

# The geriatric hand: correlation of hand-muscle function and activity restriction in elderly

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On the basis of the importance of hand manipulation in activities of daily living (ADL), deterioration of hand function because of various factors reduces quality and independence of life of the geriatric population. The aim of this study was to identify age-induced changes in manual function and to quantify the correlations between hand-muscle function and activity restriction in the geriatric age group, through grip and pinch measurements and a set of questionnaires. Twenty-four geriatric (aged 65–79 years) volunteers participated in the study. Bilateral grip and pinch strengths have been recorded. To document impairment of manual functions, self-estimated hand function, Duruöz and Dreiser hand indices, Geriatrics-Arthritis Impact Measurement Scale (GERI-AIMS) manual dexterity questionnaires have been completed. Activity restriction and quality of life of these patients were inquired with short form (SF)-36 and Instrumental Activities of Daily Living (IADL) scores. Grip and pinch strengths correlated best with Duruöz and Dreiser indices. Similarly, SF-36 and IADL had higher correlation coefficients for Duruöz and Dreiser indices. A very good correlation between IADL and SF-36 was calculated too. Male and female participants revealed statistically significant differences for grip and pinch strengths as well as self-estimated hand function and SF-36. Another result was that none of our parameters, including grip strength and SF-36 had differed significantly between 65–70 and 70–79 years age subgroups. However, grip strength displayed statistically significant lower values when compared with young adult mean values of a previous study. Our data in this study support the hypothesis that hand-muscle function correlates with functional dependency in the elderly. Manual function can be determined by grip strength in addition to multiple available functional tools. In this study, Dreiser and Duruöz hand function indices were the best to correlate with ADL and quality of life.

Aufgrund der Bedeutung der Handmanipulation bei den Tätigkeiten des täglichen Lebens (ADL) schränkt eine Verschlechterung der Handfunktion infolge verschiedener Faktoren die Lebensqualität und Selbständigkeit der geriatrischen Bevölkerung ein. Ziel der vorliegenden Studie ist die Ermittlung altersbedingter Veränderungen der manuellen Funktion sowie die Quantifizierung der Korrelationen zwischen der Handmuskelfunktion und Einschränkung der Aktivität in der geriatrischen Altersgruppe durch Messen der Spitz- und Grobgriffstärke und durch Fragebögen. An der Studie nahmen insgesamt 24 geriatrische Probanden (im Alter von 65–79 Jahren) teil.

Es wurden die bilateralen Griff- und Spitzstärken erfasst. Zwecks Dokumentierung der Beeinträchtigung der manuellen Funktionen, der selbstbeurteilten Handfunktion, der Duruöz und Dreiser Handindizes und der GERI-AIMS (geriatrische Arthritis Impact Measurement Scale) wurden Fragebögen zur Fingerfertigkeit ausgefüllt. Mit Hilfe des kurzen Formulars SF-36 und der Scores der instrumentellen Tätigkeiten des täglichen Lebens (IADL) wurden Items wie Einschränkungen bei Tätigkeiten des täglichen Lebens und die gesundheitsbezogene Lebensqualität dieser Patienten ermittelt. Die Griff- und Spitzstärken korrelierten am besten mit den Duruöz- und Dreiser-Indizes. Ebenso wiesen SF-36 und IADL bei den Duruöz- und Dreiser-Indizes höhere Korrelationskoeffizienten auf. Ferner wurde auch zwischen IADL und SF-36 eine sehr gute Korrelation berechnet. Bei den männlichen und weiblichen Teilnehmern wurden statistisch signifikante Unterschiede für die Griff- und Spitzstärken und die selbstbeurteilte Handfunktion sowie SF-36 deutlich. Des weiteren ergab sich, dass bei keinem unserer Parameter, d.auch weder bei der Griffstärke noch dem SF-36, signifikante Unterschiede zwischen den Altersgruppen 65–70 und 70–79 Jahre feststellbar waren. Die Griffstärke wies im Vergleich mit den mittleren Werten junger Erwachsener aus einer früheren Studie jedoch statistisch signifikant niedrigere Werte auf. Die bei unserer Studie gewonnenen Daten bekräftigen die Hypothese, dass die Hand-Muskel-Funktion mit der funktionalen Abhängigkeit bei älteren Menschen korreliert. Die manuelle Funktion kann zusätzlich zu den zahlreichen zur Verfügung stehenden funktionalen Tools anhand der Griffstärke ermittelt werden. Im Rahmen dieser Studie korrelierten die Handfunktionsindizes nach Dreiser und Duruöz am besten mit den ADL und der Lebensqualität.

Dada la importancia del uso de las manos durante la realización de actividades de la vida diaria (AVD), el deterioro del funcionamiento de estas, a causa de diversos factores, disminuye la calidad de vida y la independencia de la población geriátrica. El objetivo de este estudio fue identificar las alteraciones del funcionamiento de las manos inducidos por la edad y cuantificar las correlaciones entre el funcionamiento de los músculos de las manos y las restricciones relativas a la realización de actividades en el grupo de participantes de edad geriátrica, mediante la medición de las fuerzas de prensión y de agarre en pinza y el uso de un conjunto de cuestionarios. En el estudio participaron 24 voluntarios de edad geriátrica (65 a 79

años). Se midieron las fuerzas de prensión y de agarre en pinza en ambas manos. Para documentar las deficiencias relativas al funcionamiento de las manos, el funcionamiento de las manos percibido y los índices de Duruöz y Dreiser de funcionamiento de la mano, se utilizó la Escala de Medición del Impacto de la Artritis para pacientes geriátricos (GERI-AIMS). Las restricciones relativas a la realización de actividades y la calidad de vida de estos pacientes se investigaron mediante el cuestionario SF-36 y los puntajes de la escala de Actividades Instrumentales de la vida Diaria (AIVD). Las fuerzas de la prensión y del agarre en pinza se correlacionaron mejor con los índices de Duruöz y Dreiser. De manera similar, el cuestionario SF-36 y la escala de AIVD mostraron mayores coeficientes de correlación con los índices de Duruöz y Dreiser. También se halló una muy buena correlación entre la escala de AIVD y el cuestionario SF-36. Se hallaron diferencias estadísticamente significativas entre los varones y las mujeres participantes en el estudio en cuanto a las fuerzas de prensión y de agarre en pinza, así como entre el funcionamiento de la mano percibido y el cuestionario SF-36. Otro resultado fue que ninguno de nuestros parámetros, entre ellos la fuerza de prensión y el cuestionario SF-36 mostraron diferencias importantes entre los subgrupos de edades de 65 a 70 y de 70 a 79. No obstante, la fuerza de prensión mostró valores estadísticamente significativos menores que la media de los valores obtenidos en adultos jóvenes participantes en un estudio anterior. Los resultados del presente estudio respaldan la hipótesis de que el funcionamiento de los músculos de las manos se correlaciona con la dependencia funcional de los ancianos. El funcionamiento de las manos puede determinarse mediante la fuerza de prensión, además de mediante numerosas herramientas de valoración funcional disponibles. En este estudio, los índices de Duruöz y Dreiser de funcionamiento de las manos se correlacionaron mejor con las AVD y la calidad de vida.

Compte tenu de l'importance des fonctions manuelles dans les activités de la vie quotidienne (AVQ), la détérioration de la fonction manuelle en raison de divers facteurs a pour effet de réduire la qualité et l'indépendance de vie de la population gériatrique. Cette étude avait pour objet d'identifier les changements induits par l'âge dans la fonction manuelle et de quantifier les corrélations entre la fonction des muscles de la main et la restriction d'activité dans la tranche d'âge gériatrique, par le biais de mesures des forces de préhension et de pincement et une série de questionnaires. Vingt-quatre bénévoles âgées (de 65–79

## Introduction

On the basis of the importance of hand manipulation in normal activities of daily living (ADL), deterioration in hand-muscle function reduces quality and independence

of life in the geriatric population. The decline in manual function has been postulated to be because of weakness in muscle mass, strength and coordination, finger dexterity and hand sensation as well as degeneration of

ans) ont participé à l'étude. Les forces de préhension et de pincement ont été enregistrées. Pour documenter la dégradation des fonctions manuelles, les participants ont rempli des questionnaires d'autoévaluation des fonctions manuelles et de dextérité manuelle utilisant les indices manuels de Duruöz et Dreiser et l'échelle de mesure d'impact de l'arthrite chez les personnes âgées («Impact Measurement Scale ' - GERI-AIMS). La restriction d'activité et la qualité de vie de ces patients ont été évaluées en utilisant le formulaire court (SF)-36 et les scores d'activités instrumentales de la vie quotidienne (IADL). Les forces de préhension et de pincement présentent la plus forte corrélation avec les indices de Duruöz et Dreiser. De même, les évaluations SF-36 et AIJD présentent les coefficients de corrélation les plus élevés pour les indices de Duruöz et Dreiser. Une très bonne corrélation entre l'IADL et le SF-36 a également été calculée. Les hommes et les femmes participant ont révélé des différences statistiquement significatives au niveau des forces de préhension et de pincement ainsi que de l'autoévaluation des fonctions manuelles et du formulaire SF-36. Un autre résultat a été qu'aucun de nos paramètres, y compris la force de préhension et le formulaire SF-36, n'a présenté de différences significatives entre les tranches d'âge 65–70 et 70–79 ans. Toutefois, la force de préhension a affiché des valeurs inférieures statistiquement significatives à celles d'une étude précédente portant sur les jeunes adultes. Les données de notre étude soutiennent l'hypothèse que les fonctions des muscles de la main présentent une corrélation avec la dépendance fonctionnelle des personnes âgées. Les fonctions manuelles peuvent être déterminées par la force de préhension, en complément des nombreux outils techniques disponibles. Dans cette étude, les indices de fonction manuelle de Dreiser et Duruöz ont été les meilleurs éléments de corrélation avec l'ADL et la qualité de vie. *International Journal of Rehabilitation Research* 00:000–000 © 2009 Wolters Kluwer Health | Lippincott Williams & Wilkins.

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of life in the geriatric population. The decline in manual function has been postulated to be because of weakness in muscle mass, strength and coordination, finger dexterity and hand sensation as well as degeneration of

the central nervous system (Ranganathan *et al.*, 2001). An understanding of the determinants of manual function is critical for the design of interventions to prevent or delay dependency (Hughes *et al.*, 1995).

The aim of this study was to document impairment of manual functions in the elderly and to quantify the correlations between hand-muscle function and activity restriction in the geriatric age group through grip and pinch measurements and a set of questionnaires and to identify the best determinants of function.

## Methods

The study was designed to be cross-sectional with 24 geriatric volunteer patients (aged between 64 and 79 years) who admitted to outpatient clinics of physical medicine and rehabilitation department for minor musculoskeletal complaints of lower extremity such as pes planus, hallux valgus etc. Participants were community-dwelling individuals and exclusion criteria were neurological diseases with possible hand impairment or cognitive dysfunction (Parkinson's disease, hemiplegia, dementia etc.), previous trauma or fracture of upper extremity, advanced hand osteoarthritis, inflammatory arthritis, and entrapment neuropathies. Informed consent and detailed history were obtained by self-report. Age, sex, height, weight, dominant hand (the one preferred for writing, eating, and throwing a ball) were recorded (Bohannon, 1998). Body mass index of the patients have been calculated according to kilogram/square meter formula.

A detailed physical examination of the upper extremities has been carried out including range of motion, muscle testing, and neurological examination. Handgrip strength for both dominant and nondominant hands were measured with Jamar dynamometer (JA Preston Corp., Ontario, Canada) with patient seated, shoulder adducted and elbow flexed to 90°.

Tip pinch strength measurements were made bilaterally between thumb and index fingers with patient seated, using manual pinchmeter that measures finger prehension force (Mathiowetz *et al.*, 1985). Patients made three maximum attempts for each measurement and the average value of these trials were recorded. One-minute rest was given between each attempt and hands were alternated to minimize fatigue affects. No verbal encouragements were made. The calibration of both instruments was tested periodically during the study.

To document impairment of manual functions of the participants, several indices and questionnaires listed below have been completed. All questionnaires were administered by trained physicians at the same setting for all patients and final scores have been recorded.

For further evaluations, participants were subgrouped according to sex and age. There were 13 patients aged between 65 and 70 years and 10 patients aged between 70 and 75 years. The only participant older than 75 years (aged 79 years) was included in the older group (total 11). Grip strength values of a group of young adults (mean age  $30.21 \pm 5.91$  years) were used for comparison of a broad age range.

### Self-estimated hand function

Self-estimated hand function (SEHF) was recorded on a 10-cm visual analog scale. Hand function was defined as the ability to use hand to perform activities (Dellhag and Bjelle, 1999). Participants were asked to put a mark on the line somewhere between the end points of 'no hand function' and 'full hand function'.

### Duruöz hand index (Cochin scale)

This scale was developed originally for rheumatoid arthritis patients to assess disability and functional handicap but has been validated for different patient populations (hand surgery, hemodialysis patients etc.). The scale is based on questions concerning activities commonly performed by the hand in a person's daily environment. Each question being scored from 0 (performed without difficulty) to 5 (impossible to do) (Lefevre-Colau *et al.*, 2001; Duruöz *et al.*, 2003).

### GERI-AIMS manual dexterity

The dexterity scale of the Geriatrics-Arthritis Impact Measurement Scale (GERI-AIMS), a modification of the AIMS for use in research in geriatrics. The scale contains five questions about the ease with which the person can write, turn a key, button clothing, tie shoes, and open a jar (Falconer *et al.*, 1991).

### Dreiser hand function index

An algofunctional index designed for evaluation and symptomatic follow-up of patients with digital osteoarthritis. This is a change-sensitive index, based on a physician-administered questionnaire on 10 daily activities involving the hands. The patient is asked to answer each item using a 4-point verbal scale, from 'possible without difficulty' (0) to 'impossible' (3 points); thus, total scores range from 0 to 30 (Dreiser *et al.*, 1995).

### Instrumental Activities of Daily Life questionnaire

The Instrumental Activities of Daily Life (IADL) scale is an assessment scale that allows health professionals to determine the capacity an elderly patient has for autonomous living through answers of nine questions (Lawton and Brody, 1969).

### Short form 36

The Short form (SF)-36 is recommended where a detailed and broad ranging assessment of health is required,

particularly in community-dwelling older people with limited morbidity (Haywood *et al.*, 2005). It consists of a multi-item scale that assesses eight health concepts: physical functioning, role limitations because of physical problems, bodily pain, general health perception, vitality, social functioning, role limitations because of emotional problems, and mental health.

### Statistical analysis

All statistical analyses were performed with SPSS 9.0 package program for windows (SPSS Inc., Chicago, Illinois, USA). Minimum–maximum and mean  $\pm$  SD values for all quantitative demographic data as well as questionnaire scores have been processed with descriptive analyses. Comparisons between patient subgroups (according to sex and age) were tested using *t*-tests and Mann–Whitney *U* test. Relationships between variables were computed with Spearman's correlation analyses. A *P* value of less than 0.05 was accepted as significant.

### Results

The study group included 24 community-dwelling geriatric patients aged between 65 and 79 years (mean  $69.16 \pm 3.73$ ). There were nine males and 15 females and all were right handed. The younger elderly (aged 65–70 years) and older elderly (aged 70–79 years) subgroups included 13 and 11 individuals, respectively.

Quantitative demographic data of the participants and sex–age subgroups are listed in Table 1. Age-based subgroups revealed only nonsignificant variations. Similarly, dominant and nondominant hands did not display statistically significant differences. As expected, men had stronger grip and pinch forces for both sides ( $P < 0.01$ ). Female participants displayed statistically significant different scores in SEHF and SF-36 scores ( $P = 0.041$  and  $0.01$ ).

We investigated the relationship between impairment and disability measures. In this manner, correlation analyses of handgrip strength, hand function indices,

and quality of life questionnaires have been performed. Correlation analyses revealed good-to-excellent correlations between grip and pinch forces ( $r = 0.776$  and  $r = 0.754$  for left and right sides, respectively).

Grip and pinch strength values correlated better with Duruöz and Dreiser indices than SEHF and GERI-AIMS ( $r = 0.750$ ,  $r = 0.680/r = 0.760$  and  $r = 0.676$  for right hand grip and pinch strength values, respectively). IADL and SF-36 also had better and statistically significant relationship with Duruöz and Dreiser hand function indices ( $r = 0.807$ ,  $-r = 0.869$  and  $r = 0.787$ ,  $-r = 0.805$ , respectively). A very good correlation between IADL and SF-36 was calculated too, revealing a strong relationship of dependence in activities of daily life, actual disability, and quality of life ( $r = 0.848$ ).

We compared the mean dominant handgrip strength values of this study population with the mean dominant handgrip strength values of 149 healthy volunteers (mean age of  $30.21 \pm 5.91$  years) calculated for a previous study (Arinci *et al.*, 2002) and the difference was significant for both grip and pinch forces (Table 2).

### Discussion

With increasing healthcare opportunities now more people reach older ages. This increase in the geriatric population resulted in an emphasis on their quality of life (Hanks and Lichtenberg, 1996). As a fact aging results with impairments in body functions; cognitive and motor skills leading to impaired mobility and lack of independence

**Table 2 Grip and pinch strength values recorded from dominant hands (kilogram force)**

	Geriatric group	Young group	<i>P</i> value
Age (mean $\pm$ SD)	69.16 $\pm$ 3.73	30.21 $\pm$ 5.91	<0.0001
Grip strength (mean $\pm$ SD) kg	24.12 $\pm$ 8.67	39.07 $\pm$ 11.21	<0.005
Pinch strength (mean $\pm$ SD) kg	6.71 $\pm$ 1.67	7.82 $\pm$ 2.10	<0.005

**Table 1 Quantitative demographic data of the participants and sex–age subgroups (mean  $\pm$  SD values)**

	Total group ( <i>n</i> : 24)	Male ( <i>n</i> : 9)	Female ( <i>n</i> : 15)	Younger elderly (65–70 years) ( <i>n</i> : 13)	Older elderly (70–79 years) ( <i>n</i> : 11)
Age (years)	69.16 $\pm$ 3.73	69.66 $\pm$ 3.34	68.73 $\pm$ 3.76	66.46 $\pm$ 1.45	72.18 $\pm$ 2.81
BMI (kg/cm <sup>2</sup> )	27.66 $\pm$ 4.57	25.94 $\pm$ 3.54	28.86 $\pm$ 4.94	26.83 $\pm$ 2.80	28.50 $\pm$ 5.87
Grip R (kg)	24.12 $\pm$ 8.67	32.33 $\pm$ 7.96	19.20 $\pm$ 4.26	24.15 $\pm$ 8.92	24.09 $\pm$ 8.81
Grip L (kg)	23.29 $\pm$ 8.96	31.67 $\pm$ 7.81	18.26 $\pm$ 5.00	22.76 $\pm$ 9.11	23.90 $\pm$ 9.19
Pinch R (kg)	6.71 $\pm$ 1.67	8.37 $\pm$ 0.83	5.83 $\pm$ 1.27	6.73 $\pm$ 1.65	6.70 $\pm$ 1.78
Pinch L (kg)	6.73 $\pm$ 1.73	8.12 $\pm$ 0.95	6.00 $\pm$ 1.60	7.07 $\pm$ 1.74	6.30 $\pm$ 1.70
SEHF	8.16 $\pm$ 2.03	9.00 $\pm$ 2.00	6.00 $\pm$ 3.42	6.70 $\pm$ 1.78	8.00 $\pm$ 1.73
Duruöz HI	11.25 $\pm$ 16.19	3.33 $\pm$ 9.63	16.00 $\pm$ 17.70	11.38 $\pm$ 13.09	11.09 $\pm$ 19.93
GERI-AIMS	1.54 $\pm$ 1.93	0.77 $\pm$ 1.64	2.00 $\pm$ 2.00	1.84 $\pm$ 2.11	1.18 $\pm$ 1.72
Dreiser	4.20 $\pm$ 5.88	1.66 $\pm$ 4.30	5.73 $\pm$ 6.29	4.69 $\pm$ 5.36	3.63 $\pm$ 6.66
IADL	25.54 $\pm$ 2.24	26.11 $\pm$ 2.66	25.20 $\pm$ 1.97	25.00 $\pm$ 2.48	26.18 $\pm$ 1.83
SF-36	97.15 $\pm$ 24.03	115.42 $\pm$ 20.84	86.50 $\pm$ 19.27	96.00 $\pm$ 25.30	99.19 $\pm$ 23.48

Duruöz HI, Duruöz hand index; GERI-AIMS, Geriatrics-Arthritis Impact Measurement Scale; IADL, Instrumental Activities of Daily Life; SEHF, self-estimated hand function; SF-36, short form-36; L, left; *n*, number; R, right.

in ADL. Effects of aging on motor function include a marked decline in strength and muscle mass. Two major mechanisms are responsible for strength loss. One is a reduction in muscle mass resulting from loss of functional motor units, an incomplete reinnervation of abandoned muscle fibers by surviving motor neurons and selective atrophy of fast-twitch muscle fibers. The other mechanism is a reduced ability to fully activate muscles in aging (Ranganathan *et al.*, 2001). Hand-muscle function is also affected from this decline; old individuals have decreased ability to maintain steady submaximal forces, an increase in time required to manipulate small objects and a decrease in finger-pinch strength.

On the basis of the previous analyses of hand-muscle function, grip and pinch strengths are expected to be one of the determinants of manual performance (Hughes *et al.*, 1995). A decline in hand strength may be expected with advancing age. It has been reported that a 15% loss in strength per decade occurs in 50–70-year-old individuals (Grabner and Enoka, 1995). We analyzed age-based differences, however, the intergroup variations (between 65–69 and 70–74 age groups) were not statistically significant ( $P > 0.5$  for both grip and pinch strengths). We hypothesized that the age range – 5 year for each group – might not be wide enough to display alterations in strength. In addition, the small number of patients included in the study resulted in larger variations within each age group. In available literature, previous study designs included more significant intergroup age variations, therefore though beyond the scope of our primary aim, we compared the mean dominant handgrip and pinch strength values of this study population with the mean dominant handgrip and pinch force values of 149 healthy young volunteers and the difference was significant for both grip and pinch forces ( $P < 0.01$ ).

Grip strength displays sex-related differences in multiple studies (Schmidt and Toews, 1970; Lagerström and Nordgren, 1998). There is a statistically significant difference between both grip and pinch forces of our male and female participants ( $P$  values  $< 0.01$  for all) and this is in accordance with previous studies (Agnew and Maas, 1982).

All patients in our study group were right handed, therefore the validity of the 10% rule was expected. According to this rule dominant hand displays a 10% stronger grip force than the nondominant side; this rule has shown to be valid only for right-handed people (Petersen *et al.*, 1989; Armstrong and Oldham, 1999; Arinci *et al.*, 2002). However, the expected variance between dominant and nondominant hands could not be verified in our study. We concluded that the decline in overall muscle in the geriatric population might underestimate these force alterations and be responsible for

fading away of both age and side-based variations (Reikeras, 1983; Armstrong and Oldham, 1999).

Studies on manual function have reported increased difficulties in performing everyday tasks such as tying shoelaces, fastening buttons, manipulating earrings, retrieving objects from a purse, and writing a note (Ranganathan *et al.*, 2001). By a series of functional questionnaires, we aimed to investigate the grip strength, manual performance, and ADLs relationships. Persons who score these tools must be able to hear instructions, process instructions mentally, and have the neuromuscular and musculoskeletal capacity to manipulate their upper extremities successfully (Hughes *et al.*, 1995). All participants in the study met these criteria. Correlation analyses in our geriatric group has shown a strong relationship between grip and pinch strengths with Duruöz and Dreiser indices. These two indices were also the best to correlate with IADL, the selected measure of activity limitation of our study. Duruöz and Dreiser indices share some similar questions such as ‘can you cut meat with a knife, can you button your shirt’ etc., but such an interaction is present with other questionnaires in one or two tasks too. The high correlation between these tests indicates that they can be used alternatively.

SEHF scores differ from other measures used with relatively poor correlation with grip, pinch forces and other function indices. This test measures the participant’s perceptions of hand function, whereas other questionnaires include set of activities requiring hand function. In accordance with Dellhag and Burckhardt (1995) study, our SEHF results display an underestimation of functional ability.

To distinguish degrees of functional loss, SF-36 is used in this study. SF-36 is especially recommended where a detailed and broad ranging assessment of health is required, particularly in community-dwelling older people with limited morbidity (Lawton and Brody, 1969). Our participants were also community dwelling with independent ambulation and with appropriate cognitive skills to live independently. None had major comorbidities or functional limitations because of systemic diseases. SF-36 scores were well correlated with Duruöz and Dreiser indices too. The development of dependence in ADL of our study population was explained by the participants as mainly being caused by decreased manual function.

Another finding was that the sex-dependent difference in SEHF and SF-36 components of the study ( $P = 0.041$  and  $P = 0.01$  for SEHF and SF-36, respectively). Women reported worse self-reported manual function and disability than men. Previous study by Verbrugge has shown a relationship between female sex and increased self-reported disability especially with respect to performance

of tasks requiring strength, endurance, or dexterity (Verbrugge *et al.*, 1991; Verbrugge, 1992).

Hence, our data support the hypothesis that hand-muscle function correlates with functional dependency in the elderly. As mentioned before in our study, Duruöz and Dreiser indices were best to correlate with ADL and quality of life. Further prospective studies with a larger number of participants would be informative because valid, objective measures of dependency are needed to identify high-risk populations efficiently and to prevent limitations in daily activities.

## References

- Agnew PJ, Maas F (1982). Hand function related to age and sex. *Arch Phys Med Rehabil* **63**:269–271.
- Arinci Incel N, Ceceli E, Durukan P, Erdem HR, Yorgancioglu ZR (2002). Grip strength: effect of hand dominance. *Singapore Med J* **43**:234–237.
- Armstrong CA, Oldham JA (1999). A comparison of dominant and non-dominant hand strengths. *J Hand Surg* **24B**:421–425.
- Bohannon RW (1998). Reference values for extremity muscle strength obtained by hand-held dynamometry from adults aged 20–79 years. *Arch Phys Med Rehabil* **78**:26–32.
- Dellhag B, Bjelle A (1999). A five year follow up of hand function and activities of daily living in rheumatoid arthritis patients. *Arthritis Care Res* **12**:33–41.
- Dellhag B, Burckhardt CS (1995). Predictors of hand function in patients with rheumatoid arthritis. *Arthritis Care Res* **8**:16–20.
- Dreiser RL, Maheu E, Guillou GB, Caspard H, Grouin JM (1995). Validation of an algofunctional index for osteoarthritis of the hand. *Rev Rhum Engl Ed* **62** (6 Suppl 1):43S–53S.
- Duruöz MT, Cerrahoglu L, Dincer-Turan Y, Kürsat S (2003). Hand function assessment in patients receiving hemodialysis. *Swiss Med Wkly* **133**:433–438.
- Falconer J, Hughes SL, Naughton BJ, Singer R, Chang RW, Sinacore JM (1991). Self report and performance based hand function tests as correlates of dependency in the elderly. *J Am Geriatr* **39**:695–699.
- Grabner MD, Enoka RM (1995). Changes in movement capabilities with aging. *Exerc Sport Sci Rev* **23**:65–104.
- Hanks RA, Lichtenberg PA (1996). Physical, psychological and social outcomes in geriatric rehabilitation patients. *Arch Phys Med Rehabil* **77**:783–792.
- Haywood KL, Garratt AM, Fitzpatrick R (2005). Quality of life in older people: a structured review of generic self-assessed health instruments. *Qual Life Res* **14**:1651–1668.
- Hughes SL, Gibbs J, Dunlop D, Singer R (1995). Predictors of hand function in older persons: a two year longitudinal analysis. *J Am Geriatr Soc* **43**:122–130.
- Lagerström C, Nordgren B (1998). On the reliability and usefulness of methods for grip strength measurement. *Scand J Rehab Med* **30**:113–119.
- Lawton M, Brody E (1969). Assessment of older people: self maintaining and instrumental activities of daily living. *The Gerontologist* **9**:179–186.
- Lefevre-Colau MM, Poiraudou S, Fermanian J, Etchepare F, Alnot JY, le Viet D, *et al.* (2001). Responsiveness of the Cochin rheumatoid hand disability scale after surgery. *Rheumatology* **40**:843–850.
- Mathiowetz V, Kashman N, Volland G, Weber K, Dowe M, Rogers S (1985). Grip and pinch strength: normative data for adults. *Arch Phys Med Rehab* **66**:69–74.
- Petersen P, Petrick M, Connor H, Conklin D (1989). Grip strength and hand dominance: challenging the 10% rule. *Am J Occup Ther* **43**:444–447.
- Ranganathan VK, Siemionow V, Sahgal V, Yue GH (2001). Effects of aging on hand function. *J Am Geriatr Soc* **49**:1478–1484.
- Reikeras O (1983). Bilateral differences of normal hand strength. *Arch Orthop Trauma Surg* **101**:223–224.
- Schmidt RT, Toews JV (1970). Grip strength as measured by the Jamar dynamometer. *Arch Phys Med Rehab* **51**:321–327.
- Verbrugge LM (1992). Disability transitions for older persons with arthritis. *Aging Health* **4**:212–243.
- Verbrugge LM, Gates DM, Ike RW (1991). Risk factors for disability among US adults with arthritis. *J Clin Epidemiol* **44**:167–182.

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