

ORIGINAL ARTICLE



Patterns of Physical Activity and Its Impact on the Quality of Life: A Structural Equation Modeling Analysis

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ABSTRACT

Background. In many countries, including Indonesia, the tendency for non-communicable diseases is increasing. Consequently, health costs must be paid by the state and continue to increase. People's lifestyles, including lack of physical activity, are thought to have contributed significantly to the problem. **Objectives.** This study aims to examine the impact of physical activity on quality of life, which is reflected in three main indicators: health, psychological and social. **Methods.** The study was conducted in the city of Surabaya and its surroundings with a total of 490 participants, consisting of 245 men and 245 women with an average age of 45.4 ± 15.4 years. Data on physical activity and quality of life were collected by questionnaire and analyzed using structural equation modeling. **Results.** The test results of the model proved that the value of chi-square = 8.259 with $p = 0.409$, RMSE = 0.008, NFI = 0.992, and CFI = 1.0. It means that the model was compatible with the data. The model explained that physical activity has a significant effect on the quality of life. **Conclusion.** People who exercise regularly are better able to cope with stress, have a lower risk of illness, and have higher pro-social behavior. Therefore, it needs serious efforts from stakeholders, especially the government, to create an ecosystem that allows the growth of movement culture in the community.

KEYWORDS: *Participation, Physical Activity, Quality of Life, Structural Equation Modeling.*

INTRODUCTION

Non-communicable diseases such as hypertension, type 2 diabetes, and heart attacks are a global phenomenon in developing countries and developed countries (1). An unhealthy lifestyle is suspected of triggering this main problem, such as smoking, alcohol, instant foods with minimal fiber, and avoiding physical activity. World Health Organization (WHO) cites that non-communicable diseases will be of global concern through the Sustainable Development Goals (SDGs) program as global commitments are weak, both in the form of legislation, budgeting, and implementation (2). In 2014, WHO conducted a global survey and made a profile report for each country related to non-

communicable diseases. For Indonesia, WHO noted that non-communicable diseases - such as heart disease, stroke, acute breathing, and diabetes mellitus - caused 71% of deaths. The increase occurred from year to year. In 1995, the death rate due to non-communicable diseases was 41.7%, in 2001, it was 49.9%, and in 2007 it was 59.5% (3). From a gender perspective, cardiovascular disease, chronic breathing, and cancer are more common in men than women. For type 2 diabetes, women suffer more than men. This report also stated as risk factors in adults due to certain conditions, namely smoking habits, in men by 67% and women by 3%; blood pressure that exceeds the standard, in men is 29.1% and in

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women is 26.6%; and obesity in men is 2.6% and in women is 6.9%.

Some special notes need to be explained related to type 2 diabetes in Indonesia. Type 2 diabetes mellitus is the third leading cause of death after stroke and coronary heart disease. The prevalence of diabetes has increased from time to time. In 2007 the prevalence was 5.7% and became 6.9% in 2013. Data from the 2017 International Diabetes Federation stated that Indonesia was ranked 6th in the world with 10.3 million sufferers (4). WHO estimates that if this dangerous and deadly disease is not dealt with seriously, by 2030, the number will increase dramatically to 21.3 million people (2). There are unfavorable conditions for Indonesia because of the habit of excessive rice consumption. It is because rice is the worst type of carbohydrate compared to corn, cassava, and potatoes. Indonesia's per capita rice consumption is 124 kg/year, the highest in the world. In contrast, Thailand and Malaysia are 80 kg/year, China 60 kg/year, Japan 50 kg/year, and Korea 40 kg/year.

The most apparent impact related to this problem is the swelling of the National Health Insurance (BPJS Kesehatan) budget far above normal. Participant fees received by the BPJS Kesehatan cannot cover the budget that must be spent to pay for the sick, so they tend to continue to lose money (5). In 2019, the BPJS Kesehatan was estimated to have a budget deficit of 32 trillion. Most of the budget is spent on non-communicable diseases, such as heart, kidney, diabetes, and stroke. A 1-year evaluation of the implementation of national health insurance shows that the number of sick Indonesian population reaches 65%, far exceeding the normal standard of 10-15% of the total population. This disease is generally caused by unhealthy lifestyles, including lack of movement. An imbalance between food intake and energy burned or expelled can cause obesity, a simple indicator of the greater size of the abdominal circumference. People who are obese have the potential to suffer from cardiovascular disease, a disease related to the heart and blood vessels (6, 7). Such conditions are certainly very detrimental to the country in the long run. Therefore, it needs to be rethought whether the treatment strategy is curative by providing as many health services as possible or is promotive and preventive by providing adequate infrastructure so that the community can carry out physical activities

optimally so that the number of sick people decreases.

Besides physical health problems, mental problems are also crucial. According to WHO data, around 35 million people suffer from depression, 60 million people are affected by bipolar disorder, 21 million people contracting schizophrenia, and 47.5 million have dementia (8). How about Indonesia? The results of primary health research in 2013 showed that 14 million (6%) Indonesians aged 15 years and over had symptoms of depression and psychiatric disorders. Meanwhile, severe mental disorders such as schizophrenia reach 400 thousand people or 1.7 per thousand populations (9). Along with the increasingly complex life problems, including VUCA (volatility, uncertainty, complexity, and ambiguity), which have recently been widely discussed, an increase in the number of people with psychiatric disorders will burden the country's finances and have implications for decreasing productivity in the long term.

The fundamental question is, how does the contribution of physical activity in the context of providing solutions to overcome a number of these problems? The results prove that increased participation in sports can reduce health costs (10, 11). Research in several countries is more advanced, so it can calculate the economic burden that the state must bear due to physical inactivity. In the UK, direct costs to be borne by the government for treating overweight, obesity, and morbidity ranged from £479.3 million in 1981 to £4.2 billion in 2007 (12). Estimated indirect costs, i.e., costs arising from the impact of obesity on a broader range such as loss of productivity, costs to be borne range between £2.6 billion and £15.8 billion. Model projections show that indirect costs could amount to £27 billion in 2015. In 2006/2007, obesity-related illnesses were estimated to cost £148 million for hospitalization. In Scotland, the total social costs for obesity and overweight in 2007/2008 were estimated to be between £600 million and £1.4 billion. Research in the United States related direct health costs that the state must bear due to physical inactivity of \$29 billion in 1987 and \$76.6 billion in 2000 (13). Physical inactivity is also strongly suspected of having a risk of coronary heart disease (14) and is estimated to save \$5.6 billion in cost if 10% of adults in America engage in regular physical activity (13). Studies in China that try to calculate the total economic burden of physical inactivity, which

combines medical and non-medical costs of five non-communicable diseases, show that physical inactivity contributes 12% to 19% to the risk of coronary heart disease, stroke, hypertension, cancer, and type 2 diabetes. Physical inactivity imposes a severe economic burden on the country because it consumes more than 15% of its medical and non-medical annual costs (15).

There is a positive relationship between involvement in physical activity and one's health condition, including psychological health (16-18). Those actively involved in physical activities show a higher level of self-confidence than those not involved. When teenagers are involved in competitive sports, they show a more positive self-concept than those not involved in competitive sports. Positive self-concept appears not only in the physical dimension but also socially, and what is even more impressive is its influence on intellectual development. Exercise can also increase stress resistance (6, 7). The study's results prove that adolescents involved in physical activity are more resilient and able to cope with stressors from their environment as it is understood that the lives of adolescents are very vulnerable to psychosocial problems, such as the temptation to use drugs, alcohol, promiscuity, and other social ills.

Although many studies have examined the effect of physical activity on health and psychological aspects, there is not enough research that examines these variables simultaneously. Research related to the quality of life of individuals is more approached from a disease and health perspective (19, 20). This study aims to develop a theoretical model that explains the simultaneous relationship, both directly and indirectly, between physical activities that are reflected in frequency, intensity, and duration with the quality of life reflected in medical symptoms, psychological well-being, and pro-social behavior. A quality life is the ultimate goal of every development, including part of the target of sustainable development goals. Therefore, the results of this study are beneficial for the government and the community to find practical, simple, and inexpensive ways to achieve a quality of life. From the perspective of theory development, this study explains how to obtain quality life from the dimensions of physical activity.

MATERIALS AND METHODS

Participants. This research was conducted with a survey approach, collecting information

from the population based on several samples using a questionnaire. The participants of this study were 490 people from Surabaya and its surroundings, consisting of 50% men and 50% women. They are aged between 18-78 years, with an average age of 45.4 years (SD= 15,4). In terms of employment, most participants (36.94%) work in the informal labor sector, followed by corporate employees (22.44%), government employees (13.9%), traders (13.47%), and students (9.6%). With such a composition, at least it can represent the type of work in the community.

Instruments and Procedures. Data were collected using a questionnaire. There are four questionnaires used in this study, namely a questionnaire to measure physical activity (IPAQ), a questionnaire to measure psychological well-being (Index of Well-Being and General Effect), a questionnaire to measure medical symptoms and vitality (WHOQOL), and an instrument to measure pro-social behavior (Prosoc Scale). In measuring physical activity, at least three aspects need attention: frequency, intensity, and duration (21, 22). The three principles are then developed into question items. For the frequency aspect, the score is 0 for uncertain activities; a value of 1 for one time per week; a value of 2.5 for two or three times per week; a value of 5 for four-six times per week; and a value of 7 for every day of the week. For the intensity aspect, a value of 3 for those who do ordinary activities and 5 for those who do it panting. For the duration aspect, a value of 3 for those who do activities less than 30' and 5 for those who do activities more than 30'. The trial examination results show that this instrument has a high enough validity. Using the Items-Total Correlations analysis technique, the validity coefficient ranges from 0.42 to 0.78.

With modifications, psychological dimensions were measured using the Index of Well-Being and General Affect instruments from Campbell et al. (23). The instrument measures a person's general psychological condition, including aspects of loneliness, agitation, and satisfaction. This instrument consists of 9 items with "yes" and "no" responses. The aspect of solitude is in items 4 and 5; the anxiety aspects are in items 6, 7, and 8; and the satisfaction aspects are in items 1, 2, 3, and 9. The test instrument results show that using the Items-Total Correlations analysis technique, the validity of items is 0.46 to 0.66. While using

Cronbach's Alpha, a reliability coefficient of 0.75 was obtained. Health dimensions are measured based on indicators of medical symptoms and vitality. Medical symptoms are related to how far the respondent experiences minor health problems such as insomnia, fatigue, etc. While vitality refers to the understanding of to what extent the respondent shows "excitement" in carrying out daily activities (24). There are 10 items in total, consisting of 5 items about medical symptoms and 5 items about vitality with "yes," "no," and "sometimes" responses. From the test results, the instrument shows that by using the Items-Total Correlations analysis technique, a validity coefficient of 0.35 to 0.67 is obtained. Meanwhile, by using Cronbach's Alpha, the reliability coefficient is 0.64.

Instruments for measuring social behavior are developed based on social learning theory (25, 26). The instrument was designed in the form of events that measure the quality of social behavior possessed by respondents. The higher the respondent's score in an event, the stronger the respondent's social behavior. The instrument consists of 4 items representing aspects of sharing, cooperation, helping behavior, and altruism. From the test results, the instrument shows that by using the Items-Total Correlations analysis technique, the validity coefficient is 0.32 to 0.76. Meanwhile, using Cronbach's Alpha, the reliability coefficient is 0.42.

Data Analysis. Data analysis was performed using the Structural Equation Modelling (SEM) method, a confirmatory multivariate statistical technique to examine some variables' structural relations simultaneously. Statistically, SEM is a combination of regression analysis and factor analysis. In SEM, two types of variables are commonly used, namely the latent variable and the observed variable. Latent variables, often called factors, are abstract constructs that can only be measured indirectly through their effect on the observed variables.

In contrast, the observed variables are variables that can be measured empirically, which are also called indicators. In causal logic, latent variables are called exogenous or independent variables, while observed variables are called endogenous or dependent variables. The final result of SEM is a

theoretical model, a summary of theories that illustrate the interrelation between variables usually expressed in mathematical formulations. A model is said to be good if it can explain the actual phenomenon with a small error rate.

In SEM, there are two interrelated stages. First, test the truth of the model by seeing whether there are significant differences between the model and data. Second, if there is a match between the model and the data (the difference is not significant), then the analysis can test the model's structural relationship to test the suitability of the theoretical model with the data using the goodness of fit test. If the null hypothesis is accepted, which means there is no difference between the model and the data, then the theoretical model proposed is fit to explain the data. If an appropriate model has been obtained, then each hypothesis can be tested, showing the impact of a variable on other variables. The testing criteria are based on a small Chi-square with $P \geq 0.05$, Goodness of Fit Index (GFI) ≥ 0.90 , Adjusted Goodness of Fit Index (AGFI) ≥ 0.90 , and Root Mean Square Error of Approval (RMSEA) ≤ 0.08 .

RESULTS

Based on the results of data analysis, in general, the level of physical activity of the people of Surabaya and surrounding areas is still low. The average frequency score is 1.83, the average intensity score is 2.16, and the average duration score is 2.70. There are no differences in physical activity patterns between men and women (Table 1). The difference only occurs in the aspect of frequency; in male respondents, the average frequency score is 1.98, while in female respondents, it is 1.68. It shows that there has been a significant development in terms of equality of participation between men and women in physical activity. This condition is different from the past 20 years. Our research shows that women's participation rates are far lower than men's. After we conducted a treasure study, this was caused by women's perceptions of reproductive health problems when exercising, discriminatory treatment from physical education teachers, lack of social support, gender factors, and limited time for physical activities.

Table 1. The Differences in Physical Activity between Male and Female

	Sum of Squares	df	Mean Square	F	Sig.
Frequency					

Between Groups	11.480	1	11.480	4.306	0.038
Within Groups	1300.961	488	2.666		
Total	1312.441	489			
Intensity					
Between Groups	.000	1	0.000	0.000	1.000
Within Groups	789.584	488	1.618		
Total	789.584	489			
Time					
Between Groups	0.008	1	0.008	0.002	0.961
Within Groups	1624.490	488	3.329		
Total	1624.498	489			

Table 2. Effect Size in Adjusted Structural Equation Model

Dependent Variables	Independent Variables					
	Physical Activity			Quality of Life		
	DE	IE	TE	DE	IE	TE
Quality of life	0.35** (.03)	-	0.35**(.03)	-	-	-
Pro-social behavior	-	0.07* (.08)	0.07*(.08)	0.19*(1.2)	-	0.19*(1.2)
Medical symptoms	-	0.23** (.05)	0.23**(.05)	0.65**(.27)	-	0.65**(.27)
Psychological well-being	-	0.17* (.01)	0.17*(.01)	0.50**(.10)	-	0.50**(.10)
Frequency	0.53** (1.9)	-	0.53**(.19)	-	-	-
Intensity	0.89** (.34)	-	0.89**(.34)	-	-	-
Time	0.99** (.04)	-	0.99**(.04)	-	-	-

Remark: DE= direct effect, IE= indirect effect, TE= total effect; * P<0.05, ** P<0.01; the value in parentheses is standard error of regression

Table 3. The Differences in Quality of Life between Regular and Non-regular Physical Activity

	Sum of Squares	df	Mean Square	F	Sig.
Psychological well-being					
Between Groups	1.500	1	1.500	11.772	0.001**
Within Groups	62.184	488	0.127		
Total	63.684	489			
Medical symptoms					
Between Groups	9.660	1	9.660	21.383	0.000**
Within Groups	220.456	488	0.452		
Total	230.116	489			
Pro-social behavior					
Between Groups	3.600	1	3.600	2.989	0.084
Within Groups	587.724	488	1.204		
Total	591.324	489			

** P<0.01

Data analysis also shows no correlation between age and physical activity patterns. After 18 years, physical activity tends to stagnate until adulthood. It seems that this is related to the productive age; individuals who have entered the productive age will concentrate a lot on how they work and plan for the future. Much time is spent on economically motivated activities. As a result, the time to do physical activity is limited. This study also found a significant correlation between frequency, intensity, and duration. The correlation between frequency and intensity was .48 with P<0.001. The correlation between frequency and duration of .53 with P<0.001. The correlation between intensity and duration was .88 with P<0.001. These facts prove that these

three things are interrelated in determining the level of physical activity. The strongest relationship occurs between intensity and duration.

Another finding from this study is that there is no difference in physical activity patterns between respondents who live in urban and suburban areas. This condition is understandable given that Surabaya, which has an area of around 350 km² and a population of 2.9 million, is all a city area, nothing rural. Public awareness of the importance of health, including physical activity, is balanced along with equitable development. This condition is certainly different from studies that have been done in previous years, which distinguish between physical activity in urban and

rural areas. The level of participation in physical activity in urban areas is relatively higher compared to rural areas.

Then, what is the theoretical relationship between physical activity and individual quality of life? The results of data analysis conducted using SEM show that the theoretical model compiled fits the data, with chi-square of 8,259 and $P=0.409$, RMSEA of .008, NFI of 0.992, and CFI of 1 (Figure 1). Variables that affect physical

activity sequentially are contributed by the duration of physical activity, the intensity of physical activity, and the frequency of physical activity. The variables that affect the quality of life in a row are contributed by health factors, psychological well-being, and pro-social behavior (Table 2). A significant direct relationship between physical activity variables and quality of life is indicated by a regression coefficient of .35 with $P=0.001$.

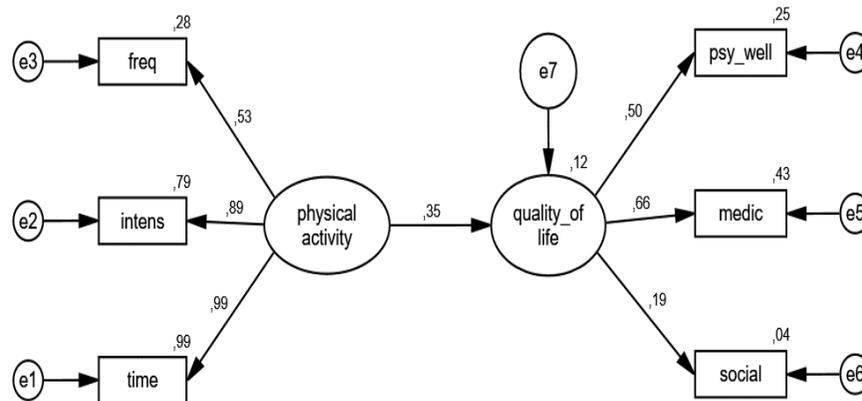


Figure 1. The causal structure of physical activity and quality of life

Remarks: freq= frequency; intens= intensity; psy_well= psychological well-being; medic= medical symptoms; social= pro-social behavior

Besides, there is a direct relationship between physical activity and the quality of life of individuals in the test also found an indirect relationship between physical activity and health with a regression coefficient of .23 with $P=0.001$. There is an indirect relationship between physical activity and psychological well-being with a regression coefficient of .17 with $P<0.05$. There is an indirect relationship between physical activity and pro-social behavior with a regression coefficient of .07 with $P<0.05$ (Table 2).

In addition to developing theoretical models, this study also examined the differences in the effect of regular and non-regular physical activities on quality of life (Table 3). The test results indicate a significant difference in terms of psychological well-being between those who carry out regular and non-regular physical activities, with an F -value of 11,772 at $P=0.001$. There is a significant difference in terms of medical symptoms between those who do regular and non-regular physical activities, with an F -value of 21,383 at $P=0.000$. Those who do regular physical activity better psychological

conditions and health. While for the pro-social behavior aspect, there is no significant difference between those who carry out physical activities on a regular and non-regular basis.

DISCUSSION

In general, this research has provided empirical evidence of structural relationships between physical activity and the quality of life of individuals. The physical activity carried out regularly - frequency three times or more a week with each exercise 30' - will be able to improve the quality of life. From the psychological dimension, people who do regular physical activity are more optimistic about life. His life feels more valuable and useful; he does not feel alienated and generally feels more satisfied in his life. The results of this study align with what has been done by several studies which state that sports activities positively impact one's psychological well-being (6, 27, 28). This research has also proven that someone involved in physical activity is more resilient and able to cope with stressors from his environment (29, 30). It is in line with other researchers who state that there

is a positive relationship between involvement in sports and one's psychological condition (7). Those actively involved in sports activities showed a higher level of self-confidence than those not involved.

On the health dimension, as measured by medical symptoms and vitality, this study has also proven that those who do physical activity in decreases experience fewer health complaints than those who do not engage in physical activity. Health complaints include headaches, colds, insomnia, and if anyone experiences pain for a long recovery time. Although in different contexts, these findings are at least in line with previous studies that prove that regular physical activity can reduce blood pressure for those who have a risk of high blood pressure (7, 31, 32). Similar research also shows that someone who does not exercise has twice the risk of developing cancer as someone who actively does sports (6, 16).

Physical activity is considered the most important step in improving health for adults and the entire population (33, 34). Lack of physical activity is a risk factor for chronic diseases such as diabetes, depression, cardiovascular disease, and stroke. If we are regularly involved in physical activity, and even in minimal quantities, it can reduce the risk of many diseases. Research conducted on 410 respondents aged 65-70 years in Serbia, Switzerland, and Greece shows that physical activity positively influences the quality of life of the elderly, contributing to their health and interpersonal relationships (35).

On the dimension of social behavior, this study has not been able to prove the positive impact of physical activity on pro-social behavior. This finding is not too surprising, considering that most people doing sports activities aim to get health benefits or obtain a victory in the match. In other words, the sport has not been seen as a vehicle to instill values such as togetherness and respect for others (36, 37). Many studies were conducted on this problem, and the results also show inconsistent conclusions. For example, Van Yperen et al. studied the effect of sports, especially competitive sports, on pro-social behavior. The results prove that children participating in competitive sports show a decrease in their pro-social behavior (38, 39). Likewise, other research states that the maturity of an athlete's moral reasoning is lower than the maturity of moral reasoning of non-athletes at the

same age level (40, 41). Meanwhile, other studies prove different things, as has been done by Donnelly et al. & Horn. They stated that sports activities positively impact the cooperative behavior of the individuals participating in them (42, 43).

In connection with these two different findings, a debate emerged, pro-social behavior is formed by itself (internalized) when people do sports activities, or sports activities must be constructed in such a way as to shape the social behavior of the culprit. Related to this debate, the results of this study seem to support the opinion that participating in sports activities does not necessarily shape the social behavior of individuals, but what is considered to be social values must be organized, constructed, and transformed into the basic structure of individual reasoning who participated in it (44-46). What is encouraging about this study is that although sports activities do not partially affect the dimensions of social behavior, when this dimension joins the psychological and health dimensions as a totality that shapes the concept of quality of life, the social behavior dimension becomes meaningful.

In the future, we hope that more research results will promote the excellence of physical activity in life. If necessary, research is carried out using a neuropsychology approach to be more convincing to the public. As an illustration, Yuki et al. conducted an interesting study on physical activity and brain development, namely whether daily physical activity can prevent the development of brain atrophy with age (47). The study subjects were 381 men and 393 women who had participated in a baseline survey and follow-up for 8.2 years. Magnetic Resonance Imaging (MRI) measurements in the frontal and temporal lobes were performed during the baseline survey and follow-up. Daily physical activity and total energy expenditure of participants are recorded. In male participants, the development of frontal lobe atrophy for the fifth quartile compared with the first quartile in energy expenditure activity was 3,408 ($P= 0.05$; 1,205-9,643) and for the number of steps was 3,651 ($P= 0.05$; 1,304-10,219)—men and women with low total energy expenditure risk frontal lobe atrophy. The study concluded that physical activity and total energy expenditure are significant predictors of the development of frontal lobe atrophy over eight years. Therefore, promoting sports activities is

beneficial in reducing age-related frontal lobe atrophy and to prevent dementia.

There is no "final word" to find the truth in research. Opportunities are always available for further research to perfect previous research findings. Although this study has proved that physical activity positively impacts the quality of life, it is uncertain whether the improvement in quality of life occurs solely because the person concerned carries out physical activity or is influenced by other factors. Further research is expected to cover this problem.

CONCLUSION

Based on the analysis and interpretation of the data that has been described, the following conclusions can be formulated. First, the theoretical model that explains the structural relationship between physical activity and quality of life fits the data. Second, the group of respondents who do physical activity regularly has a better psychological condition compared to respondents who do not do physical activity. Third, the group of respondents who do physical activity regularly has better health conditions compared to respondents who do not do physical activity. Fourth, there is no significant difference in terms of pro-social behavior between groups of respondents who do physical activities regularly and groups of respondents who do not do physical activities. However, overall, the group of respondents who did physical activity regularly had a better quality of life than those who did not do physical activity. This research has succeeded in proving that physical activity positively impacts the psychological condition and health of the culprit, but at the same time has not succeeded in proving that sporting activities have a positive effect on social behavior. Related to this last thing, it needs to be studied further why it happened and whether there is something

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"wrong" in our sports. Research with a theme like this is still very rare, even though this needs to be done on a larger scale to provide empirical evidence and confidence to anyone, especially policymakers, that sports development is an urgent matter.

APPLICABLE REMARKS

In line with the results of this study, researchers recommend several things to the government, the community, and researchers:

- First, the government needs to provide adequate financial support for physical activities as a form of investment related to improving the quality of Indonesian human resources. This study has proven that regular physical activity can improve the culprit's quality of life. Therefore, there needs to be a policy that encourages schools, government agencies, and non-governmental institutions, as well as the community, to carry out physical activities regularly. Physical activity must be designed as an inexpensive activity so that the whole community can do it. In addition, program diversification needs to be done by considering demographic characteristics, local conditions, economic levels, etc.
- Second, new awareness must be raised that physical activity is necessary and therefore needs to be done regularly to fulfill it. The community has the right to receive sports services, including the availability of open space and sports human resources. If these rights have not been fulfilled, they must be fought.
- Third, this research is ex post facto, in which the researcher does not give treatment to the subjects. So it cannot be ascertained that the positive impact on quality of life is sole as a result of physical activity undertaken by the subjects. Therefore, the same research needs to be done with an experimental approach.

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