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ORIGINAL ARTICLE

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Overweight is associated with low fitness level among regional government employees in Denpasar City

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ABSTRACT

Background and purpose: Time spent on sedentary work is a potential risk factor of nutritional problems among employees, which could lead to a low level of fitness. This study aims to determine the correlation between nutritional status with fitness level among government employees of Denpasar City.

Methods: This is an analytic observational study with a cross-sectional design. The samples of this study are 285 government employees in Denpasar City who had taken a physical fitness measurement test using the Rockport method and complete demographic data. Data on fitness level, nutritional status, age, gender, and pulse rate were included in the analysis using a multinomial logistic regression test.

Results: The median age of employees are 47 years old and slightly more females (51.6%) than males. More than half of the employees had a low level of fitness (50.9%) and most were overweight (47%). The overweight group was 4.11 times more likely to have a low fitness level than the healthy weight group (RRR=4.11; 95%CI: 1.03-16.32).

Conclusion: There is a significant relationship between nutritional status and fitness level after gender, age, and pulse rate were controlled. Therefore, it is necessary to maintain a normal nutritional status to maintain or enhance individual fitness level by routinely following regular sports activities that have been programmed and do stretching in between working hours.

Keywords: knowledge, vitamin D, health education, sun exposure
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INTRODUCTION

The ability to carry out activities effectively and efficiently can be seen from the level of physical fitness. Physical fitness is a condition when human body can carry out activities properly without feeling significant fatigue, and there are energy reserves to carry out other activities.[1] Based on a report from Indonesian Community Recreational Sports Federation (FORMI) on physical fitness carried out among young generation and adults from several institutions in the last decade, the Indonesian level of physical fitness fell into the low category.[2]

Fitness level can be an indicator of a person's risk for metabolic disease.[3] From 2015 to 2019, there was an increase in the prevalence of metabolic diseases by 7.4% in Indonesia.[4] In addition, fitness level has been widely associated with one's work productivity. A study found that the level of fitness has a significant relationship to employee productivity (p-value=0.001).[5] Several factors affect fitness levels, including gender, age, physical activity, pulse rate, and smoking behavior.[6] Based on Pradini et al. study, the results show that nutritional status is the most influential factor of fitness level (OR=2.51; 95%CI: 1.19-5.30).[7]

Low levels of fitness were observed among employees from both the formal and informal sectors.[8,9] The fitness level of regional government employees in Denpasar City tends to be low; about 52% of employees have poor fitness.[10] In general, these employees in Denpasar City work for 8 hours per day.[11] Regional government employees are at risk for having nutritional problems since they are working by sitting for long periods, forming a sedentary behavior.[12] This condition could be the predictor of low level of fitness among government employees in Denpasar City.

Fitness levels of government employees in Denpasar City were measured annually using the Rockport method by Denpasar City Health Office, but no further data analysis has been carried out to explore predictors of fitness level. Therefore this study aims to utilize the available secondary data to determine the relationship between nutritional status and level of fitness of regional government employees in Denpasar City.

METHODS

This is an analytical observational study with a cross-sectional design conducted in January-May 2020. The study used secondary data from the Denpasar City Health Office (a record of the fitness of regional government employees in Denpasar City with the Rockport method in 2019). The Rockport method was used to measure cardiorespiratory endurance performed by walking or running 1600 meters consistently. The minimum sample size in this study was 156 people which calculated with the sample size formula for study applying regression analysis with reliability coefficient ($Z\alpha$)=1.96; standard coefficient of research power ($Z\beta$)=0.884; OR=2.5; proportion of overweight (Px)=0.59; prevalence of low fitness level (Py)=0.55. A total of 294 employees' demographic and fitness level data were available, but only 285 of them were completely filled which then included in our analysis.

Nutritional status was the main independent variable which was obtained based on body mass index (BMI) value in kg/m^2 calculated from weight and height. Weight was measured with a calibrated weight scale, and height was measured with a microtoise. Then the BMI value was classified into underweight, normal, and overweight.[13] The fitness level as the dependent variable recorded in an ordinal scale, measured using the maximal oxygen consumption (VO_2max) value obtained based on the employee's running or jogging time, and then classified into very poor, less, sufficient, good, and very good fitness level, adjusted by gender and age,[14] based on the Rockport method of measuring fitness level.[15]

Confounding variables such as age, which was analyzed on a ratio scale, and gender on a nominal scale, are obtained from the employee identity cards. In addition, pulse rate (the number of employee resting pulses per minute) was included as a covariate variable, which was analyzed on a ratio scale. The data obtained were then descriptively analyzed, followed by bivariate analysis with simple multinomial logistic regression test and Spearman correlation, then multivariate analysis with multiple multinomial logistic regression tests. In bivariate analysis, simple multinomial logistic regression test was used to assess the association between nutritional status and gender with fitness level, while for the association between age and pulse rate with fitness level, Spearman correlation was used. The normality distribution of numeric scale data was carried out with Kolmogorov–Smirnov test. A p-value of less than 0.05 was used to designate the statistical significance in all analyses.

This study has been approved by the Research and Development Ethics Commission of Udayana University/ Sanglah Hospital under number 697/ UN14.2.2.VII.l4/LT2020.

RESULTH

Characteristics of samples

The results of the study in Table 1 show that there are slighlty more female employees (51.6%) than male. The median age of the employees who took the fitness test was 47 years. Almost half of the employees were categorized as overweight (47%), with a median BMI=24,8 kg/m^2. Meanwhile, more than half of the employees (50,9%) had a low fitness level with median VO_2max value of 24 ml/kg/min.

Fitness level based on nutritional status, gender, age, and pulse rate

Based on Table 2, it can be seen that both in female and male, only a small proportion of government employees have high fitness level, while almost half male (45.7%) and more than half (55.9%) of female employees have low fitness level. In addition, both the underweight and overweight group have lower fitness level compared to the normal nutritional group.

Table 1. Characteristics of samples

Characteristics (n=285)	F (%)	Median (IQR)	Minimum-Maximum
Gender			
Male	138 (48.4)		
Female	147 (51.6)		
Age		47 (4)	20-58
Pulse Rate (times/minute)		82 (4)	58-116
Body Mass Index (Kg/m^2)		24.8 (3)	16.8-37.3
Nutritional Status			
Underweight	25 (8.8)		
Normal	126 (44.2)		
Overweight	134 (47)		
VO_2max (L/minute)		24 (5)	21-42
Fitness Level			
Low	145 (50.9)		
Moderate	126 (44.2)		
High	14 (4.9)		

IQR=Interquartile Range

Table 2. Distribution of fitness levels based on nutritional status and gender

Variable	Fitness Level					
	High		Moderate		Low	
	n	%	n	%	n	%
Nutritional Status						
Underweight	2	8.0	8	32.0	15	60.0
Normal	9	7.1	67	53.2	50	39.7
Overweight	3	2.2	51	38.1	80	59.7
Gender						
Male	10	7.3	65	47.1	63	45.7
Female	4	2.7	61	41.5	82	55.9

The data distribution of fitness level based on age and pulse rate was shown in Table 3 in median values. The data were numerically scaled and not normally distributed based on the normality test ($p<0.05$). Thus, referring to Table 3, employees with a high level of fitness have the youngest median age (43 years old). Pulse rate has the same median in employees with all fitness levels.

The results in Table 4 show the correlation between nutritional status and fitness level. The overweight nutritional status group had a higher risk to have a low fitness level, about 4.8 times greater compared to the normal nutritional status group (RRR=4.8; 95%CI: 1.24-18.58). However, there were no differences in risk of moderate fitness levels. The undernutrition status group did not have a different risk on fitness level. There was no significant correlation between gender and fitness level, either at moderate fitness level (RRR=2.35; 95%CI: 0.70-7.87) or low fitness level (RRR=3.25; 95%CI: 0.98-10.86).

There was a correlation between age and fitness level, in particular at moderate fitness level. The older the employees' age, increase the risk of having a moderate fitness level than a high fitness level, about 1.06 times with a one year increase in age (RRR=1.06; 95%CI: 1.01-1.12). However, no significant correlation at low fitness level (RRR=1.03; 95%CI: 0.98-10.86). Pulse rate did not correlate with fitness level, either at moderate fitness level (RRR=1.04; 95%CI: 0.96-1.11) or low fitness level (RRR=1.06; 95%CI: 0.94-1.13).

Table 3. Distribution of fitness levels by age and pulse rate

Variable	Fitness Level					
	High		Moderate		Low	
	Median	IQR	Median	IQR	Median	IQR
Age	43	25	49	12	46	12
Pulse Rate	80	12	80	6	82	6

IQR=Interquartile Range

Table 4. Correlation between nutritional status, gender, age, and pulse rate with fitness level

Variable	Fitness Level						
	Moderate			Low			High
	RRR	95%CI	*p**	RRR	95%CI	*p**	
Nutritional status							
Normal	*ref.*			*ref.*			
Underweight	0.54	0.10-2.94	0.48	1.35	0.26-6.94	0.72	
Overweight	2.28	0.59-8.87	2.28	4.80	1.24-18.58	0.02**	
Gender							*ref.*
Male	*ref.*			*ref.*			
Female	2.35	0.70-7.87	0.17	3.25	0.98-10.86	0.06	
Age	1.06	1.01-1.12	0.01**	1.03	0.99-1.09	0.16	
Pulse Rate	1.04	0.96-1.11	0.30	1.06	0.94-1.13	0.07	

*ref.=baseline group; RRR=relative risk ratio; *Multinomial Logistic Regression Test; **Significant at p<0.05*

Table 5. The correlation between nutritional status and fitness levels after controlling variables of age, gender, and pulse rate

Variable	Fitness Level						
	Moderate			Low			High
	RRR	95%CI	*p*	RRR	95%CI	*p*	
Nutritional status							
Normal	*ref.*			*ref.*			
Underweight	0.51	0.09-3.05	0.46	1.10	0.20-6.22	0.46	
Overweight	1.89	0.47-7.53	0.37	4.11	1.03-16.32	0.04**	
Gender							*ref.*
Male	*ref.*			*ref.*			
Female	2.46	0.69-8.71	0.16	2.99	0.85-10.57	0.09	
Age	1.05	0.99-1.11	0.06	1.01	0.96-1.07	0.58	
Pulse Rate	1.01	0.94-1.09	0.72	1.05	0.98-3.63	0.18	

*ref.=baseline group; RRR=relative risk ratio; *Mutinomial Logistic Regression Test; **Significant at p<0.05*

Association between nutritional status and fitness levels

Pulse rate was included as a covariate variable among the relationship between nutritional status and fitness level. Based on the results of bivariate analysis, it was found that pulse rate has no relationship with fitness level. However, based on the Spearman correlation test analysis, pulse rate has a weak negative relationship with fitness level (r=-0.24).

In addition to covariate variables, there were also confounding variables. Based on bivariate analysis, employees' age had no relationship with fitness level. However, based on the Spearman correlation test, age had a weak negative relationship with fitness level (r=-0.36), and age had a weak positive relationship with nutritional status (r=0.16). Based on the simple multinomial logistic regression test, the results showed no difference in risk for each nutritional status on fitness levels based on gender.

Pulse rate, age, and gender were controlled by multivariate analysis using the Multiple Multinomial Logistic Regression test to assess the independent relationship between nutritional status and fitness level. The results of the multivariate analysis in Table 5 show that the only variable associated with fitness level in this study was the nutritional status. In comparison with the normal nutritional status group, the overweight group had a 4.11 times greater risk of having low fitness level than the normal nutritional status group (RRR=4.11; 95%CI: 1.03-16.32). Unfortunately, no differences were found in risk of moderate fitness levels. The underweight group did not have a different risk on fitness level compared to the normal nutritional group. There was no relationship between gender, age, and pulse rate with fitness level.

DISCUSSION

This study aims to determine the correlation between nutritional status with fitness level among government employees of Denpasar City. We found almost half of the employees were overweight (47%) and 59.7% of them had a low fitness level. Multivariate analysis between nutritional status and fitness level showed that nutritional status was associated with fitness level after gender, age, and pulse rate variables were controlled.

This finding is in line with research conducted by Nikolakaros *et al.* (2017), that found overweight and obese groups have a lower chance of having a high fitness level compared to having low and moderate fitness level.[16] People who are overweight tend to experience an increase in fat tissue mass in the body.[17] The increased mass of fat tissue results in the thickening of the heart's ventricular walls and decreased vascular endothelial function. Then it may reduce the physiological function of the heart, which has an impact on decreasing cardiac output. In addition, it causes a decrease in the amount of oxygen that circulates to the body's cells, including muscles, due to a reduced amount of blood being pumped.[18] Increased fat tissue is also associated particularly with nitric oxide production. These results increase the permeability, decrease blood vessels' ability to vasodilate, and failure of oxygen extraction, which can obstruct oxygen distribution to every cell in the body.[19] A similar study conducted by Laxmi *et al.* and Sharma *et al.* reported that BMI has a negative relationship with VO2max, which means the higher the BMI, the lower VO_2max value, which is used as an indicator of fitness level.[20,21]

Besides being overweight, undernutrition can also play a role in determining fitness levels. For example, research conducted by Kharbanda & Indra shows that respondents with normal BMI have better fitness than respondents with low or high BMI. This means that low nutritional status will also have an impact on low levels of fitness.[22] Lack of nutritional status could be because of lack of energy intake. In contrast, nutritional intake is necessary for having a good level of fitness.[23] However in this study, the underweight group did not have a different risk on fitness level compared to those with normal nutritional status. This could be due to the small proportion of the underweight group, which was 8.8%, compared to the normal nutritional status group of 44.2%. Despite the insignificant association, 60% of the underweight group showed low fitness level. This fact signify the importance to address the underweight issues if we want to improve the fitness level of employee. Programs to improve nutritional status both under or overweight should be implemented to increase fitness level which will have impact to improve productivity.

From the analysis, we found that gender, age, and pulse rate were not associated with fitness level. Based on the physiological concept, gender and age are potential confounders of the correlation between nutritional status and fitness level.[24–27] Besides being associated with the level of fitness, age and gender are also associated with nutritional status. Therefore, a confounding analysis for gender and age was carried out independently on nutritional status and fitness level in this study. There was no relationship between nutritional status and fitness level based on gender. However theoretically gender can be a confounder in the correlation between nutritional status and fitness level,[25–27] the variable was still included in the multivariate analysis. Multivariate analysis with multiple multinomial logistic regression also obtained the same result, and gender was not associated with the fitness level.

This result contradicts the theory which states that gender creates differences in nutritional status. Women are at greater risk of being overweight. It is due to estrogen, a dominant hormone found in women over men. Estrogen improves subcutaneous fat deposits, then increases the incidence of central obesity in women compared to men.[28] In addition to having a higher risk for being overweight, women also have higher risk for having low level of fitness. The study conducted by Olawale et al. supported that men have a higher average VO_2max value than women.[25] In this study, we found 43.48% of men were overweight, compared to women (50.3%). Gender plays a role in nutritional status, but physical activity can also be associated with nutritional status and fitness levels. Physical activity has a negative relationship with nutritional status.[29] In addition, physical activity is also positively associated with fitness levels.[30]

Several theories stated that age could be a confounding variable of association between nutritional status and fitness level.[24,31] Apart from being associated with fitness level, age can also independently affect nutritional status. It was found that there was a weak positive relationship between age and nutritional status in this study. This result is in line with the research that found age is positively associated with nutritional status. Bodyweight increases with increasing age up to 49 years but can decrease after that.[32] BMI can still increase along with the increasing age, especially over 50 years, even with a stable weight, due to a decrease in height.[33]

Pulse rate was also found not associated with fitness level in this study. This result contradicts the finding from a similar study conducted by Silva et al.[34] No association found could be because the pulse rate measured was the resting pulse rate. Resting pulse rate should not be used to describe cardiorespiratory endurance. A better association will be obtained if using post physical activity pulse rate.[35] In a physiological point of view, the less the heart rate, the more efficient the cardiorespiratory endurance, meaning a better individual fitness level. This is because the oxygen delivered is already in large quantities to supply tissue demand each time the heart pumps blood.[36]

There are some limitations of this study mainly due to the use of secondary data. The variables were limited , hence, we were unable to explore other potential confounders including physical activity, history of acute or chronic disease, smoking habit, and nutritional intake adequacy. Moreover, the quality of data in secondary data may be not optimal, however, the measurement was conducted by experienced health professional which should minimize this issue.

CONCLUSION

Nutritional status was associated with fitness level after controlling the gender, age, and pulse rate variables. The overweight group had a lower risk of having a high fitness level. Therefore, Denpasar City Government must work on a strategy to overcome nutritional disorders in their employees to maintain their productivity. Every employee should aware of the importance of maintaining a normal nutritional status for their physical fitness by routinely following regular sports activities that have been programmed and can do a stretch in between working hours. Future study should explore other factors associated with fitness level such as physical activity, smoking, chronic illnesses, etc.

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AUTHOR CONTRIBUTION

KDP and NPW jointly design the study, KDP conducted the statistical analysis and wrote the first draft of manuscript, NPW supervise the study, provided feedbacks and editing to the manuscript

CONFLICT OF INTEREST

The author(s) declare that they have no conflict of interest.

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