

# The effect of medicine ball games on muscular strength, $\dot{V}O_{2max}$ and abdominal fat among overweight and obese netball players

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**Abstract--** Youth girls in South East Asia are eager to play netball at schools, however, a majority of them are overweight and obese with a poor fitness level. This study aimed to determine the effect of medicine ball games (MBG) on muscular strength and  $\dot{V}O_{2max}$  as well as abdominal fat among overweight and obese netball players. Fifty overweight and obese volunteers (14-16years,  $BMI \geq 26.8 \text{ kg.m}^{-2}$ ) randomly divided into; MBG and control groups. Pre and post-test assessed muscular strength (Push-up),  $\dot{V}O_{2max}$  (Bleep-Test) and abdominal fat (WHR). MBG group completed 8 weeks MBG training program; three times/weekly, 60 minutes per session. Results showed a significant improvement in muscular strength ( $p=0.001$ ) and abdominal fat ( $p=0.001$ ) in MBG group, while no significant differences in  $\dot{V}O_{2max}$  ( $p=0.69$ ) observed between two groups. Therefore, various types of enjoyable MBG can strongly be suggested for overweight and obese netball players to enhance muscular strength and reduce abdominal fat mass. However, further studies are needed to investigate various type of MBG program on other physiological factors and body composition profile in this population.

**Keywords--** Medicine ball games, Muscular strength,  $\dot{V}O_{2max}$ , Abdominal fat, Netball players

## I INTRODUCTION

It is well known that regular physical activity plays a crucial role in preventing a number of non-communicable diseases that challenging modern society [1]. It is a prospect that physical activities during school-time have potential to improve the quality of life into adulthood [2]. While obesity is increasingly one of the severe health risk factors in the worldwide. Numerous physiological and psychological interests of physical education programs can be allied with healthy lifestyle during adolescence [3]. Similarly, previous study reported that being overweight between ages 14 and 19 years is linked with expanded mortality after age 30 years from systemic diseases [4].

In addition, Ghee et al. (2016), stated that based on 265 articles from January 2000 – February 2016, 64.0% of children in Malaysia are in the overweight and obese category [5]. Parallel to increasing obesity prevalence, managing of childhood obesity is more crucial via education strategy to improve level of physical activity and

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healthy lifestyle among girls and boys [3]. Moreover, according to the Ministry of Education strategy, physical education for young students is compulsory and aimed to reduce obesity and improve a healthy lifestyle [1].

To date, netball is a favourite sports activity with high-intensity effort in Malaysia primary and secondary schools particularly for girls, while there are obese netball players with poor fitness level [6]. This statement is supported by SEGAK data, which showed the muscular strength and cardiovascular fitness were poor among secondary school netball players [7]. In addition, netball is an alternate, and vigorous contact sports game characterised repeated high-intensity effort in a short period, where players run, jump, throw and catch the ball at high velocities, changes of directions followed by low intensity or rest phase. According to Sayers and Bishop (2017), a player who can generate maximum power output during throwing, passing, defending or attacking activities is often capable of superior performance. It has proven that, players' performance depends on their physical capability with accurate muscular strength, cardiovascular endurance and abdominal fat percentage [8].

Considering the literature about nature of game by providing strong motivation for people [9], the significant evidence suggest to successfully motivate people who currently do not exercise. Games could appropriately motivate who do not exercise or doing in low self- efficacy [10]. To overcome the improvement of physical fitness among obese children not only there are variety of physical activity in school program, but the approach of physical education class should be comprehended through PE teachers. Similar to Verhoeff et al. (2020) recommendation that the conditioning coaches need to start out and explore problems rather than following existing solutions [11]. In addition, it has also conveyed that, medicine ball games as weighted or heavy pleasurable ball games and exercises can enhance muscular strength, cardiovascular fitness and facilitate sports performance in youth exercise program [12]. According to Faigenbaum and Mediate (2006), medicine ball games (MBG) defined as weighted or heavy ball used enthusiastically for improving the physical fitness among players specifically in conditioning and strengthening exercises [13].

However, despite these potential health benefits of MBG, there has been no study investigating effects of integrating a medicine ball games on upper-body strength,  $\dot{V}O_{2max}$  and abdominal fat mass in overweight and obese youth netball players in schools. Thus, this study aimed to investigate the effect of 8 weeks medicine ball games on improving muscular strength,  $\dot{V}O_{2max}$  as cardiovascular fitness indicator and abdominal fat among 14-16 years overweight and obese girls' netball players.

## II MATERIALS AND METHODS

This study was a randomized control trail with receiving an intervention program. It was designed as an experimental approach to investigate whether upper-body muscle strength,  $\dot{V}O_{2max}$  and abdominal fat could be achieved in overweight and obese netball players after undertaking 8 weeks medicine ball game program as part of the school regular netball training.

### II.1 Sample Size and Subjects

The study's sample size was calculated by G\*Power 3.0.10 with medium effect size (0.25). It indicated a sample size of 25 would give 95% power for each variable. Then, fifty overweight and obese netball players (14-16 young,  $BMI \geq 26.8kg.m^{-2}$ ) voluntarily selected according to SEGAK scores report during August 2018. All subjects' parents and physical education teachers were informed the procedures of the study and signed a consent form prior

to participation. They were also able to withdraw of the study at any time without any consequences. They were randomly divided in two groups; medicine ball game (MBG) and control group. The subjects in both groups participated in one orientation session prior to testing procedures. The physical characteristics of the subjects are described in Table 1.

**Table 1.** Demographic characteristics of participants (Mean  $\pm$  SD) for MBG and control groups

<b>Variables/groups</b>	<b>medicine ball (n = 25)</b>	<b>Control (n = 25)</b>
Age (year)	14.68 $\pm$ 0.7	14.42 $\pm$ 0.50
Height (cm)	1.53 $\pm$ 0.04	1.52 $\pm$ 0.04
Pre-Weight (kg)	62.76 $\pm$ 3.68	61.72 $\pm$ 3.78
Post-weight (kg)	60.24 $\pm$ 3.24	61.54 $\pm$ 3.72
Pre-BMI (kg.m <sup>-2</sup> )	26.93 $\pm$ 1.01	26.54 $\pm$ 1.00
Post-BMI (kg.m <sup>-2</sup> )	25.86 $\pm$ .98	26.46 $\pm$ 1.27

## II.2 Outcome Measurements

Push-up test was used to measure the upper-body muscular strength [14]. Bleep test was conducted to measure cardiovascular fitness ( $\dot{V}O_{2max}$ ) among the subjects [15]. Waist to hip ratio (WHR) measurement for abdominal fat was taken according to the ratio of waist circumference to hip circumference [16]. It should be mentioned that push-up and bleep test are categorized and standardized as SEGAK tests introduced by the Malaysian Ministry of Education [17].

## II.3 Intervention Program; Medicine ball games

There are literally thousands of exercises that can be performed with medicine balls [13], this study carried out with a modified medicine ball game (MBG) package including backward throw wall hit, two arms throw shoot and ball fast twist race. All participants in medicine ball group followed the terms and condition of games (Table 2).

**Table 2. Medicine Ball games' term and condition**

1. The game environment should perform safe and free of risks.
2. Every session begin with dynamic warm-up activities and end with cooling-down.
3. Participant divided into five groups/teams.
4. Each participant of team stands behind the markers.
5. Each team has one MB.
6. Each participant should finish their turn.
7. Gradually increase the number of turn repetition, target distance and weight of the MB.

The game activities were conducted for MBG group, 3 sessions weekly (60 minutes per session), while the control group had only two sessions ordinary physical education class per week. All participants completed the same warm-up (5 minutes) consisting of light jogging followed by upper-body stretches and submaximal throwing and cool-down also was considered per session. A summary of modified medicine ball game (MBG) package has presented in Table 3.

**Table 3.** Summary of medicine ball game procedure

<b>MBG; type</b>	<b>Game procedure</b>	<b>Winner; final marks</b>
Backward throw wall hit	A basket was placed 1 meter away from the wall Throwing MB back to hit the wall and make sure its fall inside the basket. Taking and running to the following participant to continue the game.	Number of MB falling inside the basket.
Two arms throw shoot	5 Rings were placed 0.5 meters away from the wall. Throwing MB to the ground in front of their feet where the ring placed. Taking MB should and run to the following participant to continue the game.	Number of MB falling inside the ring
Ball fast twist race	Sitting side by side on the floor in one line with the bent knees. Rotating and passing MB to the next participant.	First team finisher (time)
Intensity: load frequency duration rest interval	week1→week 8 2kg→2.5kg MB 3→5 time of turns 12→15minutes for each game duration 3→1 minutes between each game	

## II.4 Data analysis

The data were collected via pre (before the intervention program; baseline) and post-test (after intervention program period) process. The mean and standard deviation for the demography data and upper-body muscular strength,  $\dot{V}O_{2max}$  and WHR were analyzed using IBM SPSS Statistics ver. 23.0 (IBM Co., Armonk, NY, USA). One-way univariate analysis of covariance (ANCOVA) was conducted to assess if there was difference between participants in the medicine ball game group and participants in the control group in the improvement of upper-body muscular strength,  $\dot{V}O_{2max}$  and WHR after 8 weeks medicine ball games. Also the variances for the variables between both groups assessed by using Levene test. The significance level was considered at  $p \leq 0.01$ .

### III RESULTS AND DISCUSSION

According to the preliminary examination there was no significant difference between MBG and control group participants in relation to their age, weight, height, BMI and both studied groups were statistically comparable. It worth to remark that even though the participants were in the control group, the researchers were not able to control all of their training or exercise conditions. The average attendance of participants in MBG group was 94% of sessions during 8 weeks (24 sessions). Comparisons of muscular strength (Push-up repetition) and abdominal fat (WRH) and  $\dot{V}O_{2max}$  as statistically analysed by ANCOVA for both groups after 8 weeks illustrates at Table 4.

**Table 4.** Data for muscular strength,  $\dot{V}O_{2max}$  and abdominal fat among overweight and obese netball players

Variables	MB (n=25)		Control (n=25)		Group × time interaction effects		
	baseline	Week8	baseline	Week8	f	p	Eta <sup>2</sup>
<b>Muscular strength</b> (Push-up repetition)	10.6±3.33	14.6±2.81	9.24±3.54	9.72±3.57	17.63	.00	.28
<b><math>\dot{V}O_{2max}</math></b> (ml.kg <sup>-1</sup> .min <sup>-1</sup> )	30.58±2.74	31.62±2.56	29.7±2.29	30.10±2.34	.17	.69	.01
<b>WHR (ratio)</b>	0.86±0.04	0.82±0.03	0.87±0.036	0.65±0.034	15.88	.00	.26

These results indicated a significant improvement in muscular strength ( $P < 0.001$ ) and reduction in abdominal fat ( $P < 0.001$ ) after 8 weeks in MBG group compare to control group, while no significant differences was found at baseline and after week eight of  $\dot{V}O_{2max}$  between both groups. It should be mentioned that although the improvement of  $\dot{V}O_{2max}$  was more than the control group, the interaction effects of Group × time was not significant ( $p = .69$ ).

As it earlier mentioned, the present study aims to show the effect of 8 weeks medicine ball games on muscular strength,  $\dot{V}O_{2max}$  and abdominal fat among 14-16 years overweight and obese girl's netball players. The findings indicates that involving in this regular MBG program could significantly improve muscular strength and reduce abdominal fat. Although the MBG group made greater improvement in  $\dot{V}O_{2max}$  compared to the control group, this study could not find a significant effect on  $\dot{V}O_{2max}$ .

This findings of present study were in line with a study by Trajković et al. (2017), confirming that there is a significant improvement in muscular strength after the medicine ball training session among the netball players [12]. The regular training using medicine ball seemingly affects the conditioning for young students [18]. Meanwhile, Batrakoulis et al. (2018), explained that medicine ball games are mainly conducting to improve muscular power while other physical fitness components like body composition and cardiovascular endurance can be properly improved among futsal players [19]. Moreover, Berdejo-Del-Fresno et al. (2015) study shown that

$\dot{V}O_{2max}$  enhanced following a futsal games periodization with combination of a change in the number of players, court size and type of goals to increase intensity (heart rate) and more frequent individual tactical activities [20].

Furthermore, while previous study mentioned medicine ball training as a resistance and high intensity plyometric training [21], Idrizovic et al. (2018), suggested that any specific plyometric training protocol should interchangeably use upper and lower body exercises to enhance fitness component in female volleyball players [22,23]. Similar improvements in the players' ability to participate in running activity after the medicine ball training were found by previous studies which stated although the medicine ball training design for muscle strength, it also improved  $\dot{V}O_{2max}$  level among athletes [24-26].

Since both groups of this study participated in routine physical education lesson during the period of this study, the differences of non-significant findings in  $\dot{V}O_{2max}$  with previous study might be explained by the type of MBG and number of players in a team which probably influenced on duration of their task and turn of players [27].

However, it could be reasonable to support this argument related to  $\dot{V}O_{2max}$  improvement if modification of MBG maintain endurance of involvement for overweight and obese netball players. Therefore, the findings of this study can be resulted that netball coaches or instructors may apply MBG by modifying the games in small number of players (<5 players in a team), weight of MB, diversity of games (>3 type of games), and tactical action to involved each player for their longer task and increase the  $\dot{V}O_2$  demands among overweight and obese players.

Although earlier studies recommended medicine ball training as an efficient method to promote physical fitness in school-based programs, a novel finding of this study was an eight week MBG willingly performed thrice per week created superior significantly reduce in abdominal fat in overweight and obese girl students who prefer to play regularly netball as their favorite sports.

In that, since children and teenagers love to play game, the results of this study have an important practical implication for physical education teacher to provide other similar program with medicine ball games particularly for overweight and obese school children. Owing to the increasing popularity of resistance training such as medicine ball training among school students, further investigations are looked-for to optimize the intensity of medicine ball games for greater cardiovascular fitness ( $\dot{V}O_{2max}$ ) benefit in overweight and obese youth.

#### **IV CONCLUSION**

Findings of this study propose that the medicine ball games as an effective method to improve muscular strength, and reduce abdominal fat among overweight and obese netball players to enhance their physical conditioning and performance level. In that, since children and teenagers largely enjoy playing the game, the results of this study have an important practical implication for physical education teacher to provide other similar program with medicine ball games particularly for overweight and obese school children. In conclusion, MBG can be strongly suggested as an effective and pleasurable intervention program to improve muscular strength and control abdominal fat which are health indicators among youth overweight and obese netball players.

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