The Hemoglobin And Fasting Blood Glucose As Predictors Of Sarcopenia In Elderly

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Abstract

Examination of simple predictor on sarcopenia necessary for prevent the chronic diseases. Anemia and diabetes have higher incidence in elderly. Aim of this study was to evaluate whether hemoglobin (Hb) and fasting blood glucose (FBG) could be as the predictors of sarcopenia. Study design was cross sectional. Physical performance obtained by assessing skeletal muscle mass index (SMI), hand grip (HG), and gait speed (GS). Normal values of SMI, HG, GS in both men and women by Asian Working Group for Sarcopenia. Physical activity evaluated by Physical activity scale for the elderly (PASE). There were 93 (44.5%) men (M) and 116 (55.5%) women (W). The mean of age was 69 (±7.5). Score of PASE were 49 (16-542) in M and 52 (17-874) in W. The value of SMI, HG, GS both M and W were 8.4 (5-15) and 6.9 (4.9-11) Kg/M^2, 24 (9-40) and 15.7 (2.5-31) Kg, 1.4 (0.5-2.7) and 1.2 (0.3-2.4) M/S. While the level of Hb and FBG both M and W were 13.4 (6.4-17.3) and 12.5 (8-15.3) g/dL, 113.5 (65-255) and 111.7 (67-279) mg/dL. Statistic test by the regression ANOVA was obtained that Hb levels has effect to SMI ($p=0.01$, $R2=0.05$, $C=0.2$), as well as to HG ($p<0.001$, $R^2=0.08$, $C=1.5$), and GS ($p=0.04$, $R^2=0.04$, $C=0.06$). While FBG levels has no effect to SMI ($p=0.238$), GS ($p=1.78$), and HG ($p=0.17$). Subjects were severe inactive, but almost all physical performance were normal except the women HG. Hb levels can be as a predictor of sarcopenia in elderly.

Keywords: sarcopenia predictors, Hemoglobin, Fasting blood glucose, physical activity, elderly

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INTRODUCTION

Sarcopenia is defined as a decrease in muscle mass and strength, as well as physical performance that occurs in line with the aging process, which is believed to be the beginning of the occurrence of physical manifestations in the form of weakness and frailty (Phu et al., 2020), (Wilson et al., 2017). The definition of sarcopenia was established by the International working group on sarcopenia (IWGS) (Fielding et al., 2011) for the Asian population specifically by the Asian working group on sarcopenia (AWGS) (Chen et al., 2014), (Logan et al., 2019) ,and most recently by the European working group on sarcopenia in older people (EWGSOP2) (Cruz-Jentoft et al., 2019) .There have been many studies have proven the incidence of sarcopenia, increased morbidity and mortality of chronic diseases (Phu et al., 2020), (Wilson et al., 2017).

Sarcopenia diagnosed by examining skeletal muscle mass index (SMI), hand grip strength (HG), and functional examinations, gait speed (GS) (Fielding et al., 2011), (Chen et al., 2014), (Logan et al., 2019), (Cruz-Jentoft et al., 2019). Based on the AWGS, the normal threshold values of SMI) in men and women are 7 and 5 Kg/M2 respectively. The value of GS for men and women is 1.0 M/sec. The normal threshold for HG are 28 Kg in men and 18 Kg in women (Logan et al., 2019).

The aging process associated with decreased of muscle mass, decreased of muscle stem cell function, and followed by increased of muscle

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fibrosis. The immune system, especially macrophages, has an important function in regeneration and modulation of muscle growth. In addition, the immune system significantly affects the degeneration of muscle cells. Thus it can be concluded that there is a systematic interaction between muscle cells and the immune system in line with the aging process of tissue (Wang et al., 2019). Different gene expression was found in satellite cells derived from old mice compared to young mice. In addition, inflammatory mediators and extracellular matrix components were found. These cells directly cause differentiation, inflammation and fibrosis. The process begins with the occurrence of a secretory phenotype in satellite cells, followed by changes in the microscopic environment of the tissue, which causes inflammation and fibrosis, then muscle wasting occurs in old mice (Logan et al., 2019).

The pathophysiology of sarcopenia is not fully understood, and is caused by a variety of interrelated and complex factors. Changes in the immune system related to the aging process in the form of a decrease in the immune system are thought to contribute to the occurrence of sarcopenia (Wilson et al., 2017). While a good immune system is also related to muscle mass and physical activity levels (Wang et al., 2019).

There are two health problems that are often found in the elderly, namely anemia and diabetes (Bach et al., 2014), (Chentli et al., 2015). The incidence of low hemoglobin in the elderly according to WHO is 21.1%, which increasing by age, i.e., 30.7% at the age of 80 years, and 37% at the age of 90 years and over (Bach et al., 2014). As well as the prevalence of diabetes increases with increasing life expectancy, which is 20% over the age of 60 years, and varies between 18-33% (Logan et al., 2019), (Logan et al., 2019).

It has proven that anemia has a strong relationship with the o sarcopenia (Hirani et al., 2016). It is believed that the chemical element iron (Fe), which is the main component of hemoglobin, plays a crucial role in the formation of energy metabolism. Oxidative metabolism of cells depends on the availability of Fe. In addition, Fe insufficiency causes a decrease in mitochondrial function, a decrease in glycogen reserves, followed by increasing of lactate production, and a decreasing ot the Krebs cycle (Dziegala et al., 2018).

A study has shown that people with low muscle mass in the lowest quartile have twice the risk of developing type 2 diabetes (DMT2). (13) Low muscle mass causes delayed glucose disposal thereby increasing the incidence of T2DM. Lower grip HG also a predictor of increased fasting blood sugar (GDP) (Son et al., 2017), (Wu et al., 2019). Study in the elderly population in Korea has proven that prolonged higher glycated hemoglobin (HbA1c) (>8.5%) is closely associated with lower extremity muscle weakness and decreased physical performance (Wu et al., 2019). The elderly population continues to increase, which is related to the increasing prevalence of chronic diseases. Several studies have shown that the prevalence of physical inactivity in the elderly continues to increase, i.e., 12.5% in Europe, which varies between 4.9% in Sweden and 12.9% in Portugal in 2017 (Mesinovic et al., 2019). While in Malaysia it was found that 48.8% of the elderly who were inactive in 2018 (Gomes et al., 2017). Many research data show that physical inactivity is associated with an increase of chronic diseases, which can be a comorbid for COVID-19 infection. In addition, data also obtained that physical inactivity is closely related to 3.2 million deaths every year worldwide (Chan et al., 2019). Based on this evidence, it is necessary to determine the level of physical activity in the elderly, which is generally assessed using the Physical Activity Score for Elderly (PASE) (Taylor, 2014), (Curcio et al., 2019).

The physical activity on the elderly in Indonesia estimated to be low, due to the increasing use of communication devices. Physically inactive lead to increase sarcopenia and non-infectious chronic diseases, which can add to the comorbid factors of COVID-19. Simple predictors needed to predict the occurrence of sarcopenia, so that specific comorbid precautions can be prevented.

Based on the description above, the examination of anemia and type 2 diabetes (T2DM) are simple laboratory tests that are thought to be predictors of sarcopenia.

METHODOLOGY

The research method was a cross-sectional study of elderly aged 60 years and over, living in communities and nursing homes, in February-November 2019. Subjects living in the community recruited during outpatient admission on the hospital for mild musculoskeletal or mild chronic diseases, while some subjects living in nursery home.

Inclusion criteria were able to walk without assistive devices, able to grip, and willing to be examined for physical function, Hb, and FBG. While the exclusion criteria were subjects who had neurological disfunction (exp; post-stroke, Parkinson's), and had severe musculoskeletal disfunction on the lower extremities (exp; post fractures, dislocations, severe arthritis).

Sarcopenia assessment by examination of SMI, HG, and GS. Assessment of SMI using a Body Impedance Analyzer (BIA) *BC-601F FitScan Segmental Body Composition Monitor Spanis*h, with a value in units of Kg/M2. Evaluation of HG using a Jamar dynamometer by squeezing the hand grip by fingers, the value determine according to the indicator needle on numbers in Kg. While, the GS assessed by evaluation of walking duration in meter/second on 6 meters walking track. Laboratory test in standardized laboratory in research hospital. Examination of Hb by conversion to cyamet hemoglobin with adding ferricyanide and potassium cyanide. While measurement of FBG levels after fasting for 8 hours, on blood vein examination by dry reagent in quantitative unit.

This research passed the ethical review of the ethics committee of the Faculty of Medicine, Trisakti University number of 128/KER/ FK/ III/2018.

RESULTS AND DISCUSSION

RESULTS

The study was conducted on 209 elder, consisted of 93 (44.5%) men and 116 (55.5%) women, who were recruited by consecutive random sampling.

Table 1: Subject characteristics

Characteristics	Mean	Frequency (%)
Age (year)	69 (± 7,5)	
Work		
Retired		102 (49%)
Entrepreneur		38 (18%)
unemployment		69 (33%)
Education		
Elementary		89(42%)
Junior high school		45 (21%)
Senior high school		29 (14%)
College		46 (22%)
PASE score		
Men	49 (16-542)	
Women	52 (17-874)	
Hb level (g/dL)	13 (± 6.4-17.3)	
Men	13,4 (6.4-17.3)	
Women	12,5 (8-15.3)	
Hb category		
Normal (Men ≥ 13, Women ≥ 12 g/dL)		162 (77.5%)
Low		47(22.5%)
FBG level (mg/dL)	112,5 (65-279)	
Laki-laki	113.5 (65-255)	
Perempuan	111,7 (67-279)	
FBG category		
Low (<70 mg/dL)		3 (1.4%)
Normal (70-100 mg/dL)		90 (43%)
Glucose intolerance (GI) (>100-150 mg/dL)		89 (42.6%)
Diabetes (DM) (>150 mg/dL)		27 (12.9%)

Table 2: Physical performance scores for the diagnosis of Sarcopenia

Gender	SMI (Kg/M²)	HG (Kg)	GS (M/second)
Men	8,4 (5-15)	24 (9-40)	1,4 (0.5-2.7)
Women	6,9 (4.9-11)	15.7 (2.5-31)	1,2 (0.3-2.4)
Mean	7,6 (4.9-15)	19.4 (2.5-40)	1,2 (0.3-2.7)

Table 3: Hb and FBG values as predictors of physical performance

Prediktor	Nilai performan fisik		
	SMI	HG	GS
Hb	p=0,001[b]	<0,001[b]	p=0,004[b]
	R^2=0.05	R^2=0.083	R^2= 0.04
	C=0.20	C=1.5	C= 0.06
GDP	p=0,238	p=0,170	p=0,178

[b]Regresi ANOVA, R^2 = determinant coefficient, C= regression coefficient

DISCUSSION

The study was conducted on subjects consisting of 93 men (44.5%), and 116 women (55.5%). Most of the subjects, as many as 102 (49%) were retirees from various fields of work. While the highest level of education is still equivalent to Elementary School, which is 89 (42%). The composition of the education level is in accordance with the data obtained by Novia and colleagues (Katzman et al., 2021).

The level of physical activity of the subjects assessed using PASE, obtained low scores, i.e., 49 (16-542) in men, and 52 (17-774) in women. The PASE value obtained by recording the type and intensity level of the subject's activity for

the last 7 days, which is multiplied by the duration per day in hour, then accumulated to be a score. The range of assessment scores is from 0-793 (Khasanah & Ardiansyah, 2012). The data in this study is different from the study by Logan SL, that has proven that the elderly in Canada have a higher level of physical activity based on the PASE value, which is 172 (± 72) in men and 139 (± 58) in women (McPhee et al., 2016). Low activity levels have been shown to be associated with increased chronic disease and mortality per year worldwide (Chan et al., 2019), (Taylor, 2014).Increased chronic disease may increase comorbidities for COVID-19 infection.

Physical performance values as the basis for the diagnosis of sarcopenia, consisting of SMI, HG and GS (Fielding et al., 2011), (Chen et al., 2020). The results showed that the scores obtained in men and women subjects were above the threshold value for sarcopenia according to the AWGS (Chen et al., 2020). Except for the HG value in women, which is 15.7 (2.5-31) Kg, it is still below the normal HG threshold value of 18 Kg.

Hb values in men and women were in the normal category, i.e., 13.4 (6.4-17.3) and 12.5 (8-15.3) g/dL. This study has found that 47 (22.5%) subjects suffered from anemia. This data supports the WHO findings, i.e., 21.1% of the elderly have anemia, and increasing by age (Bach et al., 2014).

Meanwhile, FBG levels in the men and women groups were above normal values; 113.5 (65-255) and 111.7 (67-279) mg/dL, which could be categorized as GI. The prevalence of subjects who experienced GI was 89 (42.6%) and who had DM were 27 (12.9%) people. The results indicated frequency of DM in the subject is lower than previous studies, that varies between 18-33% (Chentli et al., 2015), (Kirkman et al., 2012). However, low levels of physical activity will reduce muscle mass and increase the risk of developing type T2DM in the future (Dziegala et al., 2018).

Based on the ANOVA regression test, the results showed that the Hb value could be a predictor of the SMI ($p = 0.001$, $R2 = 0.05$, $C=0.20$), HG ($p<0.001$, $R2=0.083$, $C=1.5$) and GS ($p = 0.004$, $R2= 0.04$, $C= 0.06$). The highest values of the determinant coefficient and regression coefficient are on the HG variable, i.e., 0.083 and 1.5. It might be suggested that the highest effect of Hb is on HG. These data are consistent with the results of Hirani's study which states that low Hb has a correlation with the incidence of sarcopenia and disability on the elderly in Australia (Hirani et al., 2016). According to Dziegala, iron deficiency has an impact on muscle mass decline. Low levels of Fe can cause decreasing of mitochondrial function, followed by reduce of glycogen as a source of energy for skeletal muscle cells (Dziegala et al., 2018).

The value of FBG has not proven as a predictor of SMI ($p=0.170$), HG ($p=0.178$), and GS ($p=0.238$) using ANOVA regression test. A study has shown that glycated hemoglobin (HbA1C) is closely related to muscle weakness of the lower extremities (Wu et al., 2019). It might be the HbA1C is more appropriate as a predictor of sarcopenia. However, due to the higher cost and the need of more complete laboratory facilities, the assessment of HbA1C as a predictor is more difficult to do.

CONCLUSION

Hemoglobin level can be a predictor of sarcopenia in inactive elderly. While, elderly who are inactive have the risk of experiencing chronic diseases that can become comorbid of COVID-19 infection. There is necessary to increase the level of physical activity and prevent anemia in the elderly.

CONFLICTS OF INTEREST

The author(s) declare(s) that there is no conflict of interest regarding the publication of this article

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