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The Role of Serum Omega 3 Levels on Muscle Mass, Muscle Strength, and Physical Performance in the Elderly Community

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ABSTRACT

Background. Old age is related to geriatric syndrome where there are several health problems that often occur related to a decrease in body function and an increase in the inflammatory process. Decrease in muscle mass, muscle strength and physical performance will lead to a condition of sarcopenia and frailty syndrome in the elderly. The importance of prevention so that sarcopenia does not occur in the elderly by evaluating the factors that can cause it, one of which is controlling nutritional factors (macro and micro nutrients), such as in research, namely omega-3 macronutrients. The purpose of this study was to determine the correlation between serum omega-3 levels with muscle mass, muscle strength, and physical performance in the elderly community at Moehammad Hoesin Hospital Palembang. **Methods.** This research is an observational analytic study with a cross-sectional approach which was conducted at the Integrated Geriatric Clinic Internal Medicine RSMH Palembang from November 2019 to November 2020. A sample of 21 people aged> 60 years was examined for muscle mass, muscle strength, physical performance and omega-levels. 3 serums. All data processing and analysis in this study used SPSS version 25 for Windows. **Results.** Of the 21 subjects, it was found that women were 19 people (90.5%) and 2 men (9.5%). The mean value of muscle mass was 37.65 ± 5.7, hand grip strength was 24.04 ± 5 kg, and walking speed was 6.72 ± 1.8 seconds per 6 meters. There were 11 subjects with low serum omega-3 levels of 485.25 ± 110.19 mg. There was a significant relationship between serum omega-3 levels and muscle mass (p = 0.041) with moderate correlation strength (r = 0.448). **Conclusion:** Muscle mass has a significant relationship with serum omega-3 levels in the elderly with moderate strength. Meanwhile, muscle strength and physical performance did not have a significant relationship.

1. Introduction

Govinda (PERGEMI, 2015) states that old age is not a disease but an advanced stage of a life process characterized by a decrease in the body's ability to adapt to environmental stress. The Ministers of Health, including the *Regional Office for South-East Asia* (SEARO) at the 30th *Health Ministers Meeting* agreed to raise the issue of aging as a priority health problem called the *Yogyakarta Declaration on Aging and Health* 2012.[1-3] Old age is related to *geriatric syndrome* where there are several health problems that often occur, these signs indicate a decline in body function in the elderly which is the impact of lifestyle and previous disease history. Signs of *geriatric syndrome* include decreased muscle function, muscle mass, bone mass, osteoporosis, easy falls, weight loss, dementia, lack of sleep, bladder disorders, delirium, decreased organ function and body immunity.[4] Decreased muscle mass occurs 0.47% in men and 0.37% in women per year, at the age of 75 there was a decrease in muscle mass by 0.80% -0.98% in men and 0.64% -0.70% in women per year.[5, 6,7]

Changes in human muscle mass in the elderly were first reported in the late 1980s. Since then studies on the reduction of muscle mass, bone mass, muscle function have continued to be developed and the concept of sarcopenia was born. The initial methods used to detect decreased muscle mass, bone mass and muscle function were tomography and MRI (including using anthropometric measurements), then developed by examinations using other methods such as *ultrasound, bioimpedance analysis* and *dual-energy X-ray absorptiometry* to calculate regionally the total muscle mass in the body.[5] Evaluation of sarcopenia and illustrations related to old age can be seen through signs of decreased muscle mass, muscle function, physical performance.[5]

Decreased body function in the elderly will result in problems with movement disorders and function of the elderly. Elderly people experience decreased walking function, decreased balance function, decreased functional ability, decreased independence in activities of daily life. Factors that affect changes in the decrease in body muscle mass and size, such as the amount of fat mass, race, genetic factors, physical activity, body hormones and nutritional intake.[5]

On the 23rd day of old age, the Ministry of Communication and Information Technology of the Republic of Indonesia in collaboration with the Indonesian Ministry of Health plans to develop programs for the elderly with the aim of making old age independent and prosperous. One of the programs that will be carried out is rehabilitation for the elderly to improve functional abilities, mobility and activities to meet the needs of the elderly including self-care.[8]

One of the strategies that can be achieved to prevent and reduce and delay the decline in musculoskeletal function in the elderly can be done through improving nutritional intake.[9] Dietary fat is a part of nutritional macronutrients that plays a role in the formation of muscle structure and function. Fatty acids act as the main substance for the production of ATP so that they can provide the main source of energy during physical activity such as exercise, as well as being the main structural component of *sarcolemma* (muscle cell membrane).[10] Omega-3 and omega-6 are unsaturated fatty acids (*Poly Unsaturated Fatty Acid* (PUFA)) which has an important role in musculoskeletal health.[11-13] PUFA induces antioxidant-oxidant balance, preventing oxidative stress that can cause atrophy in skeletal muscles.[12-14]

Omega-3 fatty acids are known to exert beneficial health effects on a number of biological processes such as enhancing immune profiles, optimizing cognitive enhancement, and neuromuscular function.[15] Recent studies have shown a strong positive correlation between omega-3 fatty acid intake and skeletal muscle mass.[16] Consistently Jeromsol et al (2018) also show that clinically there is an increase in muscle mass and strength in those aged 65 years and over and intake of omega-3 and prevent a decrease in mitochondrial respiration.[17]

McGlorry et al (2019) found an effective way to optimize omega-3 fatty acid intake, namely through the incorporation of eicosapentaenoic acid (EPA; 20: 5n - 3) and docosahexaenoic acid (DHA; 22: 6n - 3) into the phospholipid membrane of the *sarcolemma* and intracellularly. . In their observations, McGlorry et al found that there was an increase in muscle mass and strength in the elderly who consumed omega-3 fats with EPA and DHA, and there was a decrease in inflammation and increased body immunity.[15] In general, omega-3s can provide a protective effect on bones and muscles while omega-3 -6 is thought to have a pro-inflammatory effect with adverse consequences for musculoskeletal health. So, the higher omega-3 content in the body can be especially beneficial for improving muscle health[16]

McKee's 2019 study shows populations with a higher omega-3 to omega-6 ratio in their bodies, such as Japanese or Inuit people, have lower rates of osteoporosis than populations with a lower omega-3 ratio than the omega-6 ratio.[16] As we get older, the pattern of life and nutrient intake changes, in most cases the nutritional intake decreases so that the body's macronutrients and micronutrients do not have much reserves. Omega-3 levels play a role in the anti-inflammatory process in the body while omega-6 plays a pro-inflammatory role. If the body is deficient in omega-3s, it facilitates the inflammatory process and increases levels of Interleukin 6 which can cause sarcopenia.[18]

2. Methods

This study used an *observational analytic* design with a cross sectional approach. The target population in this study were all elderly patients in the elderly community of RSMH Palembang. The affordable population is all samples aged ≥ 60 years who are members of the elderly community of RSMH Palembang. The research subjects were 21 people who met the inclusion criteria. Inclusion criteria were elderly aged ≥ 60 years, able to communicate well and understandably, willing to participate in research and sign *informed consent.*

All patients who met the sample inclusion and exclusion criteria and were willing to take part in the study by signing the consent form, were then carried out identification, including: name, age, gender, education and occupation. Anamnesis (autoanamnesis / alloanamnesis) which includes: main complaints, additional complaints, history of disease, and drugs that have been used, history of chronic disease, history of smoking. The history was carried out by the researcher. Physical examination includes height, weight, body mass index, vital sign, *Body Impedences Analysis* (BIA): BMI, fat mass (FM), free fat mass (FMM), *Visceral Fat Analysis* (VFA): *Waist Circumference* (WC), *Skeleton Muscle Index* (SMI) by researchers. The serum Omega-3 test was measured by *immunochemical quantification* using the *high performance liquid chromatography* method which was carried out in Prodia's Laboratory.

Processing and data analysis using the SPSS 25 for *Windows* program. Data is presented in tables and graphs. The data is tested whether the distribution is normal or not, if the distribution is normal then the Pearson correlation test is used and if the distribution data is not normal, the Spearman correlation test is used.

3. Results

Seen from the general characteristics of the research sample in Table 1. the sample was dominated by women as many as 19 people (90.5%) and 2 (9.5%) were men. All ages in the study were> 60 years as many as 21 samples with a mean mean of 64.81 (3,829) years, the youngest age in this study was 60 years and the oldest was 73 years. The majority of samples had normal body weight of 10 (47.6%) samples, 4 (19%) samples each had BMI less and more and 3 (14.3%) samples were obese. BMI in this study had a mean of 21.34 (2.066).

In Table 2, it is found that serum omega 3 levels in the blood at the age of the elderly sample get a mean mean of 4.55 ± 23 pg / mL in samples with 11 (52.4%) having low omega-3 levels. It can be seen in Table 4.3 that there are significant levels of omega-3 serum for age and elderly people.

Table 4. presents data on muscle mass, walking time in 6 meters, hand grip strength and PASE calories / week. It was found that the mean muscle mass in the age group> 60 years was a mean 37.65 ± 5.7. The walking duration of the samples> 60 years old was mean 6.72 ± 1.8 seconds per 6 meters. The hand grip strength in the elderly> 60 years is 24.04 ± 5 kg. PASE calories / week at age> 60 years was 740.3 ± 192.5. The results of the T test showed that there was no significant relationship between age and muscle mass, length of walking, hand grip strength and PASE calories / week.

Table 5. presents data regarding the correlation of omega 3 levels in the blood with muscle mass, muscle strength and physical performance. It can be seen that muscle mass has a significant relationship with serum omega 3 levels (p = 0.041) with moderate correlation strength (0.448). While the length of walking, hand grip strength and PASE calories / week did not have a statistically significant relationship in this study.

Figure 1 above describes the correlation of muscle mass, walking time, hand grip strength and PASE calories / week and it is found that muscle mass has moderate correlation strength (r-0.448) while walking time and hand grip strength have weak correlation strength and PASE calories / week has a weak negative correlation power.

Table 1. General Characteristics of Research Samples

General characteristics	N (%)	Mean (SD or range)
Age		
≥ 60 tahun	21 (100%)	64.81% (3.829)
Gender		
Male	2 (9.5%)	
Female	19 (90.5%)	
BMI		21.34 (2.066)
Less	4 (19%)	
Normal	10 (47.8%)	
More		
Obesity		
Comorbidity		
Nothing	15 (71.4%)	
Hypertension	3 (14.3%)	
Diabetes	3 (14.3%)	
CAD	3 (14.3%)	

Table 2. Omega-3 levels in old age

	N = 21 (%)	Mean (SD atau range)
Omega-3 level		4.55 ± 23
Less	10 (47.6%)	
Normal	11 (52.4%)	

Table 3 Correlation of Omega-3 levels with age and BMI in the elderly

Variable	Omega-3 (r)	p value
Age	-0.511	< 0.05
BMI	-0.109	< 0.05

* correlation test with Spearman's rho

Table 4. Muscle Mass, Muscle Strength and Physical Performance

Variable (n = 21)	Age ≥ 60 years	P
Muscle Mass	37.65 ± 5.7	0.479
Long Walk	6.72 ± 1.8	0.800
Hold hand	24.04 ± 5	0.570
PASE Calories / Week	740.3 ± 192.5	0.839

* Unpaired T test p value is significant if p <0.05, normally distributed data are presented with mean ± SD

Table 5 The Relationship Between Omega 3 and Muscle Mass, Muscle Strength and Physical Performance

Variable (n = 21)	Omega-3	
	R	p
Muscle Mass	0.448	0.041*
Long Walk	0.118	0.609*
Hold hand	0.142	0.540*
PASE Calories / Week	-0.167	0.144*

* Spearman's rho test, p value is significant if p <0.05, the strength of correlation is very weak if r <0.2, weak if r = 0.2-0.4, moderate if r = 0.41-0.6, strong if r = 0.61-0.8 and very strong if r> 0.8

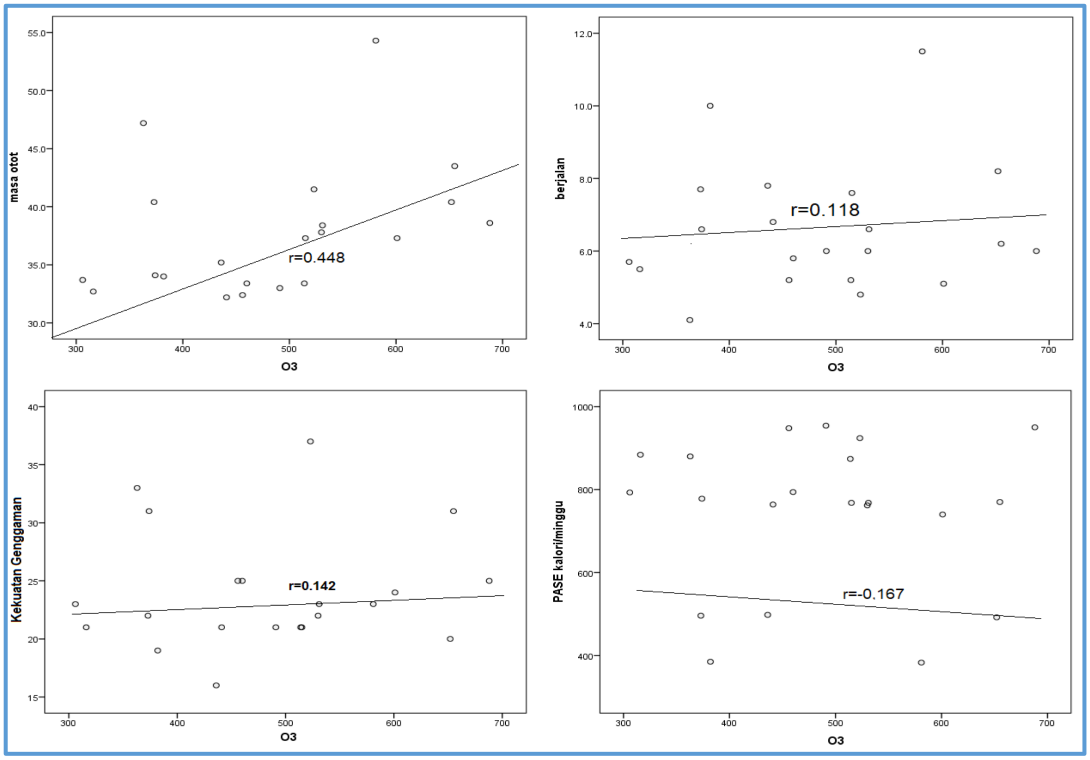

Figure 1. Graph of Correlation between Muscle Mass, Walking Time, Hand Grip Strength, PASE calories / week

4. Discussion

In this study, serum omega-3 levels in the elderly sample obtained a mean value of 4.55 ± 23 pg / mL, the correlation between age and omega-3 was significant (because it was above 0.05) but the correlation was negative (-0.511), where the higher the age, the lower the omega-3 levels. Likewise, the correlation between BMI and omega 3 is significant (because it is above 0.05) but the correlation is negative with weak strength (-0.109)

D'Ascoli et al in 2016 concluded that the elderly with omega 3 levels <500 mg had a 15.4 times risk of experiencing sarcopenia.[70] Lukaschek et al in 2016 also found that samples with low index omega-3 levels were associated with weak muscle strength, and bodily performance in the elderly.[71] Another mechanism of action of omega-3s is anabolic effects that are regulated by transcription through activation of the mTOR pathway. The mTOR pathway plays a key role in many cell growth processes, for skeletal muscle formation and muscle protein synthesis.[54] Through the downstream regulators 4E-BP1 and S6K1, mTOR regulates muscle protein synthesis. Smith et al. found an increased activation of the mTOR-p70s6k signaling pathway in response to increased amino acid and insulin supply after 8 weeks of omega-3 PUFAs compared to the placebo group.[54]

Lack of omega-3 fatty acids, caused by insufficient intake or due to diseases that reduce absorption, can inhibit brain development, physical health and environmental interactions, which have a strong effect on the formation of cognitive development. Prolonged omega-3 deficiency can be fatal. Lack of omega-3 fatty acids causes nerve and vision problems and can interfere with the development of the nervous system. As a result, there may be disturbances in the immune system, memory, mental and vision. [48-50]

In this study, the mean muscle mass in the elderly group was a mean of 37.65 ± 5.7. The walking duration of the samples> 60 years old was mean 6.72 ± 1.8 seconds per 6 meters. The hand grip strength in the elderly group was 27.04 ± 5 kg. PASE calories / week in the elderly group was 740.3 ± 192.5. The results of the T test showed that there was no significant relationship between age and muscle mass, length of walking, hand grip strength and PASE calories / week.

In this study, there was no significant relationship between muscle mass and sarcopenia in the elderly community. Changes in muscle strength with age can be affected by the number and size of muscles that change to atrophy and hypoplasia, a decrease in slow and fast motor units and the presence of atrophy in type I and II muscle fibers. Type II muscle fibers are fast fibers that have a higher glycolytic potential, low oxidative capacity and a faster response than type I (slow fibers). There is a conversion from type II to type I fibers because of the potential adaptive response. In advanced ussia muscles, the decrease in type I and II fibers results in changes in muscle function, especially muscle strength. [19,21]

In contrast to this study, Titin in 2019 in his dissertation study on 283 samples aged> 60 years found that there was a significant relationship between muscle mass and sarcopenia.72 In line with Titin, Pratiwi et al. In 2019 in their library review also concluded that muscle mass is associated with sarcopenia with the conclusion that the aging process causes accumulation of oxidative damage to proteins, DNA, lipid membranes, and cell organelles. The accumulation of damage that occurs in extracellular, intracellular and protein membranes is a basic mechanism of decline in function in the aging process and is one of the biomarkers of aging. Oxidative stress causes accumulated damage in the oxidized cell nucleus and mitochondrial DNA with mitochondrial damage. The accumulated damage due to oxidative stress will continue to increase with the aging process[73]

In this study, there was no significant relationship between physical performance by looking at the mean length of walking and PASE calories / week with the incidence of sarcopenia in the elderly community. In a 2019 study by Biben et al., They found a significant relationship between physical performance such as walking time, hand grip strength and PASE calories / week with sarcopenia ($p < 0.05$). Low capacity and efficiency of mitochondria is associated with decreased physical performance in old age, but in older people who are still active there is an increase in muscle mass and mitochondrial capacity.[74] Titin et al in 2019 also found a significant relationship between physical performance such as grip strength, length of time. walking and PASE calories / week with sarcopenia in samples> 60 years of age.[72]

In this study, it was found that muscle mass had a significant relationship with serum omega 3 levels ($p = 0.041$) with moderate correlation strength (0.448). While the length of walking, hand grip strength and PASE calories / week did not have a statistically significant relationship in this study. The dissertation research conducted by Hani in 2019 found a significant relationship with moderate strength correlation between body muscle mass and serum omega 3 levels, but it is slightly different from this study. Hani also found that physical performance and PASE calories / week also had a significant relationship with moderate correlation.[66]

There are three hypothetical mechanisms and supporting data regarding the relationship of omega 3 levels in the body to muscle mass and physical performance: anti-inflammatory effects, mammalian targets of rapamycin activation (mTOR) used as examples and reduction of insulin resistance. The anti-inflammatory effects of omega-3 PUFAs are generally accepted by the body. A meta-analysis study conducted by Custodero et al. confirmed that there was a reduction in CRP and IL-6 after taking supplementation with omega-3 PUFAs in middle-aged and older adults.[60] Additionally, a 2017 RCT conducted by Daboit et al investigated the effects of EPA and DHA therapy on inflammation in adults. older. Supplementation had a significant decreasing effect on IL-6, IL-1β and TNFα levels after 4 weeks of use and was even greater after 8 weeks.[56]

Yoshino et al. found that omega-3 PUFA supplementation induced small but important changes in gene expression, with increased expression of pathways involving regulation of mitochondrial function and decreased expression of the inhibitory pathway on mTOR, thereby supporting skeletal muscle anabolism.[61] In conclusion, omega-3 PUFAs may aid anabolic coping age-related resistance by increasing the rate of muscle protein synthesis via stimulation of the mTOR signaling pathway. Several studies have shown a role for decreased insulin resistance in response to omega-3 PUFA therapy. [59]

5. Conclusion

Muscle mass has a significant relationship with serum omega-3 levels in the elderly with moderate strength. Meanwhile, muscle strength and physical performance did not have a significant relationship.

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