Conference Paper

Differences in the Cardiorespiratory Fitness of Employees of PT Pos Indonesia Regional IV Jakarta Based on Body Mass Index and Other Factors

Rizkya Wida Pradini, Trini Sudiarti, and Engkus Kusdinar Achmad

Nutrition Study Program, Universitas Indonesia

Abstract

Low cardiorespiratory fitness is associated with the risk of cardiovascular disease and hypertension. Cardiorespiratory fitness in workers is low. This study examined differences in cardiorespiratory fitness based on body mass index (BMI), body fat percentage, dietary intake, physical activity, smoking status, and sleep quality. The study design was cross-sectional, and it was conducted between April and May 2016 with 124 sedentary employees (66 men and 58 women) of PT Pos Indonesia Regional IV Jakarta. Cardiorespiratory fitness was measured by the YMCA (Young Men's Christian Association) 3-min step test.Chi-square was conducted to determine differencesin the cardiorespiratory fitness status based on Body Mass Index (BMI), body fat percentage, physical activity, smoking status, and sleep quality. Independent T-test was conducted to determine the mean differences dietary intake based on cardiorespiratory fitness.The results showed that 55(44.4%) of the 124 employees had poor cardiorespiratory fitness.BMI and body fat percentage, in addition to dietary energy intake, carbohydrate intake, and iron intake, were associated with significant differences in cardiorespiratory fitness. Based on these results, employees are advised to monitor their BMI and body fat regularly, increase their levels of physical activity, and consume a nutritionally balanced diet.

Keywords: Cardiorespiratory fitness, employees, YMCA 3-min step test, body mass index, dietary intake

Corresponding Author:
Trini Sudiarti
trini@ui.ac.id

Received: 16 November 2017
Accepted: 15 December 2017
Published: 8 Januray 2018

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ICGH Conference Committee.

1. INTRODUCTION

Previous research revealed a significant inverse association of cardiorespiratory fitness with the risk of cardiovascular disease in women aged 18–64 years in China who had medium and high levels of cardiorespiratory fitness [32]. Aspenes et al. (2011) reported low cardiorespiratory fitness among men in Norwaywith hypertension.

Based on data from the National Health and Nutrition Examination Survey 1999–2004 on 3534 workers in the U.S., 51.6% of workers had a low fitness level [22]. Diana et al. (2009) studied fitness differences among 937 male workers of PT Semen in Padang, Indonesia and found low cardiorespiratory fitness in 15.9% of workers. The objective of this study was to determine differences in the cardiorespiratory fitness status of employees of PT Pos Indonesia Regional IV Jakartabased on body mass index (BMI), body fat percentage, physical activity, dietary intake, smoking status, and sleep quality.

2. METHODS

2.1. Study group

This cross-sectional study was conducted at the head office of PT Pos Indonesia Jakarta from April to May 2016. The sample consisted of 124sedentary employees (66 men and 58 women aged 21-53 years) who were selected using a systematic random sampling method. Primary data were used to determine the dependent variables and independent variables.

The inclusion criteria were all employees at the head office of PT Pos Indonesia Regional IV Jakarta in 2016. Exclusion criteria were employees who had a history of cardiovascular disease and asthma or who were pregnant or absent due to sickness at the time of the study. Prior to taking part in the 3-min YMCA (Young Men's Christian Association) test, all the participants completed the Physical Activity Readiness Questionnaire (PAR-Q and You) to determine their eligibility to perform the step test.

2.2. Cardiorespiratory fitness

Cardiorespiratory fitness status was assessed using the 3-min YMC Astep test. The test apparatus consist of a wooden bench with a height of 31 cm, a metronome set to 96 beats/min, and a timer (stopwatch) [7]. During the test, each participant stepped up and down on the bench for 3 min. At the end of the test, within 5 sec, the participant's pulse rate was measured for 1 min. Cardiorespiratory fitness status was determined based on the resting heart rate. Participants were considered to have poor cardiorespiratory fitness if the results of the step test were either average, below average, poor, or very poor. Subjects considered to have good cardiorespiratory fitness were those with above average, good, or excellent fitness [23]. Heart rate measurement adjusted to age.

The BMI was calculated by dividing the weight in kilograms by the square of height in meters. Body fat percentage was estimated by bioelectrical impedance analysis. Data on physical activities were recording using the Global Physical Activity Questionnaire (GPAQ) [30]. Total metabolic equivalents (METs) were calculated to express the intensity of the exercise, which was classified as light-moderate or vigorous bysumming the results of the GPAQ questionnaire. Smoking status was determined by the Fager storm Test for Nicotine Dependence [11]. Sleep quality was determined by the Pittsburgh Sleep Questionnaire Index [6]. Dietary intake was assessed based on 24-h recall [16]. Respondents were asked about their food intake in a 24-h period on one weekday and one weekend day.

2.3. Statistical analysis

Chi-square were conducted to determine the difference cardiorespiratory fitness status based on Body Mass Index (BMI), body fat percentage,physical activity, smoking status, and sleep quality. Independent T-test were conducted to determine the mean differences dietary intake based on cardiorespiratory fitness. p value> 0,5 was considered to denote a statistically significant difference.

3. RESULTS

There were 124 participants in this study, which consistedof66 men and 58 women. The ages of the participants ranged from 21 to 53 years. The mean weight and height of the participants was 67.2 ± 11.3 (range 42.2 to 91.8) kg and 160.6 ± 7.9 (144.5 to 181.5) cm, respectively. The mean pulse measurement after the fitness test was 100.69 ± 11.8 beats/min (range,76 to 132 beats/min). The cardiorespiratory fitness status of 55.6% of the participants was good, whereas it was classified as poor in 44.4% of the participants. The mean BMI and body fat percentage of the participants was 26.0 ± 3.7 (range 17.23 to 38.71) kg/m^2 and 28.5 ± 7.6% (5.6 to 43.5%), respectively. The characteristics of the participants are presented in Table 1.The mean energy intake was 1871.5 ± 415.1 kcal. Carbohydrate intake was 235.3 ± 67.3 g, protein intake was 64.8± 18.1 g, fat intake was 71.9 ± 19.9 g, and iron intake was 10.1 ± 3.6 mg.

In this study, the prevalence of poor cardiorespiratory fitness among participants with a high BMI and high body fat percentage was 2.509 timesand 3.886 times higher

Table 1: Characteristics of the participants

Variable	Frequency	Percentage
Cardiorespiratory fitness		
Poor	55	44.4%
Good	69	55.6%
Body mass index		
Underweight	4	3.2%
Normal	47	37.9%
Overweight	73	58.9%
Body fat percentage		
Normal	45	36.3%
Overweight	79	63.7%
Physical activity		
Low-moderate activity	82	66.1%
Vigorous activity	42	33.9%
Smoking status		
Smoker	13	10.5%
Nonsmoker	111	89.5%
Quality of sleep		
Good	71	57.3%
Poor	53	42.7%

Table 2: Differences in body mass index, body fat percentage, physical activity, smoking status, and quality of sleep according to the cardiorespiratory fitness status of the participants (N = 124)

Variable	Cardiorespiratory Fitness		OR (95%CI)	P value
	Poor	Good		
Body mass index				
Overweight	39 (53.4%)	34 (46.6%)	2.509	0.025*
Normal	16 (31.4%)	35 (68.6%)	(1.186-5.308)	
Body fat percentage				
Overweight	44 (55.7%)	36 (44.3%)	3.886	0.001*
Normal	11 (24.4%)	34 (75.6%)	(1.735-8.752)	
Physical activity				
Low-moderate activity	39 (47.6%)	43 (52.4%)	1.474	0.416
Vigorous activity	16 (38.1%)	26 (61.9%)	(0.690-3.147)	
Smoking status				
Smoker	7 (53.8%)	6 (46.2%)	1.531	0.665
Nonsmoker	48 (43.2%)	63 (56.8%)	(0.483-4.852)	
Quality of sleep				
Good	26 (49.1%)	27 (50.9%)	1.395	0.467
Poor	29 (40.8%)	42 (59.2%)	(0.681-2.856)	
*Denotes a significant difference				

Table 3: Differences in nutrient intake based on 24-h recall according to thecardiorespiratory fitness status of the participants(N = 124)

Variable	Good Cardiorespiratory Fitness (N = 69)	Poor Cardiorespiratory Fitness (N = 55)	P value
Energy (kcal)	1938.7 ± 443.5	1758.3 ± 431.1	0.024*
Protein (g)	66.4 ± 17.6	62.8 ± 18.6	0.273
Fat (g)	71.3 ± 20.0	72.8 ± 19.8	0.676
Carbohydrate (g)	249.5 ± 63.8	217.4 ± 63.3	0.006*
Iron (mg)	10.6 ± 3.6	9.4 ± 3.5	0.042*
*Denotesasignificant difference			

than participants with good cardiorespiratory fitness. There was no significant difference in physical activity, smoking status, and quality of sleep based on the fitness status of the participants, as shown in Table 2.

Table 3 shows the difference in the mean nutrient intake according to cardiorespiratory fitness status. The mean energy, carbohydrate, protein, and iron intakes were higher in the good cardiorespiratory fitness group than the poor cardiorespiratory fitness group. The mean fat intake was lower in the good cardiorespiratory fitness group than the poor cardiorespiratory fitness group. There was a significant difference in the energy, carbohydrate, and iron intakes between good cardiorespiratory fitness and poor cardiorespiratory fitness. However, according to the results of the statistical analysis, there were no significant differences in the protein and fat intakesof the participantswith different levels of cardiorespiratory fitness.

4. DISCUSSIONS

The results of this study showed that the cardiorespiratory fitness status of employees of PT Pos Indonesia Regional IV Jakarta was low. In common with the findings of the present study, Budi asih (2011) reported that 39.2% of employees in PT Amoco Mitsui, Banten, Indonesia had poor cardiorespiratory fitness. In the present study, the YMCA 3-min step test was chosen to measure cardiorespiratory fitness because this method is relatively quick, easy, and inexpensive [25].

BMI and body fat percentage were significantly associated with cardiorespiratory fitness status in this study. A previous study reported that a high BMI was associated with increased heart rates when performing the step test [18]. Tissue and organs require oxygen to perform their functions, with increased oxygen consumption associated with enhanced performance of the respiratory system [17]. Fogelholm et al. (2006) reported that body fat showed a negative association with cardiorespiratory

fitness in healthy Finnish men. Nieman and Lee (2007) reported that excess fat interfered with the performance of individuals.

Macronutrients (carbohydrates, fats, and proteins) consumed in the diet are used by the body to supply the energy needed for normal body function and activity, with the amount of energy intake dependent on the intensity and duration of activities [17]. Konig et al. (2003) reported that energy intake was higher among individuals with a high level of fitness. Carbohydrate intake directly influences muscle glycogen storage. Depletion of muscle glycogen has been proven to be a major cause of fatigue in high-intensity exercise of short duration [19]. In a study of 9007 men and 2826 women aged 20–84 years in Texas, Finley et al. (2006) reported thatthose with high cardiorespiratory fitness had the highest intake of carbohydrates. In another study, Laukkanen et al. (2009)reported that carbohydrate intake had the potential to improve fitness performance.

Protein supplies up to 5–10% of the energy needed to sustain prolonged exercise [19]. A study by Flogel et al. (2014) demonstrated a positive relationship between serum amino acids, which are the building blocks of the body [2], and cardiorespiratory fitness. The different result may be due to the different abilities of various instruments to assess protein in the body. In the previous study, they used body serum to assess protein in the body.

The present study revealed no significant difference between fat intake and cardiorespiratory fitness. In contrast, Brodney et al. (2002) reported a significant difference between fat intake and cardiorespiratory fitness. The discord in the results may be due to the greater number of participants in the previous study. This could have led to greater variation in the values of fat intake. According to Erlenbursch et al. (2005), the fitness performance of untrained individuals was better among those who consumed a high carbohydrate diet than a high-fat diet [10].

In a study conducted in the U.S., iron supplementation for four days affected the cardiorespiratory fitness status of trained women aged 18–33 years [4]. Iron is needed for the formation of oxygen-carrying hemoglobin (in the blood) andmyoglobin (in muscle) [2].

Physical activity increases the respiratory rate and cardiac output to ensure that an adequate supply of oxygen reaches the muscles [8]. In the present study, physical activity was not significantly associated with cardiorespiratory fitness. A study of employees at a company in Banten, Indonesia reported a similar result, with no relationship found between cardiorespiratory fitness and physical activity [12]. However,

work-related activities performed by employees might not have the same positive effects on aerobic capacity as do sports activities [26].

In this study, smoking status was not significantly associated with cardiorespiratory fitness. Tuntian (2012) also found no significant association between cardiorespiratory fitness and smoking status among employees of a packaging company in Bandung, Indonesia. The number of smokers was low in this company, so that does not provide variations on the results of the study. The effect of smoking on cardiorespiratory fitness is attributed to the adverse impact of tobacco on the body's capacity to carry oxygen [17]. Nicotine also activates the sympathetic nervous system to release epinephrine and norepinephrine, both of which increase the heart rate [29].

Previous research showed that abnormal sleep patterns increased sympathetic activity, blood pressure, and heart rates. Changes in the activity of the autonomic nervous system were shown to be associated with sleep disorders [31]. The present study found no significant difference between sleep quality and physical fitness. A previous study also found that physical fitness and sleep quality were not significantly correlated in healthy adults.This finding could be explained by the participation of healthy individuals with a lack of improvement in sleep disturbance in past research [27].

5. CONCLUSIONS

The BMI and body fat percentage, in addition to energy, carbohydrate, and iron intake levels, of employees at PT Pos Indonesia Regional IV Jakarta were significantly associated with cardiorespiratory fitness. Future research is required to determine variables other than the aforementioned factors that influence cardiorespiratory fitness in employees. A limitation of the present study was the absence of pulse measurements after the YMCA 3-min step test. Future studies using more accurate methods are needed to measure heart rate. Employees should be advised to monitor their BMI and body fat regularly, increase theirlevels of physical activity, and consume a nutritionally balanced diet

ACKNOWLEDGMENT

This study was facilitated by PT Pos Indonesia Regional IV Jakarta. The author thanks all the employees at PT Pos Indonesia Regional IV Jakarta who took part in the study. The author also thanks Ir. Trini Sudiarti, Msi, Nutrition Department, Faculty of Public Health,

University of Indonesia for valuable advice, support, and guidance throughout the study. Finally, the author thanksDr. H. E. KusdinarAchmad, MPH, Nutrition Department, Faculty of Public Health, Universitas Indonesia for valuable adviceand critical comments on this study.

References

[1] Aspenes, S., Nielsen, T., Skaug, E., Bertheussen, G., Ellingsen, O., Vatten, L., and Wisloff, U. 2011.Peak oxygen uptake and cardiovascular risk factors in 4631 healthy women and men.Journal of the American College of Sports Medicine: 1465-1473.

[2] Bernadot, D. 2012.Advance sport nutrition 2nd ed. United States: Human Kinetics.

[3] Brodney, S., McPherson, R., Carpenter, R., Welten, D., and Blair, S..2001, Nutrient intake of phisically fit and unfit men and women.Journal of the American College of Sports Medicine: 459-467.

[4] Brownlie, T., Utermohlen, V., Hinton, P., Giordano, C., and Haas, J.2002, Marginal iron deficiency without anemia impairs aerobic adaptation among previously untrained women. American Journal of Clinical Nutrition 75: 734-742.

[5] Budiasih, K. 2011. Faktor-faktor yang mempengaruhi kebugaran jasmani karyawan di PT Amoco Mitsui Indonesia tahun 2011. SkripsiS. Ked., Fakultas Kedokteran Universitas Pembangunan Nasional.

[6] Buysse DJ, Reynolds, CF, Monk, TH, Berman, SR andKupfer, DJ. 1989. The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research.Psychiatry Research 28:193-213.

[7] Coburn, J.,&Malek M. 2012.NSCA's essential of personal training-2nd edition, United States: Human Kinetics.

[8] Corbin, C., Welk, G., Corbin, W., & Welk, K. 2008.Concepts of physical fitness: active for wellness14th ed.New York: Mc Graw Hill.

[9] Diana, D., Basuki, B., & Kurniarobbi, J. 2009.Low physical activity work-related and other risk factors increased the risk of poor physical fitness in cement workers.Med J Indonesia 18 (3): 203-207.

[10] Erlenbursch, M., Haub, M., Munoz, K., MacConnie, S., & Stillwell, B. 2005. Effect of high-fat or high-carbohydrate diets on endurance exercise: a meta-analysis.International Journal of Sport Nutrition and Exercise Metabolism 15: 1-14.

[11] Fagerstorm, K., & Schneider, N. 1989. Measuring nicotine dependence : a review of the Fagerstorm Tolerance Questionnaire. J Behav Med 12(2): 159-182.

[12] Fauziyana, N. 2012. Hubungan status gizi, ktivitas fisik, dan asupan gizi dengan tingkat kebugaran karyawan PT. Wijaya Karya tahun 2012. SkripsiSGz., Fakultas Kesehatan Masyarakat Universitas Indonesia.

[13] Finley, C., LaMonte, M., Waslien, C., Barlow, C., Blair, S., andNichaman, M. 2006.Cardiorespiratory fitness, macronutrient intake, and the metabolic syndrome: The Aerobics Center Longitudinal Study.American Dietetic Association 106: 673-679.

[14] Flogel, A., Wientzek, A., Bachlechner, U., Jacobs, S., &Drogan, D. 2014.Linking diet, physical activity, cardiorespiratory fitness and obesity to serum metabolite networks: findings from a population-based study.International Journal of Obesity38: 1388-1396.

[15] Fogelholm M., Malmberg, J., Suni, J., Santila, M., Kyrolainen, H., Mantysaari, & M. 2006. Waist circumference and BMI are independently associated with the variation of cardiorespiratory and neuromuscular fitness in young adult men.International Journal of Obesity30: 962-969.

[16] Gibson, R. 2005.Principles of nutritional assessment2nded. New York: Oxford University Press.

[17] Hoeger, W., & Hoeger, S. 2011.Lifetime physical fitness and wellness: a personalized program 7th ed. Canada: Cengage Learning.

[18] Hong, S., Lee, J., Park, J., Lee, M., Kim, J., and Kim, K. 2014.Association between cardiorespiratory fitness and the prevalence of metabolic syndrome among Korean adults: a cross sectional study. BMC Public Health. 14: pp. 481.

[19] Kenney, W., Wilmore, J., &Costille, D. 2012.Physiology of sport and exercise5th ed.United States: Human Kinetics.

[20] Konig, D., Vaisanen, S., Bouchard, C., Halle, M., Lakka, T., &Baumstark, M.2003.Cardiorespiratory fitness modifies the association between dietary fat intake and plasma fatty acids.European Journal of Clinical Nutrition57: 810-815.

[21] Laukkanen, J., Laaksonen, D., Lakka, T., Savonen, S., &Rauramaa, R. 2009.Determinats of cardiorespiratory fitness in men aged 42 to 60 years with and without cardiovascular disease. Am J Cardiol103: 1598-1604.

[22] Lewis, J., Clark, J., LeBlanc, W., Fleming, L., Caban-Martinez, A., Arheart, K., et al.2011. Cardiovascular fitness levels among American workers.J Occup Environ Med53(10): 1115-1121.

[23] Nieman, D. 2011.Exercise testing and prescription : a health-related approach7th ed. New York: Mc Graw Hill.

[24] Nieman, D., & Lee, R. 2007.Nutritional assessment5th ed. Singapore: Mc-Graw Hill.

[25] Physical Health Personal Training (PHPT). 2016. Endurance test. www.phpt.co.uk (accessed March, 8 Maret 2015).

[26] Ruzic, L., Heimer, S., Durakovic, M.,&Matkovic, B. 2003. Increased occupational physical activity does not improve physical fitness.Occupational and Environmental Medicine 60: 983-985.

[27] Sander, M., Ejisvogels, T., Verheggen, R., Poelkens, F., Hopman, M., Jones, H., &Thijssen, D. 2012.Impact of physical fitness and daily energy expenditure on sleep efficiency in young and older humans.Gerontology 59: 8-16.

[28] Tuntian, I. 2012.Hubungan Tingkat Aktivitas Fisik Dengan status kebugaran pada pekerja laki-laki bagian pengemasan perusahaan A di Bandung.Thesis, Fakultas Kedokteran Universitas Indonesia.

[29] Unverdorben, M., Van der Bijl, A., Potgieter, L., Venter, C., Munjal, S., Qiwei, L., Meyer, B., &Rothig, H. 2008. Effects of differentlevels of cigarette smokeexposure on prognosticheart rate and rate–pressure-productparameters.JCardiovascPharmacolTherapeutic13(3): 175–182.

[30] World Health Organization (WHO). 2005.WHO steps surveillance manual: the WHO STEPwise approach to chronic disease risk factor surveillance.www.who.int/chp/steps/GPAQ/en (accessedFebruary, 28 2016).

[31] Yuksel, M., Yildiz, A., Demir, M., Bilik, M., Ozaydogdu, N., Aktan, A., Isik, F., Demir, S., Yazgan, U., &Toprak, N. 2014.Effect of sleep quality on hemodynamic response to exercise and heart rate recovery in apparently healthy individuals.Clin Invest Med37(6): E352-62.

[32] Zhu, W., Hooker, S., Sun, Y., Xie, M., Su, H., & Cao, J. 2014. Associations of cardiorespiratory fitness withcardiovasculardiseaseriskfactors in middle-agedChinesewomen: a cross-sectionalstudy.BMC Women'sHealth14: 62.