

41. IOP Step test, 2019. Turnitin

by Irfannuddin Irfannuddin

Submission date: 12-Nov-2021 07:26PM (UTC+0700)

Submission ID: 1700688431

File name: 41._IOP_Step_test,_2019.pdf (624.98K)

Word count: 2801

Character count: 14295

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To cite this article: Budi Santoso *et al* 2019 *J. Phys.: Conf. Ser.* **1246** 012054

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The effect of physical activity motivation to daily step count and $\text{VO}_{2\text{max}}$

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Abstract. The level of physical activity decreases with reduced skeletal muscle movement in daily activities. Motivation to keep moving and adequate physical activity can increase the value of $\text{VO}_{2\text{max}}$. This study aims to identify the effect of physical activity motivation in $\text{VO}_{2\text{max}}$ values so as to increase the degree of fitness and health. The research uses a quasi-experimental design. Samples were high school students in Palembang were divided into 2 groups: the motivation of physical activity and the control group. The motivation for physical activity is routinely done by sending an SMS every 3 days for 60 days, $\text{VO}_{2\text{max}}$ values measured using the Multistage Fitness Test and the number of daily steps using pedometers *Accupedo* application. A total of 80 subjects had a $\text{VO}_{2\text{max}}$ pretest and posttest in the intervention group amounted to 40.5 and 42.9 ml/kg/min, while the control group 41.2 and 42.7 ml/kg/min. The number of daily steps in the intervention group for 8959 steps, while the control group of 7398 steps. Statistical analysis by paired t-test showed that there was a significant effect on the motivation of physical activity daily step count ($p < 0.001$) and $\text{VO}_{2\text{max}}$ values ($p < 0.001$).

1. Introduction

Physical activity is all movement of skeletal muscles which can increase energy expenditure above resting level [1]. People who are physically inactive have a higher risk of developing non-communicable diseases [2]. In 2009, the World Health Organization (WHO) observed the importance of physical activeness and identify physical inactivity is the fourth leading risk factors for death in the world [3]. During the late 20th century, physical activity is recognized as a behavior that can improve quality of life but the current global trend of physical activity showed that more than 30% of people were physically inactive [4]. Lack of physical level of activity trend does not have a significant impact on health, especially at a young age because of the ability of homeostasis and antioxidants still good [5,6].

Cardiorespiratory Fitness (CRF) reflect the functional ability of the heart, blood vessels, blood, lungs, and muscles that are relevant to the activity or physical exercise [7]. People of all ages can improve their health and quality of life through physical activity is moderate to the high-intensity routine to improve CRF [8]. CRF can be assessed by measuring the maximal oxygen consumption ($\text{VO}_{2\text{max}}$). Daily physical activity levels adequate to increase the value of $\text{VO}_{2\text{max}}$ through an increase in cardiac output, ventilation per minute, and the number of capillaries in the muscles [9].



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In the United States, only 54% of adolescents aged 6-19 years who reached the amount of physical activity of moderate intensity and strongly recommended in the Physical Activity Guidelines for Americans [10]. Studies conducted motivation on physical activity in schools have been successful in improving the physical fitness of students when compared with other types of interventions. In the study, obtained maximal oxygen consumption ($VO_2\text{max}$) increased by 8.5% among students in the intervention group, but only 1.8% in the control group at the end of the program [11].

Physical activity behavior can be improved through physical activity motivation. Yet research on the effects of physical activity motivation on the number of daily steps and maximum value oxygen consumption is still rarely performed. Until now in Indonesia, especially in Palembang is still rarely carried out research to identify the effect of physical activity motivation on the number of daily steps were measured using pedometers and oxygen consumption values. This study is expected to increase the level of fitness and health with regular physical activity in the community.

2. Methods

The type of research is a quasi-experimental research design with the pretest-posttest control group. Samples are high school students in Palembang in the period September to December 2017. Inclusion criteria for this study are any high school student as evidenced by a student card, can walk, and have a smartphone based on Android or iOS. The research sample was then divided into intervention and control groups respectively of 40 people. The intervention group received motivational regarding physical activity whereas the control group did not.

Primary data obtained from the measurement results in Multistage Fitness Test to measure the value of $VO_2\text{max}$ pretest and posttest. Daily step count was measured using pedometers *Accupedo*, a smartphone application for 60 days. Descriptive analysis of the data used to determine the mean and standard deviation of $VO_2\text{max}$ value and the number of daily steps in each group. The bivariate analysis used is the test Independent t-test and Paired t-test.

3. Results

This study obtained results pretest mean $VO_2\text{max}$ values at 40.8 ml/kg/min, posttest $VO_2\text{max}$ of 42.8 ml/kg/min. These results indicate that the $VO_2\text{max}$ values in the studied population are still below the standard ($VO_2\text{max}$ good standard is ≥ 44 ml/kg/min for men) [12]. The mean number of daily steps are 758 steps in the intervention group and 7398 steps in the control group showed no difference in the mean number of daily steps of the two groups studied.

The number of daily steps in the intervention group obtained amounted to 8958 ± 360 steps, the control group of 7398 ± 414 steps, and the mean difference between group for 1560 (1387-1733) steps with $p < 0.001$. According to the cut-off point of the Tudor-Locke, the number of daily steps in the intervention group amounted to 8957.7 step included in physical activity behavior somewhat active while the control group amounted to 7397.5 step included in the behavior of physical activity were less active [13]. The results are consistent with previous research conducted, that motivational intervention and provision of research on the subject pedometer can increasing daily steps. Differences between the mean number of daily steps were found between the intervention and control by 2650 steps ($p < 0.05$) [14].

Table 1. Test Results Statistics Paired t-Test Value $VO_2\text{max}$ pre-test and post-test in the intervention and control groups.

	$VO_2\text{max}$ pre-test (Mean \pm SD)	$VO_2\text{max}$ post-test (Mean \pm SD)	difference in average	p
Intervention	40.5 \pm 0.96	42.9 \pm 0.93	2.45	0000
Control	41.2 \pm 1.08	42.7 \pm 1.03	1.52	0000

Table 1 displays the results of the analysis of the statistical tests motivational effect of physical activity on the value of $VO_2\text{max}$. However, to determine the effect of motivation on $VO_2\text{max}$ value by controlling the $VO_2\text{max}$ values pretest, then tested the ANCOVA analysis. From the analysis, it can be concluded that significant ANCOVA analysis, which means there is a significant effect on the effect

of physical activity on VO_2max after motivation with initial VO_2max values or prior motivation. Of all the results of the above analysis, it can be deduced that there is a significant effect on the motivation of physical activity on VO_2max values at high school students.

The results of data analysis showed a significant effect on the motivation of physical activity on maximal oxygen consumption values ($p < 0.001$). Differences between the mean increase in VO_2max values in the group given the motivation of physical activity (intervention) of 2.45 ml/kg/min and the group not given the motivation of physical activity (control) of 1.52 ml/kg/min or can be inferred value of oxygen consumption maximum (VO_2max) increased by 6.1% among students in the intervention group and 3.7% in the control group in this study.

4. Discussions

Previous research on VO_2max has been done in some countries and the results show that VO_2max values in the studied population are low or under the standard. Research on adolescent boys and girls aged 13-18 years in Spain shows that the average value of their VO_2max is successively equal to 42.5 ml/kg/min and 36.8 ml/kg/min [15]. The study on cardiorespiratory fitness as measured by VO_2max values have also been carried out in Indonesia. The study with Multistage Fitness Test showed that the average value of VO_2max of students is still considered below the standard that is 40.07 ml/kg/min in males and 34.22 ml/kg/min in women [16].

The motivation of physical activity can increase students' knowledge about the importance of physical activity to change the behavior of students to move actively. Physical activity easy to do, by walking, which in turn can increase the number of daily steps. Increased physical activity has, in turn, increased the daily energy needs through the aerobic system so that the body does not feel tired. In this study, an increase in the number of daily steps not only occur due to changes in the behavior of students to be active but also a result of the increase in energy demand and the activation system of regular aerobic exercise so do not feel tired when walking long [9].

The results are consistent with previous studies in Chile that the motivation for physical activity can increase VO_2max values ($p < 0.001$). In the study, differences between the mean increase in the intervention group VO_2max values of 2.97 ml/kg/min, and a control group of 0.65 ml/kg/min or at the conclusion of VO_2max value increased 8.5% among students in the intervention group, but only 1.8% in the control group at the end of the study [11].

Motivation on physical activity enhances students' knowledge of the importance of physical activity and being able to change the behavior of students to actively move one of which is a walk which in turn increased the number of daily steps that resulted in an increase in daily energy requirements. To meet this energy boost, there was an increase in blood flow and oxygen to the skeletal muscles. The heart muscle to contract more efficiently to pump bloodstream thereby increasing stroke volume and ultimately increase cardiac output. In addition, there vasodilatation to meet the needs of oxygen to the tissues, especially in skeletal muscle and heart, and also an increase in the number of capillaries in the muscles due to physical activity that takes place [17]. The increase in pulmonary tidal volume and the number of the capillary in skeletal muscle can increase the difference in the amount of arterial-venous oxygen. Improved the function of the cardiovascular system in the form of increased cardiac output and improved the function of the respiratory system in the form of increased the difference in the amount of arterial-venous oxygen, they are cause an increase in the maximal oxygen consumption [9].

Motivation in the step of administering physical activity intervention group was only given the introduction of physical activity and motivation to do physical activity without being offered a program of physical activity each day so that the differences between the mean values of VO_2max between intervention and control groups are not too large.

5. Conclusions

The results of the research on the effect of physical activity motivation against the daily step count and the value of maximal oxygen consumption (VO_2max) of high school students that there is a significant effect on the motivation of physical activity on the value of maximal oxygen consumption in high

school students with the difference in the intervention group VO_2max values of 2.45 ml/kg/min while the control group of 1.52 ml/kg/min ($p < 0.001$).

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Acknowledgments

The authors would like to thank all the subjects who willingly participated in this study. This research was supported by grants from Universitas Sriwijaya. The sponsor had no role in the study design, data collection, analysis or interpretation, writing of the report, or decision to submit the article for publication.

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