The relationship between body mass index and musculoskeletal disorders among tailors

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ABSTRACT

Background: Humans have a demand to have more abilities so that the role produced is as desired. Muscles and bones are important for workers to do their jobs. Complaints related to muscles and bones can be called musculoskeletal disorders. Body mass index (BMI) is one of the factors influencing the incidence of musculoskeletal problems. This is because people with a high score of BMI will try to support their weight by tightening the muscles in their lower back. On the other hand, if this happens frequently, the spinal cord pads will be under a lot of pressure. This study aimed to establish a relationship between BMI and musculoskeletal disorders.

Methods: This study used analytic observational cross-sectional research as the study design. Were 53 individuals used as samples in this study utilizing a purposive sampling method based on exclusion and inclusion criteria.

Results: Data on BMI and musculoskeletal disorders were analyzed using the Pearson correlation test, which found a significant correlation of $p=0.000$ ($p<0.05$).

Conclusion: Based on the study's results, it can be concluded that there was a relationship between BMI and musculoskeletal disorders among tailors in Denpasar City.

Keywords: body mass index, musculoskeletal disorders, tailor.

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INTRODUCTION

The role of humans in the industrial world is a source of power that is still needed.[1] Humans demand more abilities so that the role produced is as desired. Muscles and bones are important for workers to do their work. Complaints related to muscles and bones can be called musculoskeletal disorders.[2] Musculoskeletal disorders is a condition where a complaint occurs and is experienced by the skeletal muscles due to a stagnant load over a long period received by the muscles and carried out continuously and repeatedly.[3] Everyone feels and has different complaints. Some feel mild complaints, but also some feel severe complaints.[4] Muscle disorders will cause activities such as doing a job to be disrupted and can result in decreased productivity from workers.[5]

The Health and Safety Executive (HSE) in 2019 stated that musculoskeletal disorders accounted for 30% of all cases of work on workers' health[6] and according to information obtained at the Department of Health in 2005 stated that 40.5% of workers experienced occupational diseases, including musculoskeletal disorders by 16%.[7] The prevalence of musculoskeletal disorders or complaints in Indonesia in 2013 was 24.7%.[8]

Stronger muscles are needed for hard physical labor, and there is a chance that the body will start to complain in ways that could harm health. If muscles are overworked and repeatedly used in the same way for an extended period, musculoskeletal diseases will worsen. If the muscle contraction employed is only between 15% and 20% of the maximum muscle strength, there won't be any intramuscular complaints. Blood flow to the muscles will be lowered if the muscle contraction is greater than 20%, and the level of contraction is regulated by the amount of manpower used. As a result, it causes a decrease in O_2 delivery by the muscles, inhibits the carbohydrate process, and causes lactic acid accumulation, which impacts the appearance of discomfort or even pain in the muscles.[9]

BMI is related to musculoskeletal disorders. If an individual with an abnormal BMI, the risk of that person having musculoskeletal disorders increases. This is due to the person's attempt to support their body weight by tensing their back muscles. The spinal cord will be put under pressure if this continues.[10] Increased BMI causes the tonus in the abdominal muscles to become weak, pushing the body's center of gravity forward. This can cause increased lordosis in the lumbar and the onset of paravertebral muscle fatigue.[11]

A tailor is a typical worker who could suffer from musculoskeletal issues. When working, tailors typically sit still while performing the same task repeatedly for an extended period. High work demands cause stiffness in posture and muscle load in a static position. The sewing process is quite monotonous and carried out for a fairly long period has the potential to cause musculoskeletal disorders.[12]

The workload workers receive affects the performance of the muscles, cardiovascular, and respiratory systems.

A long period of doing work without any time to rest causes a decrease in the capabilities of the body so that it can cause certain parts of the body to experience pain.[5]

METHODS

This study used an observational cross-sectional design. Body mass index was used as the study's independent variable, and musculoskeletal disorders were used as the study's dependent variable. In this study, age serves as the control variable. In November 2022, this study was conducted at clothing stores in Denpasar City. Purposive sampling, based on inclusion and exclusion criteria, was the sampling strategy utilized. The inclusion criteria for this study include working as a tailor, being between the ages of 35 and 50, having a BMI between 18.5 and more than 30, and being willing to provide informed permission as proof of willingness to participate in the study. Women who are pregnant and have side occupations are excluded from this study. This study's failure to complete all measurements and questionnaires constituted a dropout. 53 individuals served as the study's sample size.

The study was started by taking an anamnesis and then measuring BMI. Body weight (kg) divided by height in meters squared (m²) is the formula used to compute the body mass index. The measuring instruments used were scales and microtomes. Then the data will be collected and classified based on Asia Pacific criteria to determine the BMI results. There are 5 BMI classifications consisting of underweight (<18.5), normal (18.5-22.9), overweight (23-24.9), obese I (25-29.9) and obese II (≥30). Furthermore, the sample measured musculoskeletal disorders with the Nordic Body Map questionnaire. There are 4 classifications of the total risk score of musculoskeletal disorders, which are 0-20 (low risk), 21-41 (medium risk), 42-62 (high risk), and 63-84 (very high risk).

The acquired data will be examined using SPSS version 25.0. This study used three different forms of data analysis: univariate, normality test, and bivariate. BMI, age, and musculoskeletal disorders were among the variables that were measured as part of the study. Univariate analysis was used to examine each of these variables. Additionally, a normality test was run to see if the data was distributed normally or not. Kolmogorov-Smirnov was employed as a normality test since the findings indicate that the data is normally distributed, and Pearson correlation testing was then utilized for additional bivariate analysis. The relationship between the independent and dependent variables was examined using bivariate analysis.

RESULTS

The descriptive characteristics of 53 respondents in this study were obtained: age, gender, BMI, and musculoskeletal disorders. Table 1 shows that 15 samples were 50 years old, namely 15 people (28.3%). The research sample was mostly female as many as 42 people (77.4%). Then, the BMI category is dominated by obese as many as 26 people (49%). Judging from musculoskeletal disorders, most of the risk of complaints felt by the sample is high risk, with a total score of 42-62, as many as 32 people (60.3%).

Based on Table 2, the results show that the variables for body mass index have a p-value of 0.074 (p>0.05), and the variables for musculoskeletal problems have a p-value of 0.058 (p>0.05). Therefore, the study's variable data are normally distributed.

Table 3 shows a substantial relationship between body mass index and the likelihood of developing musculoskeletal problems in tailors in Denpasar City, with a p-value = 0.000 (p<0.05) and a Pearson correlation value of 0.954.

DISCUSSION

The total sample size for this study was 53 people, of whom 42 (or 77.4%) were women and 12 (or 22.6%) were men. In this study, there were 15 persons (28.3%) who were over the age of 50. These findings are consistent with studies done by Rossa et al. in 2017, which

Table 1. Characteristics of respondent

Characteristic	Frequency (n)	Percentage (%)
Age		
35	7	13.2%
36	5	9.4%
37	4	7.5%
38	1	1.9%
39	2	3.8%
40	2	3.8%
42	2	3.8%
43	2	3.8%
45	1	1.9%
46	1	1.9%
47	5	9.4%
48	4	7.5%
49	2	3.8%
50	15	28.3%
Gender		
Man	12	22.6%
Woman	41	77.4%
Body Mass Index		
20-22 (normal)	9	17%
23-24 (overweight)	12	22.6%
25-29 (obese I)	26	49%
31-37 (obese II)	6	11.4%
Musculoskeletal Disorders		
21-41 (moderate)	15	28.3%
42-62 (high)	32	60.3%
63-64 (very high)	6	11.4%

Table 2. *Kolmogorov-smirnov* normality test

Variable	*p*-value
Body Mass Index	0.074
Musculoskeletal Disorders	0.058

Table 3. *Pearson* correlation test between body mass index and musculoskeletal disorders

Variable Correlation	*p*-value
Body Mass Index and Musculoskeletal Disorders	0.000

discovered a relationship between age and musculoskeletal disorders because as a person ages, the body will experience a process of degeneration, tissue damage, tissue turnover into scar tissue, and a decrease in the amount of fluid.[13] In this study, it was found that the BMI category of obese I was more dominant than other BMI values, namely 26 people (49%), followed by the overweight BMI category of as many as 12 people (22.6%). Findings conducted by Tallis et al. in 2018 stated that someone who is obese can affect the function of skeletal muscles, reducing the mobility of someone with obesity.[14] In this study, the total risk score for musculoskeletal disorders was dominated by scores 42-62 (high risk) as many as 32 (60.3%). Similar results were also found by Putri et al. in 2020 found that tailors have a risk of experiencing musculoskeletal disorders because tailors perform repetitive activities for a long time with poor positions such as bending and chairs that do not have cushions and backrests.[15]

The value of p=0.000 (p0.05) was achieved based on the findings of the data analysis test with Pearson correlation parametric analysis, suggesting a strong association between body mass index and the degree of risk for musculoskeletal disorders. BMI dominates the BMI of tailors in Denpasar City with the obese I category. An excessive BMI tends to increase mechanical stress on the body structures responsible for supporting a person's body mass.[16] The higher a person's BMI will be directly proportional to the possibility of experiencing an increased risk of musculoskeletal disorders because the individual with excessive body weight will support his body weight by contracting the lower back muscles, this causes pressure on the spinal cushion so that it will risk causing musculoskeletal disorders.[17]

Adiposity, the measurement of body fat, is not the same as the notion that it is a passive outcome of unhealthy behaviors or overindulgence. Instead, it is controlled as a byproduct of the energy homeostasis process, wherein energy consumption (food consumption) and energy intake (metabolism, exercise, and the body's energy reserves, such as fat mass) are balanced.[18] In real life, obesity can increase the amount of absolute strength and power produced by the weight-bearing muscles, but when body mass is adjusted, the muscle performance of fat people is decreased. The preparation of isolated muscles demonstrates that obesity frequently causes a decrease in the force and power produced by each unit of muscle mass. Aging and obesity have similar physiological effects. Obesity and aging's combined impact on muscular function could increase mortality and morbidity.[14]

Regarding biomechanics, the body parts and joints that support the human body, especially the lower extremities and back, will receive the greatest pressure because these parts work the hardest to withstand the gravitational force of the human body weight. Musculoskeletal disorders can affect other structures, namely the upper extremities, neck, and back, because people with excess BMI use the upper extremities to support their bodies when changing positions. Looking from a perspective beyond biomechanics, the onset of symptomatic manifestations in the upper extremities, neck, and shoulders may be based on a series of metabolic processes as a consequence of excessive BMI.[16]

The findings of this study are consistent with those of Aditya Laksana's (2020) investigation, which demonstrates a substantial connection between BMI and musculoskeletal problems. This study

states that the potential for BMI > 22 kg/m² is 4 times greater to experience musculoskeletal disorders than with BMI ≤ 22 kg/m².[19] Similar findings were also found by Icsal et al. (2016) that there is a tendency for the higher the BMI of tailors, the higher the level of complaints felt. This finding said tailors with BMI ≥ 25 kg/m² had a 2.244 times greater risk of experiencing musculoskeletal disorders.[11]

Similar results were also found in research conducted by Ari Permana Putra et al. (2020), which states that the results of his research show that A connection exists between BMI and musculoskeletal disorders. According to this study's findings known that musculoskeletal disorders can be influenced by BMI. This is a result of the frame's structural balance when supporting loads, such as body weight or other loads.[20]

An obese person is more likely to experience musculoskeletal pain due to the greater mechanical load on their body. It is well known that obesity promotes inflammation and that the person experiences pain due to the inflammation. Chondrocytes will generate more proinflammatory cytokines and proteins that tear down the cartilage matrix due to the increased mechanical stress experienced by an obese person, particularly in the lower limbs. Reduced serotonin levels contribute to enhanced pain perception. Inflammatory cytokines released in obesity affect the serotonin or kynurenine synthesis balance from tryptophan.[21]

Musculoskeletal disorders on tailors in Denpasar City are dominated by a value of 42-62 (high risk) and as many as 32 (60.3%), meaning immediate action is needed. This situation is caused by one of the individual factors in the tailor, namely body mass index. This is because tailors spend a lot of time sitting still while working. Therefore, an increased body mass index in tailors will put pressure on the spine to accept excessive loads that will cause mechanical stress in the body, and the long-term occurrence will alter the shape of the cell.[11]

This research has the advantage of examining tailors specifically, who were rarely evaluated for musculoskeletal disorders in the previous study. The

drawback of this study was that it only measured one (i.e., BMI) variable as a predictor, whereas other variables of musculoskeletal complaints, such as work position and workload, could be associated with the study outcome.

CONCLUSION

Based on the results of this study, there was a significant correlation between BMI and the risk level of musculoskeletal disorders in Denpasar City. Thus, the results of this study can be used as information and education media to find out some of the causes of factors for musculoskeletal disorders and to improve health and self-awareness to prevent the onset of pain or musculoskeletal disorders. Future researchers are expected to conduct further research on confounding variables in this study, such as physical activity, diet, work duration, and taking pain-relieving drugs, and consider using other analytical tests.

ETHICAL CLEARANCE

This study was approved by the Research Ethics Commission of the Faculty of Medicine, Udayana University. Ethical clearance with letter number 1812/ UN14.2.2.VII.14/LT/2022 and protocol number 2022.01.1.0841.

CONFLICT OF INTEREST

This study has no conflicts of interest.

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AUTHOR CONTRIBUTIONS

DAAMA is preparing study designs, writing manuscripts, and collecting and processing data. NWT, IMNW, and IMM are directing data collection and revising the manuscript.

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