Research Articles

Physical Activity Level and Resting Heart Rate
Tingkat Kepadatan Aktivitas Fisik dengan Denyut Jantung Istirahat

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Abstract

Human life quality is related to the density of daily physical activity. Human diseases are related to how many steps to take within a day. The level of human physical activity can be measured using the IPAQ scoring protocol, created by WHO in 1988. The relationship between IPAQ score and health problems show to be correlated. Nevertheless, the relationship between the level of physical activity using the IPAQ score instrument and resting heart rate is not known yet. This researcher conducted this study to determine the relationship between physical activity level using the IPAQ scoring protocol and rest heart rate. This study is an observative analytic with a cross-sectional study design using a simple random sampling technique. This study was conducted in Surabaya from November 2019 until March 2020 using primary data in the form of the IPAQ scoring method and resting heart rate examination using the Polar Heart Ratetool, which is then processed using IBM SPSS Statistics 22. The IPAQ score and resting heart rate measurement results using polar heart rate tools showed that the most college student has a high degree of physical activity level (72%) and a normal level of resting heart rate (90%). When measured with the Pearson correlation test, the correlation of those two components has a negative and weak correlation (r= -0,337, p<0,05). Overall, the correlation of physical activity level and resting heart rate are inverted and weak. For further research can be done to assess other things like one's external stressors and lifestyle.

Keywords: physical activity, IPAQ, resting heart rate

Abstrak

Kesehatan dan kualitas hidup manusia berhubungan dengan kepadatan aktivitas fisik sehari hari orang tersebut. Penyakit penyakit seseorang berhubungan dengan banyak langkah per hari yang dilakukannya. Kepadatan aktivitas fisik seseorang dapat diukur dengan skor IPAQ, yang diciptakan WHO tahun 1998. Hubungan skor IPAQ dengan gangguan kesehatan seseorang sudah teruji dan dinyatakan berhubungan. Hubungan antara kepadatan aktivitas fisik menggunakan instrumen skor IPAQ dengan denyut jantung istirahat belum diketahuihubungannya. Penelitian ini bertujuan mencari hubungan antara kepadatan aktivitas fisik dengan menggunakan skor IPAQ dengan denyut jantung istirahat. Penelitian ini merupakan jenis penelitian observasional analitik dengan rancangan penelitian *cross-sectional* menggunakan teknik simple random sampling yang bertujuan untuk menentukan hubungan antara kepadatan aktivitas fisik dengan denyut jantung istirahat pada mahasiswa peserta Unit Kegiatan Mahasiswa Beladiri dan Olahraga Universitas Airlangga di Surabaya pada periode November 2019 hingga Maret 2020 dengan menggunakan data primer berupa kuisioner skor IPAQ dan pemeriksaan denyut jantung istirahat dengan menggunakan alat Polar Heart Rate yang kemudian diolah dengan IBM SPSS Statistics 22. Hasil menunjukan bahwa mahasiswa peserta memiliki distribusi kepadatan aktivitas fisik terbanyak pada

kepadatan aktivitas fisik yang tinggi dan memiliki distribusi denyut jantung istirahat terbanyak pada denyut jantung istirahat yang normal. Hubungan antara kedua komponen tersebut memiliki hasil uji korelasi Pearson yang berbanding terbalik dan lemah (r= -0,337; p<0,05). Secara keseluruhan, hubunganantara kepadatan aktivitas fisik dan denyut jantung istirahat adalah terbalik dan lemah. Penelitian lebih lanjut bisa dilakukan dengan menilai hal-hal lain seperti stressor eksternal dan pola hidup seseorang.

Kata Kunci: aktivitas fisik, IPAQ, denyut jantung istirahat

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INTRODUCTION

Physical activity can be defined as body movement d u e t o the contraction of skeletal muscles that raises energy expenditure above resting metabolic rate. Physical activity is characterized by its modality, frequency, intensity, duration, and context of practice. (Thivel et al, 2018) Physical activity correlates with human health. Several health problems such as hypertension, stroke, and a person's quality of life are known and associated with how many steps per day (Lee et al, 2013).

The density of a person's physical activity can be measured using an instrument that has been made globally, namely the International Physical Activity Questionnaire, abbreviated as IPAQ (Lee et al, 2011). The IPAQ questionnaire measures the density of a person's weekly activity by dividing each aspect of the domain into work, transportation, homework, free time, only the sitting domain, which is not usedin scoring. Each part will have several questions about aspects of scoring. The IPAQ questionnaire will measure the level of physical activity using a score by looking at the intensity, duration, and frequency of activity (Sylvia et al, 2014). The results of the interpretation of the IPAQ questionnaire divided the questions intocategories divided into categories of low physical activity (3000 MET-minutes/week), moderate (600-3000 MET-minutes/week), and high (> 3000 MET-minutes/week) (Minder et al, 2014).

A person who is doing physical activity, that person's body will respond and compensate for the physical activity carried out to achieve continuity with the physical activity, both acutely (Nystoriak and Bhatnagar, 2018) and chronically (Lavie et al, 2015). As one of the main organs for this compensation, the heart will stretch its muscles to produce a larger final diastolic volume, known as the Frank-Sterling Mechanism, which causes an increase in cardiac venous return. The inotropic state of the heart will also increase so that the force contracts the final diastolic volume (Baggish and Wood, 2011). Furthermore, Verma et al. (2017) stated that the presence of the pump from the skeletal muscle is mainly active and increasing blood pressure. Besides, the breathing pump from the abdomen (Skytioti et al, 2018) increases cardiac venous return, which then also increases thevolume of cardiac preload. With all this, there will be a higher stroke volume of the heart, and if it is done chronically, there will be a heart impulse inhibition signal whichwill decrease a person's resting heart rate so that the efficiency of one's heart rate increases (Silva et al, 2018).

With this research, researchers are interested in providing a persuasive effect to the public about the importance of physical activity to achieve physical health and contributing to the literature review in the realm of medicine.

METHODS

This research is an analytic observational with a cross-sectional study design. The sampling technique was carried out by using the simple random sampling method. The inclusion criteria of the subject were male, aged 19 - 24 years, the subject was in good health, and the subject was willing and had signed the Informed Consent (IC). For a resting heart rate to be ascertained, the subject should not do any physical activity 12 hours before the measurement and consume alcohol 48 hours before the measurement. The researcher conducted this study at the Student Center Campus C, Airlangga University, in January-March 2020. The type of data in this study used primary data obtained by interviewing and filling out questionnaires for students participating in the Airlangga University Student Martial Arts and Sports Activity Unit. Data retrieved included age, height, weight, resting heart rate, and data regarding daily activities. Resting heart rate is measured using a polar heart rate device. Measurement of physical activity density data each week was measured using the IPAQ questionnaire. Ethics has been obtained from the KEPK Faculty of Medicine, Airlangga University no. 162/EC/KEPK/FKUA/2020. Statistical analysis was performed to describe the frequency characteristics of each patient using the descriptive frequency test in SPSS 22.

RESULTS AND DISCUSSION

This study involved students participating in the Student Activity Unit (UKM). Martial Arts and Sports as many as fifty (50) subjects, where all subjects are measured resting heart rate and stop physical activity by the method questionnaire. This research was conducted in the Student Center Building Campus C University Airlangga in Jl. Dr. Ir. H. Soekarno, Mulyorejo, Mulyorejo District, Surabaya in the period December 2019 to March 2020.

Table 1. The Characteristic of the Subjects (n=50)

Variable	n	%
Age(s)		
19	17	34
20	17	34
21	10	20
22	2	4
23	1	2
24	3	6
Body Mass Index		
Underweight	3	6
Normal	37	74
Overweight	10	20
Physical Activity Level		
Low	2	4
Moderate-	12	24
High	36	72

Source: Primary Data, 2020

The number of research subjects was 50 people. The age of the youngest subject was 19 years, and the age of the oldest subject was 24 years. Based on the number of

subjects in a certain age, 17 subjects (34%) aged 19, 17 subjects (34%) aged 20, 10 subjects (20%) aged 21, 2 subjects (4%) aged 22, 1 subject (2%) aged 23, and 3 subjects (3%) aged 24. The distribution of body weight among the subject with the BMI calculation. Table 2 shows that out of 50 participants with normal weight, the largest distribution was 37 people (74%). This was followed by ten people (20%) are overweight, and three people (6%) are underweight.

The distribution of the highest level of physical activity among students participating in the Martial Arts and Sports UKM of Airlangga University is high physical activity density of 36 students (72%), followed by moderate physical activity density of 12 students (24%), and the least is physical activity density. The distribution of the resting heart rate most of which is normal resting heart rate (60-100 beats per minute) as many as 45 students (90%), followed by resting heart rate of bradycardia (<60 beats per minute) as many as four students (8%), and the most slightly the resting heart rate of tachycardia (>100 beats per minute) as many as one student (2%).

Correlation between total IPAQ score and resting heart rate

Table 2 showed a correlation between the total IPAQ score and resting heart rate ($r = 0,017$, $P<0,05$). The relationship between the totalIPAQ score was inversely related to resting heart rate, where the higher the IPAQ score,the lower the resting heart rate ($p = -0,037$), although the relationship between IPAQ score and resting heart rate had a weak correlation ($0,21 <p <0,40$). The results of this study are in line with the results of meta-analysis research data showing that the addition of physical activity in the form of regular physical exercise, regardless of its condition, will reduce resting heart rate (Reimers et al., 2018).

Table 2. Correlation between Total IPAQ Score and Resting Heart Rate

		Resting Heart Rate
Total IPAQ Score	Pearson Correlation	-.337*
	Sig. (2-tailed)	,017
	N	50

* Correlation is significant at the 0,05 level (2-tailed).

The correlation between physical activity density and resting heart rate is weak ($0,21<p<0,40$). Due to the weaknesses of this study, whereas this study does not measure anthropometry, stresses, and diet of each subject, these things can affectresting heart rate (Fernandes et al, 2013).

Anthropometry of a person's body, referred to here as Body Mass Index (BMI), also affects a person's resting heart rate. High BMI will increase sympathetic activity, leading to an increase in a person's resting heart rate. Therefore, a person's resting heart rate is positively correlated with a person's anthropometry measured by a higher BMI (Kang et al, 2017). This also applies to both men and women (Ehrenwald et al, 2019). Due to increased sympathetic nervous system activity, this increased angiotensinogen release from adipose tissue raises angiotensinogen II formation and further increases the sympathetic nervous system activity (Silva et al, 2018).

The stress that a person has also affected that person's resting heart rate (Huang et al, 2013). Internal stress, such as lack of sleep, represents an increase in resting heart rate. It happens due to an increase in the mechanism of Interleukin-6 cells (Potter et al, 2016). External stress such as smoking can also affect resting heart rate. Compared with nonsmokers, there was a 5bpm increase in heart rate in people who had smoked for five years. Due to mechanism via increases circulating catecholamines, intercalate

sympathetic outflow, and causes a long-term decrease in a vagal drive (Papathanasiou et al, 2013).

Food consumption habits also affect resting heart rate. A person who frequently eats fish has an inverse correlation with his resting heart rate. It happens since the presenceof long-chain n-3 fatty acids and docosahexaenoic acid (DHA) in fish (J. X. Kang, 2012). The step-up of resting heart rate has been shown in people with elevated total cholesterol and triglycerides level (Freitas Júnior et al. 2012). Medications consumption of beta-blockers and non-dihydropyridine calcium channel blockers decrease the resting heart rate (Yilmaz et al, 2017). On the other hand, a low carbohydrate diet done chronically can increase resting heart rate via sympathetic nervous system stimulation and dehydration-induced tachycardia (Pilis et al, 2018).

The fundamental weakness is shown in the IPAQ questionnaire. The IPAQ questionnaire also measures only the density of a person's physical activity in a week. The IPAQ questionnaire does not measure a person's physical activity over weeks, months, up to a year or more (Ryan et al, 2018).

CONCLUSION

Based on the results of research conducted on 50 research participants from students of the Student Activity Unit for Martial Arts and Sports, Airlangga University, it was found that participants had an average high physical activity density and a normal resting heart rate. The relationship between physical activity density and resting heart rate has an inverse relationship, but the relationship is classified as weak. It is hoped for further research, an examination of anthropometry, stress, and food consumption of research subjects will be carried out.

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CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest.

REFERENCES

Baggish AL, Wood MJ. 2011. Athlete's Heart and Cardiovascular Care of the Athlete: Scientific and Clinical Update. Circulation.

Ehrenwald M, Wasserman A, Shenhar-Tsarfaty S, Zeltser D, Friedensohn L, Shapira I, Berliner S, Rogowski O. 2019. Exercise Capacity and Body Mass Index - Important Predictors of Change in Resting Heart Rate. BMC Cardiovascular Disorders.

Fernandes RA, Ronque ERV, Venturini D, Barbosa DS, Silva DP, Cogo CT, Carnelossi MS, Batista MB, Coelho-E-Silva MJ, Sardinha LB, Cyrino ES. 2013. Resting Heart Rate: Its Correlations and Potential for Screening Metabolic Dysfunctions in Adolescents. BMC Pediatrics.

Freitas Júnior IF, Monteiro PA, Silveira LS, Cayres SU, Antunes BM, Bastos KN, Codogno JS, Sabino JPJ, Fernandes AR. 2012. Resting Heart Rate as a Predictor of Metabolic Dysfunctions in Obese Children and Adolescents. BMC Pediatrics.

Huang CJ, Webb HE, Zourdos MC, Acevedo EO. 2013. Cardiovascular Reactivity,Stress, and Physical Activity. Frontiers in Physiology.

Kang JX. 2012. Reduction of Heart Rate by Omega-3 Fatty Acids and the Potential Underlying Mechanisms. Frontiers in Physiology.

Kang SJ, Ha GC, and KJ Ko. 2017. Association between Resting Heart Rate, Metabolic Syndrome and Cardiorespiratory Fitness in Korean Male Adults. Journal of Exercise Science and Fitness. 15(1):27–31.

Lavie CJ, Arena R, Swift DL, Johannsen NM, Sui Xuemei, Lee DC, Earnest CP,Church TS, O'Keefe JH, Milani RV, Blair SN. 2015. Exercise and the Cardiovascular System: Clinical Science and Cardiovascular Outcomes. Circulation Research.

Lee PH, Nan H, Yu YY, McDowell Ian, Leung GM, Lam TH. 2013. For Non- Exercising People, the Number of Steps Walked Is More Strongly Associated withHealth than Time Spent Walking. Journal of Science and Medicine in Sport. 16(3):227–30.

Lee PH, Yu YY, McDowell I, Leung GM, Lam TH, Stewart SM. 2011. Performance of the International Physical Activity Questionnaire (Short Form) in Subgroups of the Hong Kong Chinese Population. International Journal of Behavioral Nutrition and Physical Activity. 8(1):81.

Minder CM, Shaya GE, Michos DE, Keenan TE, Blumenthal RS, Nasir K, Carvalho JAM, Conceição RD, Santos RD, Blaha MJ. 2014. Relation between Self-ReportedPhysical Activity Level, Fitness, and Cardiometabolic Risk. American Journal of Cardiology. 113(4):637–43.

Nystoriak MA, Bhatnagar A. 2018. Cardiovascular Effects and Benefits of Exercise. Frontiers in Cardiovascular Medicine.

Papathanasiou G, Georgakopoulos D, Papageorgiou E, Zerva E, Michalis L, Kalfakakou V, Evangelou A. 2013. Effects of Smoking on Heart Rate at Rest and during Exercise, and on Heart Rate Recovery, in Young Adults. Hellenic Journal of Cardiology.

Pilis K, Pilis A, Stec K, Pilis W, Langfort J, Letkiewicz S, Michalski C, Czuba M, Zych M, Chalimoniuk M. 2018. Three-Year Chronic Consumption of Low-Carbohydrate Diet Impairs Exercise Performance and Has a Small Unfavorable Effect on Lipid Profile in Middle-Aged Men. Nutrients.

Potter GDM, Skene DJ, Arendt J, Cade JE, Grant PJ, Hardie LJ. 2016. CircadianRhythm and Sleep Disruption: Causes, Metabolic Consequences, and Countermeasures. Endocrine Reviews.

Reimers A, Knapp G, Reimers C-D. 2018. Effects of Exercise on the Resting Heart Rate: A Systematic Review and Meta-Analysis of Interventional Studies. Journal of Clinical Medicine. 7(12):503.

Ryan DJ, Wullems JA, Stebbings GK, Morse CI, Stewart CE, Onambele-Pearson GL. 2018. Reliability and Validity of the International Physical Activity Questionnaire Compared to Calibrated Accelerometer Cut-off Points in the Quantification of Sedentary Behaviour and Physical Activity in Older Adults. PLoS ONE. 13(4).

Silva DAS, Lima TRD, Tremblay MS. 2018. Association between Resting Heart Rateand Health-Related Physical Fitness in Brazilian Adolescents. BioMed Research International.

Skytioti M, Søvik S, Elstad M. 2018. Respiratory Pump Maintains Cardiac Stroke Volume during Hypovolemia in Young, Healthy Volunteers. Journal of AppliedPhysiology.

Sylvia LG, Bernstein EE, Hubbard JL, Keating L, Anderson EJ. 2014. Practical Guide to

Measuring Physical Activity. Journal of the Academy of Nutrition and Dietetics.

Thivel D, Tremblay A, Genin PM, Panahi S, Rivière D, Duclos M. 2018. PhysicalActivity, Inactivity, and Sedentary Behaviors: Definitions and Implications inOccupational Health. Frontiers in Public Health.

Verma AK, Garg A, Xu D, Bruner M, Fazel-Rezai R, Blaber AP, Tavakolian K. 2017. Skeletal Muscle Pump Drives Control of Cardiovascular and Postural Systems. Scientific Reports.

Yilmaz S, Akboga MK, and Aydogdu S. 2017. Resting Heart Rate. Angiology.