

ORIGINAL ARTICLE

Relationship between Magnesium Intake and Handgrip Strength in Elderly


Hubungan antara Asupan Magnesium dan Kekuatan Genggam pada Lansia

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ABSTRACT

Background

Elders experience an aging process that is marked by a decrease in muscle mass that can result in a decrease in overall muscle strength. Handgrip strength is a parameter used to assess maximum handgrip which can represent an overall muscle strength. Magnesium has a role for skeletal muscles and also affects muscle performance. This study aims to measure the relationship between magnesium intake and handgrip strength in the elderly.

Methods

This study is an observational analytical study with a cross-sectional design, involving elders aged \geq 60 years in elderly nursing homes as the study subjects. Elders who were able to communicate actively were included and elders who had physical disability were excluded. The Semi Quantitative Food Frequency Questionnaire (FFQ) was used for assessing magnesium intake and handgrip strength was measured using a handgrip dynamometer. Data were analyzed with Chi-Square statistical test and Fisher's Exact Test with a significance of < 0.05 .

Results

A group of 71 elders participated in this study. The result of this study shows that subjects with sufficient magnesium intake amounted to 18 subjects (25.4%) and 53 (74.6%) with low magnesium intake. The distribution of subjects with sufficient handgrip strength amounted to 36 subjects (50.7%) and 35 (49.3%) with low handgrip strength. Statistical analysis shows that there is no significant relationship between magnesium intake and handgrip strength in elders ($p=0.539$; $p>0.05$), while sociodemographic factors of age and gender showed a significant relationship towards handgrip strength ($p=0.012$ and $p=0.028$; $p<0.05$).

Conclusions

There is no significant relationship between magnesium intake and handgrip strength in elders. Sociodemographic factors of age and gender showed significant relationships towards handgrip strength.

Keywords: magnesium intake, handgrip strength, elderly

ABSTRAK

Latar Belakang

Lansia mengalami proses penuaan yang ditandai dengan adanya penurunan massa otot dan berdampak pada menurunnya kekuatan otot. Kekuatan genggam adalah instrumen yang digunakan untuk penilaian kemampuan menggenggam maksimal yang dapat mewakili penilaian terhadap kekuatan otot secara keseluruhan. Magnesium memiliki peran pada kinerja otot rangka. Penelitian ini bertujuan untuk menilai hubungan asupan magnesium dan kekuatan genggam pada lansia.

Metode

Penelitian ini merupakan penelitian analitik observasional dengan desain *cross-sectional* dengan melibatkan lansia berusia ≥ 60 tahun yang tinggal di Panti Wreda sebagai subjek penelitian. Lansia yang dapat berkomunikasi aktif merupakan kriteria inklusi dan lansia yang memiliki gangguan mobilitas fisik dijadikan sebagai kriteria eksklusi. Penilaian asupan magnesium menggunakan *Semi Quantitative Food Frequency Questionnaires* (SQ-FFQ) dan penilaian kekuatan genggam menggunakan *hand-grip dynamometer*. Selanjutnya data dianalisis dengan uji statistik *Chi Square* dan *Fisher's exact test* dengan batas kemaknaan $< 0,05$.

Hasil

Sejumlah 71 lansia berpartisipasi pada penelitian ini. Distribusi asupan magnesium cukup sebanyak 18 subjek (25,4%) dan asupan magnesium kurang sebanyak 53 (74,6%) subjek. Distribusi kekuatan genggam cukup sebanyak 36 subjek (50,7%) dan kekuatan genggam kurang sebanyak 35 subjek (49,3%). Analisis statistik menunjukkan tidak terdapat hubungan bermakna antara asupan magnesium dan kekuatan genggam pada lansia ($p=0,539$; $p>0,05$), sementara faktor sosiodemografi usia dan jenis kelamin menunjukkan hubungan yang bermakna pada kekuatan genggam ($p=0,012$ dan $p=0,028$; $p<0,05$).

Kesimpulan

Tidak didapatkan hubungan bermakna antara asupan magnesium dan kekuatan genggam pada lansia. Faktor sosiodemografi usia dan jenis kelamin menunjukkan perbedaan yang bermakna pada kekuatan genggam.

Kata Kunci: Asupan magnesium, kekuatan genggam, lans

INTRODUCTION

Based on the Elderly Population Statistics by *Badan Pusat Statistik* 2022, the elderly account for 10.48% of the Indonesian population, which amounts to over 28 million people.¹ The population of the elderly will increase rapidly due to several factors such as decreased birth and death rates and increased life expectancy. This number will continue to increase in 2025 (33.69 million), 2030 (40.95 million) and 2035 (48.19 million).² The elderly experience an aging process which is characterized by changes in body composition in the form of loss of muscle mass. Muscle fiber loss and muscle fiber atrophy are the two major influences on the loss of muscle mass and function with age.³

Measurement of handgrip strength has been recommended to assess the function of the musculoskeletal body including muscle weakness and disability.⁴ This test is often used as a biomarker because it corresponds to overall muscle strength.⁵

Magnesium is an element that is required as a cofactor for more than 300 enzymatic reactions and is therefore required for biochemical functions in various metabolic pathways. Magnesium homeostasis is regulated by the intestines, the bones, and the kidneys. The storage distribution of magnesium in the body can be found mostly in bones, then muscles and soft tissues. Magnesium has a role for skeletal muscles in protein synthesis, muscle and nerve

transmission, and neuromuscular conduction and also affects muscle performance in terms of transmembrane transport, muscle contraction, and relaxation.⁶ In a study conducted by DiNicolantonio *et al.*⁷, it was found that there tends to be a decrease in magnesium intake in the elderly. Magnesium deficiency contributes to pathological events, namely increased production of inflammatory factors like CRP (C-reactive protein) and oxidative stress, which can cause problems in the elderly, especially in terms of sarcopenia and muscle protein damage.⁸ A study in Hong Kong stated that the prevalence of decreased hand-held muscle strength in the elderly was 16.5%.⁹

Kettiq *et al.*¹⁰ found a relationship between good magnesium intake on hand grip strength in the elderly. This study differs from a study conducted by Veronese *et al.*¹¹ and Suranto *et al.*¹² which showed no significant relationship between oral magnesium intake and hand grip strength in elderly women. Various studies show different results so no conclusive conclusions have been reached, this study aims to conduct research on the relationship between magnesium intake and hand grip strength in the elderly.

METHODS

This research is an observational analytic study with a cross-sectional design approach that was conducted from August to December 2019 at the Elderly Nursing Home in West Jakarta. This study involved the elderly as subjects with inclusion criteria, namely aged over 60 years and able to communicate actively. Elderly people who suffer from impaired physical mobility, post-surgery, post-trauma, and suffer from neurological disorders, congenital abnormalities of the kidneys, and taking magnesium supplements, were included as an exclusion criterion.

The calculation of sample size was done using the formula for testing the difference of 2 proportions. The prevalence of decreased handgrip muscle strength in the elderly of 16.5%⁽⁹⁾ was used in the calculation of sample size, at a significance level of 95% and an accuracy of 0.05. The number of elderly people in the orphanage is 88 subjects, therefore the minimal sample size needed is 63 subjects. The selection of research subjects was carried out using consecutive non-random sampling. All elderly in elderly nursing homes who met the inclusion criteria were included as research subjects.

This research was obtained based on primary data from direct measurements of the research subjects. Magnesium intake was assessed using the Semi Quantitative Food Frequency Questionnaires (SQ-FFQ). Subjects were asked to state the type of food consumed. According to the type and amount of food subjects consumed, to be equalized with the magnesium content as provided in the FFQ table. The results of these intakes are then converted to the amount of total magnesium intake per day. Magnesium intake is grouped into sufficient magnesium intake (Men: ≥ 350 mg; Women: ≥ 320 mg) and insufficient magnesium intake (Men: <350 mg; Women: < 320 mg).^(13,14) Assessment of handgrip strength using a handgrip dynamometer. The results of handgrip strength were grouped into sufficient handgrip strength (≥ 17 kg) and insufficient handgrip strength (<17 kg).

Sociodemographic factors including age and gender were obtained from questionnaire data. Gender is distinguished by sex/gender male and female. Age was grouped into 2 categories, namely the age group 60-69 years and above 70 years of age.

Data analysis used in this study are univariate and bivariate analysis. Univariate analysis showed descriptive analytic data which described the distribution of each research variable, including age, gender, magnesium intake, and grip strength. Chi-square bivariate statistical tests and Fisher's exact tests were performed to assess the relationship between the two study variables. The significance level used in this study is 0.05.

The research was carried out after obtaining ethical clearance from the Research Ethics Commission of the Faculty of Medicine, Universitas Trisakti (Number: 66/KER-FK/VII/2019).

RESULTS

Table 1. Distribution of the characteristics of the respondents (n=71)

Variable	Frequency (n)	Percentage (%)
Age		
60-69 years	43	60.6
≥ 70 years	28	39.4
Sex		
Male	9	12.7
Female	62	87.3
Magnesium intake		
Sufficient	18	25.4
Insufficient	53	74.6
Handgrip strength		
Sufficient	36	50.7
Insufficient	35	49.3

This research was carried out from August to December 2019 at the Elderly Nursing Home in West Jakarta which involved 71 elderly as research subjects.

The subject age was divided into two groups, namely ages 60-69 years and ≥70 years according to the age distribution in the 2018 elderly population statistics.⁽¹³⁾ Age distribution was dominated by the age group 60-69 years with 43 subjects (60.6%), while 28 subjects (39.4%) were aged ≥70 years. Gender characteristics were dominated by the female sex with a total of 62 subjects (87.3%) while male sex amounted to nine subjects (12.7%) (Table 1).

Results of the assessment of magnesium intake were adjusted according to the cut point of the Indonesian Nutrition Adequacy Rate with sufficient and deficient categories.¹⁴ There were 18 subjects (25.4%) in the sufficient magnesium intake group, while there were 53 subjects (74.6%) in the insufficient magnesium intake group. The results of the hand grip strength assessment using the 17 kg cut point correspond to the median value of the handgrip strength results in the study population. The results of the handgrip strength assessment were grouped into two categories, namely the sufficient category, consisting of 36 subjects (50.7%), and the insufficient category, consisting of 35 subjects (49.3%) (Table 1).

Table 2. Relationship between magnesium intake and sociodemographic characteristics and handgrip strength (n=71)

Variable	Grip strength		p
	Sufficient	Insufficient	
Age			
60-69 years	27(62.7%)	16 (37.3%)	0.012 ^{a)} *
≥ 70 years	9(32.1%)	19 (67.9%)	
Sex			
Male	8 (88.9%)	1 (11.1%)	0.028 ^{b)} *
Female	28 (45.1%)	34 (54.9%)	
Magnesium intake			
Sufficient	8 (44.4%)	10 (55.6%)	0.539 ^{a)}
Insufficient	28 (52.8%)	25 (47.2%)	

a): Pearson Chi-square; b)Fisher's exact test; *: Significance (p<0.05)

In the age group 60-69 years, the distribution of sufficient handgrip strength was higher, namely 27 respondents (62.7%) while in the age group ≥ 70 years, the distribution was dominated by those with insufficient handgrip strength, namely 19 respondents (67.9%). The chi-square results showed that there was a significant relationship between age and handgrip strength (p=0.012; p<0.05).

The distribution of grip strength in men was dominated by those with sufficient handgrip strength, namely 8 respondents (88.9%), while in women, it was dominated by those with weak grip strength, namely 34 respondents (54.9%). Analysis of the relationship between sex characteristics and handgrip strength was carried out using Fisher's test and showed that there was a significant relationship between gender and handgrip strength (p=0.028; p<0.05) (Table 2).

The distribution of handgrip strength in the subject group with sufficient and nonsufficient magnesium intake showed an almost equal percentage, namely 8 (44.4%) 10 (55.6%), 25 (47.2%), and 28 (52.8%) respectively. Analysis of the relationship between magnesium intake and handgrip strength was carried out by Pearson Chi-square. The results showed that there was no significant relationship between magnesium intake and grip strength (p=0.539 ; p>0.05) (Table 2).

DISCUSSION

Based on the results of this research, the frequency distribution of the subject's age was dominated by the 60-69 years age group. The results of this frequency distribution are in line with the statistical demographic data of the elderly population in Indonesia which shows that the elderly are dominated by elderly women (60-69 years). The results of this frequency distribution are following data analysis of the elderly in Indonesia which states that the number of elderly women outnumbers elderly men.²

The results of the study found that magnesium intake in the elderly was dominated by the group with insufficient magnesium intake. These results are in accordance with research conducted by DiNicolantonio et al.⁷ who stated that there is a lack of magnesium intake in the elderly which is typically caused by irregular eating patterns and unbalanced food choices in the elderly, which results in magnesium deficiency. Handgrip strength distribution carried out in this

study showed results with a median value of 17 kg. These data show smaller results compared to the study by Setiati et al.¹⁵ which showed cut-off handgrip strength of 22 kg and 34 kg.

The results showed that there was a significant relationship between age and handgrip strength in the elderly. According to Riviaty et al.¹⁶ these two variables can be related due to the age factor, handgrip strength will decrease with age due to a decrease in type II muscle fibers. This type II fiber plays an important role in anaerobic metabolism, so it is believed to be the main mechanism for decreased muscle strength. In a study conducted by Lino et al.¹⁷ it stated that there was an average reduction of 0.11 kg in grip strength in each year of increase after the age of 60 years.

This study showed that there was a significant relationship between gender and handgrip strength in the elderly. According to a study by Chan et al.¹⁸, men have greater handgrip strength than women, this correlates with the high amount of male lean mass in the extremities. The results study by Oktaviana et al.¹⁹ conducted on employees with pre-elderly age reported that demographic factors of age and gender as well as total muscle mass were significantly related to handgrip strength.

This is also in accordance with the study of Lino et al.¹⁷ and Oktaviana et al.¹⁸ which showed that muscle mass and function in men were higher than in women so there was a difference of up to 10 kg in grip strength between the two sexes. Higher HGS in men is associated with muscle mass and testosterone levels. The male hormone testosterone has a role in increasing handgrip strength, individuals with high testosterone have a lower risk of low muscle strength especially in non-obese subjects, this was associated with the role of testosterone in skeletal muscle through an intrinsic mechanism in mitochondria.²⁰

This study showed no significant relationship between magnesium intake and hand grip strength in the elderly. A study by Veronese et al.¹¹ explained that there was no relationship between these two variables due to the complexity of changes in the body composition of the elderly which could affect the results of the grip strength obtained. In addition, this study also hypothesized that the effect of magnesium supplementation could not be seen on handgrip strength tests involving only a few muscle units. Magnesium supplementation can have a significant effect when it is linked to the assessment of overall physical performance.¹¹ In a study by Han et al.²¹, no relationship was found between the results of handgrip strength and insufficient magnesium intake, this was because muscle strength varied greatly according to age group, sex, and body mass index. There is an interaction with low serum levels of 25-O(H)D/25-hydroxycholecalciferol that will be associated with a decrease in grip strength.

This study has limitations because it uses the Semi-Quantitative Food Frequency Questionnaire method to assess magnesium intake, which is influenced by the subject's ability to recall their diet and mis-conceptualization of portion sizes. The food list cannot cover all the foods consumed by respondents, which may lead to underreporting and also misreporting when reporting combined frequencies for a particular food eaten both alone and in mixed dishes.²² For future research, intervention should be given as magnesium supplements to evaluate the effects of magnesium intake and grip strength.

CONCLUSION

Based on the results of the study, it can be concluded that there is no significant relationship between magnesium intake and handgrip strength in the elderly ($p=0.539$; $p>0.05$). Age and gender showed a significant relationship to handgrip strength ($p=0.012$ and $p=0.028$; $p<0.05$).

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AUTHORS CONTRIBUTION

Author MIAP contributed to the drafting, data collection, and analysis. Author EH contributed to the drafting, analysis, and corresponding author. All authors have read and given their consent.

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CONFLICT OF INTEREST

There are no conflicts of interest in this study.

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