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Effectiveness of Circuit Training in Physical Education Classes on Health-Related Fitness (HRF) and Motor Skill Competence (MSC) Among Primary Schools' Obese Children

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ABSTRACT

Physical Education is one of the compulsory subjects in the Malaysian educational system and widely lacking in the process of teaching and learning, because of different approaches implemented by various schools' teachers and it needed to venture as far as this pillar of our National Education. The purpose of this study was to investigate the effectiveness of Circuit Training (CT) on obese students' specifically their health-related fitness (HRF) and motor skill competence (MSC) which is in line with the rise of obesity rate among young children nationwide. Pre and post-test with a total of 232 obese primary students who were randomized and assigned into control and experimental groups for age group 8 and 11 years old respectively. Descriptively, significantly the effectiveness of CT on obese students' body weight and even BMI index decreased for the experiment group for both age groups (31.08 kg/m^2 to 30.93 kg/m^2) but not in control groups. Thus, body weight increased in control groups (49.92 kg to 50.07 kg). HRF consisted cardiovascular, strength, endurance and flexibility showed clear results of the CT implemented especially in both groups' ages with enhancing better scores in all components (101.62 to 108.03, 5.69 to 6.59, 7.26 to 8.40, and 24.77 to 24.80 minutes separately) compared to control groups. Moreover, there were some cardiovascular and flexibility increases after 8 weeks. Hence, obese 11-year-old students showed impressive enhancing reading for all HRF. However, in the 11-year-old control groups, there was an increase in cardiovascular only and a decrease in the rest. Where else, the motor skill competencies for 8 weeks decreased in competencies of running, kicking, jumping and throwing but vice versa for the experimental groups. CT is an appropriate teaching approach in PE for MSC and HRF during primary schools as far as student-centred approaches are concerned.

***Keywords**: Circuit Training (CT), Physical Education, Health-related Components, Motor skills Competencies, Obese students*

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INTRODUCTION

According to the National Education Philosophy of Malaysia Education in Malaysia is an ongoing effort towards further developing the potential of individuals in a holistic and integrated manner, to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious, based on a firm belief in and devotion to God. Such an effort is designed to produce Malaysian citizens who are knowledgeable and competent, who possess high moral standards, and who are responsible and capable of achieving high level of personal well-being as well as being able to contribute to the harmony and betterment of the family, the society and the nation at large (Malaysia Ministry of Education, 1988) (https://www.moe.gov.my/en/dasarmenu/falsafah-pendidikan-kebangsaan).On top of it, the Teacher Professionalism Division of MOE would in line with IR 4.0 which expected teachers are encouraged to share best practices in teaching and learning in the classroom, according to the Ministry of Education (2013), and to use teaching coaching as a means of lifelong learning. This learning process depicts the evolution of teachers from phase to phase before they change their professional practice. Successful teaching guidance is based not just on the teacher's attributes but also on the role played by the educator, which includes leadership style and teaching methadologies, its contribution to the school's mission, principles, and priorities, and the approach used in the change process (Nordin, 2000; Cooper, 2003; Mahmood, 2008).

A sedentary lifestyle and changing dietary habits have significantly increased childhood obesity (Hoe, 2013). Obesity is defined as "abnormal or excessive accumulations of fat that harm health (Ismail et al., 2002). This problem has influenced the World Health Organization (WHO) to accept childhood obesity as one of the 21st century's most significant global issues (Daniels et al., 2005). The same adverse reports on unhealthy lifestyles, poor eating habits, the prevalence of inactivity, inexperienced teachers teaching physical education classes, and limited time for the problems of physical education classes affecting school children involved in the subject, in line with the Malaysian scenario (Hoe, 2013), which contributed to the obesity problem. Based on these factors, the number of children aged 6 to 12 years between 2002 and 2008 who were obese increased from 20.7% to 26.4% between 2002 and 2008 (Ng et al., 2014; Noradilah et al., 2016). A study from Naidu et al. (2013); Suzana et al. (2012) supported that one out of five children in Malaysia were obese among Southeast Asia countries. A Malaysian study by Castetbon & Andreyeva (2012); Rengasamy (2012); Zalilah et al. (2006) reported that 44 per cent of the 75 children had a sedentary way of life. Additionally, it was related to the issue or scenario of child fitness in Malaysia, which showed many cases of obesity, particularly among children in schools (Ting et al., 2017).

As a fact, obesity has many causes and is a very complex phenomenon. The rise in obesity is due to an imbalance between energy intake and spending, insufficient physical activity, excessive sedentary time, and unhealthy eating behaviours that are widely accepted. Such facts make up an unhealthy lifestyle. Moreover, many variables have been shown to affect children's physical activity, such as parent and peer support, preferences for physical activity, behavioural intentions, and program and facility access (Loprinzi et al., 2015; Sallis, James et al., 1997). Warburton et al. (2006) reported that routine physical activity improves body composition and physiological factors, referred to as health-related fitness (HRF). For most children, including those with chronic diseases and disabilities, physical activity benefits were universal (Huang et al., 2009). Physical activity is widely recognised as one of the most effective ways to prevent cardiovascular and mental illnesses and improve physical fitness. In addition, the risk factors for many diseases such as high blood pressure, diabetes, and obesity have been reduced by regular physical activity (Huang et al., 2009). This situation may also lead to the development during adulthood of chronic diseases such as high blood pressure and diabetes (Strauss, 1999). The Janssen & Leblanc (2015) systematic study, which examined the relationship between physical activity, physical fitness, and health of school-age children and adolescents, found that physical activity, particularly in high-risk youth, contributed significantly to health should be maintained moderately. Besides the significance of the development of HRF for a healthy life, successful participation in sports requires the improvement of motor skills competence (MSC) (Stodden et al., 2009). Competency in motor skills has also been linked to physical activity (PA). Several recent studies have shown the importance of the growth of motor skills and physical fitness to the development of positive or negative weight status throughout childhood (D'Hondt et al., 2011; Lopes et al., 2012).

Childhood obesity was not only caused by a single factor, as proved by research conducted in various disciplines, such as nutrition and epidemiology. Obesity has resulted from environmental, lifestyle, and cultural environments (Dehghan et al., 2005), cognitive and behavioural factors, sports preferences, and interests (Kabiri et al., 2017; Kudlacek & James, 2011). Generally, obese children tend to be physically and mentally unfit to compete in sports, so these specific groups were less likely to acquire physical activity's health benefits (Strong et al., 2005; Westendorp et al., 2011). Obese children were also at significant risk of complications of liver injury, heart disease, respiratory problems, joint damage, asthma, and type I diabetes (Barba et al., 2006). Furthermore, social stigmatism could also lead to common academic and social development problems until adulthood (Strauss, 1999; Wardle & Cooke, 2005).

In reality, motor skills competence is related to human movement development and performance (i.e., locomotives and object control skills) (Stodden et al., 2008). MSC evaluation involved different processes and product-oriented measures, including the performance scores of many necessary object control skills (throwing, striking, and kicking) and locomotives (running, jumping, and hopping) (Stodden et al., 2008). Specific MSC skills (kicking, throwing, jumping, and running) for successful participation are inherently required for football, basketball, and tennis. Moreover, children were likely to be physically unfit without these necessary skills (Clark & Metcalfe, 2002; Hands et al., 2009). These skills are learnt in Physical Education subjects in primary or even in the secondary school syllabus (KPM, 2013). The need to improve HRF and MSC has been linked to prevention programs, often based on intervention in schools, purposely promoting positive effects on physical activity and healthy eating habits to achieve health benefits. These interventions have helped prevent excessive body fat accumulation and improve children's physical fitness (Aucouturier & Thivel, 2015). Children with obesity, often need more structured programs in which increased levels of physical activity improve body composition and health.

School-based intervention programs should therefore be designed and diversified in a comprehensive and multi-component manner to prevent obesity. Physical activity intervention, primarily based on endurance and resistance training, gained interest in improving HRF and MSC (Lazaar et al., 2007). Endurance exercise, also referred to as aerobic exercise, refers to exercise performed over a long period, starting at low-to-moderate intensities and relying primarily on aerobic metabolism. In resistance practice, muscular strength and endurance exercises are included in circuit training. Several studies have recently shown that resistance or circuit training was safe and beneficial for obese children with professional supervision (Guerra et al., 2013; Morgan et al., 2015; Thivel et al., 2011). The exercise was recommended as circuit training with a moderate to vigorous intensity of physical activity for at least 30 minutes for five days a week or more, or with a vigorous intensity for at least 20 minutes for three days (Wong et al., 2008). The World Health Organization (2013) recommends a minimum of 60 minutes per day of moderate to vigorous physical activity for children. Over the years, circuit training designed to develop muscular strength and improve anaerobic endurance. For obese children, circuit training would be efficient to improve engagement in physical activity. In this context, this study's objective was to explore the effects of the fitness training program (circuit training) on health-related fitness components and motor skills among obese children.

Since most obese children were not sufficiently active, physical activity promotion during early childhood development was critical (Hatta et al., 2017). Promoting physical activity was essential because the study of Malaysian schoolchildren receiving regular physical education in schools showed a low contribution to health-related fitness components (Rengasamy, 2012). Significantly, several studies have shown that changes in motor skills (Castetbon & Andreyeva, 2012) and physical activity (Lopes et al., 2012) have contributed to weight shifts in childhood growth. A better clarification of the influence of motor skills on child physical activity is needed as a relationship, given evidence suggesting that motor skills can lead to increased physical activity over the life span (Lloyd et al., 2014). Because of the issue, the researcher suggested that adequate training programs could have been implemented at the school level with sufficient intensity levels in line with Napper-owen et al. (2000). To date, there seems to be a lack of local and international published research on the intervention of fitness training programs for obese children in physical education classes in improving health-related fitness components and its relationship with the level of motor skills competency. Therefore, there was a need to close the 'gap' by examining the effectiveness of the experimental fitness training program and applying the coaching science in improving health-related fitness and motor skills competence among obese children.

METHOD

This study would profile the differences between HRF components (cardiovascular endurance, muscular strength, muscular endurance, flexibility, and body composition) and selected MSC components (throwing, kicking, jumping and running) among obese children aged 8 and 11, respectively from different aged and geographically factors. Furthermore, this study also constructed the research objectives by using the conceptual study framework proposed to justify the enhancement of obese students between HRF and MSC components across the age of obese children. This study used pre and post-tests as the design. Pre-tests were conducted before any data was collected to see if any persons were confounded or had certain tendencies so that the design was valid and reliable.

The actual fitness training program with CT was carried out and then followed by recorded post-test results. As far as the experimental with field test was concerned, this data could be compared to the research. Three independent variables formed the field experiments: age, health-related fitness, and motor skill competence. The primary purpose of this design was to examine the number of changes produced by the experimental group. The research paradigm is designated and explained as follows:

EG	O1	T	O2
CG	O3		O4

Figure 1 Research Paradigm

O – an observation or test (subscripts refer to the order of testing, O1 first pre-test given to the experimental group. While O2 is the post-test of the experimental group, O3 is the pre-test for the control group, and O4 is the post-test for the control group). T – means an experimental (experimental or fitness training program with CT) applied. The control group acts as a comparative indicator to justify the effectiveness of the experimental fitness training program.

The sampling process began with using fishbowl techniques to select primary schools that had obese children in Malaysia. There were 13 states in Malaysia, and Selangor state had the highest number of obese children, based on reports from the (Institute for Public Health, 2015). Therefore, from 449 primary schools in Selangor, only 65 primary schools were selected using two-stage stratified random sampling. In the first phase, Selangor primary schools were stratified into ten (10) zones and randomly selected by the schools in proportion to the number of schools in each zone. Each zone is defined according to its population size and not according to a geographical layout or ethnic population distribution based on government districts. All primary schools, excluding private schools, disabled schools, and schools with a total student population of fewer than 200 students, were chosen. The Petaling Perdana area was selected because the majority of obese children were in that area. In the Petaling Perdana zone, Sekolah Kebangsaan Raja Muda and Sekolah Kebangsaan Bandar Anggerik had the highest number of obese children in Selangor, according to statistics from the Selangor State Education Department. Therefore, based on the criteria set, these schools were selected. In the second phase, those taking part in Year 2 and Year 5, aged between 8 and 11 years, were chosen as potential participants. The participants were children with obesity, having a body mass index (BMI) >25.0 kg/m^2 according to the WHO growth reference of 5 to 19 years of age (World Health Organization, 2013).

Recruitment of Participants
Primary school headmasters around Selangor were initially contacted via telephone before a face-to-face meeting. Written consent was sought from both the headmasters and the classroom teachers at each school before participants from Year 2 and Year 5 classes were recruited. All students with a letter of consent who have not had a medical condition or physical injury that prevents testing or training were eligible to take part in the study. The procedures of this study was approved by Universiti Teknologi MARA Ethical Committee.

Sample size estimation
The researcher used Cohen's Delta formula to calculate the effect size of participants needed for this study.

$$\text{Cohen's d} = \frac{M1 - M2}{\text{SD Pooled}}$$

$$\text{SD pooled} = \frac{SD1^1 + SD2^2}{2}$$

The previous study by Rengasamy (2012) showed that the effect size for cardiovascular endurance was 1.49, with 48 participants per group, and the effect size was 0.4 for flexibility with 48 participants per group. Wong et al., (2008) showed that with 12 participants per group, the effect size was 1.01 for body composition, muscular strength and muscular endurance. A study by Cohen et al. (2015); Eather et al. (2015) showed that with 13 participants per group, the effect size was 0.63 for the TGMD-2 test. Therefore, by adding 20% of dropouts, 58 participants per group were the sample size needed for this study.

Exercise Layout
The exercise in any circuit should be laid out in a specific order to enhance the training effect and prevent overload of specific muscle groups. It can be done –1. Alternating exercise to different body parts. For example; a leg press – an arm curl; sit-ups – a leg curl. 2. Using a large muscle activity between exercises will increase the aerobic effect of the circuit. Example- running, cycling, step-ups and mini trampoline.

Arrangement of CT
Station 1 – Bike – Exercise Bike Station 2 - Shoulders: Bench press, Station 3 – Lower legs: Lunges, Station 4 – abdomen: Abdominal crunch, Station 5 – Chest: Chest press, Station 6 – “mini tramp”: Rope Skipping, Station 7 – Back: Back arch, Station 8 – Upper legs: Half-Squat, Station 9 – arms: Biceps curl.

Motivation & Participant Retentions
The participants motivation and retention was strategies using variety using “up-tempo” background music, varying the circuit sequence regularly, Changing the direction of the circuit and varying the resistance for stronger individuals.

Table 1. Overall of Circuit Training (CT)

	Experimental Group	Control Group
Pre-test	SEGAK and TGMD-2	SEGAK and TGMD-2
Intervention	Eight weeks (3 days per week) Eight exercises (circuit training)	Eight Weeks (3 days a week) Regular lessons (regular PHE syllabus)
	Jog in place (body composition) Wall squat (flexibility) Star jump (cardiovascular endurance) Lunges (muscular endurance) Ball throwing (motor skills) Ball kicking (motor skills) Hurdle run (motor skills) Trampoline jump (motor skills) 30 minutes per session Eight weeks (3 days per week)	30 minutes per session
Post-test	SEGAK and TGMD-2	SEGAK and TGMD-2

ACSM, Guidelines for Exercise Testing and Prescription (2013)

Table 1 shows the circuit training performed in the planned programme and its arrangement between an experimental group and a control group. These testing instruments were highly reliable and valid to be used as far as scientific and systematic research was concerned. This planned fitness programme was executed according to the guidelines as well as consideration of the implementation of the Circuit Training method to capture the effectiveness of this chosen method after the literature thorough review with the appropriateness of researchers for this study with over 30 years of experience in applying Circuit Training in primary until university level.

Statistical Analyses

The effect size was calculated using Cohen's *d* (mean the difference between the groups divided by the pooled standard deviation). Demographic information was analysed and presented in this study as mean and standard deviation (SD). A normality test is performed to determine whether a sample or any data group fits the normal standard distribution. In addition, Independent Sample t-test and Paired Sample t-test were used to examine the changes between the experimental and control groups pre and post-test for body composition, flexibility, cardiovascular endurance, muscular endurance, muscular strength, running, kicking, jumping, and throwing.

RESULTS

Table 2. Overall Participants' Characteristics

School	SK Raja Muda		SK Bandar Anggerik		Total
Age	8	11	8	11	
Approached (n)	70	70	70	70	280
Actual Participants (n)	58	58	58	58	232
Participations (%)	82.9	82.9	82.9	82.9	

Table 3. Participants distributed according to the demographic background of age, gender and group of Planned Fitness Programme (n = 232).

		Frequency (n)	Percentage (%)
Age	8 years old	116	50.0
	11 years old	116	50.0
Gender	Male	121	52.2
	Female	111	47.8
Group	8 years old (Control)	58	25.0
	8 years old (Exp)	58	25.0
	11 years old (Control)	58	25.0
	11 years old (Exp)	8	25.0
Total		232	100.0

Tables 2 and 3 detail the participant demographics in a study involving 280 schoolchildren from Sekolah Kebangsaan Raja Muda and Sekolah Kebangsaan Bandar Anggerik, located in Shah Alam, Selangor. Out of these, 232 children met the inclusion criteria with a Body Mass Index (BMI) greater than 25.0 kg/m^2, categorizing them as obese. The participants were evenly divided by age into two groups: 116 children were 8 years old and 116 were 11 years old. Each age group was further split into control and experimental groups, with each group comprising 58 children. The gender distribution included 121 males and 111 females. This structured division ensures a balanced representation to minimize biases and accurately assess the study's outcomes.

Control and Experimental Group of Participants Based on Age of this Study

Table 4. Descriptive of obese children based on Age 8 years old control group (n = 58)

Group	Mean	SD	Minimum	Maximum
8 year old (control)				
Pre-weight (kg)	49.92	4.58	39.80	61.50
Post-weight (kg)	50.07	4.59	39.80	61.30
Pre-BMI (kg/m^2)	30.69	0.75	30.00	33.44
Post-BMI (kg/m^2)	30.80	0.74	30.00	33.65
Pre-waist/hip (inch)	0.86	0.04	0.78	1.00
Post-waist/hip (inch)	0.86			
8 year old (experiment)				
Pre-weight (kg)	50.68	4.22	41.20	61.10
Post-weight (kg)	50.44	4.22	41.00	61.00
Pre-BMI (kg/m^2)	31.08	1.36	29.32	34.90
Post-BMI (kg/m^2)	30.93	1.37	29.32	34.60
Pre-waist/hip (inch)	0.90	0.04	0.80	0.97
Post-waist/hip (inch)	0.90	0.04	0.80	0.97
11 year old (control)				
Pre-weight (kg)	67.18	7.02	54.10	89.90
Post-weight (kg)	67.37	6.98	54.00	90.00
Pre-BMI (kg/m^2)	31.33	1.59	29.27	36.50
Post-BMI (kg/m^2)	31.37	1.59	29.27	36.58
Pre-waist/hip (inch)	0.94	0.02	0.89	0.97
Post-waist/hip (inch)	0.94	0.02	0.89	0.98
11 year old (experiment)				
Pre-weight (kg)	64.74	8.64	54.60	96.70
Post-weight (kg)	64.31	8.78	52.80	96.30
Pre-BMI (kg/m^2)	31.30	2.07	29.30	40.94
Post-BMI (kg/m^2)	31.13	2.06	29.14	40.56
Pre-waist/hip (inch)	0.94	0.02	0.88	0.97
Post-waist/hip (inch)	0.94	0.02	0.88	0.98

Table 4 shows weight and BMI changes in obese children from a control and an experimental group, separated by age groups of 8 and 11 years. For 8-year-olds, those in the control group indicate slight increases in weight and BMI, while their waist-to-hip ratios remained unchanged. In contrast, the 8-year-olds in the experimental group experienced decreases in both weight and BMI, with stable waist-to-hip ratios. For the 11-year-olds, the control group had minimal increases in weight and BMI and no change in waist-to-hip ratio, whereas the experimental group noted more substantial decreasing in both weight and BMI, again with unchanged waist-to-hip ratios. These results suggest that the intervention was effective, particularly for the experimental group, in reducing weight and BMI among obese children.

Table 5. Descriptive analysis based on intervention groups between HRF components among 8-year-old obese children (n = 58)

	n	Mean	Std. Deviation
Control			
8 years old			
Pre-cardiovascular endurance (minutes)	58	78.47	18.37
Post-cardiovascular endurance (minutes)	58	80.97	16.47
Pre-muscular strength (minutes)	58	7.52	5.11
Post-muscular strength (minutes)	58	6.43	4.41
Pre-muscular endurance (minutes)	58	7.91	3.97
Post-muscular endurance (minutes)	58	7.10	3.75
Pre-flexibility (centimetres)	58	22.73	5.72
Post-flexibility (centimetres)	58	22.77	5.61
Experimental			
8 years old			
Pre-cardiovascular endurance (minutes)	58	101.62	24.32
Post-cardiovascular endurance (minutes)	58	108.03	18.86
Pre-muscular strength (minutes)	58	5.69	2.78
Post-muscular strength (minutes)	58	6.59	2.79
Pre-muscular endurance (minutes)	58	7.26	4.05
Post-muscular endurance (minutes)	58	8.40	4.17
Pre-flexibility (centimetres)	58	24.77	5.28
Post-flexibility (centimetres)	58	24.82	5.18

*. Significance at 0.05 level

Table 6. Descriptive analysis based on groups between HRF components among 11 years old obese children (n = 58)

	n	Mean	Std. Deviation
Control			
11 years old			
Pre-cardiovascular endurance (minutes)	58	132.34	14.33
Post-cardiovascular endurance (minutes)	58	133.38	13.61
Pre-muscular strength (minutes)	58	7.83	4.90
Post-muscular strength (minutes)	58	7.26	4.73
Pre-muscular endurance (minutes)	58	13.12	4.88
Post-muscular endurance (minutes)	58	12.48	4.83
Pre-flexibility (centimetres)	58	24.07	6.57
Post-flexibility (centimetres)	58	24.20	6.65

Experimental			
11 years old			
Pre-cardiovascular endurance (minutes)	58	128.52	11.59
Post-cardiovascular endurance (minutes)	58	130.55	10.25
Pre-muscular strength (minutes)	58	5.12	4.07
Post-muscular strength (minutes)	58	5.67	4.15
Pre-muscular endurance (minutes)	58	10.33	4.77
Post-muscular endurance (minutes)	58	11.33	4.75
Pre-flexibility (centimetres)	58	19.99	4.56
Post-flexibility (centimetres)	58	20.39	4.43

**Significant value p <0.05*

Tables 5 and 6 assess the effectiveness of a fitness intervention on health-related fitness (HRF) components for obese children aged 8 and 11 years, comparing control and experimental groups. For 8-year-olds, the control group exhibited slight decreases in muscular strength and endurance without any notable changes in cardiovascular endurance and flexibility. Conversely, the experimental group saw significant improvements in all fitness components, including enhanced cardiovascular endurance, increased muscular strength and endurance, and a modest improvement in flexibility. Similarly, among 11-year-olds, the control group experienced a reduction in muscular strength with minimal changes in other fitness areas, while the experimental group demonstrated marked increases across all HRF components. These outcomes indicate the intervention's success in improving overall physical fitness and flexibility in the experimental groups of both age groups.

Table 7. Descriptive analysis based on groups between MSC components among 8 years old obese children (n = 58)

		n	Mean	Std. Deviation
Control				
8 years old				
	Pre-run	58	6.00	1.44
	Post-run	58	5.50	1.26
	Pre-kick	58	6.16	2.13
	Post kick	58	5.21	1.54
	Pre-jump	58	5.21	1.99
	Post jump	58	4.66	1.54
	Pre-throw	58	5.43	1.90
	Post-throw	58	4.60	1.47
Experimental				
8 years old				
	Pre-run	58	6.83	1.20
	Post-run	58	7.28	0.81
	Pre-kick	58	5.31	1.75
	Post kick	58	6.14	1.38
	Pre-jump	58	4.62	2.13
	Post jump	58	5.79	1.25
	Pre-throw	58	4.48	2.10
	Post-throw	58	5.74	1.33

Table 8. Descriptive analysis based on groups between MSC components among 11-year-old obese children (n = 58)

		n	Mean	Std. Deviation
Control 2				
11 years old				
	Pre-run	58	3.84	2.31
	Post-run	58	3.66	2.00
	Pre-kick	58	5.09	3.17
	Post-kick	58	4.22	2.45
	Pre-jump	58	5.50	2.72
	Post-jump	58	4.53	2.22
	Pre-throw	58	7.62	1.37
	Post-throw	58	5.66	2.08
Experimental				
11 years old				
	Pre-run	58	4.38	2.52
	Post-run	58	5.12	1.99
	Pre-kick	58	3.36	2.17
	Post- kick	58	4.10	1.92
	Pre-jump	58	3.28	1.70
	Post-jump	58	3.98	1.48
	Pre-throw	58	4.45	2.42
	Post-throw	58	4.71	1.75

Tables 7 and 8 analyze motor skill competence (MSC) among obese children aged 8 and 11 in control and experimental groups, focusing on four activities: running, kicking, jumping, and throwing. For 8-year-olds, the control group showed declines in all activities from pre-test to post-test, indicating a decrease in motor skills over the intervention period. Conversely, the experimental group demonstrated significant improvements in all four activities, suggesting that the intervention positively impacted their motor skills development. Similarly, for 11-year-olds, the control group also showed decreases in their motor skill measurements, while the experimental group exhibited improvements in all tested activities. These results underline the effectiveness of the intervention in enhancing motor skills among obese children, with the experimental groups showing notable gains across both age categories.

DISCUSSIONS

As far as Circuit Training in physical education classes is concerned, advantages gained from CT would be vital to consider during PE class (Jariono et al., 2021), especially for those primarily obese students of KPM because, after the planned programme and practices of CT in the process of teaching and learning, participants' body weight and even BMI index decreased for experiment group either 8 or 11 years old excepted control group obese students because the effectiveness of the intervention planned per se. However, body weight showed increased reading in the control group because the method used was not CT. Health-related components which consisted of cardiovascular, strength, endurance and flexibility also showed clear results of the effectiveness of CT implemented in the process of teaching and learning especially obese students (Hu et al., 2018) in primary schools concerned for either 8 or 11 years old, where the statistic results clearly showed that the experiment group obese 8 years old students increased enhancing in all components of HRF above but not the control group whom PE class without using CT, however, there were some cardiovascular and flexibility increased after 8 weeks. On the other hand, obese 11-year-old students statistically showed impressive enhancing or increased reading for all HRF components with CT implementation.

However, in the control group, there was an increase in cardiovascular only and a decrease in strength, endurance and flexibility of HRF. Where else, the motor skill competencies for those 8 years old decreased in competencies in running, kicking, jumping and throwing but vice versa for the experimental group showed brilliant results of enhancing all motor skill competent increased, it concluded that CT in an appropriate teaching method in PE for motor competencies during primary schools (Abdelkarim et al., 2017) and this resulted in similar findings go for obese students of 11 years old and this re-justifying the effectiveness of CT as far as students' centred approached in PE per se. This study underscores the multifaceted benefits of incorporating structured physical activity programs into the educational system, particularly for combating obesity and promoting a healthy lifestyle among children. These findings could be instrumental in guiding future educational policies and health interventions aimed at improving child health outcomes globally such as:

Health Implications: The reduction in BMI and weight within the experimental group highlights circuit training's potential to mitigate some of the health risks associated with childhood obesity (Khattak et al., 2020), such as cardiovascular diseases and diabetes.

Educational and Behavioral Implications: The improvements in motor skills competence suggest that engaging in structured physical activities like circuit training can also enhance children's confidence in their physical abilities (Martinez-Bello & Estevan, 2021), potentially leading to increased participation in physical activities outside of school settings.

Policy Implications: The results advocate for the integration of structured physical activity programs like circuit training in school curricula to combat the rising trend of obesity in children. Such programs not only promote physical health but also enhance motor skills, which are essential for children's overall development (Seo et al., 2021).

Implication of the Study

The findings of this study contributed to several perspectives or bodies of knowledge such as:

Theory – Psychology, the body of knowledge - Teaching and Learning. Process of teaching and learning in schools Physical Education with a centred approach could again advantages of students play a more active role in their learning and develop a sense of responsibility students thanks to teachers avoiding transmission of knowledge directly, students have a chance to stimulate their analytical thinking, by "making sense of what they are learning by relating it to prior knowledge and by discussing it with others," according to American educational psychologist J. Brophy.

Practicality and Management – Circuit Training should be widely implemented in the present educational system especially Physical Education nationwide. The limitation of time or duration provided for PE classes nationwide makes CT perform within limited space and flow of the activities in various skills at one time with brilliant results gained.

Testing and Measurement – Pre and post-tests were implemented to collect the data in this study which could enhance inferential statistic implementation after this descriptive domain of one research study.

CONCLUSIONS

The outcomes of the study suggest that circuit training can be a highly effective component of physical education, particularly for addressing the complex needs of obese children. These findings are supported by the observed improvements in both health-related fitness and motor skill competence, which are critical areas of development for children at risk of obesity-related health issues. Future research can be conducted on older school age groups to find out whether the impact would be similar to the lower age groups.

CONTRIBUTION OF AUTHORS

Data analysis was done by ZAAR, OTF, and TCH. All authors contributed to the discussion, and interpretation of the results and wrote the manuscript. ZAAR, HH, and TCH carried out the measurements. All the authors reviewed the final manuscript.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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