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Correlation between body mass index and frailty in elderly men at Pemecutan Village, West Denpasar District, Bali

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Background: Frailty as a result of decreased in age-related physiological systems that causes change in health status vulnerabilities that can be triggered by minor stressor events. One of the factors related to frailty is body mass index (BMI).
Objective: We aimed to examine the correlation between BMI and frailty of elderly men in Pemecutan Village, West Denpasar District.
Methods: A cross-sectional analytic study was conducted in Busung Yeh Kangin and Busung Yeh Kauh Banjar, Pemecutan Village, West Denpasar District. Data were collected after informed consent had been obtained through interview methods, grip strength, walking speed and anthropometric measurements. Interviews, anthropometry and frailty was assessed by Frailty Phenotype Fried. The Spearman correlation test was used to determine the bivariate relationship.
Result: A total of 62 elderly men subjects with mean age of 69.26±7.11 years old. Frailty syndrome occurred in 50% subjects (n=32). There was no correlation between BMI and frailty in this study ($r = 0.07$; $p = 0.5$).
Conclusion: There was no correlation between BMI and frailty in this study. This shows frailty is not related with poor BMI.
Keywords: body mass index, frailty, elderly men.

Latar Belakang: *Frailty* sebagai akibat dari penurunan system fisiologi terkait usia yang mengubah kerentanan status Kesehatan. Hal ini dapat dipicu oleh peristiwa kejadian-kejadian tertentu. Salah satu faktor yang berhubungan dengan kelemahan adalah indeks massa tubuh (IMT).
Tujuan: Untuk mengetahui hubungan IMT dengan *frailty* pada pria lanjut usia di Desa Pemecutan Kabupaten Denpasar Barat.
Metode: Penelitian analitik potong lintang dilakukan di Busung Yeh Kangin dan Busung Yeh Kauh Banjar, Desa Pemecutan, Kabupaten Denpasar Barat. Pengumpulan data dilakukan setelah *informed consent* diperoleh melalui metode wawancara, kekuatan genggaman, kecepatan berjalan, dan pengukuran antropometri. Wawancara, antropometri dan *frailty* dinilai dengan Frailty Phenotype Fried. Uji korelasi Spearman digunakan untuk mengetahui hubungan bivariat.
Hasil: Jumlah subjek lansia laki-laki yaitu sebanyak 62 orang dengan rerata usia 69,26 ± 7,11 tahun. Sindrom *frailty* terjadi pada 50% subjek (n=32). Tidak ada korelasi antara IMT dan frailty dalam penelitian ini ($r = 0,07$; $p = 0,5$).
Simpulan: Tidak ada korelasi antara BMI dan frailty dalam penelitian ini. Hal ini menunjukkan kelemahan tidak berhubungan dengan BMI yang buruk.
Kata kunci: Indeks massa tubuh, *frailty*, lansia laki-laki

INTRODUCTION

Globally in 2004, the rapidly growing elderly population estimated at 461 million people over the age of 65 years old and expected to be 2 billion by 2050, which will have implications for planning and health and social services. The most common problem in the elderly population is frailty. Frailty as a result of a decreased in age-related physiological systems that results in changes in health status vulnerabilities that can be triggered by minor stressor events.[1,2] A systematic review examined the prevalence of frailty in 21 community-based cohort studies involving 61,500 elderly people. At this age, women are statistically frailer than men.[1]

There are two markers of aging that need to be considered, especially to improve health in old age. One of them is increased susceptibility as a result of a decrease in

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physiological function that can lead to disability, which can be caused by minor stress, called frailty. The second marker is the accumulation of a pathology process called chronic disease. Frailty and chronic diseases become the main modulators of a healthy person's health in old age, which later determines the internal status of their body and their external health.[1,2]

Frailty is a condition of increased clinical vulnerability associated with decreased reserves and multiple physiological system functions due to aging processes, such as the ability to deal with acute stressors that increase the risk for bad external effects such as, falls, disabilities, and delirium.[1,2] One of the factors that contributes to the onset of frailty is BMI. Weight loss and weight changes contribute to the risk of frailty. BMI is the right scale to evaluate a person as thin or overweight. Frailty in individuals based on BMI who weighed less (< 18.5 kg/m^2) at normal weight (18.5-24.9 kg/m^2), or obesity (> 30 kg/m^2) had a higher risk of death than those who were not frail. The correlation between BMI and frailty is important because it determines the prognosis for elderly patients.[4-6]

A cross-sectional study of some subjects across the UK showed that BMI had a U-shaped relationship, where the prevalence of frailty showed that the BMI range was associated with the lowest prevalence of frailty at 18.5-24.9 and 25-29.9 kg/m^2. Although the optimal BMI range among studies varies, their findings suggest that it is important to maintain a healthy BMI to prevent frailty.[7-9] The average BMI between English and Indonesians is different. This study aimed to find out the correlation between BMI and frailty in elderly men patients in Bali, especially the city of West Denpasar.

MATERIAL AND METHODS

Research Design

This study was a cross-sectional study, located in Banjar Busung Yeh Kangin and Banjar Busung Yeh Kauh, Pemecutan Village, West Denpasar District, Bali, in September 2019. The population of this study was people in Busung Yeh Kangin and Banjar Busung Yeh Kauh, Pemecutan subdistrict, West Denpasar district that met the inclusion criteria and did not meet the exclusion criteria. Inclusion criteria included elderly (age ≥60 years old) who are males that live or were in Busung Yeh Kangin and Busung Yeh Kauh Banjar, Pemecutan Village, West Denpasar District. Exclusion criteria included elderly people who were experiencing acute infections, suffering from autoimmune diseases, malignancy, clinically leading to suffering from active pulmonary tuberculosis, elderly people taking corticosteroids, non-steroidal anti-inflammatory drugs, psychoactive drugs for at least the last 2 weeks, elderly with a sequel to stroke resulting in loss of muscle strength, inability to be interviewed due to socio-linguistic and or aphasia problems, and elderly with impaired cognitive weight function.

The number of samples for this study was calculated based on the formula for correlative analysis research obtained a minimum sample number of 62 subjects, and taken using consecutive sampling method. The independent variable research was frailty enforced with a score system of Fried's Frailty Phenotype consisting of 5 criteria (weight loss, fatigue, muscle weakness, decreased walking speed, and decreased physical activity). While the dependent variable on this study was BMI measured by finding a ratio between height and weight.

Data collection

Data were collected after informed consent had been obtained through interview methods, grip strength, walking speed and anthropometric measurements. Data collection was carried out directly by researchers and carried out in one stage. Height in the elderly is determined using knee height measurements. The method of measuring knee height is to measure the knee height on the left leg with the ankle and knee bent at an angle of 90° and ensure that the joint angle is perpendicular. At the end of the capillary remains placed under the heel and the moving side is pulled down to the anterior surface of the leg, approximately 5 cm proximal to the patella above the condylus femur. The capillary shaft is positioned at the lateral malleolus, posterior to the head of the fibulae and parallel to the tibia. The measurement is taken when the moving side is pressed against the soft tissue. Readings are made to the nearest millimeter. The measurement results in cm were converted using the height formula for the elderly:

Male height = 59.01 + (2.08 x knee height in cm).
Female height = 75.00 + (1.91 x knee height in cm) - (0.17 x age).

Measurement of superior extremity muscle strength (Handgrip Dynamometer Camry, kg) and body weight measurement (Onemed weight scales, kg).

Research Variables

The research variables analyzed in this study were determined based on previous studies and the clinical judgement of the researcher. Independent variables, confounding variables and dependent variables were measured and incorporated into the analysis. The independent variables in this study were BMI, while the dependent variables were frailty.

The Body Mass Index (BMI) was calculated using the formula of weight (BW) (in kg) / (height)^2 (in meters).

The classification of BMI is based on the Ministry of Health of the Republic of Indonesia 2013 used in this study:

- Underweight ; BMI <18,5 kg/m^2
- Normal ; BMI ≥18,5-<24,9 kg/m^2

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- Overweight ; BMI ≥25,0-<27,0 kg/m^2
- Obesities ; BMI ≥27,0 kg/m^2

A knee height measurement was used to determine the height of the elderly. The way of measuring the height of the knee was to measure the height of the knee on the left leg with the ankle and knee bent at an angle of 90 degree, and ensured the angle of the joint was straight. In the end, the capillaries remained placed under the heel and the moving side was pulled down to the anterior surface of the limbs, approximately 5 cm from the proximal patella above the condylus femur. The capillary stem was positioned in the malleolus lateralis, on the posterior caput fibulae and parallel to the tibia. Measurements were performed when the moving side was emphasized in the soft tissue. The reading was done to the nearest millimeter. Measurement results in cm were converted using height formula in elderly

Men's Height = 59,01 + (2,08 x knee height in cm).
Women's height = 75,00 + (1,91 x knee height in cm) – (0,17x age).

The waist circumference and pelvic circumference were measured using a cloth meter, expressed in centimeters (cm).

Frailty

Frailty is operationally defined by Fried *et al*, if it meets three of the five phenotive criteria of reduced grip strength, low energy, slow walking speed, low physical activity, and/or accidental weight loss. Pre-frail conditions if they meet one or two criteria, identified as high-risk individuals develop into frailty.[10]

Statistical analysis

The data was analyzed using statistical package for the social sciences (SPSS) version 22.0 software. Mean and standard deviation were used to present numeric variables. Univariate analysis was used to present frequency and percentage data of categorical variables. A hypothetical test to determine the correlation of BMI with frailty used Spearman's analysis with abnormally distributed data (kolmogorov-smirnov normality test). The Confidence Interval (CI) used was 95% and the p value of <0.05 was considered meaningful.

RESULTS

Characteristics of research samples

The number of research samples was 62 subjects. All of the samples were males and were at least 60 years old. The age range of 60-74 years old was 52%, and the age range of >75 years old was 10%, with an average age of 69 years old. The prevalence of BMI was an average of 23.90, underweight was 8.1%, normal was 53.2%, overweight was 22.6% and obesity was 16.1%. The prevalence of frailty obtained was 50% and nonfrailty was 50%. More than half of the five frailty phenotypes measured were fatigue (69%) and decreased physical activity (58%) (Table 1).

Correlation between BMI and Frailty

From 62 subjects, 50% had frailty and nonfrailty. The abnormal distribution results were obtained and analyzed using Spearman's correlation after the normality test with the Kolmogorov-smirnov test. Results showed no correlation between BMI and frailty (p=0.5) (Table 2).

The effect of BMI as an independent variable on Frailty score is also presented in the form of a scatter plot (Figure 1). The distribution of points does not form a pattern following a linear line so that the regression model is not linear.

DISCUSSION

This study aimed to determine the correlation between BMI and frailty. In this study, it was found that there was no significant correlation between BMI and frailty. The not statistically significant of this study may be caused by the intervention of other variables that were not examined in this study. Blaum *et al.*, suggested that high BMI and obesity are associated with frailty syndrome. In this study,

Table 1. Characteristics of the research sample.

Characteristic	Result
Age (year), Mean ± SD	69.26 ± 7.11
Age, n (%)	
60 – 74	52 (83.9)
≥ 75	10 (16,1)
BMI, n (%)	23.90±3.56
Underweight	5 (8.1)
Normal	33 (53.2)
Overweight	14 (22.6)
Obese	10 (16.1)
Weight (kg), Mean ± SD	65.17 ± 10.58
Frailty, n (%)	
Frail	31 (50)
Non-frail	31 (50)
Frailty score, median (min-max)	2.60 (0-5)
Frailty Phenotype, n (%)	
Decrease of body weight	29 (46.8)
Fatigue	43 (69.4)
Decreased walking speed	23 (37)
Decreased physical activity	36 (58)
Muscle weakness	30 (48.4)

Table 2. Correlation between Body Mass Index with Frailty.

Variable	r	*p*
BMI	0.07	0.5

BMI, body mass index

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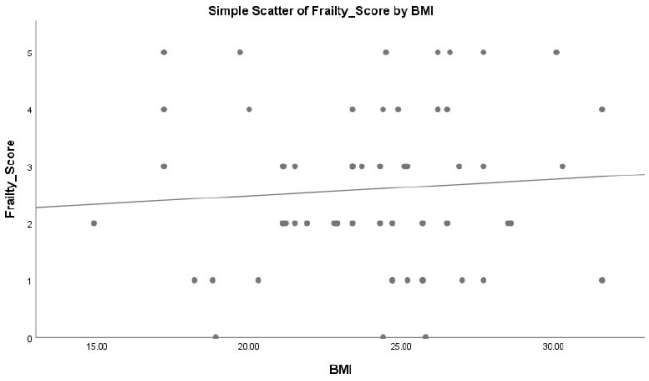

Figure 1. The scatter plot of the BMI with Frailty Score.

the Cardiovascular Health Study (CHS) criteria were used to measure frailty, namely weight loss, fatigue, inaction, low activity and weakness. Underweight elderly was not included because they were considered a confounding factor related to the CHS criteria used (weight loss).[11]

A study conducted by Villareal states obesity is a cause of physical dysfunction in the elderly, almost all subjects have objective and subjective characteristics of frailty syndrome. The condition of frailty in obesity is caused by the low relative muscle mass and muscle quality. A study conducted by Strandberg states that the greatest risk of frailty caused by someone who loses weight, whereas individuals who are consistently overweight also have a greater risk of frailty than a normal BMI.[12]

Metabolic disease conditions such as obesity and overweight are known to accelerate morbidity and disability. Obesity is a risk factor for fragility through various physiological markers associated with fragility, especially inflammatory markers. A study showed an important role of inflammation in the frailty process. It is thought that during the aging process, the main dysregulation of the mechanisms that initiate, modulate, and inhibit the inflammatory response usually occurs frequently. In the study, high levels of pro-inflammatory cytokine plasma levels included tumor necrosis factor-α (TNF-α), interleukin-6 (IL-6), and interleukin-1 (IL-1) in the elderly. Pro-inflammatory mechanisms are thought to have an effect on the development of sarcopenia due to increased cytokines in conditions of reduced muscle protein synthesis and increased protein degradation. There was an association between high CRP, low carotenoids and a high BMI. In addition, there was a possibility of sarcopenic obesity in the obese elderly, an imbalance between fat and muscle occurs. This syndrome is associated with reduced strength and increased disability.[11,13]

Unrelated result between BMI and frailty can caused by the limitation of BMI to measure body fat mass. BMI measurement had limitations because it can not distinguish between body fat mass and lean body mass. A person can have a large BMI but have small fat mass and vice versa. In addition, the insignificant results can be caused because the entire population in this study were male. This can affect the measurement of BMI because the BMI in the male population tends to be higher than that of women, although the fat mass relative to body mass is greater in women than in men.[14]

This study also showed that frailty was not uncommon in the population and this data was useful as a predictor when the elderly are still relatively functional. A few years earlier, frailty was mainly evaluated only in the inpatient or nursing home population, where study subjects tended to be characterized by elderly with frailty conditions accompanied by acute comorbidity who had experienced disabilities.[10]

The weakness of this research is this study was not a longitudinal study that analyzes causal relationships and did not include other variables that had the potential to be confounding in this study. The study population was also limited to elderly men in the Denpasar area, so the generalization was limited due to differences in race, topography and lifestyle. Based on these weaknesses, it is necessary to conduct further longitudinal studies in the future with a larger population, so that it can be known the causal relationship between variables and generalization becomes wider.

CONCLUSION

In this study, there was no correlation between BMI and frailty in cross-sectional studies of the elderly men in the Pemecutan village, West Denpasar. This could be due to other variable interventions against frailty that were not studied in this study and the inability of BMI to distinguish body fat mass from lean body mass.

CONFLICT OF INTEREST

The authors report no conflicts of interest regarding this study.

ETHICS CONSIDERATION

Ethics approval has been obtained from the Ethics Committee, Faculty of Medicine, Universitas Udayana, Sanglah General Hospital, Bali, Indonesia, prior to the study being conducted.

FUNDING

None.

AUTHOR CONTRIBUTIONS

All authors equally contribute to the study from the conceptual framework, data acquisition, data analysis, and

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reporting the study results through publication.

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