UNIVERSITY OF CAPE COAST

EFFECT OF NINE-WEEK SKIPPING ON BODY MASS INDEX OF PRIMARY SIX PUPILS IN UNIVERSITY PRIMARY SCHOOL, CAPE COAST

JAMES BOADU FRIMPONG

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BY

JAMES BOADU FRIMPONG

Thesis submitted to the Department of Health, Physical Education and Recreation of the Faculty of Science and Technology Education, College of Education Studies, University of Cape Coast, in partial fulfilment of the requirements for the award of Master of Philosophy Degree in Physical Education

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: ……………………….. Date: ……………………….

Name:…………………………………………………………………………..

Supervisors' Declaration

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature: ………………………. Date: ……..……..

Name:…………………………………………………………………………..

ABSTRACT

Research exist regarding the effects of skipping on physiological responses including body mass index (BMI) globally. Using the one-group pre-test post-test repeated measures pre-experimental design, this study investigated the effects of nine-week skipping intervention on BMI of primary six pupils in University Primary School (UPS), Cape Coast. Seventy-seven pupils were chosen for the study using simple random sampling (without replacement) technique. A researcher-generated data summary sheet was used to record the pupils' measurements (height, weight, gender, skipping frequency, age, and BMI). The hypotheses were tested with independent samples t-test, one-way ANOVA with repeated measures and multiple linear regression, all at 95% confidence level. There was no statistically significant difference in BMI between male (M = 20.15, SD = 4.36) and female (M = 20.68, SD = 5.32; t (75) = -.484, p = .63) pupils. There was a statistically significant difference in BMI between pre-test (M = 21.47, SD = 4.94); (M = 21.56, SD = 5.80) and post-test (M = 20.15, SD = 4.36); (M = 20.69, SD = 5.32) measurements of male and female pupils, respectively. None of the demographic characteristics of the male pupils had a marked predictive relationship with their BMI after the nine-week skipping training intervention. However, only baseline measurements of height (B = .37, $p < .05$), weight (B = -.57, $p < .05$) and BMI (B = 2.20, $p < .05$) had predictive relationship with BMI for post-test 3 for female pupils. It was concluded that skipping could be used to improve the BMI of the primary six pupils with normal weight. School authorities should adopt skipping for both male and female pupils to improve their BMI status.

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DEDICATION

To my family

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CHAPTER ONE

INTRODUCTION

Physical inactivity and childhood obesity are on the upsurge and thus have become critical public health concern to nations across the world (Bailey et al., 2012; Lytle, 2012). Mears (2008) established that about 11% of children in the United States live a sedentary life while 66% do not meet the recommended physical activity (PA) threshold. A study conducted in North Carolina in the United States of America revealed that 55.4% of 11-12-year-old pupils spend their entire day engaging in sedentary activities with 41.7%, 2.2% and 0.7% spending their day on light, moderate and vigorous PA respectively (Treuth et al., 2007).

Apparently, school children in Ghana spend about eight hours in school with a greater portion of the time being used for sedentary activities (Adom, De Villiers, Puoane, & Kengne, 2019; Aryeetey et al., 2017). In light of this, Physical Education (PE) classes and breaks have been included on the time table to encourage pupils to be active and to reduce boredom. Nonetheless, anecdotal experience has revealed that some pupils refuse to participate in PE classes due to the unenjoyable nature of such engagements. As this phenomenon persists, serious consequences come to bear on the physiological responses of these children, thus affecting their proper development and maintenance of optimum health status. Consequently, PA or exercise interventions such as skipping is deemed necessary to mitigate childhood obesity and its associated health risks, and to improve the physical fitness of pupils.

Background to the Study

Lately, some young students are unwilling to participate in PA in the schools even if they have been made to understand the instructions and rules associated with the activity, which in the long run results in overweight and poor physical fitness among them (Chen, 2010). This is likely to happen when they think the activity is not enjoyable and enthusiastic enough. Also, careful observation reveals that school children will likely not partake in any exercise or PA when the instructor or teacher fails to motivate and engage them in the activity as much as possible.

Exercise is any bodily activity that is structured and repetitive in nature conducted for the purpose of enhancing or maintaining physical fitness as well as complete health and wellness (Corbin & Lindsey, 2007). People engage in exercise for a myriad of reasons including strengthening, improving the cardiovascular system, weight loss, rehabilitation, for enjoyment and quality of life. The lack of it, according to Corbin and Lindsey (2007), and Tsai (2009) increases the chance of deterioration of the systems of the body including contraction of chronic cardiovascular diseases.

Skipping, also known as jump rope or rope jump is a form of aerobic exercise which involves one or more participants skipping over a rope swung such that it passes under the feet and over the head of participants in a continuous uninterrupted manner (Canadian Association for Health, Physical Education, Recreation, Dance and Sports [CAHPERDS], 2005). Skipping may consist of only one person swinging and jumping over the rope or a minimum of three participants taking turns, two of whom swing the rope and the rest of the participants jumping over the rope (Cooper, 2006). The rope is portable and relatively cheaper compared to other exercise equipment (Partavi, 2013).

Skipping has been performed by children as a fun game and also used by boxers as a warm-up exercise before workouts and as cardio exercises since time immemorial (Aagaard, 2012; Eler & Acar, 2018). Recently, many countries around the globe have incorporated skipping in their physical education (PE) lessons (Partavi, 2013). This is to help children achieve a better quality of life, and improve or maintain physical fitness through moderate PA. This was informed by the proposition of Janssen and LeBlanc (2010), that children and youth should increase their level of moderate to vigorous intensity PA by 30 minutes daily for optimum health.

PA such as skipping does not only impact the physical development and rate of maturation of young children, it also develops their psychological and social well-being (Moses, 2012). For instance, skipping may provide young children the opportunity to feel competent in physical performance and their sense of being morally responsible may also be enhanced (LeGear et al., 2012; Stodden et al., 2008). Moreover, through skipping young children have a feeling of joy and love for their own body, learn to cooperate with others as well as develop skills that are needed for competitive activities in adulthood (Trecroci, Cavaggioni, Caccia, & Alberti, 2015). Moses further submitted that most of these psychological benefits are derived even without the guidance of an adult. This notwithstanding, the presence of an adult during such activities is important in guiding them to ensure they are safe and to maximise their developmental opportunities.

Skipping employs the muscles of the upper and lower extremities and enhances cardiovascular functions and metabolism (Arazi, Jalali-Fard, & Abdinejad, 2016; Partavi, 2013). Swinging of the rope with the arms, and jumping and landing on the balls of the feet are the basic techniques in skipping. When skipping, it is important to maintain a well-balanced posture and rhythm. According to Arazi et al., the skipping activity is divided into the mid-air and the landing stage. The authors further state that joints and muscles need to relate in diverse roles in each hop, so that with continuous training they will add to the development of body muscles and bones.

Generally, skipping requires minimum working space to perform. For instance, it can be performed in rooms, balconies and even in porches. Skipping can be done at anywhere in the house or any other open place and the intensity or difficulty level, number of repetitions and type can be changed at any point in time. Skipping is not dependent on favourable weather condition and does not require a special facility before it is performed (Lee, 2010). Research indicates that skipping is now an independent sport with different skills as rhythmic and acrobatics performed along with music, by different groups to battle for speed and beauty of the execution of the skill (Aagaard, 2012; CAHPERDS, 2005; Cooper, 2006; Lee, 2010) with the ultimate motive of improving health and wellness of participants.

Several researchers have reported the efficacy of skipping in different studies. Jahromi and Gholami (2015) established that jump rope training was an effective intervention for improving the physical fitness levels of 9-10 years female students. Grivedehi, Nourbakhsh and Sepasi (2014) observed that skipping exercises have positive effects on all gross motor skills or bodily fitness and movement factors, especially in children of school going age who participate in one PA or the other. Also, positive effects have been found of skipping on blood circulation in the heart, flexibility, balance, muscle strength, coordination, speed, vertical jumping and rhythm (American College of Sports Medicine [ACSM], 2000; Orhan, Pulur, & Erol, 2008).

Conversely, skipping is likely to lead to knee injuries when not performed well since the impact of each jump or step is rivetted by the balls of both feet rather than the heels (Lee, 2010). This reduces the ground reaction forces through the patello-femoral joint. This blend of an aerobic workout and co-ordination building foot work has made rope skipping a popular form of exercise for athletes (Brown & Ferrigno, 2005; Santana, 2019). It is an activity not only suited for competition or recreation, but also for cardiovascular workout which is similar to jogging, swimming, playing football or bicycle riding (Aagaard, 2012). Brown and Ferrigno, and Santana further indicated that this aerobic exercise can achieve a burn out rate of up to 700 calories per hour of moderate to vigorous intensity skipping activity, with about 0.1 calories consumed per jump.

According to Berenson (2012), child obesity and low participation of PA among children reduce physiological efficiency and when care is not taken, it can lead to long term health issues. Even though pupils are biomechanically and physiologically not efficient, they depend primarily on aerobic metabolism for exercise (Heyward, 2001). Nonetheless, pupils have lower creatine phosphate stores per muscle gram (Baquet, Guinhouya, Dupont, Nourry, & Berthoin, 2004) and less glycogen stores per muscle gram combined with less phosphofructokinase which is a glycolytic enzyme (Moses, 2012).

Pupils are incapable of producing low blood PH or high blood lactate values for utilisation in anaerobic activities (Beighle & Moore, 2012). Essentially, when the body is exposed to PA or exercise including skipping, such that it becomes very demanding, the cardiovascular system adapts to the demands of the activity. These physiological changes can be chronic or acute (American Heart Association [AHA], 2010). The chronic adaptation is the long-term effect whereas the acute is the short-term effect of a structured or unstructured PA. An example of an acute physiological change is the increase in blood pressure (BP) during PA and that of a chronic physiological change is the reduction of BP following bouts of exercise.

Biomechanically, there are a number of physiological variables that sports and exercise science researchers find intriguing. Some of the notable physiological variables are BP, heart rate, blood lipids and lipoproteins, vital capacity, maximum oxygen uptake (VO_2 max), percentage body fat (%BF), body mass index (BMI) and bone density (Muritala, 2004). However, this study considered only BMI because BMI which is directly related to child obesity has recently become a global health concern and also related to several adverse physical and psychosocial development which could predispose people to obesity during adulthood (He & Karlberg, 2001; Simmonds, Llewellyn, Owen, & Woolacott, 2016). Additionally, only BMI was considered for the study since the instruments for measuring the other physiological variables were unavailable. Weight and height of participants were measured to enable me calculate their BMI.

The weight of a body is the earth’s gravitational pull on the body (Lee, 2010), measured in kilograms (kg) using the weighing scale. Usually, the weight of a person is taken without any heavy accessory such as shoes on. A person loses weight when the body exerts more energy than what it is consuming from food and other nutritional supplements. The body uses the stored energy in the form of fat in prolonged physical activities, gradually leading to weight loss. It is rare to find a person who has an ideal body weight to continuously seek for additional weight loss unless the person wants to achieve a more attractive body image.

The height of an individual is the distance from the bottom of the feet to the top of the head which is usually measured in centimetres (cm) when employing the metric system with the use of a stadiometer (Corbin & Lindsey, 2007). According to Corbin and Lindsey, the feet (ft) and inches (in) are used when using the imperial system of measurement. The development of height can serve as an indicator of two key components, namely: nutritional quality and health (Hoeger & Hoeger, 2007). In poor or war struck regions, environmental factors like prolonged malnutrition during childhood or adolescence may result in delayed growth and or substantial decrease in adult stature even without the presence of any of these medical complexities (U.S. Department of Health and Human Service [USDHHS], 2008).

BMI is the ratio of weight to the square of height of a person (Berenson, 2012), measured in kilogram per metres square (Kg/m^2). The index classifies people into underweight, normal weight, overweight and obese (Corbin & Lindsey, 2007). Even though the BMI is a measure of fitness level, it can sometimes be misleading. For instance, a body builder or weight lifter whose muscles are predominantly fat free can have a BMI classification as overweight or obese. This is because muscles weigh a lot more than fat and such a person could be high in weight and less of fat. This is why laboratory techniques are often used nowadays for very active groups of people.

Generally, the BMI categorisation for adults differ from that of children and adolescents. For adults, people are categorised as being underweight [BMI of less than 18.5kg/m^2], normal weight [18.5kg/m^2-24.9kg/m^2], overweight [25.0kg/m^2-29.9kg/m^2] or obese [BMI of 30 kg/m^2 or more] (Dietz, 2004; Hoeger & Hoeger, 2007; Reilly, 2006). However, for children and adolescents [of ages 2-20 years old] percentiles from growth charts are used to classify them as underweight [less than 5th percentile], healthy weight [5th-85th percentile], at risk of overweight [85th-95th percentile] and overweight [above 95th percentile] (Barlow, 2007; Kelly et al., 2013; Strawbridge, Wallhagen, & Shema, 2000).

Several theories have been used to explain how the systems of the body adapt to PA but this study will be confined to the dynamical systems theory [DST] (Thelen, Ulrich, & Wolff, 1991). DST proposes that for a successful derivation of physiological gains in PA, there is the need for a mutual interconnection between the individual, the task to be performed and the environment in which the activity will be carried out (Amui, 2006; Moses, 2012). DST also proposes that skill development is influenced by subsystems that are interconnected (Thelen, 2005).

Some studies have shown that performing skipping for a period of six weeks improve physical fitness of participants (Ghorbani et al., 2014; Kim et al., 2007; Lee & In, 2017). Other studies also reported significant improvement in physiological variables of participants after performing skipping for seven weeks (Chen, 2010; Partavi, 2013), eight weeks (Arazi et al., 2016; Mullur & Jyoti, 2019), 12 weeks (Chao-Chien & Yi-Chun, 2012; Kim et al., 2020), 15 weeks (Jahromi & Gholami, 2015) and 40 weeks (Lee, 2010). Therefore, this study will consider nine weeks of skipping training. This is because it is expected that there would be significant improvement in the variable of interest (BMI) of participants after nine weeks of skipping training.

Based on the findings of some previous studies (Arazi et al., 2016; Chen, 2010; Ghorbani et al., 2014; Lee, 2010; Partavi, 2013) which indicated that significant improvement of participants' physical fitness variables were realised after constantly going through skipping exercises for a minimum of six weeks and a maximum of 40 weeks, it is conceptualised in this study that, nine weeks of skipping training may influence or affect some of the demographic characteristics of participants. Specifically, the BMI which I am more intrigued to investigate in this study, may improve after taking participants through nine weeks of skipping training. Moreover, I conceive in this study that there may be some relationship between demographic characteristics of the participants and their BMI after going through the nine-week skipping training intervention.

Various investigations have been conducted on different variables to either prove or invalidate the effectiveness of skipping or jump rope training. A study conducted by Orhan (2013a) which investigated the effects of eight weeks of skipping on heart rate, anaerobic power and reaction time of 40 basketball players showed a significant improvement in weight, heart rate and aerobic power. However, no significant effect was detected in reaction time following the skipping training. Orhan thus upheld the effectiveness of skipping on the improvement of weight, heart rate and anaerobic power.

Another study conducted by Eler and Acar (2018) on the effect of 10 weeks skipping training programme on strength, speed and VO_2 max of 240 ten to twelve-year-old boys showed a significant improvement in all the parameters (weight, %BF, VO_2 max, leg strength and height), except speed. They concluded that since skipping improved these parameters in children, it is laudable to include them in PE and sports curriculum to help in their development. Contrary to this finding, a different study conducted by Chao-Chien and Yi-Chun (2012) on jumping rope intervention on health-related physical fitness in students with intellectual impairment showed no significant influence on BMI. Yet, skipping influenced the cardiovascular endurance, flexibility and muscular strength and endurance of the students. They concluded that the reason for this finding could be as a result of not controlling their diet intake since not only aerobic exercise influence BMI.

A study by Arazi et al. (2016) which compared two aerobic training methods (running vs rope jumping) on health-related physical fitness in 10-12 years old boys showed a significant effect of rope jump on aerobic power, muscular endurance and body composition. Based on the results, the authors concluded that skipping, which requires limited space, can be a good alternative for running training in homes, schools and educational centres in this era of rapid urbanisation. Partavi (2013) confirmed the efficiency of skipping in his study which examined the effects of seven weeks of rope jump training on cardiovascular endurance, speed and agility in middle school boys. The results showed a significant improvement in cardiovascular endurance and agility of the students. On the contrary, Partavi's study found no significant effect on the speed of the students following the seven weeks of skipping. This variation was attributed to the ability of the muscle fibres to adapt to the intensity of training since the fibres are inheritable traits.

Similarly, a study by Jahromi and Gholami (2015) investigated the effects of 15 weeks of jump rope training on physical fitness of 9-10 year old female pupils. The authors found no significant improvement in the speed of the participants. Nonetheless, the training improved balance, agility and power of the 20 female pupils.

Although most of the studies enumerated above validate the effectiveness of skipping on physical fitness components, there still exist some contrasting views regarding it. While some researchers (Arazi et al., 2016; Eler & Acar, 2018; Orhan, 2013a) found significant improvement in physical fitness variables, others (Chao-Chien & Yi-Chun, 2012; Jahromi & Gholami, 2015; Partavi, 2013) did not. This means that more studies need to be conducted to ascertain the feasibility and effectiveness of skipping on improving physiological responses especially, BMI of pupils.

Statement of the Problem

Despite the widespread education on PA and its benefits, many school children do not participate in PA at home or practical PE lessons at school which has led to the increased rate of overweight or obesity among school children (Alselaimi, 2010; Ocansey et al., 2016). University Primary School (UPS), Cape Coast, takes no exception to this worrying trend. Anecdotal experience indicate that pupils of UPS are growing at a faster rate due to their socioeconomic background whilst engaging in more sedentary activities which predispose them to becoming overweight or at risk of overweight and could present detrimental health consequences to their lives. It has therefore become expedient to design an alternative training method which is feasible and equally effective for improving BMI of pupils of UPS, Cape Coast.

Although there exist various researches which have studied the effects of skipping on physiological responses and physical fitness, especially on cardiovascular endurance, BMI, %BF, heart rate and BP (Arazi et al., 2016; Chao-Chien & Yi-Chun, 2012; Eler & Acer, 2018; Jahromi & Gholami, 2015; Orhan, 2013a; Partavi, 2013), to the best of my search so far, very little is known of such studies among pupils in Ghana and this gap exists among the available literature. Moreover, the studies mentioned employed smaller sample sizes which do not provide better generalisation of the findings. Again, the previous studies were not backed by any theoretical frameworks making them relatively less scientific which has given rise to this current study. Therefore, in filling this wide gap created in existing literature, this study is deemed important to be conducted.

Purpose of the Study

The purpose of this study was to examine the effect of nine-week skipping intervention on BMI of primary six pupils in UPS, Cape Coast, Ghana.

Hypotheses

The study sought to test the following hypotheses:

1: There will be differences in BMI between male and female primary six pupils in UPS, Cape Coast, following a nine-week skipping training intervention programme.

2: There will be a statistically significant difference in BMI between pre-test and post-test measurements of primary six pupils in UPS, Cape Coast, following a nine-week skipping training intervention programme.

3: There will be a statistically significant relationship between demographic characteristics and BMI of male primary six pupils in UPS, Cape Coast, following a nine-week training intervention programme.

4: There will be a statistically significant relationship between demographic characteristics and BMI of female primary six pupils in UPS, Cape Coast, following a nine-week training intervention programme.

Significance of the Study

The findings of the study provide relevant information about the BMI of primary six pupils of UPS, Cape Coast, to parents, teachers, and management of the school. Specifically, parents of the pupils will use this study's findings to decide on the kinds of exercise their wards should do at home considering their health status whether being normal or overweight. The findings of this investigation seeks to guide the teachers to know the exercises that are age-appropriate and safe for pupils based on their health status (i.e., being normal weight or overweight or at risk or overweight). Management of UPS will also use this finding to adopt skipping in its physical education activities through the help of the physical education teachers. Again, the study validates the efficiency and effectiveness of skipping in the improvement of BMI of primary school pupils. It also helps parents, teachers, management and other stakeholders of UPS, Cape Coast to better understand the fitness levels and developmentally appropriate PAs available for the pupils to contribute to their health and wellness.

Furthermore, the study serves as a source of reference for future research work in the areas of skipping training and physiological response, especially

BMI among various populations. Also, the study seeks to contribute to knowledge on the effectiveness of skipping training on physiological responses.

Delimitations

The study was delimited to the pre-experimental research design. Again, only primary six pupils in UPS, Cape Coast who were considered fit were used for the investigation. The study was also confined to a nine-week skipping training intervention programme. Also, the study only considered BMI as the main physiological response which was derived from the formular weight/ height X height. Furthermore, the study was delimited to physical measurements of height and weight using stadiometer and bathroom weighing scale, respectively. The study was also restricted to descriptive statistics (i.e., means and standard deviations) and inferential statistics (i.e., multiple linear regression analysis, one-way of variance [ANOVA] with repeated measures and independent samples t-test). Finally, a decision criterion of .05 was used.

Limitations

The study employed only pupils who had normal or healthy weight which might have influenced the findings. The study also did not use a control group which could have provided a relatively firm basis that indeed, engaging in skipping training intervention programme three times in a week over a period of nine weeks improved the BMI of the primary six pupils. Moreover, even though the participants were advised to engage in skipping training if they would want to exercise, the guarantee that they followed such instructions and that they did not do any other physical activity except skipping which might have influenced the findings could not be established. Also, the dietary patterns and behaviours of participants was not controlled for, subjecting the results of the study to interrogations.

In trying to limit the effects of these limitations, participants were advised on the negative effects of eating junk foods on their health particularly their BMI both at home and during school hours. Also, participants were taken through the skipping training intervention at the same time to avoid discrepancies in the effects of the intervention.

Definition of Terms

A primary six pupil: A pupil who is in primary six and considered fit for the study.

Body mass index (BMI): The ratio of fat mass to fat free mass or muscles in the body.

Demographic characteristics: These are the age, height, weight, gender, skipping frequency and BMI of the participants at baseline.

Physiological responses: The changes that the systems of the body undergo for efficient participation in physical activity. Example is the improvement in BMI owing to physical activity.

Skipping: An aerobic exercise in which participants swing and jump over a rope continuously for fitness purposes.

Stadiometer: A device that is used to measure height in metres or centimetres.

Organisation of the Study

The study was captured under five chapters. Chapter one was the introductory chapter. It entails the background to the study, statement of the problem, purpose of the study, hypotheses, significance of the study, delimitations, limitations, and definition of terms. Review of related literature were presented in Chapter two. Topics such as the concept of physical activity and fitness, history and effect of skipping on physiological responses, measurement of physiological responses in children, physiological responses and gender, children's adaptation to physical activity, theoretical framework, conceptual framework and summary were captured in Chapter two. Chapter three dwelled on the research methods. This comprised research design, study area, population, sampling procedures, data collection instruments, data collection procedures, data processing and analysis and chapter summary. Chapter four also focused on results and discussion while Chapter five specifically dealt with summary, conclusions and recommendations. Suggestions for further studies were also captured.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

The purpose of this study was to examine the effect of nine-week skipping training on body mass index (BMI) of primary six pupils in University Primary School (UPS), Cape Coast, Ghana. For this purpose, books, research articles, journals, magazines, newspapers, online and basic research reports were searched and the literature reviewed under the following headings:

1. The Concept of Physical Activity and Physical Fitness
2. History and Effects of Skipping
3. Measurement of Physiological Responses in Children
4. Physiological Responses and Gender
5. Children's Adaptation to Physical Activity
6. Relationship Between Demographic Characteristics and BMI
7. Theoretical Framework
8. Conceptual Framework
9. Summary

The Concept of Physical Activity and Physical Fitness

This part of the review focuses on physical activity (PA) and physical fitness. PA is the umbrella term that is used to represent all types, intensities and domains without regard to any particular aspect or choice of movement. The relativity in fitness levels cannot be underestimated. It is therefore key to note that the level of fitness needed in one profession may not be the same as the other. The concepts of PA and physical fitness are explained subsequently.

Physical activity

People from all walks of life (young and old, large and small, of all racial and ethnic groups, religious and academic groups and with or without disabilities) are required to move a part or the entire body throughout life. Physical activity (PA) therefore continues to remain an important aspect of human life since one needs to move to get things done.

PA has been defined by various authorities in the area of Physical Education (PE), Sports Science, Kinesiology, and other related fields. Generally, PA is any bodily movement that is generated by the contraction of skeletal muscles which leads to a substantial elevation in the normal energy expenditure (Malina, Bouchard & Bar-Or, 2004; Physical Activity Guidelines Advisory Committee [PAGAC], 2018; U.S. Department of Health and Human Services [USDHHS], 2008). PA is the umbrella term that is used to represent all types, intensities and domains without regard to any particular aspect or choice of movement. Such activities include but not limited to free play, household chores, school PE, exercise and organised sports. According to USDHHS, PA is the commonly used word to describe moderate-to-vigorous-intensity kinds of physical activities (PAs).

PA can be done at varied levels of intensity or difficulty. Research indicates that highly intensive activities yield some significant impact on both chronic and acute health variables and body function of individuals (Swedish National Institute of Public Health [SNIPH], 2010). In essence, all activities whether for the purpose of recreation, amusement or improvement of health have some bearing on the human body systems. For instance, the impact of walking on the body may vary from that of running, weeding the garden, washing or dancing.

This may be so because even though they all provide some sort of benefits to the systems of the body, their intensities vary hence, that disparity in the impacts they have on the body. PA can be either moderate or vigorous.

Moderate PAs are the activities that are usually simple and require the use of less energy in accomplishing them (Corbin, Masurier & McConnell, 2014). They can be performed by people of all age classifications and ability levels. According to Corbin et al., the metabolic equivalent (MET) which is the quantity of oxygen or energy needed for life can be used to determine how intense or difficult an activity is. PAs are rated from very light (sedentary) to maximal (vigorous) depending on the MET values. For instance, a person sitting at rest needs one MET to survive. Essentially, the body requires more MET levels as one engages in more demanding activities. The authors further stated that activities including standing, preparing food, walking slowly, and ironing which require 2-3.9 METs are regarded as light activities. However, for teens, activities such as eating, reading and using the computer which need 2 METs are viewed as light.

Moreover, activities that require an individual to expend 4-7 METs than being sedentary are regarded as moderate PAs (Corbin et al., 2014; PAGAC, 2018). A typical example for teens is brisk walking. Corbin et al. submitted that moderate PAs are further categorised into lifestyle PAs (everyday life activities including walking to and from school and doing house work), moderate sports (e.g., golf and bowling), moderate recreational activities (e.g., slow bicycling and recreational dance) and occupational activities (e.g., bricklaying and carpentry). Considering the documented effects of early participation in such activities, children and young adults should be encouraged and supported to engage in PAs at their young age in order to inculcate the behaviour in them through to adulthood.

Vigorous PAs are activities that demand that an individual uses more than 7 METs in the successful completion of the task (Corbin et al., 2014; PAGAC, 2018). Such activities include jogging, skipping, aerobic exercise, playing hockey and tennis. Vigorous PAs demand high levels of energy, increased heart rate, increased blood pressure levels, elevated secretion of adrenaline, general increase in body temperature, rise in maximum oxygen uptake (VO_2max), a surge in stroke volume (quantity of blood expelled by the heart after a strike), and an elevated cardiac output (quantity of blood pumped in a minute) as compared to light and moderate PAs (O'Leary, Mueller & Sala-Mercado, 2012; SNIPH, 2010). Mostly, a lot of people derive the health advantages offered by PA from deliberately planned activities or exercises.

Exercises are deliberately designed PA that are performed on a regular basis with the intent to ameliorate the health status, physical fitness and general wellbeing of the individual or group of people for whom they were intended (Buchner, 2009). Exercises, as a subset of PA have similar characteristics, intensities and benefits. However, exercises are sometimes viewed as difficult and debilitating task by young people and the aged population (Hardman & Stensel, 2003) due to its repetitive and structured nature. Hence, sports and exercise science and public health experts prefer to use the term PA to refer to moderate-vigorous intensity PA. One essential requirement for efficient completion of exercises and or PA is energy. The human body utilises three systems to supply energy during PA.

Vigorous PAs take a very short time in its execution phase usually lasting for 10 seconds or less such as sprinting and lifting a heavy load. These activities make use of the adenosine triphosphate-phosphocreatine (ATP-PC) which is an elevated energy product (in the ATP-PC system) reserved within the musculature of the body (Corbin et al., 2014). This system provides the immediate energy required by the muscles for performing very short but intense activities. The authors further recounted that when this energy system has been fully used by the muscles, another energy system called the glycolytic system which is the second, is used. Vigorous activities including jogging around a field, lifting a metal severally, among others that last between 11 seconds and 90 seconds, according to Corbin et al., use the glycolytic system as a source of energy. In this system, a carbohydrate known as glucose is kept in the musculature as glycogen for utilisation (Seagal & Bearden, 2012).

Seagal and Bearden (2012) hinted that the last and final energy system known as the oxidative or aerobic system supplies energy to be expended by the body during sustained activities such as weeding a piece of land, or walking over a distance. Just as the glycolytic system, the aerobic system utilises glucose (glycogen) for energy production. Nevertheless, since ample oxygen is obtainable to change oxygen to glucose to be used by the muscles during sustained activity, the muscles do not entirely depend on glucose (glycogen) as a source of energy.

Many people of diverse age groups worldwide are confronted with the question, how much of PA is enough? In response to this question the USDHH (2008) developed a comprehensive guideline known as the Physical Activity Guidelines for Americans which was further expanded by PAGAC (2018). The guideline provided suggestions on PA for young and middle-aged populations, the adult population, expectant mothers and women who recently conceived (postpartum), and adults battling with various disabilities. For children and adolescents, the guideline recommended that they do a minimum of 60 minutes of PA in a day with majority of the time being spent on either moderate-or-vigorous intensity aerobic PA.

This aerobic PA should necessitate a vigorous-intensity PA of not less than three days every week. PAGAC (2018) further recommended that the daily 60-minute minimum of PA should include both bone as well as muscle-strengthening activities for not less than 3 days every week. The guideline stressed that PA designed for children and adolescents must be enjoyable, age appropriate and varied in nature. In light of this, the PE curriculum in basic schools worldwide is instituted to help in that regard though not enough.

With regard to adults, the guideline advocated that they should make the conscious effort to avoid sedentary behaviours (inactivity) since any amount of PA regardless of the type and intensity offers some significant health benefits. That is to say, even a little amount of PA is better than none. The guideline further added that adults should engage in a minimum of about 150 minutes of moderate-intensity weekly, and or a total of about 75 minutes of vigorous-intensity aerobic PA in a week, or an amalgamation of moderate-and-vigorous intensity oxygen-dependent (aerobic) activity. Actually, the oxygen-dependent PA may be performed in bits of 10, 20 or 30 minutes throughout the week. The guideline further urged that, for adults to derive optimum health benefits it warrants that they increase their aerobic PA to about 300 minutes of moderate-intensity in one week, or at least 150 minutes of vigorous-intensity aerobic PA in a week, or combining moderate-and-vigorous intensity PA in a week. Thus, substantial health gains will be derived when the time is further increased. More so, the guideline advised that adults include moderate or high intensity muscle-strengthening activities that employ key sets of muscles in at least two or a few more days every week.

The recommended guidelines for adults suffice for older adults however, few additions were made. When older adults are unable to engage in about 150 minutes of moderate intensity PA in one week due to a prolonged health ailment, they should do PAs that are permissible by their condition. Activities to improve or sustain their balance will be appropriate for those who have the tendency to fall easily. Also, older adults should ascertain whether their level of effort in doing a PA is at par with their fitness levels as well as understand the influence of their health condition in PA participation.

Different authors from diverse jurisdictions and backgrounds have grouped PA into various types. For example, USDHHS (2008) grouped PA into baseline and health-enhancing PAs. Baseline activities are activities that do not require much energy and are done as part of daily life including walking, standing, and holding lightweight objects. Individual differences exist in the amount of PA one can contain, hence, those who do only baseline activities are regarded as inactive (Alberga, Sigal, Goldfield, Prud'homme, & Kenny, 2012; Hill, Wyatt, & Peters, 2012). Conversely, health-enhancing PAs are activities that provide significant improvement in health and wellbeing when combined with baseline activities (Hill, Levine, & Saris, 2003). These activities include skipping (jump rope), brisk walking, dancing, continuously lifting weight, doing yoga, and playing during breaks. Epidemiological evidence indicates that PA levels start to lessen at teen years at a rate of about 2.7% and 7.4% annually for male and females respectively (Sallis et al., 2006).

Over the years, researchers across the globe have studied and confirmed the health benefits of PAs on most age classifications. Interventions targeting moderate to vigorous intensity PA among children and young populations result in a decline in their adiposity (Albers, 2015), hence, they are about 5.2 times less likely to be considered as obese compared to their inactive colleagues (Lee, Shin, Lee, Jun, & Song, 2010; Wittmeier, Mollard, & Kriellaars, 2008).

Additional studies have found that participation in moderate to vigorous intensity PA reduces the chances of contracting hypokinetic diseases (including stroke, cancer, diabetes, etc.), strengthening of bone tissues, maintenance of body weight in a conventional manner as a result of energy utilisation, enhanced academic performance status, and general improvement in fitness levels (Abernethy, Hanrahan, Kippers, Mackinnon, & Pandy, 2005; ACSM, 2010; Corbin et al., 2014; Kelly et al., 2013; Malina et al., 2004, SNIPH, 2010), as well as psychological health advantages such as improved levels of anxiety, reduction in stress and depression, among others (Mouton et al., 2000). Even though PAs result in significant benefits in the health of individuals, others participate in them merely for fun, to socialise with friends and loved ones, and to enhance their appearance and self-esteem (PAGAC, 2008; USDHHS, 2018).

Physical fitness

Globally, most people's attention has been drawn considerably to the idea of being in shape or in good physical condition for an occupation or profession, a sporting discipline, or even the daily demands of the individual (Kelly et al., 2013). The relativity in fitness levels cannot be underestimated. It is therefore key to note that the level of fitness needed in one profession may not be the same as the other. In the same vein the level of fitness may differ in the various sporting disciplines (Albers, 2015). For instance, a boxer may require a certain level of fitness to succeed in the field of boxing. Having a low fitness level may predispose the boxer to constant losses or failures and in some instances, ridicules. Similarly, in the area of football an attacker may require a different fitness level compared to a defensive player. Therefore, fitness is something that one must strive to attain considering the fact that it is not constant as it lasts for a very limited period of time.

Hoeger and Hoeger (2007) opined that "individuals are physically fit when they can meet both ordinary and the unusual demands of daily life safely and effectively without being overly fatigued and still have energy left for leisure and recreation activities" (p. 7). This means that a person who is regarded as physically fit must be able to attend to all mandatory or scheduled activities in a day and still be able to meet any unplanned duty without breaking down. For instance, children of school going age who are physically fit must be able to go to school, do all the things required of them and still be able to run errands or go to play upon their return from school. Most parents and guardians expect their wards to be able to do all these usual activities without any difficulty. Their inability to attend to any unplanned activity raises eyebrows.

Corbin et al. (2014) reiterated that "physical fitness refers to the ability of the body systems to work together efficiently to allow one to be healthy and perform activities of daily living" (p. 19). That is, a situation where a person's body is able to effortlessly do a number of activities and still have the alertness to attend to any unforeseen event. Similarly, Garber et al. (2011) concurred that physical fitness is "the ability to carry out daily tasks with vigour and alertness, without undue fatigue, and with ample energy to enjoy leisure-time pursuits and respond to emergencies" (p. 1335). People are able to tell whether they are fit or not at any particular point in time. Surprisingly, some people get the conviction of not being fit even if they have not subjected themselves to any medical fitness test. This situation buttresses the fact that physical fitness is a personal feeling which the individual strives to attain for life's maintenance and enjoyment.

Inferring from the above definitions, I will define physical fitness as a physiological or medical state where one is able to accommodate all strenuous and easy daily tasks and yet have adequate energy to attend to any natural and unnatural happenings. Simply put, physical fitness is having the vitality to meet daily work without being unnecessarily exhausted. Children of school going age should endeavour to be physically fit. They must be able carry out all activities related to their daily lives such as waking up in the morning to go to school and learn, participate in PE, be able to run from any impending danger, walk back home, play with friends, run errands, watch television, wash utensils and learn in the evening without complaining of severe tiredness. However, with the decline in their level of PA as a result of modernisation and technological advancement (Sallis et al., 2006), their physical fitness levels are questionable. This requires that PA interventions that pose minimal detrimental effects be designed to mitigate the possible aggravation of their physical fitness levels.

Many people conceive that most of the health conditions that befall humans later in life have their origins in the early stages of life (Corbin et al., 2014; PAGAC, 2018). For instance, physical inactivity as well as obesity which appear to be risk factors for most chronic diseases begin to spring up during childhood. Hence, children should be encouraged to cultivate the habit of engaging in PAs early in life to accustom themselves to such healthy lifestyles. This will manifest in their body image perception and have the kind of life they wish for.

Several authors have established that different, yet related, components of health contribute to the entire physical fitness of an individual (Corbin et al., 2014; Hoeger & Hoeger, 2007; PAGAC, 2018). These authors categorised physical fitness into two broad components namely health-related and motor skill-related physical fitness. The health-related physical fitness which helps an individual to live a desirable life regardless of their activity level, comprises cardiorespiratory endurance, muscular strength, muscular endurance, flexibility and body composition. The motor skill-related physical fitness helps an individual to perform successfully and gracefully in activities that demand motor skills such as in football, basketball, and goalkeeping. The motor skill-related physical fitness is made up of, coordination, agility, balance, power, speed and reaction time.

Apparently, a long-distance runner who runs several kilometres without getting fatigued will be regarded as possessing a good fitness in one of the health-related components (that is cardiorespiratory endurance), but may be deficient in another component, for example flexibility (Corbin et al., 2014; Hoeger & Hoeger, 2007). This means that the various fitness components must be deliberately developed through training since having good fitness in one does not guarantee good fitness in the others. More so, it is crucial to clearly comprehend that having a good fitness does not make one immune to certain infirmities such as infectious diseases and digestive tract infections (USDHHS, 2018). A good fitness may facilitate better living and possibly speed up recovery.

History and Effects of Skipping

Exercises can be done either aerobically or anaerobically. PAs or exercises are said to be aerobic when a greater quantity of oxygen is consumed in the performance of the activity (Corbin & Lindsey, 2007). Conversely, PAs that are done anaerobically do not require oxygen consumption in the performance of the activities. Children's steady participation in aerobic exercises or PAs such as skipping has been vividly recommended by health experts and researchers due to the long-lasting effects or benefits on their health (Buchner, 2009; USDHHS, 2018).

Skipping which is otherwise known as rope skipping or rope jump or jump rope is a form of aerobic exercise in which a person simultaneously rotates the wrists to move or turn the rope over the head and under the feet while bouncing on the feet (Aagaard, 2012; Lee, 2010). Teams or groups of individuals can also engage in the skipping exercise. According to Aagaard and Lee, skipping which was then considered as a recreational activity for children for fun, and used by boxers as warm up exercises prior to a match or training session, has transformed to an independent competitive sport over the years.

The benefits of skipping are not only limited to aerobic capacity or cardiorespiratory fitness. Young children who engage in such activities derive positive benefits. For example, Lee (2010) reported that a significant gain to bone health can be realised at early stages. In essence, the prepubescent stage seems to be a particularly critical moment for strong bone development

(PAGAC, 2018; USDHHS, 2018). More so, skipping provides load or weight on bones, especially at the hip region where osteoporosis fracture is more likely to occur (Alberga et al., 2012; Corbin et al., 2014; Garber et al., 2011). Therefore, developing strong and healthy bones in the early stages of life may counteract the development of osteoporosis and its debilitating effects. Skipping is also a good conditioning training regimen for improving shoulder strength (Duzgun, Baltaci, Colakoglu, Tunay, & Ozer, 2010).

History of skipping

The origin of skipping dates as far back to 1600 B.C. at the time when ancient civilisation had sprung up (Kosova, 2012). It is said that the Egyptians who lived at that time used to go over vines to learn how to defend themselves from untamed animals. According to Kosovo, people from other cultural backgrounds also used jumping as a component of a traditional rite earmarked for cultivating crops. Nonetheless, recent history credits the Dutch as the originators of skipping as some tourists settled in America and used ropes to jump while chanting in their native language, hence, they were referred by people from other descents as “Double Dutch” (Aargaard, 2012). This term which is still relevant in skipping was used to belittle the Dutch and their culture.

Skipping as a sport grew much later in the 70s and 80s in the United States of America (USA). Richard Cendali who is fondly referred to as the father of skipping, contributed substantially to the expansion of the skipping sport within and around the USA (Kosova, 2012). Cendali invented novel jumps and variations after he realised the positive outcomes of the jumps on his fitness. Cendali subsequently began to teach and extend the sport to different populations and areas in the US (Jump Rope Institute [JRI], 2019). However, Cendali focused his teaching on children since he was a teacher.

Today, the skipping sport is governed by the International Jump Rope Union (IJRU). The IJRU is an amalgamated organisation which comprises the Fédération Internationale de Saut à la Corde (FISAC-IRSF) together with the World Jump Rope Federation (WJRF) (IJRU, 2019). According to the IJRU, the goal of the organisation is to popularise the skipping sport and contribute positively to improving the health of member nations. Many countries have now set up organisations to oversee all competitions and activities pertaining to the skipping sport in their respective countries.

Effects of Skipping on Physiological Responses

A considerable number of studies have been done by various researchers to ascertain the efficacy of skipping training on physiological responses and physical fitness components in different populations. However, for the purpose of this study, effects of plyometric training on physiological responses and physical fitness were also included. This is because, since plyometric training is related to skipping training, I deemed it necessary to include it in this write up. This study concentrated on studies conducted on children of school going age (preadolescents) since that stage is marked by rapid growth and development (Malina et al., 2004).

Some studies have been conducted to examine the effect of skipping on BMI. Mullur and Jyoti (2019) for example studied the impact of eight weeks skipping training on the BMI of 12-16 years in-school children. Mullur and Jyoti employed the purposive sampling technique to recruit 40 pupils and randomly placed them into the experimental group (n = 20) and the control group (n = 20).

The authors then conducted a baseline test for both groups. The experimental group continued the skipping training spanning over a duration of eight weeks whilst the control group received no training, and a post test was further conducted on both groups. The study revealed that the skipping training conducted over eight weeks significantly improved the BMI of the children in the experimental group as against their colleagues in the control group.

Lee and In (2017) also conducted a study to investigate the effect of skipping exercise programme on body composition of 12 female college students over a period of six weeks. In this study, the authors conveniently placed participants into two distinct groups, the daily living group and the skipping exercise group. Participants' measurements of BMI, %BF and waist circumference were taken before and after the training programme. The study yielded a statistically significant improvement in the BMI of the participants following the six weeks skipping exercise programme.

Jahromi and Gholami (2015) examined the effectiveness of jump rope training on the physical fitness of 9-10 years old female students over 15 weeks. In the study, 20 female students who volunteered to participate were randomly placed into training (n = 10) and control group (n = 10). Participants in the training group were taken through jump rope training sessions three times a week for a period of 15 weeks, whereas those in the control group had no training sessions to undergo. The study revealed that the 15 weeks jump rope training intervention elicited a statistically significant improvement in the BMI of the training group as against their counterparts in the control group. Jahromi and Gholami concluded that jump rope is an effective means of improving general physical fitness including BMI, agility, balance and power.

Kim et al. (2007) examined the effect of six weeks skipping training programme on body composition of 26 and 14 obese and lean male adolescents respectively in Korea. The 26 obese male adolescents were divided into obese exercise group (n = 14) and obese control group (n = 12). Participants in the obese exercise group were subjected to both a six-week skipping training programme and regular PE lessons. However, participants in the obese control group and the lean control group only participated in regular PE lessons. The study discovered a statistically significant change or improvement in the BMI of the participants in the obese exercise group after six weeks of skipping training.

In Taiwan, Chen (2010) conducted a case study on a student with mild intellectual disability to ascertain the effectiveness of skipping training on the health-related physical fitness of the participant for seven weeks. Chen employed both quantitative and qualitative means to test the health-related physical fitness of the participant before and after the training intervention. The result indicated that the seven-week skipping training programme accounted for a significant reduction in the BMI from 31 kg/m^2 to 29 kg/m^2. Chen's study also yielded a significant improvement in cardiovascular endurance, muscular endurance and flexibility, giving evidence that skipping training raises the physical fitness of people with mild intellectual disability.

Further, Lee (2010) conducted a study to ascertain whether 40 weeks skipping training intervention had any effect on physical fitness of elementary school pupils in Pingtung City, Taiwan. Lee conveniently placed participants into experimental (n = 20) and control (n = 20) groups. The experimental group performed the skipping training five days a week for 40 consecutive weeks during recess. All participants were taken through physical fitness test at baseline and after the intervention. Results of the one-way analysis of covariance showed a statistically significant improvement in BMI of participants in the experimental group. Lee further concluded that owing to the remarkable effect of the skipping training on physical fitness of elementary school pupils, it is worthy to popularise and introduce it to them at an early stage.

Partavi (2013) investigated whether seven weeks skipping training could be used to improve physical fitness in sixth grade boys aged 11-12 years. In Partavi's study 28 male pupils were randomly recruited and assigned to either skipping training (n = 14) group or control (n = 14) group. The skipping training group completed seven weeks of skipping training three times in a week, whereas those in the control group participated in the regular PE class only. Dependent and independent sample t-test were conducted to compare the differences within and between the groups. The study discovered a statistically significant improvement in the physical fitness variables including cardiovascular endurance, agility and BMI following the seven weeks skipping training programme.

Arazi et al. (2016) compared the effects of running and skipping training methods on health-related physical fitness in 10-12-year-old boys. The study used 33 male pupils and randomly placed them into the skipping training (n = 12), running training (n = 11) and control (n = 10) groups. Participants in the skipping training group performed the skipping training for eight weeks just as those in the running training group. Those in the control group also continued their regular activities for eight weeks. Flexibility, muscular endurance, aerobic power, BMI and %BF of participants were measured at baseline and after the eight-week training period. The study revealed that the skipping training and the running training methods significantly improved aerobic power, muscular endurance and BMI as against the control group. In their conclusion, Arazi et al. agreed that skipping could be used as a good alternative for running to improve physical fitness since rapid urbanisation has reduced the availability of space for performing PA in homes and many other educational setups, especially for the promotion of children's health.

Ghorbani et al. (2014) investigated the effects of aerobic training comprising running and rope skipping performed for six weeks on cardiovascular fitness, BMI and mental health of female students. In the study, 30 female participants were randomised into experimental (n = 15) and control (n = 15) groups. The experimental group performed six weeks of aerobic training consisting of running and skipping training regimen, whereas the control group performed their usual activities. An incredible improvement in cardiovascular fitness, BMI and mental health indices of participants in the experimental group was reported.

Conversely, Chao-Chien and Yi-Chun (2012) studied the effect of skipping rope intervention on health-related physical fitness of intellectually impaired students aged 13-15 years. The study employed the simple random sampling technique to recruit nine students and assigned them into the experimental group (n = 6) and the control group (n = 3). Pre-test and post-tests were conducted on the health-related physical fitness of participants before and after 12 weeks of skipping training. The study revealed no statistically significant improvement in BMI of the participants after the training programme. This, according to

Chao-Chien and Yi-Chun, was as a result of not controlling the diet of the participants.

Concerning the effects of skipping training on %BF, the following studies have been conducted. Jahromi and Gholami (2015) conducted a study to validate the effectiveness of jump rope training continued for 15 weeks on physical fitness of 9-10 years female students in some selected schools in Jahrom, Iran. Twenty volunteers were separated into experimental (n = 10) and control (n = 10) groups. The experimental group performed 15 weeks of jump rope training, while those in the control group performed their normal daily activities. The authors found that 15 weeks of jump rope training intervention significantly improved the %BF of the study participants. In their concluding remarks, Jahromi and Gholami observed that jump rope training when planned cautiously improves %BF and increases general physical fitness levels.

Pettersson, Nordström, Alfredson, Henriksson-Larsen and Lorentzon (2000) compared the influence of weight-bearing PA on the physical fitness of athletes and non-athletes. The first group constituted female adolescents participating in a competitive skipping training programme (n = 10) for averagely six hours in a week; the second group was made up of soccer players (n = 15) who trained for an average six hours per week; and the third group consisted of a control group (n = 25) who engaged in PA for less than an hour in a week. Pettersson et al. reported that compared to the control group, the participants in the skipping group had a significantly lower %BF. The authors further concluded that high impact activities such as rope skipping has significant association with bone geometry alteration, especially at the principal body parts.

In another study, Heumann and Swan (2014) compared the qualitative ultrasound indices of competitive skipping training participants (n = 19) and normally active girls (n = 18) aged 9-12 years. Heel qualitative ultrasound, height, weight, %BF and other parameters of participants were measured before and after the study. The results indicated that the competitive skipping training participants had significantly lower %BF as against their counterparts. Heumann and Swan observed that prepubertal girls who engage in high intensity PA such as skipping on a regular basis seem to have improved physical fitness although they have similar bone quality and function like normally active girls.

Eler and Acar (2018) examined the efficacy of 10 weeks skipping training programme in PE lessons on body weight and %BF of 10-12 years old boys. Two hundred and forty male pupils were recruited and assigned into skipping group (n = 120) and control group (n = 120). Whiles participants in the skipping group completed both the 10 weeks skipping training and regular PE lessons, those in the control group only participated in the regular PE lessons. The results of the study showed a statistically significant improvement in body weight and %BF of participants after the 10-week skipping training programme.

In another study, Arazi et al. (2016) compared the effects of running and skipping training methods on health-related physical fitness in 10-12-year-old boys. In this study 33 apparently healthy male pupils were recruited and randomly placed in the skipping training (n = 12), running training (n = 11) and control (n = 10) groups. Participants in the skipping training group performed skipping training for eight weeks and those in the running training did same for eight weeks, while those in the control group continued their regular activities for eight weeks. Flexibility, muscular endurance, BMI and %BF of participants were measured at baseline and after the eight-week training period. The study revealed that compared to the control group, the skipping training and the running training methods significantly improved muscular endurance and %BF. In their conclusion, Arazi et al. supported the claim that skipping could be used to improve physical fitness amidst the recent issue of unavailability of space in homes and many other educational setups, especially for children's health promotion.

Orhan et al. (2008) conducted a study comparing the effects of skipping training and weighted rope training on a number of physiological and physical variables of basketball players. After one week of preliminary technical and rope training, the participants were randomly placed into the skipping training (n = 12), the weighted rope training (n = 12) and the control groups to undergo their respective training. They trained three times in a week for eight weeks. Participants in the control group performed only technical training throughout the eight weeks period. Results of the investigation indicated a noticeable improvement in the physical parameters of interest and physiological response particularly the %BF of the skipping training group in comparison with the control group.

Furthermore, Öztin, Erol and Pulur (2003) investigated the effect of an eight-week explosive power and plyometric training programmes (which are similar to skipping training) on selected physical and physiological variables of male basketball players aged 15-16 years. Forty-five basketball players were randomly placed into plyometric group (n = 15), control group (n = 15) and the strength training group (n = 15). The plyometric and strength training groups were together considered as the experimental group, hence, performed explosive power, strength training and technical training three days a week for eight weeks. During the period, the control group completed only technical training. Consequently, the explosive power and plyometric training groups had a marked improvement in horizontal and vertical jumps, %BF, anaerobic power, 20m shuttle run, lean body weight and 30m sprint.

Kim et al. (2020) investigated the effect of skipping training on body composition, insulin sensitivity and academic-self efficacy (ASE) in obese adolescent girls for 12 weeks. In this study 48 adolescent girls diagnosed with prehypertension and obesity were placed randomly into experimental (n = 24) and control (n = 24) groups. Participants were assessed on their body composition, %BF, blood glucose, insulin levels, homeostasis of insulin resistance (HIR) and ASE at baseline. Results of the investigation revealed a substantial improvement in waist circumference, %BF, blood glucose, insulin levels and HIR. A strong correlation (r = - 0.58) was reported between ASE and body composition after the training period.

The following studies have been conducted regarding the effects of skipping on heart rate. Tsai (2009) studied the effect of skipping on the physical fitness of students who have amblyopia. In this study, a total of 16 special education students with amblyopia aged 15-17 years were randomly placed into experimental (n = 8) and control (n = 8) groups. Participants in the experimental group were taken through 50 minutes skipping training three times in a week for 10 continuous weeks. The control group on the other hand maintained their regular activities throughout the 10 weeks. All participants were assessed on their health-related physical fitness before and after the skipping training, and dependent sample t-test and analysis of covariate (ANCOVA) were subsequently conducted. The result showed that there was a statistically significant improvement in heart rate of the participants in the experimental group compared to their counterparts in the control group.

Orhan (2013a) investigated whether skipping training could have any significant effect on heart rate, anaerobic power and reaction time of basketball players aged 16-19 years. Orhan randomly divided the 40 male basketball players with at least three years of experience in the game, into experimental (n = 20) and control (n = 20) groups. Participants in the experimental group completed a skipping training programme three times in a week for eight weeks as well as a technical training. The participants in the control group, however, went through only technical training three times in a week for the same number of weeks. All participants were assessed at baseline and after the eight-week training programme. A paired sample t-test analysis was carried out to determine whether any statistically significant difference emerged among the variables of study. The results indicated that the eight-week skipping training programme significantly improved the heart rate and anaerobic power of the players, but not the visual and auditory reaction time.

Orhan et al. (2008) conducted a study comparing the effects of skipping training and weighted rope training on a number of physiological and physical variables of basketball players for eight weeks. After taking the participants through one week of preliminary technical and rope training, they were randomly placed into the skipping training (n = 12), the weighted rope training (n = 12) and the control (n = 12) groups to undergo their respective training together with the technical training three times in a week. Participants in the control group performed the technical training throughout the period. Results of the investigation indicated a marked improvement in the physical parameters of interest and physiological response particularly the heart rate of the skipping training group in comparison with the control group.

Another study by Orhan (2013b) also investigated whether jumping training performed with weighted rope and by repetition method could be employed to improve junior level basketball players' heart rate, anaerobic power, agility and reaction time. Having played basketball for a minimum of three years was the inclusion criteria. Participants were separated randomly into experimental (n = 20) and the control (n = 20) groups. Subsequent to a one-week preliminary rope training, the experimental group performed the weighted rope jumping training together with the technical training three times in a week for eight consecutive weeks. The control group, however, performed just the technical training for the same period of weeks. As a consequence, Orhan noted that jumping training performed with weighted rope and by repetition method positively influenced the heart rate and anaerobic power of the basketball players.

Concerning the effects of skipping on BP, the following studies have been conducted. A study was conducted by Lee (2010) to ascertain whether 40 weeks of skipping training intervention had any effect on physical fitness of elementary school pupils in Pingtung City, Taiwan. Lee conveniently placed participants into experimental (n = 20) and control (n = 20) groups. The experimental group completed the skipping training five days a week while the control group had no special treatment. Pre-test and post-test measurement of participants' physical fitness were duly recorded and subsequently analysed.

Results of the one-way analysis of covariance showed a statistically significant improvement in BP of participants in the experimental group.

Kim et al. (2020) investigated the effect of skipping training programme performed for 12 weeks on body composition, insulin sensitivity and academic-self efficacy (ASE) in obese adolescent girls. In this study 48 adolescent girls diagnosed with prehypertension and obesity were placed randomly in two distinct groups being experimental (n = 24) and control (n = 24) groups. Participants were assessed on their body composition, BP, blood glucose, insulin levels, homeostasis of insulin resistance (HIR) and ASE at baseline and after the 12 weeks of training. Results of the investigation revealed a substantial improvement in waist circumference, systolic BP, blood glucose, insulin levels and HIR. A strong correlation (r = - 0.58) between ASE and body composition after the training period was also reported. Kim et al. concluded that skipping exercise intervention could be effectively used as a therapeutic treatment in the improvement of cardiovascular diseases risk factors and ASE in obese adolescent girls diagnosed with prehypertension.

Dilber and Doğru (2018) used 30 sedentary men aged 24 years to investigate whether high-intensity functional training (HIFT) had any significant effect on their anthropometric and physiological characteristics. Participants went through cross-fit training system during the HIFT four times a week for a duration of 12 weeks. Subsequent to the investigation, the results from the statistical analyses of the pre-test and post-test measurements showed a marked improvement in %BF, systolic BP, diastolic BP, left and right-hand grip, back strength and leg strength of the sedentary men.

Based on the reported findings in the aforementioned studies, skipping training intervention significantly improved physiological and physical fitness parameters. However, most of the studies reviewed employed smaller sample sizes which do not present adequate generalisations to the study population, limiting the findings. Also, none of the aforementioned investigations was guided by a theoretical framework limiting the scientific relevance of the findings. These presented as gaps that need to be addressed with further investigations. Therefore, this study seeks to investigate whether a nine-week skipping training intervention programme could be used to improve the BMI of primary six pupils in UPS, Cape Coast, Ghana with the identified gaps in mind.

Measurement of Physiological Responses in Children

This aspect of review of the literature focuses on the different ways of measuring the physiological responses of the general population including children either trained or untrained. Mostly, sports and exercise physiologists wish to ascertain the changes that occur to the systems of the body, whether immediately or over an extended period of time, after repeated bouts of exercise (Kenney, Wilmore & Costill, 2012; Wilmore & Costill, 2004). For example, a sports and exercise physiologist may be interested in finding out how a person's body systems respond to skipping just after the exercise (acute) or after some weeks of training (chronic).

Biomechanically, acute physiological responses are the instant reactions a person experiences in one or more systems of their body owing to series of exercise (Kenney et al., 2012; Wilmore & Costill, 2004). For example, an increase in BP and an elevated heart rate immediately after running a 50m dash or using a treadmill. In contrast, chronic physiological adaptation arises when a person habitually engages in exercises over a long time usually weeks or months, such that their body systems have accustomed to the physiologic demands of the exercise (Alberga, 2013; American Heart Association [AHA], 2010). For instance, a drastic reduction in fat percentage or a lowered BP after weeks of exercise is regarded as a chronic adaptation to exercise.

Physiological responses and gender

Formerly, young females were customarily prohibited from engaging in strenuous PAs whereas their male peers were allowed to take up any form of active PA they so desired including tree climbing, racing and sports (Kenny et al., 2012). According to Kenny et al., the reason behind this thought was that boys were expected to be more active and stronger, but girls were regarded as vincible and unfit to compete. In this light, PE lessons required girls to exercise distinctly than their male peers by running short distances and doing modified PAs as they advanced through school.

A study by Abernethy et al. (2005) revealed that in the early stages of childhood, body composition and body size are not significantly different among boys and girls. However, girls start to increase in fat during the later stages of childhood, with boys having a surge in their fat-free mass in the early stages of adolescence as compared to females (Malina et al., 2004). Generally, the disparity in body composition between males and females exist as a result of the secretion of endocrine glands as they develop (Kenny et al., 2012). For instance, the secretion of hormones including the follicle-stimulating hormone (FSH) together with the luteinizing hormone (LH) by the pituitary gland in minute amounts during the prepubertal stage arouse the ovaries and testes (gonads).

Nonetheless, during the pubertal stage the pituitary gland secretes greater quantities of LH and FSH which lead to the onset of oestrogen secretion and the formation of ovaries in females, and the onset of testosterone secretion and development of the testes in males (Kenny et al., 2012). Kenny et al. further concurred that the secretion of testosterone during adolescence elevates the formation of bone in males than in females and further result in increase in the musculature which may linger on to adulthood. This makes men have a greater muscle distribution in the upper body compared to women (ACSM, 2016). Kenny et al. stated again that, oestrogen secretion induces the development of breast, widening of the pelvis and the accumulation of fat at the thighs and hips.

Other researchers (Deaner et al., 2012; Sylvia-Bobiak & Caldwell, 2006) have also established that participation in PA varies based on gender. For instance, Deaner et al. found that males are predominantly more likely to engage in vigorous PA compared to females. This was confirmed by Sylvia-Bobiak and Caldwell who revealed in their study that males reported relatively high active lifestyle than females. These findings manifested possibly because of males having greater vital capacity than their female peers, making male able to contain the stressful demands of vigorous PA (Hands, Parker, Larkin, Cantell, & Rose, 2016).

Few studies endeavoured to ascertain the differences in BMI between male and female participants after weeks of going through physical activity intervention including skipping training. For instance, Domaradzki, Cichy, Rokita and Popowczak (2020) ascertained the effect of a 10-week high intensity interval training (HITT) called "Tabata" during physical education (PE) classes on body composition (i.e., BMI) and physical performance (i.e., aerobic and anaerobic) among adolescents who are underweight, normal and overweight. Domaradzki et al. noted no substantial differences between male and female participants following the 10-week training.

Ham, Sung, Lee, Choi and Im (2016) also conducted a study to examine the effectiveness of an eight-week transtheoretical model (TTM) based counselling together with a 12-week skipping training programme with music. The study considered the TTM and health parameters including BMI of 11-year-old Korean obese children. Ham et al. found no marked gender difference in BMI among the experimental group after the eight weeks of TTM-based counselling conducted alongside the 12 week skipping training combined with music.

In ascertaining the impact of an after-school non-competitive PA programme on BMI, Vizcaíno et al. (2008) concentrated on skinfold and percentage body fat of school children aged 9-10 years over a 24-week duration. Vizcaíno et al. found no clear gender difference in the effectiveness of the training programme on BMI after 24 weeks.

Children's adaptation to physical activity

This aspect of the literature review focuses on children's adaptation to PA and training. However, owing to the paucity of literature in children's adaptation, I included the general adaptation to PA and training since I view it as relevant and beneficial to this study.

Scientists across the world have devoted a chunk of their active life years in designing specialised training programmes whilst maximising the prevention of injuries. A study by Abernethy et al. (2005) has shown that continuous training can alter how sets of muscles shorten and lengthen with a single force (strength), the rate at which the muscle contraction takes place, as well as the capacity of the nervous system to adequately restrain actions of the musculature.

Biomechanically, the human body has a terrific capacity in adapting to sustained bouts of exercise over a period. This long-term alteration of the body systems is termed as chronic adaptation (Wilmore & Costill, 2004). The primary intent of engaging in exercise is to instigate the muscles to metabolically and structurally adapt to retard tiredness or fatigue (Heyward, 2002). Apparently, trained individuals are able to sustain exercises of higher volumes and intensities compared with their untrained peers. For instance, children who engage in a lot of play activities regularly are able to go through more activities during PE classes than their inactive mates. As a rule, cognisance must be taken in developing training programmes that improve exercise capacity regarding the energy systems that supply ATP to the musculature, especially in children.

The amount of glycogen needed for endurance training such as team sports, skipping and jogging has to increase in storage (Abernethy et al., 2005). This is to prevent muscles from getting fatigued during an endurance PA or exercise. Put differently, the highly endured trainer will engage in exercise for long prior to fatigue owing to glycogen exhaustion. Aside from the mentioned points, studies have shown that the high intensity nature of physical activity such as skipping training causes high degree of breakdown in accumulated fat in the body (Narici et al., 2021; Styner et al., 2014).

This supports the idea that regular participation in vigorous PA has some positive health outcome regardless of age and body size (Lazaar, Aucouturier, Ratel, Rance, Meyer, & Duché, 2007; López-Sánchez, Díaz-Suárez, Radzimiński, & Jastrzębski, 2017; Nagai & Moritani, 2004; Wassenaar et al., 2021). This could explain why the long-term suspension of sporting activities as a result of a pandemic such as COVID-19 could affect one's health and bouncing back with vigorous PA improves one's health significantly (Genin et al., 2021; Hudson & Sprow, 2020; Narici et al., 2021).

Relationship Between Demographic Characteristics and BMI

Few studies have examined the relationship between the demographic variables of participants and their BMI following some weeks of participation in PA. For instance, Al-Nuaim et al. (2012) investigated the significant role of gender, age, type of school and geographical location on PA levels of male and female normal and obese young people in Al-Ahsa. Al-Nuaim noted that gender, geographical location and type of school significantly contributed to their PA level.

Mustelin, Silventoinen, Pietiläinen, Rissanen and Kaprio (2009) also examined the relationship between environmental and genetic factors and health markers (i.e., BMI and waist circumference) as a result of PA. Mustelin et al. found an inverse relationship between PA and females BMI owing to the heritable traits of the females.

Gildner, Barrett, Liebert, Kowal and Snodgrass (2015) assessed the contribution of age, weight, country of origin and sex in self-reported BMI of participants. The study revealed a significant contribution of weight in the reported BMI of the participants. However, age had no marked contribution in the BMI of the participants.

Theoretical Framework

Several theories have been formulated to explain how the systems or organs of the body adapt to exercise patterns and the changes that occur as one exercises or engages in PA. Theories have also been developed to explain the fundamental factors that account for such changes and adaptations. However, the Dynamical Systems Theory (DST) by Thelen et al. (1991) proves to be the most relevant theory for this study.

DST proposes that for a successful derivation of physiological gains in PA, there is the need for a mutual interconnection between the individual, the task to be performed and the environment in which one engages in the activity (Amui, 2006; Moses, 2012). Essentially, the proponents of DST submit that the development of a skill which subsequently leads to physiological gains or improvement is influenced to a large extent by a working interaction of the subsystems including the circulatory, nervous and respiratory systems (Amui, 2006; Moses, 2012; Thelen, 2005; Thelen et al., 1991).

DST emphasises the consideration of the individual as a system consisting of numerous subsystems that interact with one another such as the experiences of individuals, strengths, inspirations and abilities that emanate from the interaction among the subsystems (Glazier, Davids, & Bartlett, 2003). An alteration of one subsystem could possibly have an impact on the total performance. Examples of the subsystems that could affect the overall performance are the difficulty of task to be performed, the natural characteristic of the environment, size and weight of the equipment and skill level of the individual (Amui, 2006; Moses, 2012).

From the perspective of DST, movement patterns do not always advance in a sequence of movements that are easily predicted, however, these patterns may alter or improve through the passage of time with some degree of likelihood (Glazier et al., 2003; Moses, 2012). Human movement comprises numerous specific patterns or phases, degrees of freedom and these sub-patterns may vary during movement. In effect, definite patterns are employed in the development of specific movement or motor skills. The degree of freedom in the sub-patterns of the entire movement should be decreased in order to derive a more stable movement.

According to Van Emmerik, Ducharme, Amado and Hamill (2016), the stability in the patterns of movement that are usually detected overtime as a result of continuous trials and task conditions are referred to as behavioural attractors. Stergiou, Jensen, Bates, Scholten and Tzetzis (2001) also submit that attractor pathways are typically the patterns that alter with the passage of time. According to Stergiou et al., attractor pathways may not remain stable or assume stability at all times as a result of the dynamic interaction among the subsystems or the alterations in constraints that change overtime.

DST posits that the subsystems that collaborate also organise themselves to reduce the degrees of freedom which brings about stability in movement. Essentially, when the performer ushered to a novel attractor pattern or pathway of movement, some parameters serve as control to prompt the individual to migrate from an initial ineffective movement pattern to a more synchronised and stable movement pattern (Thelen, 2005; Thelen et al., 1991). This means that as the individual begins the performance of a skill, little gains are accrued but as the person continuously engages in the activity, the person becomes more competent in the skill, and this leads to physiological gains or adaptation.

Conceptual Framework

In developing PA interventions such as skipping training in appreciating and addressing the challenges of obesity and other hypokinetic diseases on the overall health of children of school going age, it is important to adopt experimental frameworks that test the effectiveness of such interventions rather than that of correlational designs (Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003). Therefore, to accomplish the goal for which this study was developed, this framework was designed to confirm the empirical evidence from theoretical dimensions. This conceptual framework also depicts the possible connections between the variables of interest (Malina et al., 2004). The framework upon which this study hinges is presented in Figure 1.

Figure 1 shows that the skipping intervention is expected to have an effect on demographic characteristics and physiological response (BMI) of participants over time. The skipping training which included diverse plyometric activities and other PAs, without a deviation from the already established training principles (intensity, duration and frequency) were manipulated to maximise training outcomes (fitness). Figure 1 depicts that the manipulation of the training variables is expected to cause the physiological systems of the body to adapt to the increasing and varying demands of the training.

Biomechanically, when a person regardless of their demographic background (that is, age sex, weight, height and skipping frequency) is subjected to bouts of PA or exercise, short term effects such as increased heart rate and elevated BP are expected (Hoeger & Hoeger, 2007). Continuous engagement in the training schedules as supported by literature, is subsequently expected to cause significant long-term effects in the demographic characteristics (physical and physiological) all things being equal (ACSM, 2016; Corbin et al., 2014; Kelly et al., 2013).

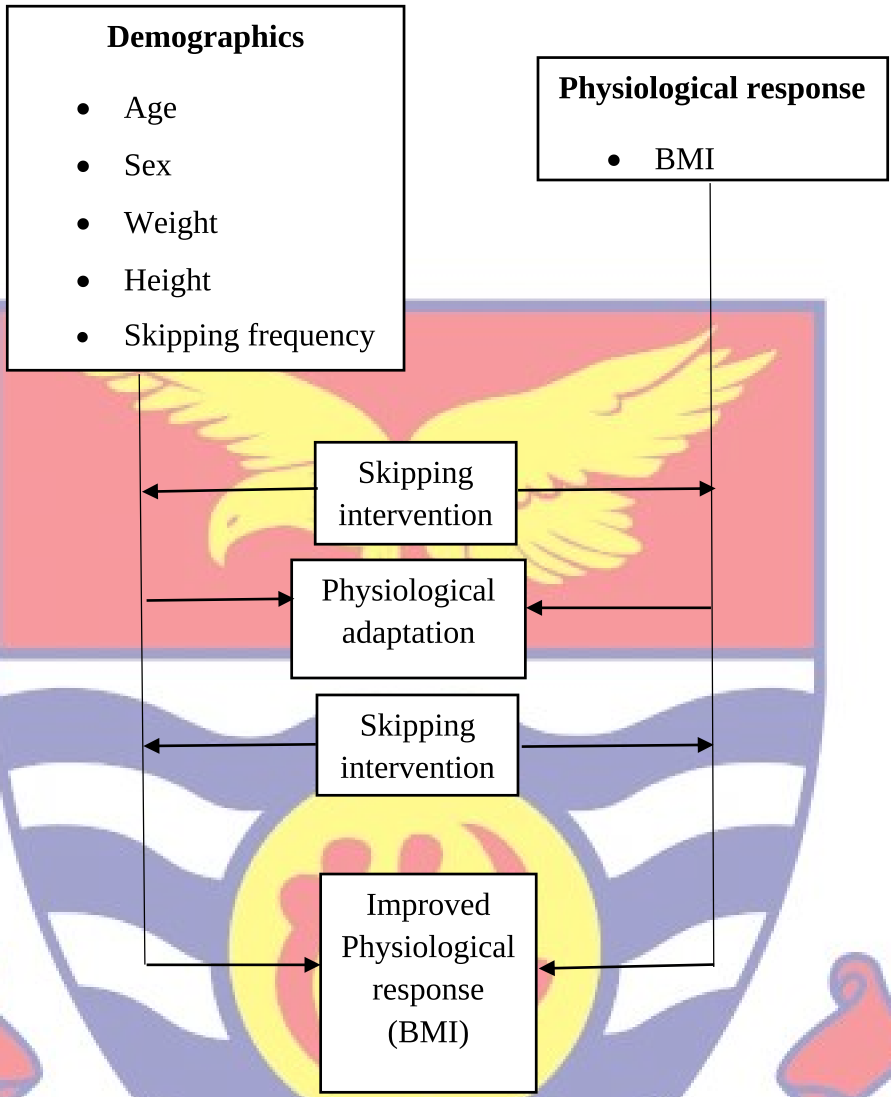

Figure 1: Conceptual framework of effects of skipping intervention on BMI (ACSM, 2016; Corbin et al., 2014; Kelly et al., 2013)

Figure 1 also provides the basis to explore the relationship that exist between demographic characteristics and training outcomes (fitness) of the participants. For example, the relationship between height, weight, and physiological response and fitness of participants after weeks of training were explored. The major conjecture stressed in this conceptual framework is that, there seems to be inadequate knowledge in the declaration of the effectiveness of skipping intervention on BMI and fitness of school children.

Summary

This chapter reviewed extensive literature on effects of skipping training intervention programme on physiological response (BMI). Efforts were made to clearly report the effects of skipping or PA in general on physiological responses of children and consequently their health.

PA or exercise has been proven to have enormous physiological effects on one's health regardless of the purpose. Skipping training which is one of the well-known high intensity aerobic PAs improves physiological responses of individuals. With the increase in childhood obesity and other hypokinetic diseases, the introduction of skipping training to primary six pupils in PE lessons will contribute positively to their health. At that age they grow fast, while engaging in more sedentary activities. This may predispose them to numerous health diseases which may even linger on till adulthood.

Studies have shown that high intensity PAs or exercises such as skipping improve heart rate, enhance the secretion of adrenalin, improve blood pressure, enhance one's BMI and improve a person's ability to consume more oxygen during exercises or sustained PAs. Moreover, there is easy blood flow through the blood vessels which facilitate the distribution of nutrients and oxygen to the organs, systems and tissues of the body. Additionally, studies indicate that interventions such as skipping training reduces the adiposity of children, hence, they become less susceptible to childhood obesity.

CHAPTER THREE

RESEARCH METHODS

The purpose of this study was to examine the effect of nine-week skipping training intervention on body mass index (BMI) of primary six pupils in University Primary School (UPS), Cape Coast. This chapter describes the methods used to conduct the study. It comprises research design, study area, population, sampling procedure, data collection instruments, data collection procedures, and data processing and analysis.

Research Design

This study employed the pre-experimental research design. Specifically, one-group pre-test post-test repeated measures technique was used. This technique is used when a researcher wants to examine the effectiveness of an intervention (Kothari, 2004; Neuman, 2014) conducted at different times and where it is impossible to randomly assign participants into distinct groups (Babbie, 2008). In this study only one group was used, hence the participants were not assigned to any special group. This enabled me to attribute the changes in the post-test scores (dependent variable) to the nine-week skipping intervention (Cohen, Manion & Morrison, 2007; Ogah, 2013).

A demerit to the pre-experimental research design however, is the probability that the conclusions that may be derived from the study may not be a true reflection of the intervention (internal invalidity) and the fact that the findings cannot be generalised to other populations (Babbie, 2008; Ogah, 2013). Babbie and Ogah further stated that pre-test may alert participants about the experimental treatment which might as well influence the post-test scores. Moreover, there is a higher tendency for participants to drop out before the end of the study which could affect statistical comparisons and conclusions (Cohen et al., 2007; Kothari, 2004).

Study Area

The study was conducted at UPS in the Cape Coast Metropolis. UPS, Cape Coast is a day mixed sex educational institution which is located on the South campus of University of Cape Coast (UCC). UPS was founded in 1962 as a nursery school, now UCC Kindergarten (UPS Administration, 2020). According to UPS Administration, the primary section was later setup in 1964 to accommodate the children who progressed from the nursery to the next level. UPS is bounded by the Cape Coast-Takoradi highway to the south, the UCC west gate/UCC multipurpose gymnasium to the west, the UCC police station/UCC fire service station to the east and the UCC hospital to the north.

UPS is about seven minutes' walk from the UCC west gate and about three minutes' walk from the UCC hospital. The school currently has a student population of about 1500 with 76 staff members (UPS Administration, 2020). According to the UPS Administration, the school serves as a model or experimental school for UCC. All classes (from 1-6) have six streams (A-F) namely; Naana Opoku Agyemang, Addow-Obeng, Ribeiro, Sam Jonah, Agyepong and Casley-Hayford.

Population

The population for this study comprised all of primary six pupils in the six streams (A-F) of UPS, Cape Coast. The number of pupils in primary six in the 2020/2021 academic year was 240 (UPS Administration, 2020). According to UPS Administration, each class or stream has 40 pupils (males and females).

Sampling Procedure

The simple random sampling (without replacement) technique was employed to select two classes with each of the classes comprising 40 pupils from the six streams of classes and all the 40 pupils from the two selected classes were used. This was to ensure that pupils from all the classes have equal chance of being included in the study (Cohen et al., 2007; Neuman, 2014). Therefore, a sample size of 80 was used (Eler & Acar, 2018). However, out of the 80, only 77 of the participants completed the study and thus had complete records needed for the statistical analysis. I considered this sample size to be appropriate since it is in line with Ogah's (2013) recommendation that for experimental research, it is appropriate to use sample sizes of not less than 30. This, according to Ogah is because most statistical computations or analyses are based on a minimum sample size of 30. Moreover, the sample size of 77 which is sizeable enough could help eliminate the violation of assumptions for statistical analysis as a result of experimental mortality (Babbie, 2010). Table 1 outlines the demographic characteristics of the participants.

Table 1 shows that the average age of both male and female pupils who took part in the study was approximately 12 years. However, males were slightly older (*M* = 11.92, *SD* = .59) than females (*M* = 11.72, *SD* = .46). Moreover, males were able to skip more (*M* = 149.32, *SD* = 64.67) than their female peers (*M* = 135.03, *SD* = 57.45) at baseline. This finding indicates the superiority of males in terms of physical fitness over their female counterparts.

Further, females were taller (*M* = 153.91, *SD* = 7.99) compared to their male colleagues (*M* = 150.96, *SD* = 5.49). Table 1 also indicates that females were heavier (*M* = 51.28, *SD* = 14.88) than males (*M* = 49.02, *SD* = 12.16) at baseline. Notwithstanding, it can also be observed from Table 1 that the BMI of males (M = 21.47, SD = 4.94) and females (M = 21.56, SD = 5.80) were similar.

Table 1: Demographic data of Participants

Gender	Variable (pretest)	Min	Max	*M*	*SD*
Male	Age (years)	11.00	14.00	11.92	.59
	SF	42.00	361.00	149.32	64.73
	H (cm)	142.50	162.50	150.96	5.49
	W (kg)	32.80	97.90	49.02	12.16
	BMI (kg/m^2)	13.90	40.70	21.47	4.94
Female	Age (years)	11.00	12.00	11.72	.46
	SF	42.00	342.00	135.03	57.45
	H (cm)	127.00	168.00	153.91	7.99
	W (kg)	26.60	98.00	51.28	14.88
	BMI (kg/m^2)	12.30	45.40	21.56	5.80

Source: Field data (2021) N (male = 38, female = 39)

Plotting the average age of 12 years against an average BMI of 21.43 kg/m^2 for the male pupils on the BMI-for-age growth chart (see Appendix A) shows that the males fell in between the 25th and 50th percentiles. This means that the male pupils who took part in the investigation at baseline had a healthy or normal weight (see Appendix A). Moreover, plotting an average age of 12 years against an average BMI of 21.56 kg/m^2 for the female pupils on the BMI-for-age growth chart shows that the female participants fell between the 25th and 50th percentiles, suggesting that the female pupils who took part in the study had a normal or healthy weight at baseline.

Data Collection Instruments

A researcher-generated data summary sheet (see Appendix B) was developed to collect data for the study. The data summary sheet had seven columns. The first column captioned "ID" was used to record participants' identity numbers. Participants' ages were recorded under the second column captioned "Age", whilst their gender was recorded under the third column dubbed "Gender." The 4th – 7th columns were used to record the measurements of participants at four different time points. Columns 4-7 were further divided into four subdivisions each, which were used to record participants' skipping frequency, height, weight and BMI.

Physical characteristics (height and weight) of participants were measured as demographics using stadiometer (measuring tape) and a weighing scale, respectively. Age of participants were recorded in years whilst participants' respective gender were also recorded by writing either M for males or F for females. Again, participants' BMI were derived using the formula weight/height X height in Kg/m^2. The details of all the measurements are captured in Appendix C. Detailed information about the devices/instruments that were used to collect the required information are explained subsequently:

Weighing Scale

The Camry electronic personal weighing scale with model number EB9377 which is made in China was used to measure the weight of participants in kilograms (kg). The scale has a maximum weight capacity of 150kg. Freedman, Dietz, Srinivasan and Berenson (2011) reported r = .90 for weight-height indices. Bourbonnais et al. (2002) reported r = .96 for weighing scale. The weighing scale is a standardised instrument, however, I at all times cross-checked to ensure that it was in proper working condition before and during data collection.

Stadiometer

A locally manufactured stadiometer with a maximum calibration of 210cm was used to measure the height of participants in metres. To ensure the validity of the stadiometer, I always checked it prior to the data collection to ensure that it was working accurately. Bourbonnais et al. (2002) detected a strong Pearson product correlation coefficient of .99 for stadiometer.

The CDC growth chart and interpretation

For children and adolescents (of ages 2-20 years old) percentiles from growth charts (see Appendix A) are used to classify them as underweight (less than 5th percentile), healthy weight [5th-85th percentile], at risk of overweight [85th-95th percentile] and overweight [above 95th percentile] (Barlow, 2007; Kelly et al., 2013; Strawbridge, Wallhagen, & Shema, 2000). To determine whether a person is underweight, healthy weight, at risk of overweight or overweight, the BMI scores (kg/m^2) are plotted against the age (years) of the person.

The BMI scores (in kg/m^2) are on the vertical axis whereas the age (in years) are on the horizontal axis. The percentile curves are also drawn on the graph. To determine the percentile in which one falls, we plot the BMI score against the age of the person on the graph. This intersection point is the person's percentile. An intersection point that falls below the 5th percentile curve means that person is underweight. Also, any point that falls between the 5th and 85th percentile curves shows that the person has a healthy weight. Any point that falls between the 85th and 95th percentile curves means that person is at risk of overweight. People are regarded as overweight if their point falls above the 95th percentile curve.

Pilot Study

A pilot study was conducted using primary five pupils of UPS, Cape Coast since they did not form part of the main study group and had similar characteristics with primary six pupils. Essentially, all the pupils in one class who were physically fit were used for the miniature study, following the same experimental protocols set out for the main study over a period of three weeks. Since the miniature study was intended to ascertain the workability of the data summary sheet and measuring instruments, the three weeks was deemed acceptable. The pilot study helped me to ascertain whether the instruments were in good condition and whether the designed data summary sheet could be used to collect the required data for the main study. Furthermore, it was meant to enable me to make any needed adjustments with respect to the research protocols for the main study as well as identify any possible problems that may arise during the main study.

Data Collection Procedure

First, an approval and ethical clearance for the research protocol was obtained from the Institutional Review Board (IRB) of UCC (see Appendix D). In addition, an introductory letter was obtained from the Head, Department of Health, Physical Education and Recreation (HPER), which introduced me to UPS authorities and provided an access to the participants for data collection (see Appendix E). These protocols were in line with the proposition of Ogah (2013), that in order to prevent the violation of the rights of human research participants, it is incumbent on the researcher to obtain the approval of a well instituted research ethical committee to ascertain that the research protocol and data collection procedures conformed to that of the committee. Consequently, the ethical clearance and the introductory letter served as a means of gaining permission to enter the school and to enhance the cooperation of the participants as well as UPS authorities for the study to be conducted.

I held an interaction session about the health benefits of taking part in the study with the pupils after explaining the purpose of the study to the headmistress, the assistant headmaster and teachers of the pupils before data was collected. Afterwards, the consents of the participants were sought from their parents, teachers and UPS authorities prior to the study.

A notice was given to pupils of the selected streams of UPS, Cape Coast, about the forthcoming study. The permission of their parents, teachers and head teacher was obtained with the help of an informed consent form which served as an official agreement and commitment between the participants and me (see Appendix F) which was backed with the Youth Physical Activity Readiness Questionnaire (PAR-Q) (Warburton, Jamnik, Bredin, & Gledhill, 2011) (see Appendix G) indicating the readiness of the participants in the study. Afterwards, I met with all the pupils of the two randomly selected classes to explain the purpose and experimental protocols to them. Ample time was set aside for questions which were duly and sufficiently answered.

Data were collected by five trained research assistants and I. These five research assistants were recruited and trained on how measurements are to be taken and the ethical issues regarding the study to assist with data gathering. The entire data collection lasted for nine weeks in which each session was made of a maximum of 30 minutes. The skipping training sessions were conducted three times in a week, that is Mondays (30 minutes), Wednesdays (30 minutes) and Fridays (30 minutes). Participants of the study were assured of their confidentiality and that, the findings will be solely for the purpose of the study. The following procedures were followed in gathering data on the physiological and demographic variables of participants:

Age: The participants' dates of birth were recorded and subsequently subtracted from the present date. The obtained values were then recorded to the nearest whole number in years.

Weight: The weight of participants were obtained by allowing them to stand on the electronic weighing scale bare-footed, whilst dressed in their PE kits. The weight were recorded to the nearest point in kg.

Height: Each of the participants was directed to stand bare-footed, in an upright position with the hands beside the body, feet together and buttocks and head against the wall whilst looking straight forward. The height was then recorded to the nearest point in metres (m) using a stadiometer (measuring tape).

BMI: The BMI of the participants were computed using the formula, weight (kg)/ square of height (m^2) in kg/m^2.

Skipping frequency: The number of times the participants jumped over the skipping rope within the space of time given, according to their strength or threshold was also recorded in whole numbers

Safety Guidelines for Training

The following safety guidelines were adhered to in each session or training day throughout the nine-week skipping training period:

1. All participants were taken through warm up and stretching activities before the skipping activity, and cool down and stretching activities afterwards.
2. All participants were instructed to wear the appropriate attire (PE kit) and a non-slip sports shoe with socks.
3. Each participant was physically screened to be sure that they were physically sound to be able to participate in each session.
4. All participants were instructed to properly lace their shoes to avoid any injury.
5. Adequate skipping ropes were provided for the training sessions.
6. Sachets of water were provided for drinking during each resting period.
7. Participants were instructed to come along with small towels to wipe their sweat. Disposable tissues were also made available for participants who had no towels to wipe their sweat.
8. Resting mats were provided to help surmount all emergency situations.
9. A nurse or first aider with a first aid kit was always present during each session of the training.
10. The working area was well ventilated and illuminated.
11. Hand washing equipment was provided at every training session for participants to wash their hands before and after every session.
12. Social distancing protocol was also observed.
13. The grip or handle of the skipping ropes were sanitised before and after every training session.

Inclusion criteria

All pupils whose parents or guardians confirmed that they had no cardiovascular diseases, joint problems, currently not under any form of medication, had been physically screened by me and had the appropriate apparel (PE kit and non-slip sports shoe with socks) were used for the study. Participants who did not report being sick at training sessions were allowed to participate.

Exclusion criteria

All pupils whose parents or guardians had confirmed that they had cardiovascular diseases, joint problems, placed under medication, had not passed a physical screening conducted by me, and did not have the appropriate apparel (PE kit and non-slip sports shoe with socks) were excluded from the study. Also, pupils who reported being sick on the days of training were exempted from taking part in the training.

Intervention

This aspect of the study highlights the weekly physical activities designed for the primary six pupils over the nine weeks period to ascertain the effectiveness of the skipping training on their BMI. Participants were taken through carefully designed skipping training and age-appropriate plyometric activities in each of the training sessions throughout the entire nine weeks. In order to motivate them to participate, the variety of activities were fun and accompanied with music at all times. Moreover, participants were refreshed with fruits at the end of each session throughout the study. A baseline test was conducted on the first day of the training programme (Pre-test). Similar tests were done in week three (Post-test 1), week six (Post-test 2) and finally in week nine (Post-test 3).

Week One

Test 1 (Pre-test/baseline testing)

Warm up: 10 minutes

Activities:

1. Jogging
2. Neck side flexion
3. Skipping without rope
4. Jumping jacks
5. Galloping with left leg in front over 20m
6. Galloping with right leg in front over 20m

Main activity: Skipping with rope (9 minutes)

Reps: 3 minutes

Sets: 3 sets

Rest: 2 minutes

Cool down: Leg raises and side stretch (3 minutes)

Packing and dispersion of pupils: 4 minutes

Materials required: One stop watch, 10 recording sheets, five pens, 80 skipping ropes, one weighing scale, one stadiometer, one whistle, one bluetooth audio speaker, four cones and 25 gym mats.

Week Two

Warm up: 10 minutes

Activities:

1. Here, there, where
2. Triceps stretch
3. Short jumps forward/backwards over 20m

4. Vertical jumps
5. Standing long jumps forward/backwards over 20m
6. Hopping side to side forward/backwards over 20m

Main activity: Skipping with rope (9 minutes)

Reps: 3 minutes

Sets: 3 sets

Rest: 2 minutes

Cool down: Slow jogging and biceps stretch (3 minutes)

Packing and dispersion of pupils: 4 minutes

Materials required: One stop watch, 80 skipping ropes, one bluetooth audio speaker, one whistle, four cones and 25 gym mats.

Week Three

Test 2 (Post-test 1 conducted during the last training session)

Warm up: 10 minutes

Activities:

1. Shuttle runs
2. Shoulder stretch
3. Skipping without rope over 20m
4. Jumping in and squat out forward/backwards over 20m
5. Jumping out and squat in forward/backwards over 20m
6. Jumping lunges to the right side/left side over 20m

Main activity: Skipping with rope (9 minutes)

Reps: 3 minutes

Sets: 3 sets

Rest: 2 minutes

Cool down: Walking and hip flexor stretch (3 minutes)

Packing and dispersion of pupils: 4 minutes

Materials required: One stop watch, 10 recording sheets, five pens, 80 skipping ropes, one weighing scale, one stadiometer, one bluetooth audio speaker, one whistle, four cones and 25 gym mats.

Week Four

Warm up: 10 minutes

Activities:

1. Picking tails
2. Supraspinatus (top of shoulder) stretch
3. Press ups
4. Jumping front and back to the right side/left side over 20m
5. Standing long jumps forward/backwards over 20m
6. Jumping to the left side/right side over 20m

Main activity: Skipping with rope (9 minutes)

Reps: 3 minutes

Sets: 3 sets

Rest: 2 minutes

Cool down: Arm raises, lower back extension and abdominal stretch (3 minutes)

Packing and dispersion of pupils: 4 minutes

Materials required: One stop watch, 80 palm leaves, 80 skipping ropes, one whistle, one bluetooth audio speaker, four cones and 25 gym mats.

Week Five

Warm up: 10 minutes

Activities:

1. Jogging
2. Upper back extension
3. Sit ups
4. Jumping jacks
5. Short jumps forwards/backwards
6. Hopping side to side on one foot (alternatively)

Main activity: Skipping with rope (9)

Reps: 3 minutes

Sets: 3 sets

Rest: 2 minutes

Cool down: Body shakes, marching, arm circles and quadriceps stretch (3 minutes)

Packing and dispersion of pupils: 4 minutes

Material required: One stop watch, 80 skipping ropes, one bluetooth audio speaker, one whistle, four cones and 25 gym mats.

Week Six

Test 3 (Post-test 2 conducted during the last training session)

Warm up: 10 minutes

Activities:

1. Jogging
2. Adductor (groin) stretch
3. Galloping with alternating legs over 20m
4. Jumping over obstacles or imaginary line
5. Press ups
6. Vertical jumps

Main activity: Skipping with rope (9 minutes)

Reps: 3 minutes

Sets: 3 sets

Rest: 2 minutes

Cool down: Trunk twists and shoulder stretch (3 minutes)

Packing and dispersion of pupils: 4 minutes

Materials required: One stop watch, 10 recording sheets, five pens, 80 skipping ropes, one weighing scale, one stadiometer, one bluetooth audio speaker, one whistle, four cones and 25 gym mats.

Week Seven

Warm up: 10 minutes

Activities:

1. Here, there, where
2. Quadriceps stretch
3. Standing long jump forward/backwards
4. Jumping lunges to the right side/left side
5. Jogging on the spot
6. High knee picking

Main activity: Skipping with rope (9 minutes)

Reps: 3 minutes

Sets: 3 sets

Rest: 2 minutes

Cool down: Walking and upper back extension (3 minutes)

Packing and dispersion of pupils: 4 minutes

Materials required: One stop watch, 80 skipping ropes, one bluetooth audio speaker, one whistle, four cones and 25 gym mats.

Week Eight

Warm up: 10 minutes

Activities:

1. Shuttle runs
2. Hip flexor stretch
3. Aerobic dance with music
4. Skipping on one foot alternatively without rope
5. Sit ups
6. Heel kick ups

Main activity: Skipping with rope (9 minutes)

Reps: 3 minutes

Sets: 3 sets

Rest: 2 minutes

Cool down: Side stretch with music (3 minutes)

Packing and dispersion of pupils: 4 minutes

Materials required: One stop watch, one bluetooth audio speaker, 80 skipping ropes, one whistle, four cones and 25 gym mats.

Week Nine

Test 4 (Post-test 3 conducted during the last training session)

Warm up: 10 minutes

Activities:

1. Jogging
2. Neck side flexion

3. Aerobic dance with music
4. Press ups
5. Standing long jumps forward/backwards
6. Hopping side to side forward/backwards

Main activity: Skipping with rope (9 minutes)

Reps: 3 minutes

Sets: 3 sets

Rest: 2 minutes

Cool down: Biceps stretch with music (3 minutes)

Packing and dispersion of pupils: 4 minutes

Materials required: One stop watch, one bluetooth audio speaker, 80 skipping ropes, one whistle, four cones and 25 gym mats.

Description of Exercises

Jumping jacks: Participants stand shoulder-width apart with the hands beside their body. Upon hearing the whistle, they jump with the legs spread sideways and hands moving from the side over the head. The action is repeated continuously.

Galloping: This is a forward-facing locomotor movement in which the lead leg moves ahead of the trail leg, without both legs crossing at any point in time. The participants move forward using a “springing” action with a push from the heel of the trail leg.

Shuttle runs: Participants stand in a ready position behind a cone or line. Upon hearing the whistle, they run to two cones placed about 10m away from the starting point, and about 5m apart. Participants run to the first cone and back to the starting point, and then run to the second cone and back to the starting position.

Short jumps: Participants stand shoulder-width apart. Upon hearing the whistle, they take off from both feet with the hand moving forwards and backwards to propel the body forwards. They land on both feet (on balls of feet) with a slightly bent knee. The action is repeated.

Vertical jumps: From a shoulder-width apart standing position, participants bend their body forward and draw their hands from the front to the back to propel them forwards, taking off from both feet. They land on both feet with slightly bent knees.

Standing long jumps: Participants bend slightly behind the starting line with the hands drawn to the back for a forward drive. Upon hearing the whistle, they take off from both feet and land on both feet with a slightly bent knee. The action is repeated.

Hopping: Participants slightly raise one foot from the ground and take off from the other foot with the hands drawn to the back to generate the force for the body to move.

Jumping in and squat out: From a shoulder-width apart standing position, participants start jumping with the feet together and then jump the feet wide whilst slightly squatting. The action is repeated.

Jumping out and squat in: From a shoulder-width apart standing position, participants start jumping with the feet wide and then slightly squat when the feet are brought closely together. The action is then repeated.

Jumping lunges: Participants stand in ready position with one foot forward. Upon hearing the whistle, they jump and slightly "sit in" after landing. The activity is then repeated after switching to the other leg.

Press ups: From a prone position, participants slightly bend and straighten the elbow to bring the entire body down and up respectively, whilst resting on the toe (for boys) or knee (for girls). The action is repeated.

Sit ups: From supine lying position with bent knees and feet on the ground, participants lift the upper body to a sitting position and return to the supine position with the hands relaxed on the thigh. The action is repeated.

High knee picking: From a shoulder-width apart standing position, participants run on the spot with the knee raised to the hip level with a well-coordinated arm and foot movement (alternate action).

Heel kick ups: Participants stand shoulder-width apart and run on the spot with the arm and foot action, whilst kicking the buttocks with the heels.

Picking tails: Participants place palm leaves at the back of their shorts and jog around the working area trying to remove the tails of others, and at the same time protecting their tails from being picked by others.

Here, there, where: Participants stand anywhere in the working area. They run to the position of the instructor upon hearing the "here" command. Upon hearing the "there" command, they run to the location that the instructor points at. Participants run to their desired location in the working area upon hearing the "where" command.

Description of stretching activities

Neck side flexion: From a shoulder-width apart standing position, participants lower their ear towards their shoulder while keeping their face forwards.

Participants hold the position for 30 seconds and repeat the activity at the other side.

Triceps stretch: From a shoulder-width apart standing position, participants raise both arms over their head and bend their elbows such that the forearms are behind their head. They then grasp one elbow with the other hand and push the elbow down or towards the other shoulder so that the forearm drops towards the middle of the shoulder blade. The activity is repeated at the other arm.

Supraspinatus (top of shoulder blade) stretch: Participants stand shoulder-width apart and cross one arm in front of the body to hold the other shoulder. They then hold the elbow of the bent arm and pull it towards the shoulder of the holding arm. The activity is repeated at the opposite shoulder.

Shoulder stretch: From a shoulder-width apart standing position, participants hold a skipping rope between both hands at their back. They then gently pull the rope upwards with one hand and at the same time pull the rope downwards with the other hand. Participants repeat the activity at the opposite shoulder.

Side stretch: From a shoulder-width apart standing position, participants bend their upper body to the right while still looking forward. They then use their right hand to gently push their right hip in the opposite direction. The same activity is repeated at the opposite side.

Biceps stretch: Participants sit on a floor mat and place their feet flat on the floor and bend their knees. They then place their hands flat on the floor (fairly close together) with their fingers pointing away. They then walk their hands away from their buttocks. The activity is then repeated.

Quadriceps stretch: Participants raise their right foot at the ankle with the right hand. They then pull up their ankle gently to feel the stretch at the quadriceps whilst having the left leg been slightly bent. The same activity is repeated on the other side.

Adductor (groin) stretch: From a shoulder-width apart standing position, participants widen their feet whilst holding their hips for balance. They then lunge sideways such that the weight of the body rest on the left foot as they bend the knee to feel the stretch at the right groin. The same activity is then repeated on the other side.

Hip flexor stretch: From a shoulder-width apart standing position, participants kneel by placing their right knee on a mat with the left foot been placed flat on the floor in front of them. They then rest on their left knee with their hands and keep their body erect and hold the position for 30 seconds. The activity is then repeated on the other foot.

Lower back extension and abdominal stretch: Participants lie prone on a mat. They then lift the upper body off the floor by straightening the elbow to feel the stretch along the front of the abdomen. The activity is repeated.

Upper back extension: Participants kneel on their knees and hands at the same time and stretch their arms in front of them along the floor, while allowing their head to drop towards the floor with the buttocks moving towards their heel. The stretch is felt at the upper back between their shoulder blade.

Ethical considerations

In conducting this investigation, all the ethical issues that were identified were strictly adhered to. Measurement records of participants were made private as much as possible. All information provided by and derived from participants were treated as confidential to the principal investigator and supervisors and were not to be released by the researcher to any third party unless required to do so by law. This means that no part of the collected data of participants were to be given to any other third party without legal approval. Numbers (A001-A080) were given to the participants as their pseudo names. Under no circumstance were the names or anything that identifies participants be indicated on the data summary sheets.

Consent of participants were also sought from the school, parents and the participants themselves. Participants were made to understand the purpose of the study before they were asked to participate. They were notified that participation was purely at their will and that they could decide to opt out of the study at any point they felt intimidated or at any instance they felt sick. All the data gathered were analysed as a group. As such, it was impossible to trace the physical measurement of any pupil who took part in the study as an individual.

Data Processing and Analysis

Data were screened for missing values and outliers and subsequent replacement and correction. This was done to ensure that the data met the assumptions of normality, homogeneity of variance and linearity for one-way repeated measures analysis of variance (ANOVA) and t-test. Also, the assumptions of outliers, normality, linearity, homoscedasticity and independence of residuals were checked using the normal P-P plot of regression standard residual and the scatterplot for the multiple linear regression (see Appendix H). Also the Mahalanobis and Cook’s distances were all not problems suggesting that the assumptions have been met. The satisfaction of the assumptions paved way for the analysis of the data. Hypothesis 1 was analysed with independent samples t-test to determine the differences in BMI between the male and female participants after the nine-week skipping training intervention. The choice of this statistical tool was influenced by the submission of Huck (2012) and Pallant (2020) that when comparing the group means of measurements (i.e., measured on continuous scale) of participants of two independent groups, the appropriate statistical tool is the independent samples t-test.

Hypothesis 2 was analysed with one-way ANOVA with repeated measures. One-way ANOVA with repeated measures was used to analyse Hypothesis 2 to determine the differences in BMI between pre-test measurement and the post-test scores of the participants within the test period. The choice of this statistical tool was influenced by the submission of Huck (2012) that when comparing more than two group means (i.e., measured on continuous scale) of measurements of participants at different times, the appropriate statistical tool is the one-way ANOVA with repeated measures.

Hypotheses 3 and 4 were analysed with multiple linear regression to determine the predictive relationship between demographic characteristics (age, height, skipping frequency, weight and BMI at baseline) and BMI of male and female primary six pupils in UPS, Cape Coast after nine weeks of training. Since the determination of BMI for males differed from that of females (see Appendix A), the data file was split before conducting the analysis. Hence, two regression results were generated for male and female pupils. The choice of this statistical tool was influenced by the submission of Babbie (2010) and Pallant (2020) that when determining the predictive relationship or association between two or more continuous scaled independent variables and an outcome or dependent variable measured on a continuous scale, the most appropriate statistical tool to use is multiple linear regression. The decision criterion was pegged at .05 level of significance.

Summary

The purpose of this study was to examine the effect of nine-week skipping training intervention on BMI of primary six pupils of UPS, Cape Coast. Following the pre-experimental research design, the one-group pre-test post-test repeated measures technique was specifically employed. Simple random sampling (without replacement) technique was used to select two classes out of six classes for the study. In all, 77 pupils (males = 38, females = 39) completed the study.

A researcher-generated data summary sheet was used for recording participants' measurements. The weight and height of participants were measured with a weighing scale and stadiometre (tape measure), respectively, while BMI was derived from the formula, weight (kg) / height (m^2). The study conformed to all the research protocols, safety guidelines and ethical issues that were identified. Participants' height, weight, skipping frequency and BMI were measured at baseline, on the 3rd, 6th and 9th weeks. The hypotheses were tested with independent samples t-test, one-way ANOVA with repeated measures and multiple linear regression, all at 95% confidence level.

CHAPTER FOUR

RESULTS AND DISCUSSION

The purpose of this study was to examine the effect of nine-week skipping training intervention on body mass index (BMI) of primary six pupils of University Primary School (UPS), Cape Coast. In this chapter, emphasis is laid on the presentation and the interpretation of results that came out of the investigation. Existing literature were used in discussing the findings derived from the investigation.

The study was a pre-experimental study in which the one-group pre-test post-test repeated measures design was specifically used. Data was collected at four different time points (i.e., one pre-test and three post-tests). The participants were primary six pupils of two randomly selected classes of UPS who met the inclusion criteria. Out of the 80 pupils who were selected, only 77 completed the study and thus had complete records needed for the statistical analysis. In this light, the statistical analysis was based on the sample size of 77 (males = 38, females = 39).

Hypothesis 1: There will be differences in BMI between male and female primary six pupils in UPS, Cape Coast, following a nine-week skipping training intervention programme.

Hypothesis 1 sought to test whether any differences existed between male and female pupils regarding their BMI after the nine weeks skipping intervention programme. However, before Hypothesis 1 was tested, a preliminary analysis was conducted to examine whether the BMI of male and female pupils at baseline differed. The intent of this was to provide a basis for the difference or similarities in BMI before examining the differences in their BMI scores after the nine weeks skipping intervention programme. In accomplishing this task, independent samples t-test analysis was conducted. Table 2 presents the details of the analysis.

Table 2: Differences in BMI at Baseline Between Male and Female Pupils

Gender	N	*M*	*SD*	*df*	*t*	Sig.	Eta squared (η^2)
				75	-.074	.941	.00007
Male	38	21.47	4.94				
Female	39	21.56	5.80				

Source: Field data (2021)
Significant at $p < .05$

From Table 2, the values for *df, t,* Sig. and η^2 are 75, -.074 and .00007, respectively. Table 2 shows that there was no statistically significant difference in the BMI at baseline between male participants ($M = 21.47$, $SD = 4.94$) and female participants ($M = 21.56$, $SD = 5.80$; t (75) = -.074, $p = .94$). This implies that male and female pupils did not differ in terms of their BMI scores before the nine-week skipping training intervention programme. Moreover, the magnitude of the difference in the means (mean difference = -.09, 95% CI = -2.54, 2.36) was also found to be incredibly small ($\eta^2 = .00007$). The practical implication of this is that gender accounted for less than 1% (i.e., .0007%) of the variations in the BMI at baseline.

In other words, gender was not a predisposing factor for having a high or low BMI at baseline. Since no differences existed in the BMI at baseline between male and female pupils, it was prudent to examine whether any difference existed in BMI after the nine weeks skipping intervention programme between male and female pupils. Table 3 presents the results of the analysis on gender difference in BMI after the nine weeks skipping intervention programme.

Table 3: Differences in BMI for Post-test 3 between Male and Female Pupils

Gender	N	*M*	*SD*	*df*	*t*	Sig.	Eta squared (η^2)
				75	-.484	.630	.003
Male	38	20.15	4.36				
Female	39	20.68	5.32				

Source: Field data (2021)
Significant at $p < .05$

Table 3 indicates that there was no statistically significant difference in BMI after the nine-week skipping training intervention programme between male (M = 20.15, SD = 4.36) and female (M = 20.68, SD = 5.32; t (75) = -.484, p = .63) pupils. This implies that male and female pupils did not differ in terms of their BMI scores after the nine-week skipping training intervention programme.

The magnitude of the difference in the means (mean difference = -5.37, 95% CI = -2.75, 1.67) was also found to be incredibly small (η^2 = .003). This means that, practically gender accounted for less than 1% (i.e., 0.3%) of the variations in the BMI after the nine weeks skipping intervention programme. In other words, gender was not a predisposing factor for having high or low BMI after the nine weeks skipping training intervention programme. Upon this revelation, the null hypothesis that stated that "There will be no differences in BMI between male and female primary six pupils of UPS, Cape Coast, following a nine-week skipping training intervention programme" was supported.

This hypothesis was purposed to examine whether any substantial difference existed in the BMI between male and female pupils after the nine-week skipping intervention programme. The study found that there was no statistically significant difference in BMI between male and female pupils after the nine-week skipping training intervention programme. This implies that male and female pupils did not differ in terms of their BMI scores after the nine-week skipping training intervention programme, with an incredibly small magnitude. Indicating that, practically gender accounted for less than 1% of the variations in the BMI after the nine weeks skipping intervention programme. In other words, gender was not a predisposing factor for having high or low BMI after the nine weeks skipping training intervention programme.

This finding was not surprising as the difference in BMI of the male and female participants was also not substantially significant at baseline. The finding derived from this study is similar to that of other prior studies (Domaradzki, Cichy, Rokita, & Popowczak, 2020; Ham, Sung, Lee, Choi, & Im, 2016; Vizcaíno et al., 2008). For instance, Domaradzki et al. ascertained the effect of a 10-week high intensity interval training (HIIT) called "Tabata" during physical education (PE) classes on the body composition (i.e., BMI) and physical performance (i.e., aerobic and anaerobic) among adolescents who are underweight, normal and overweight. Domaradzki et al. found no substantial gender difference among the participants following the 10-week training.

Similarly, Ham et al. (2016) conducted a study to examine the effectiveness of an eight-week transtheoretical model (TTM) based counselling together with a 12-week skipping training programme with music. The study was based on the TTM and health parameters including BMI of 11-year-old Korean obese children. The study found no marked gender difference in BMI among the experimental group after the eight weeks of TTM-based counselling conducted alongside the 12-week skipping training combined with music.

Another study by Vizcaíno et al. (2008) ascertained the impact of an after-school non-competitive PA programme on BMI, skinfold and percentage body fat of school children aged 9-10 years over a 24-week duration. Vizcaíno et al. found no clear gender difference in the effectiveness of the training programme on BMI after 24 weeks.

A valid explanation that could be ascribed to this finding of having no substantial gender difference in BMI after the nine-week skipping training intervention programme is the consistency in the training protocol for both the male and female pupils. The finding could also be as a consequence of the methodological approach employed in this study. That is the use of only one group as opposed to more than one group. In the near future, studies could adopt different methodological designs to test this same hypothesis for a better understanding of the situation (i.e., gendered difference in BMI after participating in a skipping training programme for normal or overweight school pupils).

The implication of this result is that the same physical activity (PA) interventions such as skipping can be used for both male and female pupils who intend to improve their BMI status. In other words, skipping training could be appropriate exercise intervention for both male and female pupils.

Hypothesis 2: There will be a statistically significant difference in BMI between pre-test and post-test measurements of primary six pupils in UPS, Cape Coast, following a nine-week skipping training intervention programme.

Hypothesis 2 was formulated to test whether any statistically significant difference existed between the baseline and post-test measurements of BMI. The BMI of the participants was measured at four different time points (i.e., pre-test, post-test 1, post-test 2, post-test 3). Moreover, since the BMI determination for males and females differ (see Appendix A), the data was split before conducting this analysis and the results given were for separate for males and female pupils. In examining the baseline and post-test measurements of BMI, a one-way ANOVA with repeated measures was conducted. Table 4 shows the results of the analysis.

From Table 4, *F*, Sig and η_p^2 values for male were 9.42, < .001 and .201, respectively. Moreover, female's *F*, Sig and η_p^2 values were 7.35, < .001 and .162, respectively. Table 4 indicates that there was a statistically significant difference in at least one of the BMI scores for both males [$F(3,111) = 9.42$, $p < .001$, $\eta_p^2 = .203$] and females [$F(3,114) = 7.35$, $p < .001$, $\eta_p^2 = .162$], indicating that the magnitude of the effect was large for both males and females. The Post-hoc comparisons employing the Bonferroni adjustment revealed that for male pupils, no significant reductions in BMI was identified between the pre-test (*M* = 21.47, *SD* = 4.94) and post-test 1 (*M* = 21.43, *SD* = 4.81) means. After six weeks of intervention, still no major differences were recorded among pre-test (*M* = 21.47, *SD* = 4.94), post-test 1 (*M* = 21.43, *SD* = 4.81) and post-test 2 (*M* = 21.31, *SD* = 4.63). This means the BMI of the male participants did not improve significantly after the sixth week.

Table 4:One-way Repeated Measures ANOVA for the Effect of Nine-week Skipping on BMI of Male and Female Pupils

Gender		*M*	*SD*	*F*	*df*	Sig.	Partial eta squared (η_p^2)
				9.42	3,111	<.001	.203
Male	BMI Pretest	21.47[a]	4.94				
	BMI Posttest1	21.43[b]	4.81				
	BMI Posttest2	21.31[c]	4.63				
	BMI Posttest3	20.15[abc]	4.36				
				7.35	3,114	<.001	.162
Female	BMI Pretest	21.56[d]	5.80				
	BMI Posttest1	21.25[ef]	5.47				
	BMI Posttest2	21.07[eg]	5.41				
	BMI Posttest3	20.68[dfg]	5.32				

Source: Field data (2021); N (male = 38, female = 39)
Male: Significant at $p < .05$ = [a, b, c]
Female: Significant at $p < .05$ = [d, e, f, g]

Significant differences were however, indicated after nine weeks of intervention between pre-test (*M* = 21.47, *SD* = 4.94) and post-test 3 (*M* = 20.15, *SD* = 4.36) signifying an improvement in the BMI status of the male participants. This result also confirms the contention by Arazi et al. (2016) and Jahromi and Gholami (2015) that major effects are indicated after seven weeks of intervention in experimental studies.

For female pupils, no substantial reductions in BMI was identified between pre-test (*M* = 21.56, *SD* = 5.80) and post-test 1 (*M* = 21.25, *SD* = 5.47) means. After six weeks of intervention, there were still no substantial differences between pre-test (*M* = 21.56, *SD* = 5.80), post-test 1 (*M* = 21.25, *SD* = 5.47) and post-test 2 (*M* = 21.07, *SD* = 5.41) means. This means the BMI of the female participants did not improve significantly after six weeks. However, substantial differences were recorded after the nine weeks of intervention between pre-test (*M* = 21.56, *SD* = 5.80) and post-test 3 (*M* = 20.68, *SD* = 5.32) means. This signifies an improvement in the BMI status of the female participants after nine weeks of intervention (Arazi et al., 2016).

Since there was a statistically significant reduction in the BMI scores after the nine weeks of the skipping training intervention programme (i.e., BMI pre-test versus BMI post-test 3) for both male and female pupils in primary six, it can be said that the skipping training intervention programme conducted over nine weeks was effective in improving the BMI of male and female pupils of primary six in UPS, Cape Coast. Hence, the null hypothesis which stated that "There will be no statistically significant difference in BMI between pre-test and post-test measurements of primary six pupils of UPS, Cape Coast, following a nine-week skipping training intervention programme" was not supported.

This hypothesis tested whether any statistically significant difference existed between the baseline measurement of BMI and that of the BMI of the post-tests. Put differently, this hypothesis was purposed to examine the efficacy of skipping training intervention conducted three times in a week over a nine-week period in improving the BMI of primary six pupils. The study found that there was a statistically significant difference between the baseline score of BMI and that of the post-test scores for both male and female pupils. After comparing the pre-test and post-test 3 BMIs, it was indicated that there was a statistically significant reduction in the BMI scores for both male and female pupils after the nine-weeks skipping intervention programme. This implies that the nine-weeks skipping training intervention programme was effective in improving the BMI of primary six pupils of UPS, Cape Coast. This finding has some similarities with the findings of other investigations (Arazi et al., 2016; Chen, 2010; Ghorbani et al., 2014; Jahromi & Gholami, 2015; Kim et al., 2007; Lee, 2010; Lee & In, 2017; Mullur & Jyoti, 2019; Partavi, 2013).

For instance, Mullur and Jyoti (2019) studied the impact of eight weeks skipping training on the BMI of 12-16 years in-school children. The study revealed that the skipping training conducted over eight weeks significantly improved the BMI of the children in the experimental group as against their colleagues in the control group. The commonality between the current study and Mullur and Jyoti's study is that skipping training when performed for some weeks improve BMI of school children. However, while the current study used nine weeks to realise the marked improvement, Mullur and Jyoti used eight weeks to record this same effect and this could be as a result of the difference in training intensity.

Similarly, Lee and In (2017) conducted a study to investigate the effect of skipping exercise programme on body composition of 12 female college students over a period of six weeks. The study yielded a statistically significant improvement in the BMI of the participants following the six weeks skipping exercise programme. The finding that skipping training performed after some weeks improve BMI as reported by Lee and In is similar with the current study. However, while Lee and In used only six weeks to note this effect, the current study used nine weeks. A possible reason could be as a result of the differences in the sample used. Using only females in Lee and In's study might have accounted for an improvement in BMI just after six weeks which could be linked to female's not having improved fitness compared to males.

Jahromi and Gholami (2015) also examined the effectiveness of jump rope training on the physical fitness of 9-10 years old female students over 15 weeks. The study revealed that the 15 weeks jump rope training intervention elicited a statistically significant improvement in the BMI of the training group as against their counterparts in the control group. The similarity between Jahromi and Gholami's study and the present investigation is that improvement in BMI is realised after continuous participation in skipping training. However, while Jahromi and Gholami used 15 weeks, the current study used nine weeks and this could be due to the differences in the training intensity. Since the current study used pupils aged 12 a slightly higher intensity was used compared to the intensity that would be used for children aged nine to ten years.

In another study, Kim et al. (2007) examined the effect of six weeks skipping training programme on body composition of 26 and 14 obese and lean male adolescents respectively in Korea. Kim et al.'s study discovered a statistically significant change or improvement in the BMI of the participants in the obese exercise group after six weeks of skipping training. Kim et al. had a similar finding with the current study in that which re-echoed the improvement of BMI after weeks of skipping training. This notwithstanding, Kim et al. used only six weeks to realise the significant effect while the current study took nine weeks. A likely reason for these discrepancies may be because this study used healthy pupils while Kim et al. used obese adolescents.

In Taiwan, Chen (2010) also conducted a case study on a student with mild intellectual disability to ascertain the effectiveness of skipping training on the health-related physical fitness (HRPF) for seven weeks. The result indicated that the seven-week skipping training programme accounted for a significant reduction in the BMI from 31 kg/m^2 to 29 kg/m^2, supporting the evidence from the current study that skipping training performed for some weeks improve the BMI of the participants. However, Chen used seven weeks to note the significant improvement in the BMI of the student.

Further, Lee (2010) conducted a study to ascertain whether 40 weeks skipping training intervention had any effect on physical fitness of elementary school pupils in Pingtung City, Taiwan. The ANCOVA results showed a statistically significant improvement in BMI of participants in the experimental group. This finding shares some commonality with the finding of the current study. However, it took Lee 40 weeks to note the impact of the skipping training. This could be attributed to the differences in the sample. Since the participants in Lee's study were elementary school pupils, the training intensity may be lower compared to that of this study.

With a similar intention, Partavi (2013) investigated whether seven weeks skipping training could be used to improve physical fitness in sixth grade boys aged 11-12 years. Partavi's study discovered a statistically significant improvement in the physical fitness variables including cardiovascular endurance, agility and BMI following the seven weeks skipping training programme. Which is similar to the finding of the current study. However, while the current study used nine weeks to detect a marked improvement in BMI, Partavi used only seven weeks. Differences in training intensity might have accounted for this differences.

Again, Arazi et al. (2016) compared the effects of running and skipping training methods on HRPF in 10-12-year-old boys. The study revealed that the skipping training and the running training methods significantly improved aerobic power, muscular endurance and BMI as against the control group. This finding also confirms the improvement of BMI after weeks of skipping training which is similar to the finding of the current study. Hence, skipping training could be used as a perfect alternative to running for the improvement of BMI for school going children as indicated in the current study.

Similarly, Ghorbani et al. (2014) investigated the effects of aerobic training comprising running and rope skipping performed for six weeks on cardiovascular fitness, BMI and mental health of female students. An incredible improvement in cardiovascular fitness, BMI and mental health indices of participants in the experimental group was reported. Ghorbani et al.'s study also confirms the effectiveness of skipping training performed over some weeks on BMI, which is similar to the current study. However, Ghorbani et al. used six weeks to confirm the efficacy of skipping training in improving BMI while the current study used nine weeks. A likely reason could be because, Ghorbani et al. used only females whose fitness level may be relatively lower.

However, the finding of the current study contradicts the finding of Chao-Chien and Yi-Chun (2012). Chao-Chien and Yi-Chun studied the effect of skipping rope intervention on health-related physical fitness of intellectually impaired students aged 13-15 years. The study revealed no statistically significant improvement in BMI of the participants after the training programme. This, according to Chao-Chien and Yi-Chun, was as a result of not controlling the diet of the participants.

Despite the fact that this investigation used only one group, there was still a marked improvement in the BMI of the pupils after the nine-week skipping intervention programme even though not entirely conclusive. An acceptable reason for the finding of this study could be attributed to the high intensity nature of the skipping training causing high degree of the breakdown of accumulated fat in the body (Narici et al., 2021; Styner et al., 2014). Another reason accounting for this finding could be the direct positive linkage between regular participation in vigorous PA and positive health outcomes irrespective of body size and age (Lazaar et al., 2007; Nagai & Moritani, 2004).

It could also be that the long-term suspension of sporting activities in schools as a result of COVID-19 which rendered the pupils inactive for long played a role in the improvement of their BMI after the nine weeks of engaging in the skipping training intervention programme (Genin et al., 2021; Hudson & Sprow, 2020; Narici et al., 2021).

Essentially, this study has demonstrated that regular participation in vigorous PA such as skipping training intervention over a period of nine weeks could act as an efficacious means of promoting child health by preventing the likelihood of overweight among young children. This result has implications for the inclusion of skipping training in the school life of pupils to help manage their BMI levels.

Hypothesis 3: There will be a relationship between demographic characteristics and BMI of male primary six pupils in UPS, Cape Coast, following a nine-week training intervention programme.

This hypothesis was formulated and tested to examine the predictive relationship between the demographic characteristics (age, skipping frequency, height, weight and BMI) of male participants taken at baseline and their BMI after the entire nine weeks skipping intervention programme. In this case, the predictor variables were the demographic characteristics (age, skipping frequency, height, weight and BMI) while BMI for post-test 3 was the outcome variable. Both the predictor and outcome variables were measured on continuous scale. The data was split before conducting the analysis which was for both Hypotheses 3 and 4. This was because the determination of BMI scores for males and females are not the same, hence, the BMI-for-age growth chart for males and females which is a standardised means of BMI determination for people aged 2-20 years was used for the specific gender (see Appendix A).

In examining the predictive relationship between the demographic characteristics (age, skipping frequency, height, weight and BMI) of male participants taken at baseline and their BMI after the entire nine weeks skipping intervention programme, a multiple linear regression analysis was conducted. Table 5 outlines the results of the regression coefficient of BMI for post-test 3 for male and female pupils together with the model summary.

Table 5 shows that the value of R for male and female was .871 and .970, respectively. More so, the value of R square for male and female was .759 and .941, respectively. The model containing age, height, skipping frequency, weight, BMI at baseline and BMI for post-test 3 was statistically significant for both male [$F(1,37) = 20.15$, $p < .001$, adjusted $R^2 = .721$] and female [$F(1,38)$

= 105.17, $p < .001$, adjusted $R^2 = .932$]. The results imply that 72.1% and 93.2% of the variations in BMI of the male and female pupils respectively, after the skipping intervention are attributable to age, height, skipping frequency, weight and BMI at baseline.

The results as presented in Table 5 further shows that for male pupils, the baseline measurements of age (*B* = -.19, *p* = .80), skipping frequency (*B* = -.003, *p* = .62), height (*B* = .040, *p* = .92), weight (*B* = -.15, *p* = .80), and BMI (*B* = 1.10, *p* = .41) did not have any predictive relationship with the BMI for post-test 3. This implies that age, skipping frequency, height, weight and BMI at baseline did not contribute to the BMI status of male pupils after the nine-week skipping intervention. On the basis of this finding, the null hypothesis that stated that "There will be no relationship between demographic characteristics and BMI of male primary six pupils in UPS, Cape Coast, following a nine-week skipping training intervention programme" was supported.

This hypothesis tested whether any predictive relationship existed among male participants' demographic characteristics and their BMI after the nine-week skipping training intervention. The investigation revealed that for male pupils, the baseline measurements of age, skipping frequency, height, weight, and BMI did not have any predictive relationship with the BMI after the nine-week skipping training intervention programme. A finding that contradicts that of previous studies (Al-Nuaim et al., 2012; Mustelin, Silventoinen, Pietiläinen, Rissanen, & Kaprio, 2009). A plausible explanation for this finding could be as a result of the physical activity (PA) level and the competitive nature of the male pupils. Since this study found that the male pupils were superiorly physically fit than their female peers, their physical fitness level or competitiveness might have suggested an already existing improved BMI. This probably led to an insignificant relationship after a routine exercise programme such as the nine-week skipping training programme (Deaner et al., 2012; Sylvia-Bobiak & Caldwell, 2006).

Another reason why demographic characteristics of the male participants did not have any marked predictive relationship with their BMI after the nine weeks of skipping training could be linked with males having relatively larger heart and lungs. They also have greater vital capacity than their female peers, making males comparatively able to contain the stressful demands of vigorous PA (Hands, Parker, Larkin, Cantell, & Rose, 2016). To Hands et al., such physiological attributes may give males an undue advantage and render the training regime to have insignificant relationship with the training outcome.

Hypothesis 4: There will be a relationship between demographic characteristics and BMI of female primary six pupils in UPS, Cape Coast, following a nine-week training intervention programme.

This hypothesis tested the predictive relationship between the demographic characteristics (age, skipping frequency, height, weight and BMI) of female participants taken at baseline and their BMI after the entire nine weeks skipping intervention programme. In this case, the predictor variables were the demographic characteristics (age, skipping frequency, height, weight and BMI) while BMI for post-test 3 was the outcome variable. Both the predictor and outcome variables were measured on continuous scale.

Table 5: Predictive Relationship between Demographic Characteristics and BMI for Post-test 3 for Male and Female Pupils

		Unstandardised Coefficients		Standardised Coefficients		
Gender	Model	B	Std. Error	Beta	*t*	Sig.
Male	(Constant)	.482	53.451		.009	.993
	Age	-.185	.707	-.025	-.262	.795
	Skipping frequency (Pretest)	-.003	.006	-.046	-.501	.620
	Height(Pretest)	.040	.367	.050	.108	.915
	Weight(Pretest)	-.148	.567	-.413	-.261	.796
	BMI (Pretest)	1.100	1.328	1.248	.829	.413
	R	.871				
	R Square	.759				
	Adjusted R Square	.721				
Female	(Constant)	-44.417	19.248		-2.308	.027
	Age	-.795	.528	-.068	-1.505	.142
	Skipping frequency (Pretest)	-.007	.004	-.073	-1.523	.137
	Height(Pretest)	.373*	.132	.560	2.815	.008
	Weight(Pretest)	-.570*	.180	-1.594	-3.158	.003
	BMI (Pretest)	2.189*	.417	2.387	5.251	.000
	R	.970				

R Square	.941
Adjusted R Square	.932

Source: Field data (2021) *Significant, $p < .05$

Male- $F(1,37) = 20.15$, $p < .001$; Female- $F(1,38) = 105.17$, $p < .001$

Table 5 also indicates that for female pupils, the baseline measurements of age ($B = -.80$, $p = .14$) and skipping frequency ($B = -.01$, $p = .14$) did not have any predictive relationship with BMI for post-test 3. This implies that age and skipping frequency at baseline did not contribute to the BMI status of female pupils after the nine-week skipping intervention. Nevertheless, baseline measurements of height ($B = .37$, $p < .05$), weight ($B = -.57$, $p < .05$) and BMI ($B = 2.20$, $p < .05$) had predictive relationship with BMI for post-test 3. This implies that height, weight and BMI at baseline contributed to the BMI status of female pupils after the nine-week skipping intervention programme. The results show that a positive significant relationship existed between the baseline measurements of height and BMI, and BMI for post-test 3, but a negative significant relationship existed between the baseline measurement of weight and BMI for post-test 3.

The general implication of this finding is that female pupils who had higher scores in both height and BMI were more likely to have a higher BMI after the nine-week skipping intervention. In other words, female pupils who were taller and had worse BMI at baseline were more likely to have a worse BMI at the end of the skipping intervention.

However, the female pupils who had higher scores for weight were less likely to have higher BMI score after the nine week skipping intervention. In other words, female pupils who were heavier in weight were less likely to have worse BMI. On the basis of this finding, the null hypothesis that stated that "There will be no relationship between demographic characteristics and BMI of female primary six pupils in UPS, Cape Coast, following a nine-week skipping training intervention programme" was partially supported.

For female pupils, the baseline measurements of age and skipping frequency did not have any predictive relationship with BMI after the nine-week skipping training intervention programme. Nevertheless, baseline measurements of height, weight and BMI had predictive relationship with BMI after the nine-week skipping training intervention programme. There was a positive significant relationship between the baseline measurements of height and BMI, and BMI after the nine weeks of skipping training, but a negative significant relationship existed between the baseline measurement of weight and BMI after the nine weeks of skipping training. The general implication of this finding is that female pupils who had higher scores in both height and BMI were more likely to have a higher BMI after the nine week skipping intervention. The opposite is also true.

The finding that a significant positive relationship existed between the baseline measurements of height and BMI, and BMI after the nine weeks of skipping training is similar with the observations of other investigations (Al-Nuaim et al., 2012; Mustelin et al., 2009). The generally held notion that females are relatively inactive and less competitive could be a possible reason for this study's outcome (Deaner et al., 2012; Sylvia-Bobiak & Caldwell, 2006) as this study found that females were comparatively less physically fit than male participants. Another acceptable explanation for this finding could be as a result of the substantial contribution of height in ones' BMI (Gildner, Barrett, Liebert, Kowal, & Snodgrass, 2015). It could also be that the tall female pupils with high BMI at baseline were lazy in performing the skipping training. The finding that females had higher height and BMI scores at baseline in this study might have also influenced this finding. Hence, PAs that aim at improving BMI of female pupils should pay attention to tall female pupils with higher BMI at baseline.

However, the female pupils who had higher scores for weight were less likely to have higher BMI score after the nine week skipping intervention. A likely reason for this observation could be attributed to the effectiveness of the participation in consistent vigorous PA for its health benefits (Lazaar, Aucouturier, Ratel, Rance, Meyer, & Duché, 2007; López-Sánchez, Díaz-Suárez, Radzimiński, & Jastrzębski, 2017; Nagai & Moritani, 2004; Wassenaar et al., 2021). Since, the study indicated variations in BMI, it gives credence to the effectiveness of the nine-week skipping training. Even though the finding should be treated with caution since there are identified limitations, the study still provides a fundamental ground upon which further studies could be based for improved investigative approaches and findings.

The practical implication of this finding is that interventions that seek to improve the BMI of female pupils in UPS should focus on tall females with high baseline BMI before the training intervention.

Summary

The purpose of this study was to examine the effect of nine-week skipping training intervention on BMI of primary six pupils in UPS, Cape Coast. The study revealed that there was no statistically significant difference in BMI after the nine-week skipping training intervention programme between the male and female participants. This implies that male and female pupils did not differ in terms of their BMI scores after the nine-week skipping training intervention programme.

The investigation also revealed that there was a statistically significant reduction in the BMI scores after the nine weeks of the skipping training intervention programme (i.e., BMI pre-test versus BMI post-test 3) for both male and female pupils in primary six. This indicates that the skipping training intervention programme conducted over nine weeks was effective for improving the BMI of primary six male and female pupils in UPS, Cape Coast.

For male pupils, the baseline measurements of age, skipping frequency, height, weight, and BMI did not have any predictive relationship with the BMI for post-test 3. This implies that age, skipping frequency, height, weight and BMI at baseline did not contribute to the BMI status of male pupils after the nine-week skipping intervention.

For female pupils, the baseline measurements of age and skipping frequency did not have any predictive relationship with BMI for post-test 3. This means that the age and skipping frequency at baseline did not play any contributory role in the BMI status of female pupils after the nine-week skipping intervention programme. Nevertheless, only baseline measurements of height, weight and BMI had predictive relationship with BMI for post-test 3. This means that height, weight and BMI at baseline contributed to the BMI of female pupils after the nine-week skipping intervention programme. A positive significant relationship existed between the baseline measurements of height and BMI, and BMI for post-test 3, but a negative significant relationship existed between the baseline measurement of weight and BMI for post-test 3 for the female participants.

The general implication of this finding is that tall female pupils with high baseline BMI were more likely to have a higher BMI after the nine week skipping intervention. However, the female pupils who had higher scores for weight were less likely to have higher BMI score after the nine week skipping intervention.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to examine the effect of nine-week skipping training intervention on body mass index (BMI) of primary six pupils in University Primary School (UPS), Cape Coast. This chapter concentrates on the summary, key findings, conclusions drawn from the investigation as well as the recommendations.

Summary

This investigation was conducted to examine whether nine-week skipping training intervention programme could be used to improve the BMI of primary six pupils in UPS, Cape Coast. Four hypotheses were tested to give answers to the investigation. Following the pre-experimental research design, the one-group pre-test post-test repeated measures technique was specifically employed. Simple random sampling (without replacement) technique was used to select two classes out of six classes for the study. In all, 77 pupils (males = 38, females = 39) completed the study, hence, all the statistical analyses were conducted based on this sample size.

A researcher-generated data summary sheet was used to record participants' measurements. The weight and height of participants were measured with a weighing scale and stadiometre (tape measure), respectively, while BMI was derived from the formula, weight (kg) / height (m^2). The study conformed to all the research protocols, safety guidelines and ethical issues that were identified. Participants' height, weight, skipping frequency and BMI were measured at baseline, on the 3rd, 6th and 9th weeks. The hypotheses were tested with independent samples t-test, one-way ANOVA with repeated measures and multiple linear regression, all at 95% confidence level.

Key Findings

1. There was no statistically significant difference in BMI between male (M = 20.15, SD = 4.36) and female (M = 20.68, SD = 5.32; t (75) = -.484, p = .63) primary six pupils of UPS, Cape Coast, after the nine-week skipping training intervention programme. This implies that male and female pupils had similar BMI status after the nine-week skipping intervention programme.
2. There was a statistically significant difference in BMI between pre-test (M = 21.47, SD = 4.94); (M = 21.56, SD = 5.80) and post-test measurements (M = 20.15, SD = 4.36); (M = 20.69, SD = 5.32) of male and female primary six pupils respectively, after the nine-week skipping training programme. This means that the nine-week skipping intervention programme contributed to the improvement of the BMI status of primary six pupils.
3. The baseline measurements of age, skipping frequency, height, weight, and BMI of the male pupils did not have any predictive relationship with the BMI for post-test 3. This implies that age, skipping frequency, height, weight and BMI at baseline did not contribute to the BMI status of male pupils after the nine-week skipping intervention.
4. Only baseline measurements of height (B = .37, $p < .05$), weight (B = -.57, $p < .05$) and BMI (B = 2.20, $p < .05$) had predictive relationship with BMI for post-test 3 for female pupils. This means that only height,

weight and BMI at baseline contributed to the BMI status of female pupils after the nine-week skipping intervention programme.

Conclusions

1. Male and female primary six pupils of UPS, Cape Coast did not differ in terms of their BMI after the nine-week skipping training intervention.
2. Since there was a statistically significant reduction in the BMI after the nine weeks skipping training intervention (i.e., BMI pre-test versus BMI post-test 3) for both male and female pupils, it can be said that the intervention was effective for improving the BMI of primary six pupils of UPS, Cape Coast.
3. None of the demographic characteristics (age, height, weight, skipping frequency and BMI) of male pupils contributed to their BMI after the nine weeks skipping training intervention.
4. Tall female pupils with high BMI at baseline were more likely to have a higher BMI after the nine week skipping intervention. However, the female pupils who had higher scores for weight were less likely to have higher BMI after the nine week skipping intervention.

Recommendations

This study recommends that:

1. School authorities should adopt the same physical activity (PA) interventions (e.g., skipping) for both male and female pupils to improve their BMI status.
2. School authorities through the Physical Education (PE) teachers should adopt and include 30-minute skipping training, thrice a week for nine

weeks in the school's activities to help maintain or improve the BMI of pupils.

3. Interventions that seek to improve BMI of male primary six pupils in UPS should pay little attention to baseline measurements of male pupils before the training intervention.
4. Interventions that seek to improve the BMI of female primary six pupils in UPS should focus on tall female pupils with high baseline BMI before the training intervention.

Suggestions for Further Studies

Even though the results from this study are not conclusive, the study serves as a beginning point for future research in Ghana using different populations such as overweight pupils, pupils who are at risk of overweight and inactive in-school adolescents. Future studies investigating effects of skipping training intervention should:

1. Consider adopting other research designs such as a quasi-experimental research design where participants will be accidentally allocated to either a control or experimental group in order to rule out other possible confounding effects.
2. Consider using only overweight pupils or pupils who are at risk of overweight to provide a better conclusion regarding the efficacy of skipping training in improving pupils' BMI.
3. Examine whether skipping training intervention could be used to improve other physiological health-related parameters (such as heart rate, percentage body fat, blood pressure and bone density).

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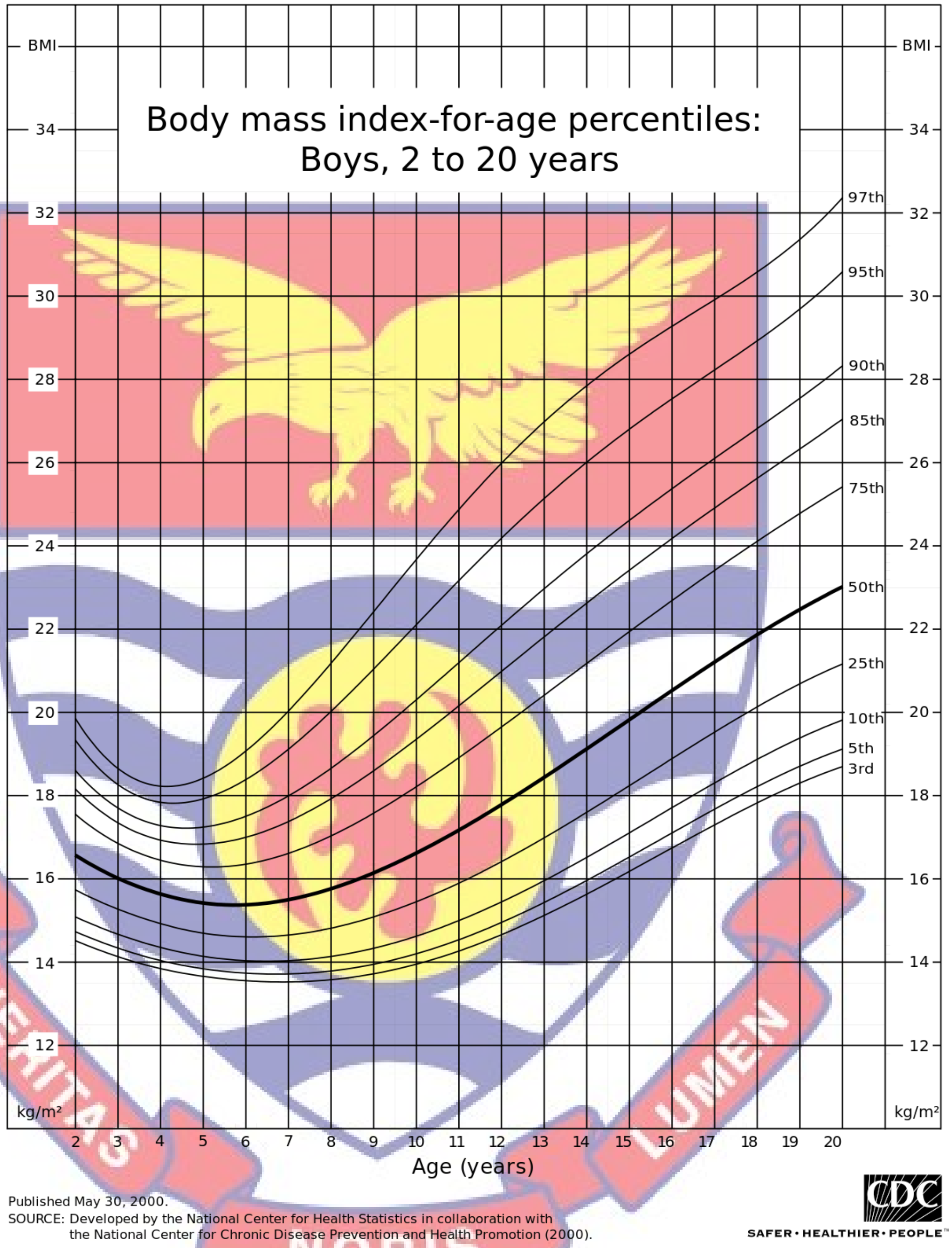
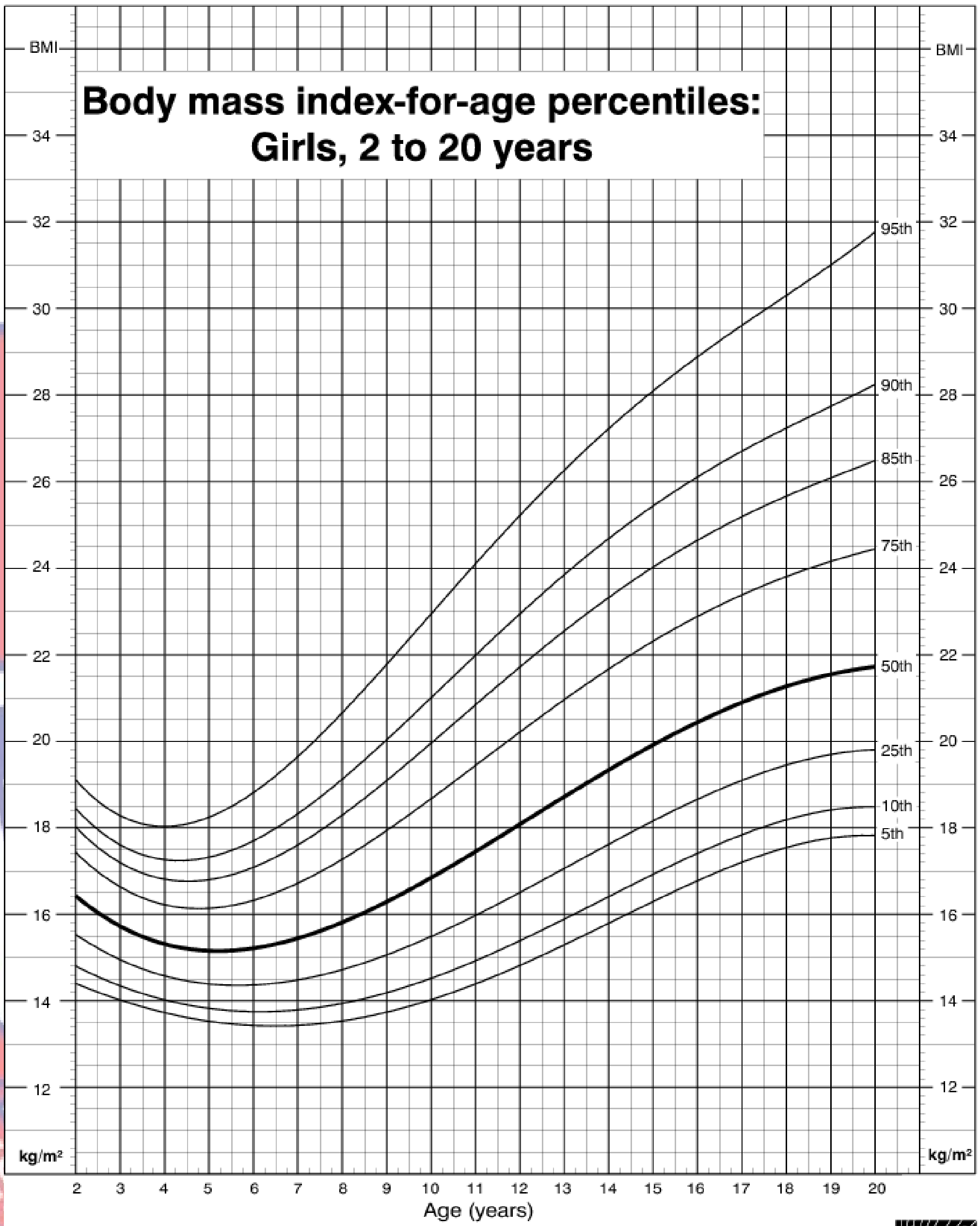
APPENDICES

APPENDIX A

CDC GROWTH CHARTS AND INTERPRETATION





Published May 30, 2000.
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).

CDC
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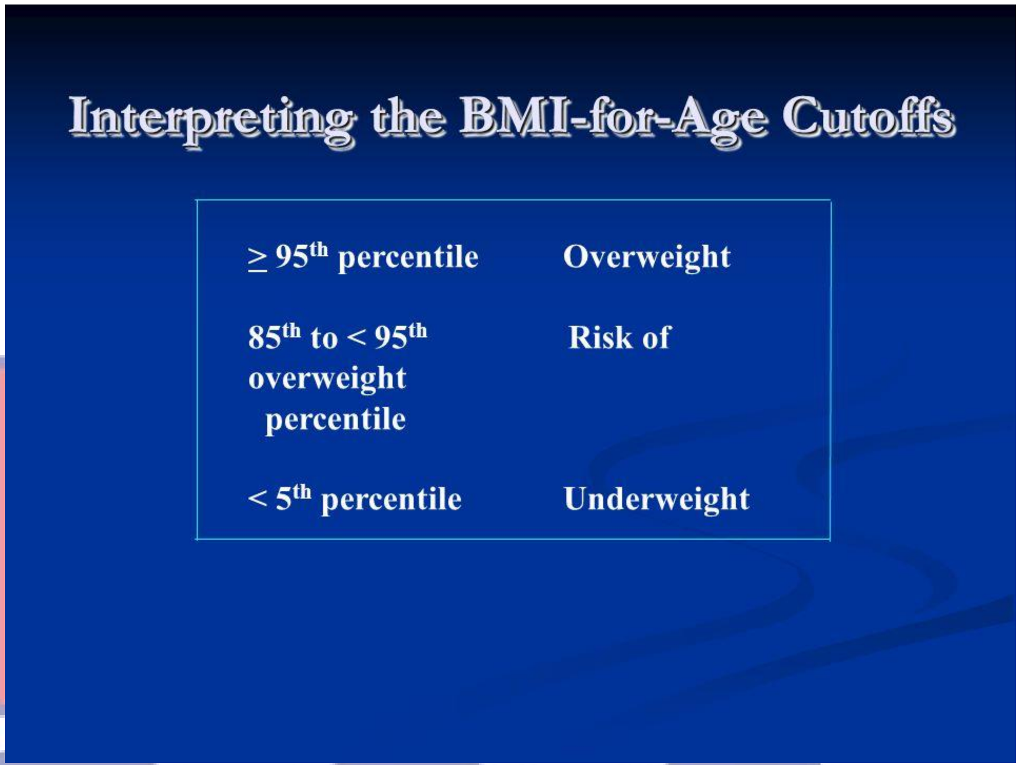


Source: CDC (2000)

APPENDIX B

DATA SUMMARY SHEET

S/N	ID	Age	Gender	Pre-test				Post-test 1				Post-test 2				Post-test 3			
				SF	H	W	BMI	SF	H	W	BMI	SF	H	W	BMI	SF	H	W	BMI
1.																			
2.																			
3.																			
4.																			
5.																			
6.																			
7.																			
8.																			
9.																			
10.																			

APPENDIX C

DETAILS OF MEASUREMENTS FROM PARTICIPANTS

S/N	ID	Age	Gender	Pre-test				Post-test 1				Post-test 2				Post-test 3			
				SF	H	W	BMI	SF	H	W	BMI	SF	H	W	BMI	SF	H	W	BMI
1.	A01	12.00	1.00	190.00	147.00	34.70	16.10	260.00	147.00	34.70	16.00	255.00	147.00	35.10	16.20	154.00	147.00	35.00	16.20
2.	A02	12.00	1.00	220.00	147.50	37.90	17.40	246.00	147.50	38.40	17.70	205.00	147.50	39.00	17.90	200.00	147.50	38.30	17.60
3.	A04	11.00	1.00	97.00	160.00	64.10	25.00	157.00	160.00	65.70	25.70	157.00	160.00	66.50	25.90	250.00	160.00	44.00	17.20
4.	A05	11.00	1.00	120.00	155.00	43.10	17.90	230.00	155.00	43.40	18.10	250.00	155.00	43.60	18.10	230.00	155.00	42.00	17.50
5.	A06	12.00	1.00	250.00	150.00	58.70	26.10	224.00	150.00	58.80	26.10	261.00	150.00	59.50	26.40	211.00	150.00	34.30	15.20
6.	A07	11.00	1.00	200.00	145.00	33.30	15.80	249.00	145.00	33.70	16.00	206.00	145.00	34.20	16.30	250.00	145.00	34.00	16.10
7.	A08	12.00	1.00	237.00	157.50	40.30	16.20	266.00	157.50	40.70	16.40	308.00	157.50	40.90	16.50	205.00	157.50	40.50	16.30
8.	A09	13.00	1.00	108.00	147.50	50.20	23.10	200.00	147.50	50.20	23.10	204.00	147.50	49.90	22.90	208.00	147.50	40.70	18.70
9.	A10	12.00	1.00	117.00	147.00	45.40	21.00	136.00	147.00	45.60	21.10	120.00	147.00	42.30	19.60	222.00	147.00	41.90	19.40
10.	A11	11.00	1.00	127.00	147.50	41.80	19.00	222.00	147.50	42.10	19.40	240.00	147.50	42.30	19.40	200.00	147.50	41.00	18.80

11.	A12	12.00	1.00	127.00	150.00	47.90	21.30	171.00	150.00	47.50	21.00	178.00	150.00	48.30	21.50	200.00	150.00	48.00	21.30
12.	A13	12.00	1.00	101.00	155.00	59.80	24.90	120.00	155.00	60.00	25.00	198.00	155.00	59.70	24.80	200.00	155.00	59.00	24.60
13.	A14	11.00	1.00	159.00	152.50	39.90	17.20	173.00	152.50	39.80	17.10	161.00	152.50	39.60	17.00	234.00	152.50	39.00	16.80
14.	A15	12.00	1.00	42.00	150.00	48.30	21.50	57.00	150.00	48.10	21.40	111.00	150.00	48.20	21.40	160.00	150.00	47.40	21.10
15.	A16	12.00	1.00	160.00	150.00	54.00	24.00	164.00	150.00	53.00	23.60	100.00	150.00	52.90	23.50	105.00	150.00	52.00	23.10
16.	A17	12.00	1.00	172.00	157.50	34.40	13.90	206.00	157.50	34.80	14.00	265.00	157.50	36.00	14.50	265.00	157.50	35.00	14.10
17.	A18	11.00	1.00	130.00	147.50	55.90	25.70	135.00	147.50	56.80	26.10	210.00	147.50	56.90	26.20	215.00	147.50	56.00	25.70
18.	A20	14.00	1.00	42.00	157.50	41.80	16.90	50.00	157.00	40.00	16.10	60.00	157.50	40.00	16.10	70.00	157.50	39.00	15.70
19.	A21	12.00	1.00	185.00	157.50	48.90	19.70	142.00	157.50	50.30	20.30	188.00	157.50	49.80	20.10	199.00	157.50	49.00	19.80
20.	A22	13.00	1.00	150.00	155.00	45.00	18.70	246.00	155.00	43.10	17.90	200.00	155.00	44.60	18.60	201.00	155.00	44.00	18.30
21.	A23	12.00	1.00	152.00	157.50	40.00	16.10	259.00	157.50	42.00	16.90	159.00	157.50	40.90	16.50	170.00	157.50	40.00	16.10
22.	A24	12.00	1.00	130.00	162.50	59.00	22.30	192.00	162.50	57.30	21.70	190.00	162.50	57.30	21.70	195.00	162.50	57.00	21.60
23.	A25	12.00	1.00	361.00	155.00	50.00	20.80	312.00	155.00	50.10	20.90	202.00	155.00	49.00	20.40	372.00	155.00	48.00	20.00
24.	A26	12.00	1.00	120.00	157.50	45.90	18.50	279.00	157.50	46.40	18.70	100.00	157.50	46.10	18.60	134.00	157.50	45.00	18.10

25.	A27	11.00	1.00	178.00	142.50	32.80	16.20	203.00	142.50	33.60	16.50	200.00	142.50	33.80	16.60	281.00	142.50	33.10	16.30
26.	A28	12.00	1.00	150.00	142.50	37.90	18.70	140.00	142.50	38.70	19.10	120.00	142.50	38.60	19.00	125.00	142.50	38.00	18.70
27.	A29	12.00	1.00	140.00	142.50	50.10	24.70	160.00	142.50	49.30	24.30	150.00	142.50	48.00	23.60	160.00	142.50	47.00	23.10
28.	A31	12.00	1.00	105.00	150.00	50.90	22.60	115.00	150.00	49.90	22.20	120.00	150.00	49.50	22.00	150.00	150.00	49.00	21.80
29.	A32	12.00	1.00	152.00	147.50	50.20	23.10	150.00	147.50	50.50	23.20	154.00	147.50	50.20	23.10	159.00	147.50	49.60	22.80
30.	A33	12.00	1.00	220.00	147.50	52.00	23.90	243.00	147.50	51.70	23.80	244.00	147.50	50.20	23.10	247.00	147.50	49.00	22.50
31.	A34	12.00	1.00	170.00	150.00	58.30	25.90	144.00	150.00	56.50	25.10	127.00	150.00	56.80	25.20	143.00	150.00	55.00	24.40
32.	A37	12.00	1.00	80.00	147.50	56.00	25.70	101.00	147.50	54.90	25.20	102.00	147.50	56.10	25.70	110.00	147.50	55.10	25.30
33.	A38	12.00	1.00	57.00	155.00	97.90	40.70	60.00	155.00	96.40	40.10	101.00	155.00	93.10	38.80	102.00	155.00	92.00	38.30
34.	A39	12.00	1.00	278.00	155.00	56.30	23.40	149.00	155.00	57.00	23.70	150.00	155.00	55.10	22.90	152.00	155.00	54.00	22.50
35.	A41	12.00	1.00	100.00	142.50	52.00	25.60	110.00	142.50	51.00	25.10	121.00	142.50	50.00	24.60	165.00	142.50	49.00	24.10
36.	A42	12.00	1.00	73.00	155.00	69.90	29.10	110.00	155.00	69.40	28.90	100.00	155.00	68.90	28.70	157.00	155.00	50.10	20.90
37.	A43	12.00	1.00	144.00	147.50	42.40	19.50	243.00	147.50	42.00	19.30	143.00	147.50	41.00	18.80	184.00	147.50	40.00	18.40
38.	A45	12.00	1.00	130.00	142.50	35.70	17.60	240.00	142.50	35.80	17.60	147.00	142.50	36.00	17.70	248.00	142.50	35.00	17.20

39.	B01	12.00	2.00	202.00	162.50	57.40	21.70	205.00	162.50	56.20	21.30	256.00	162.50	55.50	21.00	300.00	162.50	54.00	20.50
40.	B02	12.00	2.00	95.00	157.50	47.50	19.10	124.00	157.50	47.20	19.00	161.00	157.50	48.00	19.30	165.00	157.50	47.40	19.10
41.	B03	12.00	2.00	128.00	150.00	43.50	19.30	130.00	150.00	43.30	19.20	152.00	150.00	43.00	19.10	155.00	150.00	42.00	18.70
42.	B05	12.00	2.00	72.00	152.50	45.70	19.70	128.00	152.50	46.00	19.80	146.00	152.50	46.00	19.80	155.00	152.50	45.00	19.30
43.	B06	12.00	2.00	186.00	168.00	54.50	19.30	188.00	168.00	54.30	19.20	208.00	168.00	54.00	19.10	210.00	168.00	52.00	18.40
44.	B07	12.00	2.00	42.00	168.00	80.00	28.30	60.00	168.00	79.90	28.30	70.00	168.00	79.80	28.30	102.00	168.00	77.00	27.30
45.	B08	12.00	2.00	150.00	157.50	49.30	19.90	196.00	157.50	48.80	19.70	145.00	157.50	47.00	18.90	148.00	157.50	45.00	18.30
46.	B09	12.00	2.00	149.00	162.50	52.90	20.00	150.00	162.50	52.20	19.80	101.00	162.50	52.00	19.70	102.00	162.50	51.00	19.30
47.	B10	12.00	2.00	100.00	152.50	63.00	27.10	202.00	152.50	63.50	27.30	112.00	152.50	62.50	26.90	144.00	152.50	61.00	26.20
48.	B11	11.00	2.00	150.00	157.50	55.00	22.20	195.00	157.50	54.30	21.90	163.00	157.50	54.00	21.70	165.00	157.50	53.00	21.40
49.	B12	12.00	2.00	120.00	157.50	53.70	21.60	154.00	157.50	53.20	21.40	140.00	157.50	52.90	21.30	172.00	157.50	51.80	20.90
50.	B13	12.00	2.00	110.00	157.50	44.00	17.70	100.00	157.50	43.50	17.50	135.00	157.50	43.20	17.40	150.00	157.50	43.00	17.30
51.	B14	12.00	2.00	175.00	155.00	47.80	19.90	127.00	155.00	48.90	20.30	109.00	155.00	48.60	20.20	112.00	155.00	47.00	19.60
52.	B15	12.00	2.00	120.00	155.00	47.80	19.90	120.00	155.00	47.80	19.90	135.00	155.00	47.50	19.80	195.00	155.00	46.50	19.40

53.	B16	11.00	2.00	64.00	152.50	46.80	20.10	141.00	152.50	47.00	20.20	108.00	152.50	46.00	19.80	110.00	152.50	45.00	19.30
54.	B17	11.00	2.00	89.00	168.00	78.90	27.90	90.00	168.00	79.60	28.20	107.00	168.00	78.90	28.00	174.00	168.00	77.00	27.30
55.	B18	11.00	2.00	342.00	157.50	42.00	16.90	173.00	157.50	41.30	16.60	196.00	157.50	41.00	16.50	200.00	157.50	40.00	16.10
56.	B19	12.00	2.00	101.00	150.00	38.00	16.90	55.00	150.00	38.20	17.00	97.00	150.00	38.00	16.90	112.00	150.00	37.00	16.40
57.	B20	12.00	2.00	124.00	157.50	44.80	18.10	150.00	157.50	45.20	18.20	129.00	157.50	45.00	18.10	130.00	157.50	44.00	17.70
58.	B21	12.00	2.00	120.00	147.00	26.60	12.30	130.00	147.00	26.60	12.30	160.00	147.00	26.10	12.10	165.00	147.00	26.00	12.00
59.	B22	11.00	2.00	232.00	155.00	49.20	20.50	230.00	155.00	49.40	20.60	228.00	155.00	49.00	20.40	230.00	155.00	48.00	20.00
60.	B23	12.00	2.00	110.00	155.00	75.00	31.20	116.00	155.00	74.90	31.20	102.00	155.00	74.50	31.00	107.00	155.00	73.00	30.40
61.	B24	12.00	2.00	80.00	147.00	98.00	45.40	82.00	147.00	97.60	45.20	85.00	147.00	96.00	44.40	86.00	147.00	95.00	44.00
62.	B25	12.00	2.00	70.00	150.00	53.00	23.60	200.00	150.00	52.50	23.30	90.00	150.00	53.20	23.60	95.00	150.00	53.10	23.60
63.	B26	12.00	2.00	157.00	157.50	54.80	22.10	200.00	157.50	54.10	21.80	192.00	157.50	53.20	21.40	282.00	157.50	53.00	21.40
64.	B27	11.00	2.00	180.00	150.00	43.80	19.50	300.00	150.00	43.90	19.50	230.00	150.00	44.10	19.60	236.00	150.00	43.00	19.10
65.	B28	12.00	2.00	168.00	157.50	40.60	16.40	264.00	157.50	40.50	16.30	237.00	157.50	39.80	16.00	238.00	157.50	39.00	15.70
66.	B29	11.00	2.00	50.00	150.00	44.50	19.80	70.00	150.00	45.40	20.10	80.00	150.00	45.00	20.00	81.00	150.00	44.00	19.60

67.	B30	12.00	2.00	60.00	151.00	52.00	22.80	67.00	151.00	51.10	22.40	70.00	151.00	51.00	22.40	110.00	151.00	50.00	21.90
68.	B31	12.00	2.00	182.00	127.00	42.30	26.20	170.00	127.00	42.10	26.10	130.00	127.00	42.00	26.00	132.00	127.00	41.00	25.10
69.	B32	12.00	2.00	153.00	140.00	37.40	19.10	250.00	140.00	37.80	19.30	259.00	140.00	37.50	19.10	260.00	140.00	37.00	18.90
70.	B33	11.00	2.00	99.00	150.00	33.20	14.80	119.00	150.00	33.80	15.00	120.00	150.00	33.20	14.80	124.00	150.00	33.00	14.70
71.	B34	11.00	2.00	137.00	137.00	33.90	18.10	350.00	137.00	33.90	18.00	199.00	137.00	33.50	17.80	200.00	137.00	33.00	17.60
72.	B35	12.00	2.00	125.00	147.50	44.30	20.40	272.00	147.50	44.20	20.30	210.00	147.50	44.00	20.20	239.00	147.50	43.00	19.80
73.	B36	12.00	2.00	180.00	152.50	46.10	19.80	190.00	152.50	45.30	19.50	160.00	152.50	45.00	19.30	164.00	152.50	44.00	18.90
74.	B37	12.00	2.00	164.00	160.00	40.80	15.90	190.00	160.00	41.00	16.00	249.00	160.00	40.00	15.60	250.00	160.00	40.00	15.60
75.	B38	12.00	2.00	100.00	162.50	87.50	33.10	50.00	162.50	60.10	22.80	60.00	162.50	60.00	22.70	65.00	162.50	59.00	22.30
76.	B39	11.00	2.00	180.00	155.00	59.90	24.90	204.00	155.00	60.10	25.00	199.00	155.00	59.20	24.60	200.00	155.00	59.00	24.60
77.	B40	11.00	2.00	200.00	152.00	44.50	19.30	244.00	152.00	44.40	19.20	242.00	152.00	44.10	19.10	245.00	152.00	44.00	19.00

Key: SF = skipping frequency; H = height; W = weight; BMI = body mass index. For Gender, Male = 1.00; Female = 2.00

APPENDIX D

ETHICAL CLEARANCE

UNIVERSITY OF CAPE COAST

INSTITUTIONAL REVIEW BOARD SECRETARIAT

TEL: 0558093143 / 0508878309
E-MAIL: irb@ucc.edu.gh
OUR REF: UCC/IRB/A/2016/1036
YOUR REF:
OMB NO: 0990-0279
IORG #: IORG0009096

2ND AUGUST, 2021

Mr James Boadu frimpong
Department of Health, Physical Education and Recreation
University of Cape Coast

Dear Mr. Frimpong,

ETHICAL CLEARANCE – ID (UCCIRB/CES/2021/46)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted Provisional Approval for the implementation of your research titled ***Effect of Nine-Week Skipping on Body Mass Index of Primary Six Pupils of University Primary School, Cape Coast.*** This approval is valid from 2nd August, 2021 to 1st August, 2022. You may apply for a renewal subject to submission of all the required documents that will be prescribed by the UCCIRB.

Please note that any modification to the project must be submitted to the UCCIRB for review and approval before its implementation. You are required to submit periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol.

Yours faithfully,

Samuel Asiedu Owusu, PhD
UCCIRB Administrator

ADMINISTRATOR
INSTITUTIONAL REVIEW BOARD
UNIVERSITY OF CAPE COAST

APPENDIX E

INTRODUCTORY LETTER

UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION
DEPARTMENT OF HEALTH, PHYSICAL EDUCATION & RECREATION

TELEPHONE: +233 - (0)20661093 / (0)543021384 / (0)268392819
TELEX: 2332, UCC, GH

EMAIL: hper@ucc.edu.gh
Cables & Telegrams:
UNIVERSITY, CAPE COAST

Our Ref: **ET/MPE/19/0010/7**

31st May, 2021

The Head Teacher
University of Cape Coast Primary School
Cape Coast

Dear Madam,

INTRODUCTORY LETTER:
MR. JAMES BOADU FRIMPONG (ET/MPE/19/0010)

The above named person is a student of the Department of Health, Physical Education and Recreation of the University of Cape Coast. He is pursuing a Master of Philosophy degree in Physical Education. In partial fulfilment of the requirements for the programme, he is conducting a research for his thesis titled **"Effects of Nine-Week Skipping on Body Mass Index of Primary Six Pupils of University Primary School, Cape Coast ."**

We would be very grateful if he is granted the opportunity to conduct his research and also provide him with the information needed from your outfit. The data will be used for academic purposes only and be assured that the data collected will be treated with utmost confidentiality.

We count on your usual co-operation.

Thank you.

Yours faithfully,

Daniel Apaak (Ph.D)
(Head of Department)
Tel.: +233 (0)208587866
Email: daniel.apaak@ucc.edu.gh

APPENDIX F

INFORMED CONSENT FORM

In signing this form, I, the parent/guardian of the aforementioned child, affirm that I have read this form in its entirety and I have answered the questions accurately and to the best of my knowledge. I understand that my child is responsible for monitoring themselves throughout the activity, and should any unusual symptoms occur, would cease participation and inform the instructor. As a parent or guardian, I will ensure the safety of my ward by ensuring that they have the appropriate apparel (PE kit and a pair of non-slip sports shoe) for the activity at all times.

If medical clearance must be obtained before my child's participation in an exercise session, I agree to contact the child's physician and obtain written permission prior to the commencement of the exercise activity, and that the permission be given to the instructor.

………………………………………………………   ……………..

Name & signature of parent/guardian   Date

……………………………………………………..   ……………..

Name & signature of witness   Date

For any further information, please contact the following numbers:

James Boadu Frimpong – 0244389945

(Principal Investigator)

Mr. Michael Agyei – 0244815886

(Supervisor)

APPENDIX G

YOUTH PHYSICAL ACTIVITY READINESS QUESTIONNAIRE (PAR-Q)

Dear respondent,

Your ward has been selected to participate in a nine-week skipping training exercise to examine the effect of the training on their body mass index (BMI). Your ward's participation in this exercise will enable me to test the efficiency and effectiveness of skipping training in the improvement of BMI of primary school pupils.

You are required to provide information to ascertain the readiness of your ward prior to the study. Please provide the following information honestly.

Date: ……………….

Name of Pupil: ………………………………………………………….

Gender: M [ ] F [ ]

Age: …………..years

Relationship to pupil: ……………………………………….

Contact number: …………………………………………….

Kindly read and answer the following questions as frankly as possible by ticking (√) **Yes** or **No**.

S/N	Question	Yes	No
1.	Has your doctor ever said that your child has a heart condition and that your child should only do a physical activity recommended by a doctor?		

2.	Does your child ever experience chest pain during physical activity?		
3.	Does your child ever lose balance because of dizziness or do they lose consciousness?		
4.	Does your child have a history of epilepsy or seizures?		
5.	Does your child have a bone or joint problem that could be made worse by a change in their physical activity participation?		
6.	Does your child have uncontrolled asthma (i.e. asthma that is not easily controlled by an inhaler)?		
7.	Is your doctor currently prescribing any medication for your child?		
8.	Do you know of any other reasons why your child should not undergo physical activity? (This might include diabetes, a recent injury or serious illness)		

If you answered "Yes" to any of the above questions, medical clearance from your child's physician may be required. Please give details to any of the above questions answered with "Yes" here:

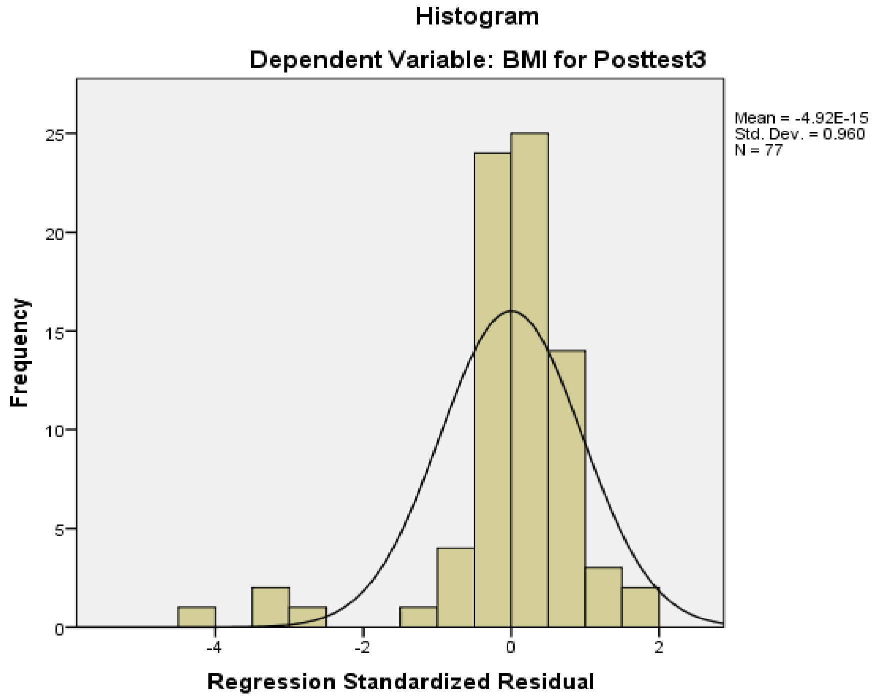
……………………………………………………………………………………

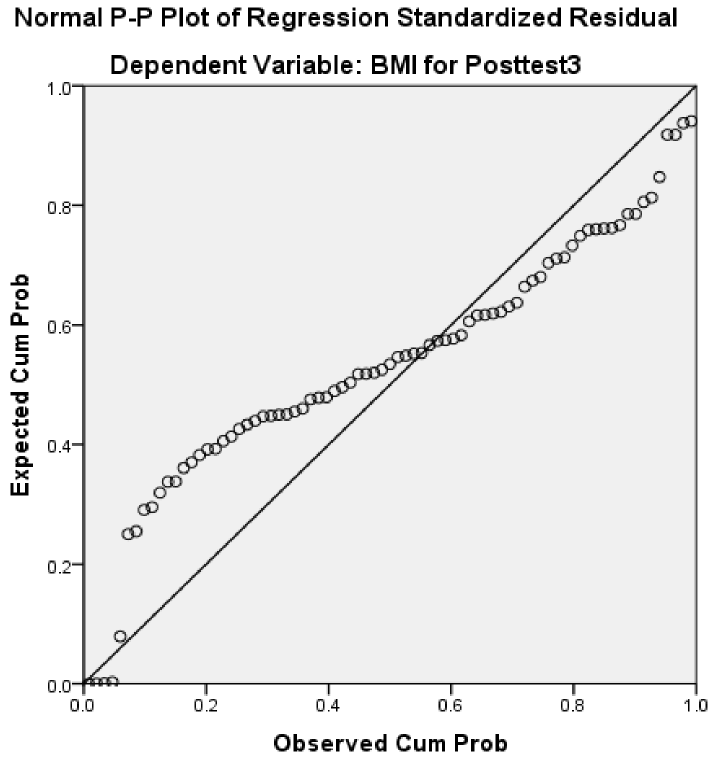
……………………………………………………………………………………

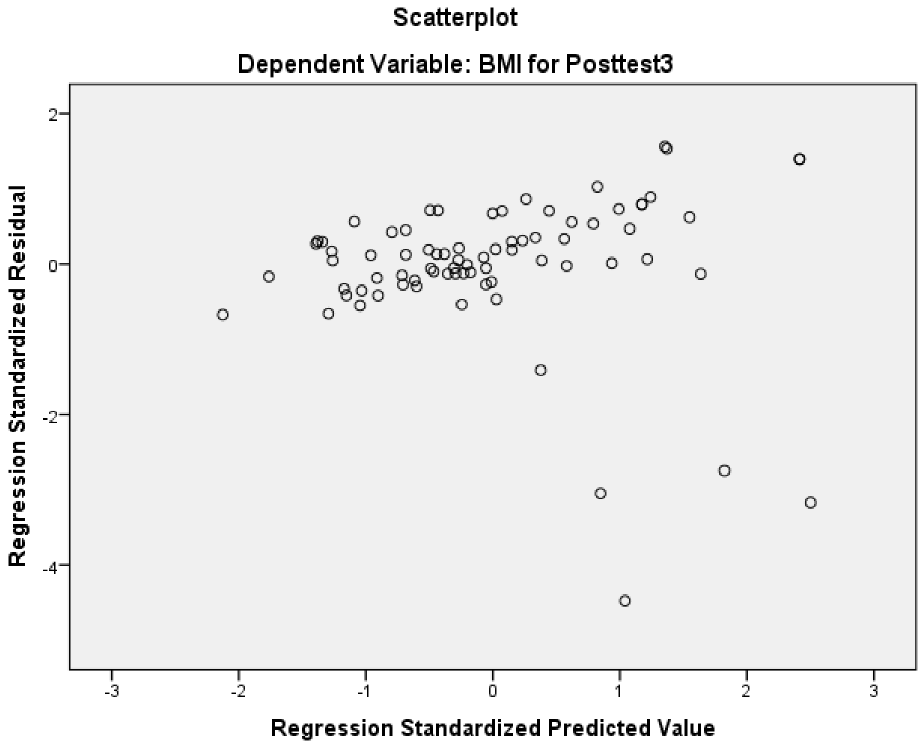
……………………………………………………………………………………

APPENDIX H

TEST OF ASSUMPTIONS FOR BMI POST TEST 3






Scatterplot
Dependent Variable: BMI for Posttest3
Regression Standardized Residual
2
0
-2
-4
-3
-2
-1
0
1
2
3
Regression Standardized Predicted Value