The Correlation of Hand Grip Strength and Nutritional Status with Functional Ability among the Elderly Women

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***Abstract*—Functional ability describes a person's independence in carrying out daily activities as well as providing important information related to functional prognosis. Physical changes in elderly have the biggest role in increasing the morbidity that occurs, one of which is the decrease in muscle strength. In addition, nutritional status is also closely related to the level of functional ability in the elderly. This study was conducted to determine the relationship between hand grip strength and nutritional status on the level of functional ability in the elderly. This study was used observational analytic study with cross-sectional approach with a simple random sampling technique and obtained a sample of 73 elderly from Desa Pemecutan Kelod. Hand grip strength was measured using a Hand-grip dynamometer, nutritional status was measured using the Short Form Mini Nutritional Status (MNA) questionnaire and the level of functional capacity was measured using Intermediate Activity Daily Living (IADL) questionnaire. The results were analyzed using the spearman correlation test. Our study shows that hand grip strength and nutritional status can be used to identify the level of functional ability in the elderly. It is hoped that health programs can be invented to slow down the occurrence of disability in the elderly.**

***Index Terms*—elderly, hand grip strength, nutritional status, functional ability**

I. Introduction

As we get older, there is an aging process in which the ability of the tissue to maintain its normal function decreases, so that it is unable to repair the damage it has experienced. This causes the elderly to experience one or more limitations in performing their daily activities [1].

Nutritional status plays an essential role in the health status among the elderly. According to the 2016 Global Nutrition Report, malnutrition affects 1 in 3 people worldwide and is a growing public health challenge [2]. Previous studies show that 31 to 46% of the elderly population are at risk for malnutrition [3]. The prevalence of malnutrition in the elderly population reached approximately 44%. Chronic malnutrition in elderly may also cause decreased muscle mass and muscle strength which can aggravate sarcopenia, decrease functional condition and lower quality of life [4]. Malnutrition has serious consequences for elderly, healthcare services, hospital admission, delayed discharge, dependence on health care, including increased risk for morbidity [5].

The decreased of muscle strength is an indicator of symptoms of disease in the elderly, such as weakness, sarcopenia, mobility limitations and the risk of fall [6]. Peak muscle strength occurs at 30 years old and then the strength decreases by 30-40% until the age of 80 years [7]. A decrease in muscle strength occurs as much as 12-15% every 10 years after a person reaches 50 years of age [8].

Decreased hand grip strength is a strong predictor that may indicate limited mobility in the elderly [9]. Hand grip strength is one of the simple indicators that recommended in assessing muscle strength [10]. The decreased hand grip strength causes the elderly to become dependent in performing daily activities and often requires participation and assistance from family and a caregiver [11]. By performing early detection of hand grip strength, it will identify the risk of mobility limitations that resulting in increased bedtime [12].

The decrease in muscle strength causes the elderly have limitations in carrying out their daily activities or the decrease in functional abilities. Functional abilities describe a person's independence in carrying out daily activities as well as providing important information related to functional abilities in the future [13]. The decreased of hand grip strength can lead to the decreased of functional ability in the elderly which in turn can cause the elderly to experience dependency [12].

The dependency ratio of Indonesia's elderly population in 2015 was 13.28, meaning that every 100 people of productive age must support around 14 elderly people. The dependency burden figure reflects the economic burden that must be borne by the productive age population to finance the elderly population, assuming

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that the elderly population is not economically productive [14].

The high dependency ratio for the elderly indicates that there is a need for indicators that are able to predict the disability status that experienced by the elderly so that the public health services and fitness center can be immediately improved and developed for the elderly. Thus, it is better for elderly to maintain the level of functional ability in an effort to reduce the level of dependence of the elderly. Therefore, the authors wished to conduct research on the relationship between hand grip strength and nutritional status on the level of functional ability independence in the elderly.

II. Material and Methods

The design of this study was an analytical observational cross-sectional study which analyzed the relationship of hand grip strength and nutritional status with functional abilities in the elderly women. Cross-sectional study is a type of research where the measurement of the variables is carried out only once, at one time [15]. Simple random sampling was used for sampling technique in this study. Inclusion criteria were the elderly who were 60 – 74 years old, be able to communicate well, willing to sign an inform consent and willing to take the measurements at the specified time. Exclusion criteria were the elderly who had deformities or abnormalities that caused the inability to move the fingers on both hands (through inspection and basic screening physical examination) and were taking drugs that can increase muscle strength. The total number of respondents were 73 elderly.

A. Hand Grip Strength (HGS)

Hand Grip Strength (HGS) was measured using a hand-grip dynamometer in kilograms. The classification of hand grip strength in elderly women uses the modified classification by Corbin and Colleagues (1978) in Heyward [16]. The HGS score > 33.3 was classified as "good", 22.5 – 33.3 was classified as moderate, < 22.5 was classified as "poor". This measurement was carried out on the right hand 3 times, where the highest score of the results was used as the value of hand grip strength in the elderly.

B. Nutritional Status

Nutritional status was measured using Mini Nutritional Status – Short Form (MNA – SF) which was developed in 2001 by Rubenstein [17]. MNA – SF consists of 6 questions where each question has a different value for each answer with a maximum score of 14. MNA – SF score 12 – 14 points was classified as "normal nutritional status", 8 – 11 points was classified as "at risk of malnutrition", 0 – 7 points was classified as "malnourished".

C. Functional Ability

The level of functional ability for elderly was measured using Intermediate Activity Daily Living (IADL) questionnaire which was modified by Lawton and Brody in 1969 [18]. IADL is an instrument that used to assess the physical abilities in the elderly that related to the use of tools and other activities that require interaction with tools or through intermediary tools. IADL score 0 – 4 was classified as "totally dependent", 5 – 8 as "severe dependent", 9 – 11 as "moderate dependent", 12 – 15 as "mild dependent" and 16 as "independent".

Data that has been collected will be proceeded by editing, coding, processing, tabulating, entering, and cleaning. The results were analyzed using the spearman correlation test to determine whether there was a significant relationship between variables. The significance level of 0.05 was used in this statistical process.

III. Results

Table I shows that the number of respondents were 73 elderly, all of whom are women. The mean age of the subjects was 68.9 ± 6.9 years. The mean BMI was 22.1 ± 4.29 kg/m^2 and 47.9 of the subjects were within normal BMI (18,5 – 22,9 kg/m^2). Majority of the elderly have a poor hand grip strength (72.6%) and there are only 4 elderly who have a good HGS score. Regarding at nutritional status, most of the subject was at risk of malnutrition (53.4%). The level of functional capacity of the subject in this study was mostly at severe dependent (50.7%).

TABLE I. Characteristic of the Subjects

Characteristics	Number of respondents	Percentage
Body Mass Index		
Underweight	10	13.7
Normal	35	47.9
Overweight	15	20.5
Obesity I	9	12.3
Obesity II	4	5.5
Hand Grip Strength		
Poor	53	72.6
Moderate	16	21.9
Good	4	5.5
Nutritional Status		
Normal nutritional status	11	15.1
At risk of malnutrition	39	53.4
Malnourished	23	31.5
Functional Capacity		
Totally dependent	8	11
Severe dependent	37	50.7
Moderate dependent	14	19.2
Mild dependent	11	15.1
Independent	3	4.1

The calculation of the relation between the nutritional status and functional capacity in the elderly is displayed in Table II. Data analysis that covered 73 respondents shows that the calculation of the Spearman Coefficient was 0.663. The obtained result of the Spearman Coefficient shows that there is a positive correlation. The test of relation significance shows that probability Sig. (2-tailed) is 0.000. This implies that there is a significant positive relation between the nutritional status and functional capacity in the elderly.

TABLE II. THE CORRELATION BETWEEN NUTRITIONAL STATUS AND FUNCTIONAL ABILITY

			Nutritional Status	Functional Ability
Spearman's rho	Nutritional Status	Correlation Coefficient	1.000	.663**
		Sig. (2-tailed)	.	.000
		N	73	73
	Functional Ability	Correlation Coefficient	.663**	1.000
		Sig. (2-tailed)	.000	.
		N	73	73

The calculation of the relation between the hand grip strength and functional capacity in the elderly is presented in Table III. The results show that Spearman coefficient was 0.654 for 73 samples. This means the positive correlation between the variables. The test of relation significance shows that probability Sig. (2-tailed) is 0.000. Similar to the results above, there is a significant positive relation between the hand grip strength and functional capacity in the elderly.

TABLE III. THE CORRELATION BETWEEN HAND GRIP STRENGTH AND FUNCTIONAL ABILITY

			Hand Grip Strength	Functional Ability
Spearman's rho	Hand Grip Strength	Correlation Coefficient	1.000	.654**
		Sig. (2-tailed)	.	.000
		N	73	73
	Functional Ability	Correlation Coefficient	.654**	1.000
		Sig. (2-tailed)	.000	.
		N	73	73

The calculation of the relation between the nutritional status and hand grip strength in the elderly is shown in Table 4. The results show that the Spearman coefficient was 0.397 for 73 samples. This means the positive correlation. The test of relation significance shows that probability Sig. (2-tailed) is 0.001. This implies that there is a significant positive relation between the nutritional status and hand grip strength in the elderly.

TABLE IV. THE CORRELATION BETWEEN NUTRITIONAL STATUS AND HAND GRIP STRENGTH

			Nutritional Status	Hand Grip Strength
Spearman's rho	Nutritional Status	Correlation Coefficient	1.000	.397**
		Sig. (2-tailed)	.	.001
		N	73	73
	Hand Grip Strength	Correlation Coefficient	.397**	1.000
		Sig. (2-tailed)	.001	.
		N	73	73

IV. DISCUSSION

During aging process, adequate nutrition is essential to maintain muscle performance in the elderly. As a result of our study, it was found there is a significant correlation between nutritional status and hand grip muscle strength. Whiting, et al stated that the decreased of hand grip strength is one of the criteria that indicates the occurrence of malnutrition in the elderly. Thus, hand grip strength is recommended as a nutritional assessment for assessing individuals at high risk of malnutrition [19]. A cross-sectional study that was conducted by Kim, et al reports that excessive carbohydrate and inadequate protein intake can lead to malnutrition and is associated with low hand grip strength in the community-dwelling elderly people [20]. The presence of certain biopsychosocial factors can also affect appetite and food consumption, such as loss of taste sensation, difficulty of chewing, and digestive dysfunction which causes decreased muscle strength in the elderly [21].

Elderly people are susceptible to malnutrition due to various reasons including physiological changes which cause the decreased of food absorption that affects their functional ability [22]. This is in line with the results of the analysis of this study, the value of p=0.000, which means that there is a significant relationship between nutritional status and functional ability. It is also strengthened by the correlation coefficient (r) value of 0.663 which indicates a strong positive relationship, which indicates that the better the nutritional status of the elderly, the better their functional ability and vice versa.

This study supports the previous research that conducted by Shanbag, et al which states that inadequate calorie intake which is caused by several things such as difficulty of chewing and swallowing, loss of appetite, lack of awareness and having financial problems are factors that affects the nutritional status of the elderly [23]. The aging process is accompanied by a high possibility to suffer from one or more chronic diseases such as respiratory problem, arthritis, stroke, depression, and dementia. This can affect appetite, ability to swallow and ability to absorb nutrients. So that it causes changes in food intake and a decrease in nutritional status in the elderly which causes a decrease in the functional ability of the elderly in performing their daily life [24].

With increasing age, there is a decrease in muscle strength due to a decrease in the characteristics of the motor unit due to changes in morphology and size of muscle fibers. The aging process changes the pattern of muscle fibers, causing a slowdown in contraction time and a slowing rate of muscle contraction [8]. The decrease in muscle strength in the aging process results from leaking of calcium from the protein group in muscle cells called ryanodine which then triggers a chain that limits contraction of muscle fibers. With less available calcium, muscle contractions weaken [25]. This decrease in muscle strength causes the elderly to have limitations in carrying out their daily activities, or in other words a decrease in the level of independence of functional abilities.

Hand grip strength as one of the benchmarks in identifying the presence of muscle weakness and limited mobility in the elderly have a strong effect on the limitation of functional activities of the elderly in their daily life [26]. This is in line with the results of the analysis of this study, the p value is 0.000, which means that there is a significant relationship between hand grip

strength and functional ability. It is also strengthened by the correlation coefficient (r) value of 0.654 which indicates a strong positive correlation. This shows that the better the strength of the elderly's hand grip muscles, the better their functional ability that they could have and vice versa.

The study are supported by the research that conducted by Tomas, et al who states that handheld muscle strength can be used as a tool to measure muscle strength because it has been identified to be very closely related to lower limb muscle strength, knee extension torsion, and muscle area of the calf cross section and can predicts a decrease in functional ability in the elderly [27]. In addition, the results of this study were in line with the research that conducted by Melissa who states that low hand grip muscle strength is seen as a predictor of accelerated dependence on daily activities leading to lower quality of life [28].

V. Conclusion

Based on the results of the study, it can be concluded that there is a positive correlation between hand grip strength and nutritional status on the level of functional abilities in the elderly. The higher level of the hand grip strength and nutritional status, the higher the level of functional abilities of the elderly, and vice versa. This study shows that the hand grip strength and nutritional status in the elderly can be used in identifying the level of functional abilities in the elderly.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Govinda Vittala led the research and prepared the manuscript; Ni Komang Dewi Semariasih analyzed the data and wrote the manuscript and I Putu Radhe Bhakti Krisnanda analyzed the data and critically reviewed the manuscript; all authors had approved the final version.

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References

[1] Navaratnarajah and S. H. D. Jackson, "The physiology of ageing," *Medicine*, vol. 41, no. 1, pp. 5-8, 2013.

[2] Global nutrition report 2016: From promise to impact: ending malnutrition by 2030. *International Food Policy Research Institute*. [Online]. Availabe: http://apfstatic.s3.ap-south-1.amazonaws.com/s3fs-public/From%20Promise%20To%20Impact.pdf

[3] M. J. Kaiser, *et al.*, "Frequency of malnutrition in older adults: A multinational perspective using the mini nutritional assessment," *Journal of the American Geriatrics Society*, vol. 58, no. 9, pp. 1734-1738, 2010.

[4] B. Saka, *et al.*, "Malnutrition in the elderly and its relationship with other geriatric syndromes," *Clinical Nutrition*, vol. 29, no. 6, pp. 745-748, 2010.

[5] S. Rasheed and R. T. Woods, "Malnutrition and quality of life in older people: A systematic review and meta-analysis," *Ageing Research Reviews*, vol. 12, no. 2, pp. 561-566, 2013.

[6] H. C. Roberts, *et al.*, "Grip strength and its determinants among older people in different healthcare settings," *Age and Ageing*, vol. 43, no. 2, pp. 241-246, 2014.

[7] T. M. Manini and B. C. Clark, "Dynapenia and aging: An update," *The Journals of Gerontology: Series A*, vol. 67A, pp. 28-40, 2012.

[8] E. V. Papa, X. Dong, and M. Hassan, "Skeletal muscle function deficits in the elderly: Current perspectives on resistance training," *Journal of Nature and Science*, vol. 3, no. 1, article e272, 2017.

[9] R. R. McLean, *et al.*, "Criteria for clinically relevant weakness and low lean mass and their longitudinal association with incident mobility impairment and mortality: The Foundation for the National Institutes of Health (FNIH) sarcopenia project," *The Journals of Gerontology: Series A*, vol. 69, no. 5, pp. 576-583, 2014.

[10] Y. H. Kim, *et al.*, "Muscle strength: A better index of low physical performance than muscle mass in older adults," *Geriatrics and Gerontology International*, vol. 16, no. 5, pp. 577-585.

[11] A. Wiśniowska-Szurlej, *et al.*, "Association between handgrip strength, mobility, leg strength, flexibility, and postural balance in older adults under long-term care facilities," *BioMed. Research International*, vol. 2019, article 1042834, 2019.

[12] T. A. Putri and S. Purnawati, "The relationship between grip muscle strength and functional ability in elderly women at elderly posyandu at Dauh Puri Kelod village, west Denpasar," *E-Journal Medicine Udayana*, vol. 6, no. 4, pp. 20-27, 2017.

[13] L. Seematter-Bagnoud and C. Büla, "Brief assessments and screening for geriatric conditions in older primary care patients: A pragmatic approach," *Public Health Reviews*, vol. 39, article 8, 2018.

[14] BPS. (2015). Statistics of elderly population 2014. *National Socio-Economic Survey Results*. [Online]. Available: chrome-extension://ibllepbpahcoppkjjllbabhnigcbffpi/https://www.bappenas.go.id/files/data/Sumber_Daya_Manusia_dan_Kebudayaan/Statistik%20Penduduk%20Lanjut%20Usia%20Indonesia%202014.pdf

[15] S. Sastroasmoro and S. Ismael, *Fundamentals of Clinical* Research *Methodology*, Jakarta: Sagung Seto, 2014.

[16] V. H. Heyward, "Advanced fitness assessment and exercise prescription," *Journal of Cardiopulmonary Rehabilitation*, vol. 12, no. 6, p. 445, 1992.

[17] L. Z. Rubenstein, *et al.*, "Screening for undernutrition in geriatric practice: Developing the short-form mini-nutritional assessment (MNA-SF)," *Journals of Gerontology-Series A*, vol. 56, no. 6, pp. M366-M372, 2001.

[18] C. Graf, "The lawton instrumental activities of daily living scale," *American Journal of Nursing*, vol. 108, no. 4, pp. 52-62, 2008.

[19] S. J. Whiting, *et al.*, "Hand grip strength as a nutritional assessment tool in long-term care homes," *Journal of Ageing Research And Healthcare*, vol. 1, no. 2, pp. 1-11, 2016.

[20] C. R. Kim, Y. J. Jeon, and T. Jeong, "Risk factors associated with low handgrip strength in the older Korean population," *PLoS ONE*, vol. 14, no. 3, article e0214612, 2019.

[21] Y. C. Wang, *et al.*, "Synergistic effect of low handgrip strength and malnutrition on 4-year all-cause mortality in older males: A prospective longitudinal cohort study," *Archives of Gerontology and Geriatrics*, vol. 83, pp. 217-222, 2019.

[22] R. Agarwalla, A. Saikia, and R. Baruah, "Assessment of the nutritional status of the elderly and its correlates," *Journal of Family and Community Medicine*, vol. 22, no. 1, pp. 39-43, 2015.

[23] D. Shanbhag, *et al.*, "Nutritional status and functional ability of the elderly in rural area of south india: A cross sectional study," *Int. J. Med. Res. Prof.*, vol. 3, no. 1, pp. 138-142, 2017.

[24] W. Leslie and C. Hankey, "Aging, nutritional status and health," *Healthcare*, vol. 3, no. 3, pp. 648-658, 2005.

[25] M. Tieland, I. Trouwborst, and B. C. Clark, "Skeletal muscle performance and ageing," *Journal of Cachexia, Sarcopenia and Muscle*, vol. 9, pp. 3-19, 2018.

[26] K. S. D. S. Vasconcelos, *et al.*, "Handgrip strength cutoff points to identify mobility limitation in community-dwelling older people and associated factors," *Journal of Nutrition, Health and Aging*, vol. 20, pp. 306-315, 2016.

[27] M. T. Tomás, *et al.*, "Functional capacity and levels of physical activity in aging: A 3-year follow-up," *Frontiers in Medicine*, vol. 4, p. 244, 2018.

[28] M. V. Omen, "Relationship of grip strength and quality of life among community-dwelling older adults," Honors theses, Western Michigan University, Michigan, 2019.

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