that individuals with low levels of physical activity can have a 3.9 times higher risk of deteriorated HGS ($p<0.05$). The risk of fall was assessed using the 21-item risk of fall, which was associated with impaired handgrip strength. Similar to our finding, the study

by Nga Thi Thuy Nguyen et al. using the TUG test to assess the risk of falls identified that low HGS was associated with a higher risk of falls [8].

As demonstrated by other authors [12],[16], we also identified participants with depression who had higher odds of having poor HGS (OR 3.7). The assessment of nutritional status had shown a significant association with hand grip strength. Older adults with osteoporosis had malnutrition that increased the odds of poor upper extremity strength 2.2 times ($p < 0.05$). The results were in line with the study by Riviati et al., which showed the association between MNA score and handgrip strength ($p<0.001$), and malnutrition increased the risk of having low handgrip strength by 1.9-fold [9]. Impaired muscle strength in malnourished conditions is due to decreasing muscle protein supply which is a useful alternative energy source [17].

5. CONCLUSIONS

Half of the study subjects had reduced HGS and a quarter of the study subjects had reduced lower limb muscle strength. Age, BMI, diabetes, lumbar spondylosis or other joints, living status and geriatric syndromes were significantly associated with impaired HGS in older patients with osteoporosis.

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