



The influence of skipping exercise to body composition and cardiorespiratory fitness index in overweight female adolescents

Gebby Dwi Edtripany¹, Hadi Riyadi¹, Hardinsyah¹

¹Department of Nutrition, Faculty of Human Ecology, IPB University, Jalan Kamper Kampus IPB Dramaga, Bogor, Indonesia

*Correspondence: hadiri@apps.ipb.ac.id

ABSTRAK

Latar Belakang: Prevalensi overweight di Indonesia dari tahun 2013 ke 2018 meningkat secara signifikan pada remaja usia 13-15 tahun sebesar 8.3% meningkat hingga 11.2% dan pada usia 16-18 tahun sebesar 5.7% meningkat hingga 9.5%. Peningkatan aktifitas fisik dan perbaikan asupan makan merupakan salah satu strategi yang dapat menurunkan prevalensi obesitas pada remaja putri. Metode latihan skipping dapat meningkatkan tingkat aktifitas fisik pada remaja putri yang mampu mendorong perbaikan komposisi tubuh dan kebugaran kardiorespiratori pada remaja putri.

Tujuan: Menganalisis pengaruh skipping terhadap perubahan komposisi tubuh dan kebugaran kardiorespiratori pada remaja putri overweight dengan metode intervensi.

Metode: Subjek adalah 28 siswi Sekolah Menengah Atas yang overweight berusia 15-17 tahun dan bersedia mengikuti penelitian. Desain penelitian ini adalah quasy experiment design pada 14 subjek kelompok intervensi dan 14 subjek kelompok kontrol. Kelompok intervensi diberikan latihan skipping selama 4 sampai 8 menit, 3 kali seminggu selama 8 minggu. Sebelum dan setelah intervensi dilakukan pengukuran komposisi tubuh (berat badan, persen lemak tubuh, massa lemak tubuh dan massa bebas lemak) menggunakan BIA dan indeks kebugaran kardiorespiratori dengan metode modifikasi Harvard Step Test pada subjek.

Hasil: Terdapat perbedaan yang signifikan pada komposisi tubuh (berat badan, persen lemak tubuh, massa lemak tubuh dan massa bebas lemak) dan indeks kebugaran kardiorespiratori sebelum dan setelah intervensi pada kelompok skipping ($p < 0.05$) sedangkan pada kelompok kontrol tidak terdapat perbedaan yang signifikan ($p > 0.05$). Metode skipping dapat mempengaruhi penurunan komposisi tubuh dan peningkatan indeks kebugaran kardiorespiratori ($P < 0.05$; R^2).

Kesimpulan: Program latihan skipping memiliki dampak signifikan terhadap komposisi tubuh dan kebugaran kardiorespiratori. Latihan skipping efektif dalam memperbaiki komposisi tubuh dan kebugaran kardiorespiratori terkait body image dan pentingnya makan secara teratur guna mencegah masalah gizi pada masa kehamilan pada kegiatan bimbingan perkawinan.

KATA KUNCI: komposisi tubuh; kebugaran kardiorespiratori; overweight; skipping



ABSTRACT

Background: The overweight prevalence of adolescents in Indonesia from 2013 to 2018 experienced a significant rising as seen in 13-15 years old age group (expressed in percentage of 8.3 % in 2013 to 11.2 % in 2018) also in the 16-18 years old age group (expressed in percentage of 5.7 % in 2013 to 9.5 % in 2018). An increase of physical activity and improvement of food intake become one solid strategy to reduce the obesity prevalence on female adolescents. Skipping exercise method is able to increase the physical activity level on female adolescents and able to promote the improvement of body composition as well as cardiorespiratory fitness on female adolescents.

Objectives: analyzes the effect of skipping exercise to changes of body composition and cardiorespiratory fitness on overweight female adolescents by intervention method.

Methods: subjects in this study were 28 female students from Junior High which experiencing overweight status and have age ranging from 15-17 years old and willing to participate in this research. Design of this study was a quasi experimental applied to 14 subjects within 1 skipping group and 14 subjects within 1 control group. The intervention group received skipping exercise with 4-8 minutes time duration, 3 times in a week for 8 weeks. Prior to intervention and after the intervention, subjects underwent a body composition measurement (body weight, body fat percentage, fat mass, and fat free mass) by employing the BIA, and a cardiorespiratory fitness index measurement by employing a modified Harvard Step Test method.

Results: according to statistical test, there are significant differences found on body composition (body weight, body fat percentage, fat mass, and fat free mass) also in the cardiorespiratory fitness index, in before and after intervention to skipping group ($p < 0.05$), while no significant difference found in control group ($p > 0.05$). Skipping exercise method able to influence the reduction of body composition and an increase to cardiorespiratory fitness index ($P < 0.05$; R^2).

Conclusions: Skipping exercise program has a significant effect on the body composition and on the cardiorespiratory fitness index. The skipping exercise is effective for improving body composition and cardiorespiratory fitness index.

KEYWORD: body composition; cardiorespiratory fitness; overweight; skipping

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INTRODUCTION

Overweight and obesity are body conditions of being too heavy due to excessive fat storage. Overweight and obesity can be seen from result measurement of Body Mass Index (BMI) calculation according to age (BMI/Age) and will be classified as overweight if the z-score results $> +1SD$ or classified as obesity when the z-score results $> +2SD$ (1). WHO stated that proportion of children and adolescents from age 5 to 19 years old with overweight condition including obesity has increased from 8 % in 1990 to approximately 20 % in 2022 (2). Indonesia prevalence of overweight including obesity in adolescents was 16 % among

adolescents aged of 13-15 years old and 13.5 % for older adolescents aged 16-18 years old (3). The result of Basih Health Research (Riskesdas) in 2018 showed that the prevalence of 16-18 years old overweight adolescents in West Sumatra was 7.78% while the prevalence of obesity was 3.72 % (4).

There are several risk factors for overweight in adolescents, such as food intake, breakfast habit, sleep duration and socio-economics (5). Lack of physical activity is one of many causal factors to the rising of obesity prevalence among adolescents. More than 340 million children and adolescents with age of 5 to 19 years old were

overweight or obese in 2016 (2). In addition, based on the Global Status Report on Physical Activity 2022 from WHO, more than 80 % of adolescents and 27 % of adults do not meet the appropriate level of physical activity as recommended (6). According to Riskesdas, proportion of less physical activity in population with age of ≥ 10 years old in Indonesia is 33.5 %, while in West Sumatra, population with age of ≥ 10 years old with insufficient physical activity reaches 39.42 % (3,4).

Obesity as one of risk factors for non-communicable diseases such as diabetes mellitus, cardiovascular disease, cancer, hypertension and arthritis increasing (7,8). In order to minimize the prevalence of non-communicable diseases, it is crucial to prevent and manage overweight and obesity. Physical activities including sports plays vital role in preventing obesity among children and adolescents (9). Sport is a body activity involves several body muscles. In general, adolescents (13-17 years old) need 60 minutes to do physical activities with moderate to vigorous intensity every day (10). One type of sport activity that can be carried out anywhere with easy, effortless, and affordable also can be done together in one room is skipping.

Skipping is an aerobic exercise with the involvement of one or more individuals who jump over a rope and swings in such a way that it passes under the feet and over the head of these individuals in continuous movement (11). Several studies had reported the impact of jumping rope on health. Such as result taken from previous research on school-aged-children showed a change of standard deviation in Body Mass Index that decreased after the jump rope intervention (12). While other research also reported result of a jump rope intervention 12 week intervention to female adolescent subjects that showed significant changes in body fat percentage, waist circumference, systolic blood pressure, blood sugar insulin level and HOMA-IR (13). In addition, other research also reported there is an effectiveness in skipping for increasing the body fitness index and lung function (14).

Nevertheless, only few studies addressed an increase of duration and intensity of skipping during intervention to attain time effectiveness during intervention that able to promote changes

in body composition and cardiorespiratory fitness in overweight female adolescents. Therefore, the researchers in this study were interested in examining the skipping effect on body composition and cardiorespiratory fitness in overweight female adolescents. This study has a purpose to analyze the skipping effect on changes in body composition and cardiorespiratory fitness in overweight female adolescents by intervention method.

MATERIALS AND METHODS

The research design was a quasy experiment design to subject study consisted of a skipping group and a control group. The subject of the study were female students of SMAN 1 West Sumatra who were included into the skipping group and female students of SMAN 1 Batipuh who were included into the control group. There is no intervention in control group. The inclusion criteria for this study were female adolescents with age of 15 – 17 years old that have a z-score $> +1SD$, currently not following a particular diet program, not smoking, and willing to take part in every research stages, do not attend regular sport classes, do not go to school by bicycle or on foot (> 2 km) and has no complaint or history of leg injury. Subject selection through screening with BMI/age before intervention. Based on obtainable equation formula, number of subjects for each treatment was 13 female adolescents, we added 10 % subject as drop out value, the final participants for each group were 14 female adolescents. However, during the intervention program, each group has one subject dropped out, so the total number of subjects who accomplished this research was 28 subjects.

This research was conducted on October to December 2023. The skipping activity was performed for 4-8 minutes, 3 times per week for 8 weeks on non-consecutive days. The intervention was carried out by adding the exercise duration time every 2 weeks with a workout to rest ratio stated as 20/10 seconds with an increase of 2 minutes every 2 weeks. Prior to main exercise and after the main exercise, the subjects performed warm up and cool down activities. Skipping was held together in one room.

Before carrying out the intervention activity, first week was designated for initial training to prepare

the subjects with basic movements for skipping group. At baseline, the body composition (body weigh, percent body fat) was measured using BIA (Bioelectrical Impedance Analysis) with omron hbf 375 brand while the cardiorespiratory fitness index was measured by modified Harvard Step Test method and calculated with formula (15) CFI: $(100 \times L)/(5.5 \times p)$, where L is the duration of the test (L = 300 s) and p is the number of heartbeats in the 1.5 min after the participant completed the test. on the subjects. Skipping was carried out and aided by video recorder media that displays video of skipping movement played on a laptop and speakers. A jump rope as research equipment was needed to follow the skipping direction, so the intervention in this study can be more valid and subjects felt easier to follow the skipping movement so the quality of the intervention is guaranteed. Subjects' food consumption data for characteristics were also looked at. Data collection using semi-quantitative food frequency and for the level of intake adequacy refer to the nutritional adequacy rate and for physical activity data refer to physical activity level with 1x24 hour recall.

Univariate analysis was selected to be used for determining the data distribution descriptively and followed by bivariate analysis through differential test and simple linear regression test to prove the research hypothesis. This research has received ethical clearance from Airlangga University under approval letter number 1143 / HRECC. FODM / X /2023. The test used to determine the normality of the data was Kolmogorov Smirnov (16).

RESULTS AND DISCUSSIONS

Data of respondent characteristics is used to determine respondents' diversity data based on age, weight, body fat percentage, fat mass, fat free mass, fitness index, nutritional status, daily physical activity level, total intake and intake level based on the groups. These data will provide description of respondents' condition and its relationship to the research problem along with the research objectives in a clear explanation. There were 28 female adolescents participated in this research, where the subject characteristics by groups is presented in **Table 1** below.

Table 1. Characteristics of Subjects

Characteristics	Skipping (n=14)	Control (n=14)	P Value
	Mean ± SD	Mean ± SD	
Age (year)	16.45 ± 0.52	15.8 ± 0.33	0.001
Body Weight (kg)	69.72 ± 13.84	70.16 ± 7.45	0.848
Nutritional Status (BMI/age)	1.42±0.64	1.35 ± 0.49	0.891
Body Fat (%)	30.67 ± 2.52	30.29 ± .28	0.681
Fat Mass (kg)	21.67 ± 5.92	21.39 ± 3.66	0.847
Fat Free Mass (kg)	48.05 ± 8.00	48.77 ± 3.96	0.741
Fitness Index	47.89 ± 6.02	46.32 ± 4.56	0.511
Nutritional Status (kg/m ²)	1.42±0.64	1.35 ± 0.49	0.891
Physical Activity Level	1.44 ± 0.05	1.42 ± 0.06	0.241
Energy Intake (kcal)	1552.33 ± 416.56	1674.55 ± 510.87	0.613
Protein Intake (g)	58.67 ± 17.15	61.84 ± 19.43	0.713
Fat Intake (g)	57.52 ± 18.71	57.66 ± 20.70	0.985
Energy Adequacy Level (%)	73.92 ± 19.83	79.74 ± 24.32	0.613
Protein Adequacy Level (%)	97.79 ± 28.58	103.06 ± 32.39	0.713
Fat Adequacy Level (%)	82.18 ± 26.73	82.38 ± 29.57	0.985

SD: standard deviationi, P-Value: no significant difference (p>0.05) (*independent t test*)

All subjects in both groups have an average age of 15 -17 years old. There was age difference between the average/mean age in skipping group (16.45 years ± 0.52) with the control group (15.8

years ± 0.33). Whereas body weight of subjects has no difference between two groups; the average body weight in skipping group stated as 69.72 kg ± 13.84 and in control group stated as

70.16 kg \pm 7.45. Same result was found in the nutritional status from subjects, where there was no difference between both groups; the average value of BMI/age for skipping group was 1.42 sd \pm 0.64 while the average value of BMI/age for the control group was 1.35 \pm 0.49. According to the average BMI/age, all subjects were overweight (15).

There was no difference found in the average percentage of body fat between both groups, the average percentage for skipping group was 30.67% \pm 2.52 while the average percentage for control group was 30.29% \pm 2.28. According to the Indonesian Ministry of health, body fat percentage of more than 25 % for women is categorized as obese (16). For the fat mass characteristic from subjects, there were no difference found in both groups with the average value for skipping group was 21.67kg \pm 5.92 and average value for control group was 30.29% \pm 2.28. The fat free mass characteristic from subjects also has no differences among both groups with the average value of skipping group was 48.05 kg \pm 8.00 while the average value of control group was 48.77 kg \pm 3.96. Female adolescents storing their excess energy in the form of body fat and as a consequence female adolescents tend to overeat, while male adolescent use their excess energy to synthesize protein. Therefore, when female adolescent reaches her physical maturity, the amount of body fat is twice higher than the body fat of male adolescent (17).

There was no significant difference found in the fitness index for both groups, the average value for skipping group was 47.89 \pm 6.02, while the average value for control group was 46.32 \pm 4.56. Table 1 described no significant difference found in the physical activity level from subjects in both groups; the average value of skipping group was 1.44 \pm 0.05 while the average value of control group was 1.42 \pm 0.06. According to FAO/WHO/UNU (2001) level of physical activity

value of \leq 16.69 is included in a light/mild category, so all subjects of this study had physical activity level that belongs to light/mild category. The physical activity and basal metabolism are prominent variables for calculating energy consumption. Energy consumption can be one example of energy necessity of an individual to live a quality life thoroughly (18).

There was no difference found in energy, protein and fat intakes for all subjects included in both groups. For the skipping group, the average amount of energy, protein and fat intakes were stated as order; (1552.33 kcal \pm 416.56), (58.67 g \pm 17.15), and (57.52 g \pm 18.71), meanwhile, the average amount of energy, protein and fat intakes from control group were stated as order; (1674.55 kcal \pm 510.87), (61.84 g \pm 19.43), and (57.66 g \pm 20.70). Aside from the intake amount, no significant difference also present in the level of intake adequacy, whether in the energy, protein and fat levels within the skipping group or in control group. In the skipping group, the level of energy, protein and fat adequacy were stated in order of (73.92% \pm 19.83), (97.79% \pm 28.58) and (82.18 % \pm 26.73) while the level of energy, protein and fat adequacy of control group were stated in order of (79.74 % \pm 24.32), (103.06 % \pm 32.39) and (82.38 % \pm 29.57). The subjects' adequacy level of energy based on RDA was classified as deficit, while the adequacy level for protein and fat were classified as sufficient.

A significant difference was found in body composition (body weight, body fat, fat mass and fat free mass) of subjects in skipping group and control group before (pretest) and after (posttest) receiving the exercise intervention, which verified by calculations using paired differential tests. Then, for identifying whether there was a difference in effect between the skipping (treatment) group and the control group, a differential test was carried out with the results presented in **Table 2** below.

Table 2. Effects of the Intervention on Body Composition

Variables	Skipping	Control	P Value ¹
BW (kg)			
Pretest	69.72 \pm 13.84	70.16 \pm 7.45	
Posttest	67.50 \pm 13.55	69.97 \pm 7.86	
Changes	-2.2 \pm 0.86	-0.18 \pm 0.60	0.000*

Variables	Skipping	Control	P Value ¹
p-value ²	0.000*	0.270	
PBF (%)			
Pretest	30.67 ± 2.52	30.29 ± 2.28	
Posttest	30.13 ± 2.45	30.55 ± 2.22	0.013*
Changes	-0.53 ± 0.79	0.26 ± 0.60	
p-value ²	0.026*	0.125	
FM (kg)			
Pretest	21.72 ± 5.93	21.36 ± 3.64	
Posttest	20.62 ± 5.68	21.48 ± 3.71	0.000*
Changes	-1.04 ± 0.54	0.12 ± 0.38	
p-value ²	0.000*	0.388	
FFM (kg)			
Pretest	48.00 ± 7.99	48.80 ± 3.97	
Posttest	46.87 ± 7.92	48.49 ± 4.37	0.007*
Changes	-1.17 ± 0.88	-0.31 ± 0.65	
p-value ²	0.000*	0.158	

BW (Body Weight), BF (Body Fat), FM (Fat Mass), FFM (Fat Free Mass) ¹independent test ²paired t test* paired t-test results significantly different between measurements, significant between groups (p≤0,05)

The result of analysis in before and after the intervention on subjects' body weight showed a significant difference for treatment group where the body weight reduction reached 2.0 kg when compared to the body weight of subjects in control group that only experiencing a weight loss of 0.18 kg. There was a reduction in body fat percentage variable in the treatment group (in before and after the intervention) reaching 0.53 %, in contrast to the control group which experienced an increase for 0.26 %. The changes in average body weight in before and after 8 weeks intervention for skipping group was 69.72 kg ± 13.84 before intervention, then decreased to 67.50 kg ± 13.55 after the intervention. Meanwhile for the control group, the average body weight before intervention was 70.16 kg ± 7.45 and 69.97 kg ± 7.86 after intervention. The average percentage of body fat for skipping group before the intervention was 30.67% ± 2.52 and decreased into 30.13% ± 2.45 after the intervention. It showed a significant difference in before and after the intervention (P<0.05). Other than that, there was an increase in percentage of body fat before intervention (30.29% ± 2.28) to (30.55% ± 2.22) after intervention for the control group, but no significant difference found (P>0.05).

This research is in line with result of research by Kim et al (2020) with jump rope intervention carried out by young women which showed significant changes in body fat percentage (13). Apart from that, result from other studies also reported that skipping intervention for school-aged children changes the standard deviation score of body mass index from high to low value (12). Physical activity or exercises have many benefits for individual with excessive nutritional status, in particular for helping with weight loss, body fat reduction, visceral fat reduction and weight maintenance after weight loss (19). Skipping exercise also an effective training program to increase the body mass without fat (lean body) and to reduce the fat mass and central adiposity in female adolescents. The result of this study is in line with previous research (20). Other findings also suggest skipping exercise as useful non-pharmacological intervention for managing risk factor associated with CVD and body composition, which may mediate the observed improvements in academic self-efficacy (13). This research is also in line with previous research that stated skipping exercise accompanied by music is more effective in improving the body composition (21).

The average amount of fat mass for the skipping group before intervention was $21.72 \text{ kg} \pm 5.93$ and amount of fat mass for control group before intervention was $21.36 \text{ kg} \pm 3.64$, meanwhile after the intervention, the amount of fat mass for skipping group became $20.62 \text{ kg} \pm 5.68$ and the amount of fat mass for control group became $21.48 \text{ kg} \pm 3.71$. Meanwhile, the average amount of fat free mass for skipping and control groups before the intervention was stated as follow; ($48.00 \text{ kg} \pm 7.99$) and ($48.80 \text{ kg} \pm 3.97$), then the average amount of fat free mass after the intervention for skipping and control groups became ($46.87 \text{ kg} \pm 7.92$) and ($48.49 \text{ kg} \pm 4.37$).

The research result exhibited significant difference found in body composition variables (body weight, percent body fat, fat mass and fat free mass) before and after the intervention for the skipping group ($P < 0.05$). On the contrary, there was no significant difference found in before and after intervention in the control group ($P < 0.05$). Furthermore, from the result of the independent test, it also can be seen there was a difference existed between the skipping group and the control group ($P < 0.05$) in the body composition variable.

Physical exercise or sport is the most important component in energy expenditure since it can affect the balance of body energy. High level of physical activity able to reduce

appetite resulting in less energy intake (22). Moreover, the energy expenditure increases through physiological processes and cellular mechanisms that accelerate the expenditure of the main energy stores (glycogen and triacylglycerol) which causes weight loss. In particular, exercise accelerates glycogenolysis in muscle and liver through the glycolysis processes, and fastening cycle of citric acid and oxidative phosphorylation in muscles also lipolysis in adipose tissue as well as the fatty acid oxidation in muscle. These effects mentioned above are achieved through stimulation of hormone secretion and changes within substrate concentration leading to enzyme activation that catalyze important steps in the above-explained catabolic pathways (23). Apart from that, improving risk factors for obesity and cardiovascular disease during adolescence period is crucial since obesity in adolescence is strongly associated to an increased risk of death from cardiovascular disease in adulthood.

Significant difference of changes in cardiorespiratory fitness index (in before and after intervention) between skipping group and control group is verified by data calculation using paired differential test. Then, to witness any differences between the treatment groups, a differential test was carried out which the following data as the calculation result is presented in **Table 3**.

Table 3 Effects of the Intervention on the Cardiorespiratory Fitness Index

Fitness Index	Skipping	Control	P value ¹
Pretest	47.89 ± 6.02	46.32 ± 4.56	
Posttest	51.82 ± 6.94	45.88 ± 5.26	0.113
Changes	3.92 ± 7.90	-0.44 ± 6.06	
p-value ²	0.050*	0.638	

*paired t-test results significantly different between measurements;¹independent test;²paired t-test

Result of the analisis showed that there was a significant difference in cardiorespiratory fitness index variable found in the skipping group, while no significant difference found in before and after the intervention in the control group. However, result from independent test showed no significant differences found between the

skipping group and the control group. The average value of cardiorespiratory fitness index in the skipping group before the intervention was 47.89 ± 6.02 and the value for control group was 46.32 ± 4.56 . After the intervention, the average value of cardiorespiratory fitness index in the skipping group changed into 51.82 ± 6.94 and the

value for control group changed into 45.88 ± 5.26 .

This research is in line to research by Stelle Tinia et al (2021) which reported that physical fitness index in the skipping and Tabata training group increased significantly. This research also in line with previous research that reported a skipping intervention carried out for 8 weeks was effective in improving the cardiovascular fitness of the subject study (24). To support these findings, other research also stated that skipping exercise accompanied by music was able to increase circulation of cardiovascular system through dynamic movements and strengthen deep breathing by activating the respiratory muscle movements to improve respiratory circulation (21). This physical activity compels subject to increase basic physical strength and endurance in obese subjects (21). Physical exercise will increase blood circulation that carries oxygen and nutrients needed by the body during exercise (14). Moreover, repeated physical activity increases blood circulation in healthy individuals thereby supporting maximum increase in cardiac output to improve the

optimal delivery of oxygen to body tissues (25).

Exercise promotes myokines release from skeletal muscle which able to mediate cardiovascular health benefits through its anti-inflammatory action, also able to increase the glucose uptake and increase the insulin secretion and sensitivity. Moreover, sport also supports cardiovascular health through the mechanism of mitochondrial biogenesis, fatty acid oxidation, and blood vessel dilation. These mechanisms can improve the cardiovascular function (26).

The influence of skipping intervention to changes found in BB, BF, FM, FFM and FI was tested by using simple regression linear method resulted in several equations as presented in **Table 4**. The result from simple regression linear test showed that the biggest effect of skipping was found in the changes of subjects' body weight. Data interpretation from meaning of each outcome equation are stated as follow: 66.9 % explains skipping treatment has an effect on weight loss in overweight female adolescents thus there are 33.1 % is influenced by factors aside the variables studied.

Table 4. Influence of Intervention on body composition and cardiorespiratory Fitness Index

Outcomes	Equality	P Value	R ²
BW (kg)	(Y) delta BB = $-4.271 + 2.043$ (skipping and control)	0.000	0.669
BF (%)	(Y) delta BF = $-1.336 + 0.800$ (skipping and control)	0.006	0.256
FM (kg)	(Y) delta FM = $-2.222 + 1.172$ (skipping and control)	0.000	0.624
FFM (kg)	(Y) delta FM = $-2.044 + 0.865$ (skipping and control)	0.007	0.249
Fitness Index	(Y) delta FM = $8.297 + -4.369$ (skipping and control)	0.113	0.094

*R²: Regresi Linear Test

According to result studies conducted by previous researchers, the risk factor for overweight in children and adolescents are obese parents, sleep duration, birth weight, eating habit, and family size (27). A significant/real relationship was found ($p < 0.05$) in a form of negative relationship between the weight delta of overweight female adolescents after receiving the skipping intervention thus giving a real

reduction of body weight of the overweight female adolescents.

The skipping training had effect on reducing body fat percentage as stated by 25.6 % which leaves the rest of percentage (74.4 %) influenced by factors other than the studied variables. Skipping also had effect on reducing fat mass as stated by 62.4 % and effect on reducing fat free mass as stated by 24.9 % in the subjects of this study. According

to Suryana (2017), another factor that influences body fat percentage is the level of physical activity, where light physical activity can cause body fat accumulation within the body. Furthermore, teenagers with less fiber intake tend to consume high fat and high calories foods such as foods made from flour, sweet foods and fried foods which have type of fatty acids for different usage, thus, it can trigger changes in adipose tissue, mitochondrial and insulin function and occurring changes in body composition (28,29). A significant/real relationship ($p < 0.05$) was found in a form of negative relationship between delta percent of body fat, fat mass and fat free mass of overweight female adolescents after receiving the skipping intervention. Thus, skipping treatment has a real decreasing effect on the PBF, FM, and FFM of the overweight female adolescents.

The skipping training had an effect on changes in IKK of overweight female adolescents as stated by 9.4 % which leaves the rest of percentage (90.6 %) influenced by factors other than the studied variables. According to previous research, other factors that able to influence increase in the cardiorespiratory fitness index are gender, age, BMI, waist circumference, percent body fat, in addition to birth weight, length of pregnancy, and gestational diabetes in pregnant woman that able to predict a low cardiorespiratory fitness during adolescence (30,31). There was no significant/real relationship ($p > 0.05$) between the IKK delta of overweight female adolescents after receiving skipping intervention. So, the skipping intervention does not increase the IKK of overweight female adolescents.

CONCLUSIONS AND RECOMMENDATIONS

A physical exercise program in a form of skipping training method held for 3 times in a week with gradual increase of 2 minutes time duration for every 2 weeks with a work ratio of 20/10 seconds rest for female adolescents aged 15-17 years had a significant impact on body composition (body weight, body fat percentage, fat mass and fat free mass) and

cardiorespiratory fitness. Skipping exercise is an effective way to improve body composition and cardiorespiratory fitness. Regular exercise program can reduce the problem of obesity and NCDs, which become the global problem affecting society in a whole. It requires awareness from respondents to monitor their body weight regularly, to increase physical activity by skipping exercise to maintain ideal body composition and improve cardiorespiratory fitness. The authors recommend a larger sample size and longer intervention time for future research so it could produce an optimal improvement in body composition and cardiorespiratory fitness. The limitation of this study is that it only focuses on providing physical activity but there are no other interventions such as dietary management and nutrition education for subjects during the intervention period, so that some variables do not have a significant effect on the interventions provided and the subject's understanding of weight control and obesity prevention cannot be known.

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