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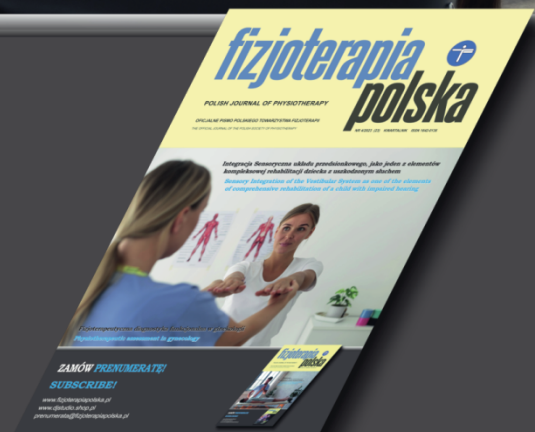
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# The aerobic exercise system for increasing Body Mass Index, waist circumference of overweight and obese students ages 20-22

*System ćwiczeń aerobowych do zwiększania wskaźnika masy ciała i obwodu talii u studentów z nadwagą i otyłością w wieku 20-22 lata*

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## Abstract

Aerobic exercise has been widely recognized as an efficacious intervention for enhancing students' body mass index and waist circumference, particularly among individuals classified as overweight and obese. However, a comprehensive search for studies conducted within the context of higher education in the Indonesia yielded no existing research. This study investigates the impact of aerobic activities on male students aged 20 - 22 [(N<sub>21 YEARS OLD</sub> = 9(45.00%), N<sub>20 YEARS OLD</sub> = 7(35.00%), N<sub>22 YEARS OLD</sub> = 4(20.00%); age mean of mean = 20.85 ± 0.75] from a selected higher education institution in the country. The present study employed an experimental research methodology, utilizing a sample of male college students who were overweight or obese. The sample size was divided equally, with a total of 20 participants (N = 20). The participants engaged in a 12-week aerobic fitness regimen consisting of one-hour session, three times per week. Independent samples t-test was used to examine the difference in the performance of both groups in relation to their BMI and WC post-test scores, while paired t-test was employed to compare the difference in the pre-test and post-test scores on participants' BMI and WC. Based on the results, a notable disparity in performance was detected between the two groups, with obese students demonstrating a considerable enhancement in their BMI [t(15.887) = -9.797, p < 0.05]. On the other hand, no significant difference was observed in the performance of the groups in terms of WC [t(16.665) = -0.505, p = 0.620]. A notable disparity was noted in the pre- and post-test scores of the participants' BMI and WC subsequent to engaging in a 12-week regimen of aerobic exercise, both in a general sense (BMI [t(19) = 14.439, p < 0.05 and WC t(19) = 14.333, p < 0.05] and within each group [Overweight: BMI t(9) = 14.488, p < 0.05] and WC t(9) = 15.057, p < 0.05; Obese: BMI t(9) = 7.922, p < 0.05] and WC t(9) = 7.746, p < 0.05]. Based on the findings, it can be inferred that involving male students who are overweight or obese in a meticulously planned aerobic exercise regimen has the potential to yield substantial improvements in their BMI and WC. This, in turn, may lead to increased performance in physical activity. Limitations and future research endeavors are hereby presented.

## Keyword

saerobic exercises, body mass index, overweightness, obesity, waist circumference

## Streszczenie

Ćwiczenia aerobowe są powszechnie uznawane za skuteczną interwencję w celu poprawy wskaźnika masy ciała (BMI) i obwodu talii (WC), szczególnie wśród osób klasyfikowanych jako mające nadwagę lub otyłe. Jednakże, szczegółowe poszukiwania badań przeprowadzonych w kontekście wyższego wykształcenia w Indonezji nie wykazały istnienia takich badań. Niniejsze badanie bada wpływ aktywności aerobowych na męskich studentów w wieku 20-22 lat [(N<sub>21 LAT</sub> = 9(45.00%), N<sub>20 LAT</sub> = 7 (35.00%), N<sub>22 LAT</sub> = 4 (20.00%); średnia wieku średnia = 20.85 ± 0.75] z wybranej instytucji szkolnictwa wyższego w kraju. Obecne badanie zastosowało metodologię badawczą eksperymentalną, wykorzystując próbkę męskich studentów z nadwagą lub otyłością. Liczba uczestników została równo podzielona na łącznie 20 osób (N=20). Uczestnicy brali udział w 12-tygodniowym programie fitness aerobowego, składającym się z jednogodzinnej sesji, trzy razy w tygodniu. Niezależny test t dla próbek został użyty do zbadania różnicy w wynikach obu grup w stosunku do ich wartości BMI i WC po teście, podczas gdy sparowany test t został użyty do porównania różnicy w wynikach przed i po teście uczestników na ich BMI i WC. Na podstawie wyników, zauważono wyraźną różnicę w wynikach między dwiema grupami, przy czym studenci otyli wykazali znaczącą poprawę w swoim BMI [t(15.887) = -9.797, p < 0.05]. Z drugiej strony, nie zaobserwowano znaczącej różnicy w wynikach grup pod względem WC [t(16.665) = -0.505, p = 0.620]. Zauważono wyraźną różnicę w wynikach przed i po teście BMI i WC uczestników po zaangażowaniu się w 12-tygodniowy program ćwiczeń aerobowych, zarówno w ogólnym sensie (BMI [t(19) = 14.439, p < 0.05 i WC t(19) = 14.333, p < 0.05] oraz wewnątrz każdej grupy [Nadwaga: BMI t(9) = 14.488, p < .05 i WC t(9) = 15.057, p < 0.05; Otyłość: BMI t(9) = 7.922, p < 0.05 i WC t(9) = 7.746, p < 0.05]. Na podstawie wyników można wywnioskować, że zaangażowanie męskich studentów z nadwagą lub otyłością w starannie zaplanowany program ćwiczeń aerobowych ma potencjał przynoszenia znaczących popraw w ich BMI i WC. To z kolei może prowadzić do zwiększenia wydajności w aktywności fizycznej. Ograniczenia i przyszłe kierunki badań są niniejszym przedstawione.

## Słowa kluczowe

ćwiczenia aerobowe, wskaźnik masy ciała, nadwaga, otyłość, obwód talii



## Introduction

In recent years, there has been growing recognition of a widespread global phenomenon characterized by a general disinterest and lack of motivation towards various physical activities [1]. There has been an observed increase in the proportion of individuals who are not participating in physical activities, with a particular focus on young teenagers, such as college students [2, 3]. Significantly, the prevailing circumstances have led to a profound transformation in the manner in which individuals conduct their lives, mostly due to the extensive calamity caused by the COVID-19 pandemic [4, 5]. One significant factor is the widespread closure of higher education institutions worldwide, resulting in a significant transition from traditional in-person instruction to online learning platforms. The unanticipated alteration in the scholarly milieu had adverse consequences on the well-being of university students, leading to challenges pertaining to their physical well-being [6, 7], including those in the Indonesia and Philippines [8–10]. Internationally, including in the Indonesia, Philippines, there is a widespread emphasis on the promotion of students' health and fitness through online physical education programs. Educators are making efforts to actively involve students in health regimens, aiming to improve their physical well-being even inside the confines of their own homes. A decrease in the duration of physical activity can exert an adverse impact on an individual's physical fitness, resulting in a deterioration of muscular strength, agility, and flexibility, as well as cardiorespiratory endurance and body composition [11–13]. According to [14], despite advancements in technology, the online platform fails to fully capture the social and experiential aspects of physical education. The lack of effective communication regarding the true purpose and value of physical education can lead to negative outcomes, particularly when students are repeatedly exposed to limited learning environments and inadequate educational resources [15]. According to a study conducted by [16], there is no discernible impact of virtual physical education courses on students' inclination to participate in physically demanding activities or their acquisition of motor skills. The variables mentioned above may contribute to a decrease in desire and interest, as well as a limited number of opportunities for meaningful peer interactions. The available data thus far indicates that the delivery of online courses continues to pose challenges, even in the aftermath of the epidemic. Physical education classes may face challenges in transitioning to online instruction. At this mo-

ment, schools went back to full-blown traditional classroom setting in which both teacher and students meet, most especially in Physical Education classes.

Numerous research have been undertaken to examine the efficacy of aerobic activities in reducing and improving individuals' body mass index and waist circumference. For instance, the recent research conducted by [17] demonstrated that students who engaged in diverse aerobic and mobility training activities saw a noteworthy and beneficial impact on the decrease of their body mass index (BMI) within an online educational setting. Most importantly, it has been prevalent across various literature that aerobic activities or exercises significantly improves body mass index, as well as waist circumference [18–21], most especially for overweight and obese individuals [22–25]. The aforementioned literature has effectively demonstrated the beneficial impact of participating in a diverse range of aerobic activities on the enhancement of an individual's body mass index (BMI) and waist circumference (WC). Nevertheless, a comprehensive search for relevant studies conducted in the Indonesia revealed a dearth of research investigating the impact of aerobic activities on students' body mass index (BMI) and waist circumference (WC). The objective of this study is to assess the efficacy of a 12-week aerobic exercise regimen for male undergraduate students classified as overweight and obese, aged 20–22 years, within a specific higher education institution in the Indonesia.

## Material and method

### Research design

This present inquiry has utilized the experimental approach to measure the effectiveness of a 12-week aerobic exercise program in the reduction and improvement of body mass index and waist circumference of a sample of male students in a selected higher education institution in the Indonesia. This scientific method entails conducting research in a methodical manner, with a strong emphasis on achieving accuracy and deriving the most definitive conclusions [26]. Table 1 presents the aerobic exercise regimen in which students are expected to engage. Additionally, this guide offers information on the calories burned that can be attained through the execution of various activities for a duration of five minutes, along with related instructions. The participants engaged in the aforementioned workout regimen for a duration of one hour, three times per week, over a span of twelve weeks.

**Table 1. Aerobic Exercise program with breaks in between**

Specific Activity	Calorie Burn	Duration	Instructions
Jumping jacks	10 cal/min	5 min	Stand up straight with feet close together, shoulders back, and arms down at the side. Keep chest and head up, and always look forward. With knees slightly bent, jump spreading the legs. When jumping, stretch the arms out wide and over the head. Land softly on the midsoles of the feet, which should be about shoulder-length apart. Reverse these steps to return to the starting position and repeat.

**Table 1. Mean  $\pm$  SD from the two groups**

Specific Activity	Calorie Burn	Duration	Instructions
Jump squats	10-14 cal/min	5 min	Stand with back straight and feet close together. Pull shoulders and elbows back, and clasp fists together in front. With the head up and looking forward, jump spreading the legs to land into a squat position. The knees should make right angle. Jump up and return to the starting position, and repeat.
High knees	3.5-7 cal/min at a moderate pace	5 min	Stand up straight with feet slightly apart, shoulders back, and arms down at the side. Keep head up and look forward. Raise right knee as high as comfortable while propelling the arm forward, generating momentum like you would when running. As the knee being brought downwards, land softly on the midsole of the foot and quickly switch to the other knee and arm. Repeat. High knees should look like exaggerated running.
Butt kicks	3.5-7 cal/min at a moderate pace	5 min	Straighten body and bend slightly forward. Feet should be slightly apart, shoulders back, and arms at the side. Keep the head up and look forward. While standing on the right leg, bring the left heel as close to buttocks as comfortable while propelling the right arm forward, generating momentum like running. As the foot being brought downwards, land softly on the midsole of the foot and quickly switch to another heel and arm. Repeat. Similar to high knees, butt kicks should be like exaggerated running.
Skaters	10 cal/min	5 min	Stand with feet slightly wider than shoulder length and with arms down on the side. While looking forward, jump onto the right foot, landing with right knee bent and the left foot behind the right. Swing left arm in front and right arm back. Reverse and repeat.
Inchworm	6-7 cal/min	5 min	Stand up straight with feet hip-width apart and the arms down at the side. Bend at waist to touch the ground. It is okay if the knees are bent. Walk the hands forward and enter a plank position. The body should be straight with muscle groups engaged. With the feet with hands, keeping the knees straight as far as can go. Bend the waist to return to the starting position.
Bear crawls	7 cal/min	5 min	Enter into a crawl position with the knees on the ground below the hips and hands aligned directly with the shoulder. With the back straight, slowly raise knees and balance on the midsoles of the feet. Engage the core and begin crawling by moving the right arm and left foot forward, then left arm and right foot. Keep the knees bent and avoid touching the ground.
Lateral plank walk	7 cal/min	5 min	Enter into a push-up position with the hands and feet shoulder-width apart. Engage the core to keep the back straight and keep the head up, looking forward. Straight with the right hand and foot, moving them simultaneously to the right while squeezing the thighs and glutes. After both right hand and foot on the ground, begin moving the left hand and foot over to the center of the body. Reverse and repeat.
Mountain climbers	10 cal/min	5 min	Enter into a push-up position with the hands at shoulder-width and feet slightly apart. Engage the core to keep back straight and bring the right knee towards the center of the torso. Return to the starting position and quickly switch to the left knee.
Donkey kicks	5-10 cal/min	5 min	Get on the hands and knees. Hands should be aligned with the shoulders and knees aligned with the hips. Engage the core to keep the back straight and start with right leg. Keeping the leg at a 90-degree angle, kick it as high as comfortable behind and slowly bring it back down. Repeat for desired repetitions, then switch to other leg to complete a set.
Corkscrew	6 cal/min	5 min	Lie with the back with legs together and palms on the ground. Suck in the belly and use the abs to lift the legs. Keeping the abs engaged and legs together, use the abs to move the legs in a circular motion. If needed more support, tuck the hands below the butt.
Flutter kicks	6 cal/min	5 min	Lie with the back with legs together and palms tucked underneath the butt to support. Suck in the belly and use the abs to lift the legs. Keeping the abs engaged, kick the feet up and down.
Bicycle crunches	3-4 cal/min	5 min	Lie with the back with feet flat, knees bent, and hands behind the head. Engage the core, bring the right knee to chest, and while keeping the leg left straight, lift at a 45-degree angle. As the knee approaches the chest, lift the shoulders blade off the ground (make sure not to pull the neck) and twist the upper body (keep the arms straight) to bring the left elbow to the knee. Repeat with opposite knee and elbow.



## Participants

The participants of the study are selected undergraduate students who are classified as overweight and obese from a selected higher education institution in the Indonesia during the 2nd Semester, A.Y. 2023-2024. In this regard, the sampling technique that was utilized is the Purposive Sampling technique. Most importantly, a selection criterion was formulated by the researchers to obtain the most reliable and accurate data from the participants:

- Male student.

- Enrolled in PATH-FIT 2 (Fitness-based).
- Classified as overweight and obese.

The profile of the participants is illustrated in Table 2. Based on the table, both undergraduate male students are equally distributed for both overweight and obese [NOVERWEIGHT = 10(50.00%), NOBESE = 10(50.00%)] with a total of N=20 participants. Lastly, most of the participants are under the age of 21, followed by 20 and 22 years old [ $N_{21 \text{ YEARS OLD}} = 9(45.00\%)$ ,  $N_{20 \text{ YEARS OLD}} = 7(35.00\%)$ ,  $N_{22 \text{ YEARS OLD}} = 4(20.00\%)$ ] with an age mean of mean =  $20.85 \pm 0.75$ .

**Table 2. Demographic characteristics**

Variable	Item	N(%)
Classification	Overweight	10(50.00%)
	Obese	10(50.00%)
Age (mean = 20.85)	20	7(35.00%)
	21	9(45.00%)
	22	4(20.00%)

## Data gathering and procedures

The acquisition of data from the participants were obtained by using two-part survey questionnaire. First, the demographic characteristics of the participants were obtained, such as age and BMI scores (pre-test and post-test). In relation to this matter, the measurement of height and weight was conducted utilizing the DETECTO 339 apparatus. The participants assumed a vertical alignment of their bodies when situating themselves on the apparatus. The participants positioned their uncovered feet on the weighing scales as part of the data collection protocol. In addition, the participants' body mass index (BMI) was determined by dividing their weight in kilograms by the square of their height in meters ( $\text{kg/m}^2$ ). Lastly, the researchers utilized the Physical Activity Readiness Questionnaire (PAR-Q) to evaluate the current health status of the participants, therefore determining the criteria for inclusion and exclusion in the study.

## Statistical analysis

A variety of statistical approaches were employed in the present investigation. The demographic features of the individuals were mostly described using descriptive statistics, including frequency, mean, and standard deviation. Furthermore, the independent samples T-test was employed to assess the statistical significance of the disparity in performance between the overweight and obese groups following their participation in a 12-week aerobic exercise program, as indicated

by the post-test scores. Finally, a series of paired t-test was conducted to examine the significant differences in the pre-test and post-test scores of all participants, as well as separately analyzing the scores of overweight and obese students.

## Ethical considerations

All participants were briefed on the experiment's goals, as well as any instruments or tests that would be used to evaluate their progress and output. The positive effects that this investigation will have on primary educational institutions and the scientific community as a whole have also been outlined.

## Results

Table 3 displays the findings of the Independent Samples T-test analysis, comparing the performance of both groups based on their post-test scores with respect to their body mass index and waist circumference. Based on the findings, a notable disparity in the scores of the participants has been noted in relation to body mass index, specifically indicating that obese students have demonstrated a significantly enhanced BMI compared to their counterpart [ $t(15.887) = -9.797$ ,  $p < 0.05$ ]. On the contrary, no significant variance was observed in between groups with respect to waist circumference [ $t(16.665) = -0.505$ ,  $p = 0.620$ ]. In relation to this matter, it can be hypothesized that both groups have had a substantial improvement in waist circumference.

**Table 3. Overweight and obese: performance analysis based on post-test scores using independent samples T-test**

	N	M ± SD	SE	Df	t-test	Sig.	Decision
Body Mass Index							
Overweight	10	25.23 ± .91	0.29	15.887	−9.797	0.000	Significant
Obese	10	30.25 ± 1.34	0.42				
Waist Circumference							
Overweight	10	34.20 ± 2.25	0.71	16.665	−0.505	0.620	Not Significant
Obese	10	34.80 ± 3.01	0.95				

Table 4 illustrates the findings of the paired t-test analysis, comparing the pre-test and post-test scores of the participants with respect to body mass index and waist circumference. In an overall perspective, it has been observed that there is a significant difference in the pre-test and post-test scores of all the participants' BMI [pre-test ( $29.79 \pm 2.89$ ) versus post-test ( $27.74 \pm 2.81$ ),  $t(19) = 14.439$ ,  $p < 0.05$ ] and WC [pre-test ( $36.65 \pm 2.56$ ) versus post-test ( $34.50 \pm 2.61$ ),  $t(19) = 14.333$ ,  $p < 0.05$ ]. For overweight students, it has also been observed that there is a significant variance in their pre-test and post-test scores in their BMI

[pre-test ( $27.34 \pm 1.20$ ) versus post-test ( $25.23 \pm 0.91$ ),  $t(9) = 14.488$ ,  $p < 0.05$ ] and WC [pre-test ( $36.50 \pm 2.32$ ) versus post-test ( $34.20 \pm 2.25$ ),  $t(9) = 15.057$ ,  $p < 0.05$ ]. Lastly, for obese students, a significant difference was observed in their pre- and post-test scores in their BMI [pre-test ( $32.24 \pm 1.68$ ) versus post-test ( $30.25 \pm 1.34$ ),  $t(9) = 7.922$ ,  $p < 0.05$ ] and WC [pre-test ( $36.80 \pm 2.90$ ) versus post-test ( $34.80 \pm 3.01$ ),  $t(9) = 7.746$ ,  $p < 0.05$ ]. In general, it can be asserted that both overweight and obese students had substantial benefits as a result of engaging in a 12-week regimen of aerobic activities.

**Table 4. Overweight and obese: BMI and WC pre- and post-test scores after 12-week aerobic exercise using paired t-test**

Overall	M ± SD	SE	Paired Differences		t	df	Sig.
			95% Confidence Interval of the Difference				
			Lower	Upper			
BMI <sup>a(pre)</sup> – BMI <sup>b(post)</sup>	2.05 ± 0.63	0.142	1.7528	2.3471	14.439	19	0.000
WC <sup>a(pre)</sup> – WC <sup>b(post)</sup>	2.15 ± 0.67	0.150	1.836	2.464	14.333	19	0.000
Overweight participants							
BMI <sup>a(pre)</sup> – BMI <sup>b(post)</sup>	2.11 ± 0.46	0.146	1.7805	2.4395	14.488	9	0.000
WC <sup>a(pre)</sup> – WC <sup>b(post)</sup>	2.30 ± 0.48	0.153	1.954	2.646	15.057	9	0.000
Obese participants							
BMI <sup>a(pre)</sup> – BMI <sup>b(post)</sup>	1.99 ± 0.79	0.251	1.4217	2.5882	7.922	9	0.000
WC <sup>a(pre)</sup> – WC <sup>b(post)</sup>	2.00 ± 0.82	0.258	1.416	2.584	7.746	9	0.000

## Discussion

Initially, a notable disparity in the participants' performance was noted subsequent to their involvement in a 12-week regimen of aerobic exercise. Specifically, individuals identified as obese exhibited substantial enhancements in their body mass index in comparison to those labeled as overweight. On one hand, no significant difference was observed between the two distinct groups in terms of the enhancement and reduction of their waist circumference. Remarkably, when considering the broader context, there exists a substantial disparity between the pre- and post-test measurements of the participants' Body Mass Index (BMI) and Waist Circumference (WC) subsequent to their involvement in a 12-week regimen of aerobic activity. In a more precise manner, it has been observed that male students who were overweight or obese experienced a notable decrease in their body mass index (BMI) and waist circumference (WC) following participation in the aforementioned workout regimen. The results of this study have been supported by various studies that were conducted in relation to this current inquiry. For example, the study of [27] emphasized that aerobic exercise has been found to be an effective means of reducing body weight, body mass index (BMI), body fat rate, and body circumference among college students. Additionally, it has been observed to contribute to a decrease in body weight, resulting in a more symmetrical body shape. Furthermore, aerobic exercise has been shown to improve lipid and glycemic components, thereby reducing the complications associated with obesity. Likewise, in the experimental study of [28] it was observed that there is a

statistically significant interaction between time and condition was found for total cholesterol (TC) ( $F(1, 21) = 5.427$ ,  $p = 0.030$ ,  $\eta^2p = 0.205$ ) and high-density lipoprotein to low-density lipoprotein ratio (HDL)/LDL ( $F(1, 21) = 5.951$ ,  $p = 0.024$ ,  $\eta^2p = 0.221$ ). The reduction in these variables was more pronounced in the RE group. The LDL levels exhibited a substantial drop solely in the RE group, as evidenced by the statistical analysis ( $F(1, 21) = 4.897$ ,  $p = 0.038$ ,  $\eta^2p = 0.189$ ). Most importantly, the study observed a decrease in body mass, body mass index (BMI), and waist circumference, as well as an increase in  $VO_{2peak}$ , in both experimental groups. However, there was no statistically significant difference observed between the two groups. The results indicate that there was no statistically significant impact of either time or condition on waist to hip ratio (WHR), fasting blood glucose (FBG), triglycerides (TG), high-density lipoprotein (HDL), total cholesterol to HDL ratio (TC/HDL), or triglyceride to HDL ratio (TG/HDL) ( $p > 0.05$ ). Furthermore, the study of [17] has also observed that there is a significant improvement in students' BMI after engaging themselves in a series of aerobic and mobility training exercise even in an online learning environment. In this regard, it can be stipulated that organized aerobic exercises can highly benefit male students most especially those who are classified as overweight and obese.

Based on a range of empirical investigations, it has been demonstrated that there exist several elements that may potentially influence students' levels of physical activity, as well as their body mass index and waist circumference. Several



studies have underscored the strong association between eating patterns and even stress, body mass index (BMI) and waist circumference (WC), highlighting its potential impact on individual physical activity performance [29–33]. This implies that there is a positive correlation between a higher body mass index (BMI) and waist circumference (WC) and a greater prevalence of unhealthy patterns, as well as a negative correlation between a lower BMI and WC and a lower prevalence of unhealthy patterns. There was a notable correlation observed between body mass index (BMI), waist circumference (WC) and variables linked to individual lifestyle preferences. Overweightness and Obesity has been associated with various dimensions of an individual's lifestyle, including insufficient physical activity, tobacco consumption, and alcohol consumption [34–37]. Subsequent research endeavors may be inclined to explore the effects of the aforementioned factors on the levels of physical activity among students, with a specific focus on their engagement in aerobic workouts, in conjunction with their body mass index and waist circumference.

## Conclusion

Based on the results of the investigation, it can be inferred that male college students who are overweight or obese and fall between the age range of 20 – 22 may exhibit favorable

participation in a 12-week aerobic exercise regimen, leading to significant reductions in both body mass index and waist circumference, so enhancing their overall physical condition. Within this particular framework, educators in the field of physical education within the institution may consistently utilize these specific physical exercises as a method to foster a positive, health-oriented, and enjoyable activity that has the potential to positively impact their body mass index (BMI) and waist circumference (WC) measurements. Previous empirical research has demonstrated that engagement in these activities yields significant advantages, not only in terms of reducing body mass index (BMI) and waist circumference (WC), but also in promoting overall well-being and improved quality of life. Conversely, it is strongly recommended to do a comparable investigation to corroborate or challenge the conclusions of this study.

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