UNIVERSITY OF EDUCATION, WINNEBA

EFFECT OF EIGHT-WEEK PHYSICAL ACTIVITY PROGRAMME ON WEIGHT LOSS IN AKWAMUMAN SENIOR HIGH SCHOOL STUDENTS

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DECLARATION

Student's Declaration

I, Ebenezer Kofi Ofosu, declare that this thesis, except for the quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

Signature ……..……

Date ……...

Supervisor's Declaration

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidance for supervision of thesis as laid down by the University of Education, Winneba.

Supervisor's Name: Dr. Emmanuel Osei Sarpong

Signature ……..……

Date ……...

DEDICATION

In memory of my sister (Mrs. Elizabeth Adjei). To my dear family and friends, I love you all dearly.

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ABSTRACT

Losing weight has become a problem for students in senior high schools in Ghana due to decrease time for physical activity. Even though GES allocated 120 minutes for PE each week, Akwamuman SHS only uses 60 minutes. This study seeks to assess the effect of eight-week physical activity on weight loss among overweight and obese students of Akwamuman Senior High School. A pre-experimental pre-test, post-test design was used with a population of 2309 (81.19%) boarding students. 113 participants made up of 72 (63.72%) overweight and 41 (36.28%) obese were purposively sampled. Results indicated weight loss in all except participants in group 50 – 59 and 110 – 119. Males did not differ significantly in their rate of weight loss from their female participants as the rate of weight loss did not differ about their ages. Conclusions: Physical activity (exercise) is a major factor in weight loss although other factors can affect the rate at which it is done. Eight weeks of physical activity can make overweight and obese students lose weight if extra hours of physical activity can be found. After eight weeks, weight loss did not differ significantly in gender and age groups even though overweight and obese males lost more weight than females. The researcher recommended that schools should adhere to the time allocated to P. E. with no reduction whilst overweight and obese students are given extra hours for properly designed activities and supervision to meet their needs.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Regular physical activity is important for good health, and it is especially important when one is trying to lose weight or maintain a healthy weight (Centre for Disease Control and Prevention [CDC], 2015). Regular physical activity increases the number of calories the body uses for energy. Burning of calories through physical activity, combined with reducing the number of calories eaten, creates a calorie deficit that results in weight loss. Weight loss also occurs because of a decrease in calorie intake. Evidence shows that one way to maintain or lose weight is to engage in regular physical activity (CDC, 2015). Engaging in regular physical activity reduces risks of cardiovascular disease and diabetes beyond what is produced by weight reduction with food alone. Physical activity, therefore, helps to maintain weight, reduce high blood pressure, reduced risk for type 2 diabetes, heart attack, stroke, and several forms of cancer. Also, it reduces arthritic pain and associated disability, reduces the risk for osteoporosis and falls, and symptoms of depression and anxiety (CDC, 2015).

Jakicic et al. (2003) stated that physical activity (PA) is an essential component of weight management as well as in the treatment of abdominal obesity. It is well known that weight-loss interventions that include physical activities are more effective than dietary instruction alone for promoting long-term weight loss. Although physical activity may have modest effects on initial weight loss, it may be a critically important strategy for the maintenance of weight loss. Relatively, high doses of physical activity may be important for the long-term maintenance of weight loss (Jakicic et al 2008). Results from cross-sectional and prospective observational studies appear to support the need for adequate levels of physical activity to promote

weight management. Lee and Paffenbarger in 2000 demonstrated that individuals who report levels of physical activity that are consistent with the consensus public health guidelines have a lower body weight than those not reporting this level of physical activity.

Aerobic physical activity is great for burning calories, but strength training can also help manage weight. Maintaining a daily fitness routine often requires careful time management and dedication. The benefits of exercise are worth every moment you spend on it. From weight management to disease prevention, exercise is a natural and proven health elixir. Making exercise a daily habit will help one reap its benefits for years to come.

Wood et al. (1998), reported that weight loss in response to physical activity was 3.0kg and 4.0kg at 7 and 12 months respectively. They, therefore, concluded that weight loss is significant about days. In response to a 12-week intervention, Hagen et al. (1986) reported significantly less weight loss for men and women (0.6%) in response to physical activity. Donnelly et al. (2003) examined the supervised physical activity of 45 minutes per day on five days per week over 16-months in overweight and Class I obese adults. The findings of these studies demonstrated that when dietary intake is unchanged for men, physical activity resulted in a weight decrease of 5.2kg verse 0.5kg decrease observed in non-physical-activity control in men. In contrast, physical activity for women blunted weight gain with weight increasing by 0.6kg in exercising women verse 2.9kg increase in non-physical-activity control women. These data appear to indicate that physical activity has a modest impact on short-term weight loss in overweight and obese adults. In effect, an individual must burn more calories than consume to lose weight. The more exercise is done, the less food intake

must be reduced. Instead of eliminating 500 calories from your food choices alone, you can cut 250 calories from your daily meal and work off the 250.

In November 2015, CDC encouraged healthy adults to complete at least two hours and 30 minutes of moderate-to-high aerobic activity per week. Moderate aerobic activity includes many forms of physical activities, such as brisk walking, using the treadmill, or swimming laps. Alternately, individuals can complete one hour and 15 minutes of vigorous aerobic activity per week, such as running or cycling. Observational evidence has shown that even though the Ghana Education Service assigned 120 minutes for physical education in the senior high schools, some students in the public senior high schools in Ghana only has a chance of engaging in 120 minutes per week of physical education class. Some of these P.E. periods are used to teach theory lessons and other activities. This reduces the number of time student has for physical activity throughout the week(s), or term in certain cases.

Overweight and obesity are now the fifth leading risk factors contributing to global mortality (World Health Organization [WHO], 2013). It is reported in many countries that one person out of two is overweight or obese (Organisation for Economic Co-operation and Development [OECD], 2020). Overweight and obesity are defined by excessive accumulation of body fat which contribute to the development of chronic diseases such as Cardiovascular Disease (CVD) and type 2 diabetes (WHO 2006). Physical inactivity impacts health, wellbeing, and the maintenance of a healthy weight. These behaviours underpin the risk of the lifestyle-related non-communicable condition. The risk for ischaemic heart disease, stroke, type 2 diabetes, osteoporosis, various cancers, and depression are linked by behavioural and biomedical health determinants such as physical inactivity, poor dietary behaviours, and overweight and/or obesity.

Although some studies have concluded that men and women do not differ in the rate at which they lose weight, others have significant data to prove otherwise. Whilst some researchers believe that a man and a woman gave the same time and set of activities will lose the same amount of weight, other schools of thoughts have different ideas. It has been argued that men lose more body fat than women when engaged in weight loss programmes. This may be due to sex differences in body fat distribution. Lean muscle uses more calories than fat and because men have more muscles than women, men intend to burn more calories than women and ultimately affecting their weight. In support, a study was conducted in which male and female weight loss attempts and coping strategies were compared (Bhogal & Langford, 2014). The researchers found no sex differences in strategies adopted when losing weight, with both men and women adopting the same strategy of consuming less fat to lose weight. However, sex differences were found in weight loss attempts, with women reporting trying to lose weight more often than men, even for women with a normal BMI (Bhogal & Langford, 2014).

The University of Copenhagen along with eight other research institutions had embarked on a study that put 2,500 pre-diabetic and overweight people on a strict eight-week calorie-controlled diet. The result indicated that on average men lost 11.8kg, but women only dropped 10.2kg (Macdonald, 2020). Researchers further explained that for the same body mass index, men will tend to have a greater muscle and a smaller fat mass or proportional fat mass. That is because of the effect of sex hormones on body fat mass as well as fat distribution. However, gender differences in muscle size, speed, and strength are mainly the result of testosterone-related differences in the quantity of muscle mass. Women will respond equally to both strength training and aerobic exercise, improving in strength, endurance, speed, and

efficiency (Macdonald, 2020). The maximum intensity and duration women can achieve during aerobic exercise is typically five to 10 percent less than their male counterparts. This is because women typically have five to 10 percent less haemoglobin (an iron-containing protein in red blood cells that helps deliver oxygen to working muscles). Women who find themselves unable to work out as hard or as long for no apparent reason should be given enough iron and vitamin B.

As we age, there is a tendency of weight gain to the tune of 1 to 2 pounds per year, according to a review published in 2013 by the Agency for Healthcare Research and Quality. That may not seem like much, but over time it can lead to significant weight gain and, in some cases, obesity. The review revealed that obesity incidence starts increasing in the twenties and peaks at 40 to 59, and then decreases slightly after age 60 (Primack, 2019). However, not everyone will become overweight during older age because body weight is highly influenced by genetic makeup, level of physical activity, and food choices (Primack, 2019). Although the amount of lean muscle we have naturally begins to decline by 3 to 8 percent every 10 years after age 30, we also lose muscle as we get less active due to age-related health conditions, such as arthritis, or when side-lined with an injury or surgery for several days.

1.2 Statement of the Problem

The human body is likened to a machine that uses fuel to survive and when not serviced properly, will break down. An unhealthy weight can affect a person's well-being in various ways. That is why many people make a conscious effort to lose excess body weight (Cohut, 2019). Centre for Disease Control and Prevention in 2016 encouraged adolescents to complete at least two hours and 30 minutes of moderate-to-high intensity physical activity per week. World Health Organisation (2018) also recommends 60 minutes of moderate-intensity physical activity daily or at least 3 to 5

times each week for overweight & obese adolescents. As widely said, physical activity (exercise) helps prevent many ill-health conditions, decrease stress, and makes you feel better (Mayo Clinic, 2019). The physical educator has a primary goal among others of making students stay healthy and well. In doing so, there is a need to keep all students conforming to all health and fitness status.

Losing and maintaining weight has become problematic for students in senior high schools in Ghana due to decrease time for physical activity. Students in the senior high schools have a maximum of 120 minutes of physical education. (Syllabus for Physical Education, S.H.S, 2017). Although the duration for physical education allocated by Ghana Education Service (GES), 2017 is less than the American College of Sports Medicine‟s recommendation, the period most time is shrieked and forced to be used for other activities by the school management. This leads to an inactive lifestyle and consequently obesity in the school. At the pre-test, 113 (4.90%) out of 2309 students were either overweight or obese. in 2016, when PE had 80 minutes each week, there were only 64 overweight and obese students in the school. Prevalence of overweight and obesity in Akwamuman SHS is almost doubled in 3 years.

On average, PE lessons are taught 14 times per term (HOD – PE, 2019). Out of this, some are used for examination and for extra-curricular activities like sports competitions, school celebrations as some also fall on holidays. Wood, Stefanick, and Dreon (1998) reported that weight loss in response to physical activity was 3.0kg and 4.0kg at 7 and 12 months respectively, and therefore concluded that weight loss is significant about days. Donnelly et al. (2003), indicate that physical activity has a modest impact on short-term weight loss in overweight and obese adults. In effect, an individual must burn more calories than consume to lose weight.

Overweight and obesity as a medical condition is when the Body Mass Index (BMI) of an individual falls within 25 – 29.9, and 30 or above respectively concerning age and sex when compared to the standard (CDC, 2015). As observed, overweight and obese students of Akwamuman Senior High School have only 60 minutes to engage in regular physical activity each week which will help in their weight management. Overweight and obese students have minimal time to engage in adequate physical activity sessions throughout the term. It is therefore not surprising that overweight and obese students have so little opportunity to engage in physical activities that could help reduce their weight which will ultimately reduce their chance of developing any of the chronic diseases associated with overweight and obesity.

1.3 Purpose of the Study

The purpose of this study is to assess the effect of eight-week physical activity (exercise) programme on the weight of overweight and obese students of Akwamuman Senior High School. Besides, the study will investigate the rate of weight loss between gender and age groups of participants.

This study would therefore push for the need to engage in after-school, weekend, and holiday physical activity in addition to the regular physical education period for overweight and obese students. The study also would help physical education teachers, as well as fitness instructors, adjust their training programmes concerning gender and age.

1.4 Objectives of the Study

1. This study will determine the effect of eight-week physical activity (exercise) programme on overweight and obese students of Akwamuman Senior High School.
2. The study besides will compare difference in the rate of weight between overweight and obese male and female students of Akwamuman Senior High School.
3. To measure weight loss among different age groups among overweight and obese students of Akwamuman Senior High School.

1.5 Research Question

The following research questions guided the study.

1. What is the effect of physical activity (exercise) programme on the weight of Senior High School students?
2. What is the difference in weight loss among senior high school boys and girls in physical activity participation?
3. What is the relationship between student ages and weight loss?

1.6 Hypothesis

This research was used to test the following hypotheses.

HO_1: There will be no significant difference in the weight of overweight and obese senior high school student and their participation in an eight-week physical activity programme.

HO_2: Gender will not be a significant factor in weight loss among boarding students of Akwamuman Senior High School.

HO_3: Age will not be a significant factor in weight loss among boarding students of Akwamuman Senior High School.

1.7 Significance of the Study

The results from the study would serve as a guide for an overweight and obese student in their attempt to lose weight as it will also justify the need to include after-school, holiday, and weekend physical activities in the physical education curriculum for students who desire to lose weight. This study will enable physical education teachers and fitness instructors to design activities to suit students‟ health and wellbeing. This will enable overweight and obese students to get extra time on the field during physical education and sports sessions as this study give available evidence in the selection of activities for boys and girls since they might not reduce weight at the same rate.

Parents as well as school authorities of overweight and obese students would also be made aware of how certain foods and behaviours affect the weight of their wards. This will help them provide balanced diets and foods low in calories.

The study will finally act as a guide to policy planners and decision-makers in their works by considering students with special needs such as for overweight and obese students since they will require extra hours of physical activity with quality and professional supervision.

1.8 Delimitation of the Study

This research was a pre-experimental one group pre-test and post-test was delimited to only boarding students of Akwamuman Senior High School in the Asuogyaman District of the Eastern Region, Ghana. Participants in the study who are either overweight or obese and within the ages 14 to 20+ but not up to 22 and were all

adolescents boarding students. The study also lasted only 8 weeks; the effects of shorter or longer periods of exercise are therefore not known. This study also did not put subjects under confinement as participants were boarding students and under the control of school authorities. It is unclear whether the results would be the same when applied to students or persons who are underweight or normal on the BMI scale, overweight and obese students who are not boarders and under own or parental control, or boarding students who are below 14 and above 22 years. In this contest, comparing the results of this study to other settings will render it invalid and baseless.

1.9 Limitations of the Study

The researcher encountered the following situations that posed limitations to the study.

1. Some participants could not go through the whole intervention. As few fell ill along the line, others had other school duties such as clubs and group meetings, and paid/free extra classes, others went home with/without permission for one reason or the other.
2. Inadequate sleep/rest was also a major limitation for this study. Even though participants were not confined and remained in the school environment, the researcher explained how sleep could affect weight loss/gain as confirmed by research. Participants who did not observe the recommended sleep for adolescents had weight loss challenges which affected the study‟s results.
3. Participants' eating habits posed a major challenge for the researcher. Students in the boarding house are expected to eat a common meal and the same quantity. However, some participants eat in-between meals as well as junk foods sold on and outside the school. This will not only add up to the calories

exercise is helping to burn to lose weight but also requires much physical activity with high intensity to burn.

4. Little research has been done on weight loss interventions among Ghanaian students. Literature supporting this study was based on works in other countries and among adults.

1.10 Assumption

The researcher made the following assumptions to guide the study.

1. The interventions given to the participants were ideal and it is meant to help them lose weight and improve their BMI.
2. Participants used for the study were all boarders and eat the same amount of food from the school dining hall at regular times. Even if some may eat in-between meals, the researcher warned participants about this.
3. Participants were all boarders hence observed the same sleeping and rising periods. The rest participants enjoy after classes and the interventions were the same for all.

1.11 Definition of Terms

Calories: Unit of measure that show the amount of energy in foods and drinks.

Calorie deficit: A state in which you burn more calories than you consume.

Cancer: A disease in which the cells of a tissue undergo uncontrolled and rapid proliferation.

Cardiovascular Disease (CVD): refers to conditions that involve narrowed or blocked blood vessels that can lead to a heart attack, chest pain (angina), or stroke.

Emotional Eating: is the practice of consuming large quantities of food, usually junk foods in response to feelings instead of hunger.

Exercise: Any bodily activity that enhances or maintains physical fitness and overall health and wellness. (Wikipedia)

Ischaemic Heart Disease (Coronary Artery Disease): A disease caused when the coronary arteries become narrowed by a gradual build-up of fatty material within their walls.

Junk food: pre-prepared or packaged food that has a low nutritional value

Obesity: Anybody that falls between 30.0 and above on the BMI classification scale.

Osteoporosis: A disease in which the bones become extremely porous and are subject to fracture.

Overweight: Anybody that falls between 25.0 and 29.9 on the BMI classification scale.

Physical Activity: Any bodily movement produced by skeletal muscles that require energy expenditure. (World Health Organisation, WHO).

Stadiometer: A piece of medical equipment used to measure human height.

Stroke: The loss of brain function arising when the blood supply to the brain is suddenly interrupted.

Type 2 Diabetes: A chronic condition that affects the way the body processes blood sugar.

Weighing Scale: Device that is used to measure the weight of an object.

Weight: The force on an object due to the gravitational attraction between it and the earth.

1.12 Acronyms

ACSM: American College of Sports Medicine

BMI: Body Mass Index

CAD: Coronary Artery Disease

CVD: Cardiovascular Disease

HOD: Head of Department

OECD: Organisation for Economic Co-operation and Development

SHS: Senior High School

WHO: World Health Organisation

WHR: Weight to Hip Ratio

BF: Body fat

LBM: Lean Body Mass

VO_2max: Maximal Oxygen Consumption

TBM: Total body mass

FM: Fat mass

HSS: Department of Health and Human Services

PBF: Percentage of Body Fat

PPT: Physical Performance Test

1.13 Organization of the Study

The study was organized into five chapters. The first chapter introduces the study, consisting of the background of the study, statement of the problem, the purpose of the study, objectives of the study, research questions, and significance of the study. Additionally, delimitations, limitations, assumptions, the definition of terms, acronyms, and organization of the study were also discussed. The second chapter dealt with theoretical and conceptual frameworks employed in this study and

the review of literature relevant to the study. The third chapter discusses the methodology of the study which included the research design, population, sample size, and sampling techniques used in the study, instruments, procedure of the study and a plan of how data collected will be analysed. The fourth chapter deals with data collection, data analysis, and interpretation, discussion of the findings, and its interpretations. The fifth chapter discusses the conclusions drawn from the findings, recommendations made from the study and suggests areas for future research works. References and documents which include the research instruments and other related materials are included as appendixes.

CHAPTER TWO

LITERATURE REVIEW

This chapter dealt with theories and concepts that backed this study as well as related literature.

Literatures reviewed covered the following areas and themes;

1. Weight loss
2. Physical activity and weight loss
3. Gender and weight loss
4. Age and weight loss
5. Effects of aerobic dance on weight loss
6. Effects of strength training on weight loss
7. Effects of outdoor activities on weight loss

2.1 Theoretical and Conceptual Frameworks

Theories were used to drive this research. The researcher used both conceptual and theoretical frameworks as bases for the study. A theoretical framework explaining the Frequency, Intensity, Time, and Type (FITT) principle of physical activities (exercise) and a conceptual framework were employed by the researcher.

2.1.1 Theoretical Framework

The F.I.T.T. Principle is a basic philosophy of what is necessary to gain the effect of training from an exercise programme. FITT is a form of fitness planning programme which helps one to understand what the goals of exercise are and how they can be best achieved (Waehner, 2020). The four FITT rules should always be specified in a training programme to avoid hitting a plateau, or overtraining, which are both detrimental to development and enjoying the full benefits of exercise

(Waehner, 2020). FITT describes the various factors that determine what kind of impact physical activity will have on your body. These four factors do not stand alone but are closely connected and interdependent.

The first thing to set up with your workout plan is frequency. Frequency is the number of times you exercise or how often an individual engages in an activity, usually the number of days per week. Frequency often depends on a variety of factors including the type of workout, how hard the workout is, the fitness level, and the exercise goals (Waehner, 2020). In general, the exercise guidelines set out by the American College of Sports Medicine (ACSM) gives a guideline to start when figuring out how often to workout (Geffen, 2003). Frequency is usually calculated within the context of a week.

Intensity is an extremely important aspect of the FITT principle and the hardest factor to monitor. It is the level of exertion experienced during the activity or the level of effort put into each exercise. It has to do with how hard the workout is during exercise or the type of workout. The best way to gauge the intensity of your exercise is to monitor your heart rate. Moderate-intensity exercise programmes have a targeted heart rate of around 55% to 65% of maximum heart rate. High-intensity exercise programs have a targeted heart rate of around 65% to 75% of maximum heart rate. The intensity of a workout depends on the current level of fitness, and the frequency of the workout. It is appropriate to do high-intensity training fewer times a week, allowing longer rest periods than low-intensity training. Intensity has a great impact on weight loss and athletic conditioning.

Time talks about how long exercise lasts during each session. The length of time you spend exercising is directly impacted by the other three components of the FITT model. The time for each workout depends on the fitness level and the type of

workout. For example, it is recommended that for weight loss, at least 40 minutes of moderate weight-bearing exercise is required.

The type of exercise to do is the last part of the FITT principle and an easy one to manipulate to avoid overuse injuries or weight loss plateaus. The type of physical activity you choose lies at the heart of the FITT principle. All other aspects of the model revolve around it. Types of activity include aerobic, balance, flexibility, and resistance (or strength) training, and help patients achieve different health goals.

The FITT principle is important when planning an exercise program to lose weight. They help to start with the right exercises and intensity, measure the progress, and also plan exercise to maximize long term weight loss. Using the FITT principle is also crucial to long term planning, weight loss, and fitness success. By increasing or varying any or all parts of the FITT principle elements, can increase the number of calories that are burned during each exercise session, improves cardiovascular fitness and strength. It will also help minimize overuse/overtraining injuries and also build variety into your programme.

2.2 Conceptual Framework

The conceptual framework for this study was based on the theory below.

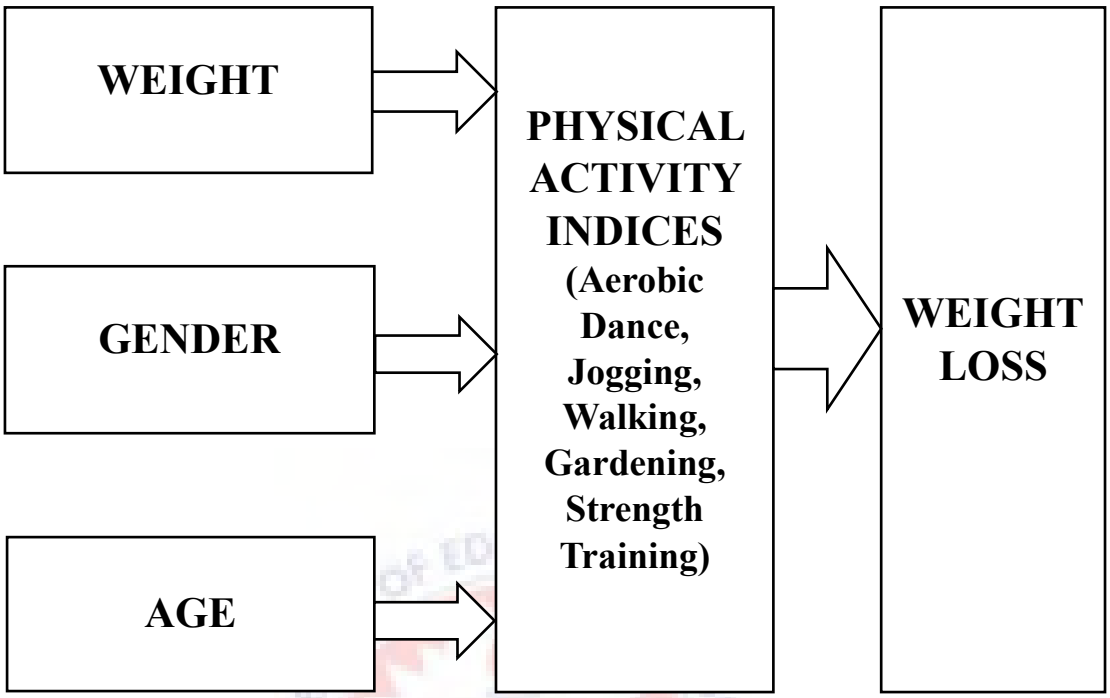

Figure 1: Conceptual Framework

The conceptual theory developed for this study was based on the diagram above. Weight loss as the ultimate target of the study was mainly dependant on physical activities. These physical activity indices are selected activities backed by literature to enhance weight loss. Activities such as aerobic dance, jogging, walking, gardening, and strength training are recommended by Motley Health, 2020. The various types of physical activities (exercises) used for this study had a direct relationship with each other and have been proved by literature to aid in weight loss. (Swift et al. 2013). Each of these sets of exercises can be done separately or with another but are inter-related and may affect the other. Ultimately, weight, gender, and age as variables will be affected by the indices described above.

2.3 Literature Review

2.3.1 Weight Loss

Weight loss in health or physical fitness refers to a reduction of the total body mass, due to a mean loss of fluid, body fat or adipose tissue, or lean mass, namely bone mineral deposits, muscle, tendon, and other connective tissue. Weight loss can either occur unintentionally due to malnourishment or an underlying disease or arise from a conscious effort to improve an actual or perceived overweight or obese state (Wikipedia, 2018). Intentional weight loss is the reduction of total body mass as a result of efforts to improve fitness and health or to change appearance through slimming. Weight loss in individuals who are overweight or obese can reduce health risks, improve fitness, and may delay the onset of diabetes. It could reduce pain and increase movement in people with osteoarthritis of the knee and can also lead to a reduction in hypertension (high blood pressure). Weight loss occurs when one uses more energy in work and metabolism than it is absorbing from food or other nutrients. It will then use stored reserves from fat or muscle, gradually leading to weight loss. People these days are driven to lose weight to achieve an appearance they consider more attractive.

Research by Hall (2012) on Successful Weight Loss, Weight Loss Maintenance, and Psychological Characteristics in Minority Men and Women Attending an Inner-city Weight Loss Program. Twenty-eight participants (26 women, 2 men) in a 12-week culturally-based weight loss program were studied. Before and after the intervention, height, weight, lifestyle information, readiness to change, eating behaviours, depression scores, and quality of life scores were measured. Participants have followed 4 and 6 months post-intervention. At baseline, 86% of the participants were obese (BMI > 30 kg/m2), 54% watched more than ten hours of television per

week, 89% did not eat breakfast, and 82% did not weigh themselves at least once a week. While mean cognitive restraint scores for men and women were relatively close, women had much higher emotional eating, uncontrolled eating, and inhibition mean scores at baseline. Participants showed significant decreases in mean BMI at the completion of the 12-week program ($p < .001$) and during the maintenance period, 4 months ($p = .005$) and 6 months ($p = .001$) post-intervention. Quality of life, depression, cognitive restraint, emotional eating, uncontrolled eating, and inhibition scores all showed improvement. The results suggest that this motivational program may provide health benefits, improve quality of life, and change the eating habits of the participants for up to 6 months.

2.3.2 Physical Activity and Weight Loss

Physical activity is any bodily movement produced by skeletal muscles that require energy expenditure. Physical activity includes exercise as well as other activities which involve bodily movement and are done as part of playing, working, active transportation, house chores, and recreational activities (World Health Organisation, 2018). Physical exercise is one sure way of staying healthy as humans and a great way to feel better and have fun. Physical exercise as defined by (Siddiqui, Nessa, & Hossain, 2010) is any bodily activity that promoted wellness, overall health, and physical fitness. He further explained that many people engaged in physical exercises for a wide range of reasons including; weight loss benefits, longevity, muscular strength, honing athletic skills, and many more.

Low physical exercise levels in individuals increase the risk of mortality attributed to cardiovascular diseases. Children experience greater losses of body fat and increases in cardiovascular fitness when they participate in regular physical

exercises (Ogden, Carroll, Kit, & Flegal, 2012). Regular physical exercises as explained by Nystoriak and Bhatnagar (2018) put the heart, lungs, and blood vessels in good shape and enhanced the effective and efficient delivery of oxygen to the muscle cells as well as boosted cardiorespiratory endurance by promoting circulatory system adaptations in the individual. Further, researchers suggested that bones developed faster at early stages in life and diminished rapidly with age.

Physical exercises largely reduced the rate at which bone losses occurred. Physical activity according to the Ministry of Health of New Zealand, (2003), was any bodily movement produced by skeletal muscles and resulted in energy expenditure. In their view, exercise was a subset of physical activity and that its distinctive forms were drawn if it was performed to improve or maintain physical fitness or health. They revealed that exercise could be done at varying intensities even though vigorous activities were often used. It could also include moderate-intensity walking. In the opinion of (Sharma, 2015), physical exercise was very important to human health. The researcher added that, if one invested in exercise it makes them conscious of other reasonable health habits. Broadly, physical exercises could be categorised into three classes; aerobic, anaerobic, and flexibility exercises. And it included physical activities that focused on agility, strength, power, speed, and accuracy. It had also often been described as dynamic or static depending on the type of bodily movement in use (Bact Med, 2020).

In 2008, a USA magazine called Parents, the American Academy of Paediatrics; American Medical Association; and the U.S. Department of Health and Human Services outlined the following as benefits of physical activities;

1. It strengthens the heart. Like other muscles, the heart‟s performance improves when it's regularly challenged by exercise. The heart responds

to exercise by becoming stronger and more efficient. Strengthening the heart muscle can help ward off heart disease - the leading cause of death in the United States, according to the U.S. Department of Health and Human Services - even in early childhood.

2. It helps keep arteries and veins clear. Exercise reduces the amount of harmful cholesterol and fats in a person's blood. It increases the flexibility of the walls of blood vessels and helps to lower blood pressure. This can reduce a person's risk for heart attack and stroke.
3. It strengthens the lungs. Working hard increases lung capacity and their efficiency in moving air in and out of the body. As a result, more oxygen is drawn into the body and more carbon dioxide and other waste gases are expelled. Regular exercise helps prevent the decline in oxygen intake that occurs naturally with age or as a result of inactivity.
4. It reduces blood sugar. Exercise prevents sugar from accumulating in the blood by triggering muscles to take up more glucose from the bloodstream and use it for energy which can reduce a person's risk of developing diabetes.
5. It controls weight. When a person is sedentary, he tends to be taking in more calories than are needed. These unused calories accumulate as fat. A physically active person may have a deficit of calories, which takes fat away and lowers weight. Lowered weight is good for the heart and can be beneficial in people with diabetes.
6. It strengthens bones. Just as muscles grow stronger when physically stressed, bones also respond by getting stronger. Exercise increases bone

density, which helps prevent osteoporosis, a condition in which bones lose density, weaken, and become porous and fragile.

7. It helps prevent cancer. People who exercise regularly have lower incidences of cancer. The cancers most affected include colon, prostate, uterine, and breast cancers.
8. It regulates blood pressure. Exercise has been shown to reduce stress levels. As the levels of stress in a person's body subsides, his blood pressure and his risk for heart disease decline.
9. It improves energy levels. Regular exercise often makes people feel more energetic, allows them to be more active, and reduces the likelihood that they'll tire during the day.
10. It enhances emotional well-being. Most people report that they feel calm and have a sense of well-being after they exercise. Exercise, according to one theory, releases beta-endorphin, a natural substance in the body that is hundreds of times more potent than morphine.

Another theory points to serotonin as the cause of the exercise high. Increased levels of serotonin in the central nervous system are associated with feelings of well-being, heightening of appetite, and lessening of mental depression. The weight loss that accompanies exercise can also cause people to feel better about themselves (Bilich, 2018).

Regular moderate-intensity physical activity such as walking, cycling, or participating in sports has significant benefits for health. According to the Department of Health and Human Services (HSS) Physical Activity Guidelines for Americans in 2008, physical activity generally refers to the movement that enhances health. Physical activity has many health benefits. These benefits apply to people of all ages,

races, and sexes. For example, physical activity helps you maintain a healthy weight and makes it easier to do daily tasks, such as climbing stairs and shopping. Physically active adults are at lower risk for depression and declines in cognitive function as they get older. Physically active children and teens may have fewer symptoms of depression than their peers. Physical activity also lowers your risk for many diseases, such as coronary heart disease, diabetes, and cancer.

The HHS released physical activity guidelines for all Americans aged 6 years and older. The 2008 Physical Activity Guidelines for Americans explains that regular physical activity improves health. They, therefore, encourage people to be as active as possible. The guidelines recommend the types and amounts of physical activity that children, adults, older adults, and other groups should do. For this study, the researcher focused on the four main types of physical activity are aerobic, muscle and bone-strengthening activities, outdoor activities, and stretching.

Research published in Procedia - Social and Behavioral Sciences (Salimin, Elumalai, Shahril, & Subramaniam, 2015) investigated the effectiveness of 8 weeks physical activity program among obese students aiming to look at the effectiveness of a physical activity programme on obese pupils of SJK (T) Barathi, Hutan melintang. Using a quasi-experimental study, the researchers selected respondents of 40 pupils with 20 male and 20 female respondents. Scan Body Composition Monitor HBF-375 was used as an instrument to measure the level of BMI among respondents. National Service physical activity manual was adapted to run in this 8 weeks programme. Descriptive analysis showed that the obesity level of the respondents reduced obviously. BMI levels for 7 respondents (17.5%) of the samples were at a normal level. Paired t-test analysis shows significant differences in mean values between pre and post-test for male and female respondents.

In a study to investigate the effect of exercise duration and intensity on weight loss in overweight, sedentary women conducted by Jakicic, Marcus, Gallagher, Napolitano and Lang (2003), in the Journal of American Medical Association volume 290 number 10, 201 sedentary women with (mean [SD] age, 37.0 [5.7] years; mean [SD] body mass index, 32.6 [4.2]) were involved in a randomized trial conducted from January 2000 to December 2001. Participants were randomly assigned to 1 of 4 exercise groups (vigorous intensity/high duration; moderate intensity/high duration; moderate intensity/moderate duration; or vigorous-intensity/moderate duration) based on estimated energy expenditure (1000 kcal/week verse 2000 kcal/week) and exercise intensity (moderate verse vigorous. All women were instructed to reduce intake of energy to between 1200 and 1500 kcal/d and dietary fat to between 20% and 30% of total energy intake. The main outcome that the researcher measured were body weight, cardiorespiratory fitness, and exercise participation. Results of the study showed that, after exclusions, 184 of 196 randomized participants completed 12 months of treatment (94%). In intention-to-treat analysis, mean (SD) weight loss following 12 months of treatment was statistically significant (P = .001) in all exercise groups (vigorous intensity/high duration = 8.9 [7.3] kg; moderate intensity/high duration = 8.2 [7.6] kg; moderate intensity/moderate duration = 6.3 [5.6] kg; vigorous intensity/moderate duration = 7.0 [6.4] kg), with no significant difference between groups. Mean (SD) cardiorespiratory fitness levels also increased significantly (P = .04) in all groups (vigorous intensity/high duration = 22.0% [19.9%]; moderate intensity/high duration = 14.9% [18.6%]; moderate intensity/moderate duration = 13.5% [16.9%]; vigorous intensity/moderate duration = 18.9% [16.9%]), with no difference between groups. Post hoc analysis revealed that percentage weight loss at 12 months was associated with the level of physical activity performed at 6 and 12

months. Women reporting less than 150 min/week had a mean (SD) weight loss of 4.7% [6.0%]; inconsistent (other) pattern of physical activity, 7.0% [6.9%]; 150 min/week or more, 9.5% [7.9%]; and 200 min/week or more of exercise, 13.6% [7.8%]. It was established that significant weight loss and improved cardiorespiratory fitness were achieved through the combination of exercise and diet during 12 months, although no differences were found based on different exercise durations and intensities in this group of sedentary, overweight women.

In a study, (Hruby, et al., 2016) researched on determinants and consequences of obesity. A narrative review of the publications of the NHS and NHS II between 1976 and 2016 was used to collect data for the study. The purpose of the study was to review the contribution of the Nurses‟ Health Studies (NHS and NHSII) in addressing hypotheses regarding risk factors for and consequences of obesity. The results indicated Long-term NHS research has shown that weight gain and being overweight or obese are important risk factors for type 2 diabetes, cardiovascular diseases, certain types of cancers, and premature death. The cohorts have elucidated the role of dietary and lifestyle factors in obesity, especially sugar-sweetened beverages, poor diet quality, physical inactivity, prolonged screen time, short sleep duration or shift work, and built environment characteristics.

Genome-wide association and gene–lifestyle interaction studies have shown that genetic factors predispose individuals to obesity but that such susceptibility can be attenuated by healthy lifestyle choices. This research has contributed to evolving clinical and public health guidelines on the importance of limiting weight gain through healthy dietary and lifestyle behaviours. In conclusions, the NHS cohorts have contributed to our understanding of the risk factors for and consequences of

obesity and made a lasting impact on clinical and public health guidelines on obesity prevention

In a study, (Swinburn, Caterson, Seidell, & James, 2004) studied diet, nutrition, and the prevention of excess weight gain and obesity used. The purpose of the study was to review the evidence on the diet and nutrition causes of obesity and to recommend strategies to reduce obesity prevalence. The evidence for potential aetiological factors and strategies to reduce obesity prevalence was reviewed, and recommendations for public health action, population nutrition goals, and further research were made. The outcome showed protective factors against obesity were considered to be: regular physical activity (convincing); a high intake of dietary non-starch polysaccharides (NSP)/fibre (convincing); supportive home and school environments for children (probable); and breastfeeding (probable). Risk factors for obesity were considered to be sedentary lifestyles (convincing); a high intake of energy-dense, micronutrient-poor foods (convincing); heavy marketing of energy-dense foods and fast food outlets (probable); sugar-sweetened soft drinks and fruit juices (probable); adverse social and economic conditions developed countries, especially in women (probable). A broad range of strategies was recommended to reduce obesity prevalence including influencing the food supply to make healthy choices easier; reducing the marketing of energy-dense foods and beverages to children; influencing urban environments and transport systems to promote physical activity; developing community-wide programmes in multiple settings; increased communications about healthy eating and physical activity, and improved health services to promote breastfeeding and manage currently overweight or obese people. It was concluded that the increasing prevalence of obesity is a major health threat in

both low- and high-income countries. Comprehensive programmes will be needed to turn the epidemic around.

Alrushud, Rushton, Kanavaki, and Greig (2017) researched the effect of physical activity and dietary restriction interventions on weight loss and the musculoskeletal function of overweight and obese older adults with knee osteoarthritis employed a systematic review and mixed-method data synthesis. The purpose of this study was to evaluate the effectiveness of combined physical activity and dietary restriction programmes on body weight, body mass index (BMI), and the musculoskeletal function of overweight and obese older adults with knee OA. A detailed search strategy was applied to key electronic databases (Ovid, Embase), Web of Science, and Cumulative Index to Nursing and Allied Health Literature (CINAHL) for randomised controlled trials (RCTs) published in English before 15 January 2017. Participants with a BMI ≥25 kg/m2, aged ≥55 years of age and with radiographic evidence of knee OA. Physical activity plus dietary restriction programmes with usual care or exercise as the comparators. The outcome indicated that one pilot and two definitive trials with n=794 participants were included. Two articles reporting additional data and outcome measures for one of the RCTs were identified. All included RCTs had an unclear risk of bias. Meta-analysis was only possible to evaluate mobility (6 min walk test) at 6 months and the pooled random effect 15.05 (95% CI −11.77 to 41.87) across two trials with n=155 participants did not support the combined intervention programme. Narrative synthesis showed clear differences in favour of reduced body weight and an increased 6 min walk in the intervention group compared with control groups. In conclusion, the quality of evidence of the benefit of combining exercise and dietary interventions in older overweight/obese adults with knee OA is unclear.

In a study (Slentz, et al., 2004) examine effects of the amount of exercise on body weight, body composition, and measures of central obesity: STRIDE; a randomized controlled study conducted, the researchers pronounced that, obesity is a major health problem due, in part, to physical inactivity whereas the amount of activity needed to prevent weight gain is unknown. The objective of the study was to determine the effects of different amounts and intensities of exercise training. A randomized controlled trial (February 1999 – July 2002) was employed for the study. Three hundred and two sedentary, overweight men and women (aged 40 – 65 years) with mild to moderate dyslipidaemia were recruited from Durham, NC, and surrounding communities as participants for the study. an intervention consisting of an eight-month exercise program with 3 groups: (1) high amount/vigorous intensity (calorically equivalent to approximately 20 miles [32.0 km] of jogging per week at 65%-80% peak oxygen consumption); (2) low amount/vigorous intensity (equivalent to approximately 12 miles [19.2 km] of jogging per week at 65%-80%), and (3) low amount/moderate intensity (equivalent to approximately 12 miles [19.2 km] of walking per week at 40%-55%) was employed. Subjects were counselled not to change their diet and were encouraged to maintain body weight. The outcome of the study measured was body weight, body composition (via skinfolds), and waist circumference. The results of the study discovered that, of 302 subjects screened, 182 met the criteria and were randomized with 120 completing the study. There was a significant ($P<.05$) dose-response relationship between the amount of exercise and amount of weight loss and fat mass loss.

The high-amount/vigorous-intensity group lost significantly more body mass (in mean [SD] kilograms) and fat mass (in mean [SD] kilograms) (-2.9 [2.8] and -4.8 [3.0], respectively) than the low-amount/moderate-intensity group (-0.9 [1.8] and -2.0

[2.6], respectively), the low-amount/vigorous-intensity group (-0.6 [2.0] and -2.5 [3.4], respectively), and the controls (+1.0 [2.1] and +0.4 [3.0], respectively). Both low-amount groups had significantly greater improvements than controls but were not different from each other. Compared with controls, all exercise groups significantly decreased abdominal, minimal waist, and hip circumference measurements. There were no significant changes in dietary intake for any group. Deductions made showed that non-dieting, overweight subjects, the controls gained weight, both low-amount exercise groups lost weight and fat, and the high-amount group lost more of each in a dose-response manner. These findings strongly suggest that, absent changes in diet, a higher amount of activity is necessary for weight maintenance and that the positive caloric imbalance observed in the overweight controls is small and can be reversed by a modest amount of exercise. Most individuals can accomplish this by walking for 30 minutes every day.

In 2010, Lee and Paffenbarger conducted a study to examine the association of different amounts of physical activity with long-term weight changes among women consuming a usual diet with the topic of Physical Activity and Weight Gain Prevention. The study was to ascertain that, the amount of physical activity needed to prevent long-term weight gain is unclear even though in 2008, federal guidelines recommended ≥150min/week (7.5 MET-hour/week) of moderate-intensity activity for "substantial health benefits". Using a prospective cohort study, following 34,079 healthy, US women (mean age, 54.2 years) were selected from 1992–2007. At baseline, 36-, 72-, 96-, 120-, 144- and 156-months" follow-up, women reported their physical activity and body weight. Women were classified as expending <7.5, 7.5-<21, and ≥21 MET-hour/week of activity at each time. Repeated measures regression prospectively examined physical activity and weight change over intervals averaging

3 years. The main outcome was measured as a change in weight. The results outlined that, women gained a mean of 2.6 kg throughout the study. In multivariate analysis, compared with women expending ≥ 21 MET-hour/week, those expending 7.5 - < 21 and < 7.5 MET-hour/week gained 0.11 kg (SD = 0.04; P = 0.003) and 0.12 kg (SD = 0.04; P = 0.002), respectively, over a mean interval of 3 years. There was a significant interaction by body mass index (BMI), such that there was an inverse dose-response relation between activity levels and weight gain among women with BMI < 25 kg/m (P, trend <0.0001), but no relation among heavier women (P, trend = 0.56 and 0.50, respectively, for BMI 25 – 29.9 and ≥ 30.0 kg/m). A total of 4,540 women (13.3%) began the study with BMI < 25 kg/m and successfully maintained their weight, gaining < 2.3 kg throughout; their mean activity level over the study was 21.5 MET-hour/week (60 min/day moderate-intensity activity). The researchers, therefore, concluded that, among women consuming a usual diet, physical activity was associated with less weight gain only among women with BMI < 25 kg/m. Women successful in maintaining a normal weight and gaining < 2.3 kg over 13 years averaged 60 min/day of moderate-intensity activity over the study duration.

In an investigation by Villarreal et al. (2011) on Weight Loss, Exercise, or Both and Physical Function in Obese Older Adults and how controversial the appropriate treatment for obese older adults has become, 107 adults who were 65 years of age or older and obese were involved in a 1-year randomised controlled trial, evaluated the independent and combined effects of weight loss and exercise.

Participants were randomly assigned to a control group, a weight management (diet) group, an exercise group, or a weight-management-plus-exercise (diet–exercise) group. The primary outcome was the change in score on the modified Physical Performance Test (PPT) whilst the secondary outcomes included other measures of frailty, body composition, bone mineral density, specific physical functions, and quality of life. The study revealed that, out of the whole population, a total of 93 participants (87%) completed the study. In the intention-to-treat analysis, the score on the Physical Performance Test, in which higher scores indicate better physical status, increased more in the diet–exercise group than in the diet group or the exercise group (increases from baseline of 21% vs. 12% and 15%, respectively); the scores in all three of those groups increased more than the scores in the control group (in which the score increased by 1%) ($P < 0.001$ for the between-group differences). Moreover, the peak oxygen consumption improved more in the diet–exercise group than in the diet group or the exercise group (increases of 17% vs. 10% and 8%, respectively; $P < 0.001$); the score on the Functional Status Questionnaire, in which higher scores indicate better physical function, increased more in the diet–exercise group than in the diet group (an increase of 10% vs. 4%, $P < 0.001$). Bodyweight decreased by 10% in the diet group and by 9% in the diet–exercise group but did not decrease in the exercise group or the control group ($P < 0.001$). Lean body mass and bone mineral density at the hip decreased less in the diet–exercise group than in the diet group

(reductions of 3% and 1%, respectively, in the diet–exercise group vs. reductions of 5% and 3%, respectively, in the diet group; P<0.05 for both comparisons). Strength, balance, and gait improved consistently in the diet–exercise group (P < 0.05 for all comparisons). Adverse events included a small number of exercise-associated musculoskeletal injuries. These findings suggested that a combination of weight loss and exercise provides greater improvement in physical function than either intervention alone.

To determine the up-to-date prevalence of overweight and obesity, the distributions of body weight perception and weight loss practice in Beijing adults, Cai, et al. (2014) conducted a cross-sectional study titled "Prevalence of Overweight and Obesity and Weight Loss Practice among Beijing Adults". A total of 2563 men and 4088 women aged 18 – 79 years from the general population were included. Data were obtained from the questionnaire and physical examination. The results indicated a prevalence of overweight (BMI 24 – 27.9 kg/m) and obesity (BMI ≥ 28 kg/m) was 42.1% and 20.3% in men and 35.6% and 17.1% in women, respectively. Age was inversely associated with overweight in both sexes and obesity in women. Education level was negatively associated with overweight and obesity in women but not in men. Only 49.1% of men and 58.3% of women had a correct perception of their body weight. Underestimation of body weight was more common than overestimation, especially in men, older people, and those with low education levels. The percentage of taking action to lose weight was inversely associated with men and old age, and positively associated with higher education level, higher BMI, and self-perception as "fat" (OR = 3.78 in men, OR = 2.91 in women). Only 26.1% of overweight/obese individuals took action to lose weight. The top two weight loss practices were to reduce the amount of food intake and exercise. The researchers concluded that

overweight and obesity were highly prevalent with high incorrect body weight perceptions in the general adult population in Beijing. Weight loss practice was poor in overweight and obese individuals. Actions at multiple levels are needed to slow or control this overweight and obesity epidemic.

To explore the prevalence of weight management practices and investigate the association of weight management goals with socio-demographic variables and practices among the United Arab Emirates (UAE) adults, an assessment of weight management practices among adults in the United Arab Emirates was conducted by (Attlee, et al., 2017). Exploratory, cross-sectional research was conducted on 1275 adult males and females, residing in UAE. A structured questionnaire was administered. Weight management goals to lose/maintain/gain weight were reported in 88.3% of participants. Weight management goals were significantly associated with age, sex, marital status, education, current body weight perception, and medical condition. Out of 21 selected weight management practices, popular strategies included increasing physical activity (52.9%), eating less fat (51.1%), consuming fewer calories (43.3%), joining the gym (27.5%), skipping meals (26.1%), and consuming natural herbs and teas (20.7%). Visiting dietician (12.3%) ranked ninth in the order of preference. Males focused on physical activity, gyms, and wellness centres and females on calories counting, dietician visits, meal replacement, skipping meals, and natural herbs/teas. Married adults reported eating less fat (54.3% versus 47.3%, $p = 0.020$); singles opted calories counting, gyms, and meal replacement. Frequent referral sources were friends (37.8%) and Internet (32.1%). In conclusion, the researchers outlined that, most UAE adults had weight management goals that were associated with socio-demographic variables and Weight Management practices.

Awareness about the ill-effects of unhealthy weight management practices and the importance of dietician"s consultation is imperative.

In a study, (Dennis, et al., 2012) explore weight gain prevention for college freshmen: comparing two social cognitive theory-based interventions with and without explicit self-regulation training to evaluate the preliminary efficacy and acceptability of two interventions to prevent freshman weight gain. One intervention provided opportunities to improve outcome expectations and self-efficacy within a social cognitive theory framework (SCT), while the other targeted the same variables but focused on explicit training in self-regulation skills (SCTSR). Forty-five freshmen (n = 45) aged > 18 years were randomized to a 14-week intervention, SCT or SCTSR; both included online modules and in-class meetings. Of the 45 students randomized, 5 withdrew before the classes began, and 39 completed pre-and post-testing. Primary outcomes included body weight/composition, health behaviours, and program acceptability. Data collected were analysed using independent sample t-tests, repeated measures ANOVA, and bivariate correlational analyses. Results indicated that body weight increased over the 14 weeks, but there was no group difference. Percent body fat increased in SCTSR but not SCT (mean difference: SCTSR, +1.63 ± 0.52%; SCT, − 0.25 ± 0.45%; P = 0.01). Class attendance was 100% (SCTSR) and 98% (SCT); SCTSR students (> 50%) remarked that the online tracking required "too much time." The researchers concluded that the intervention was well-received, although there were no improvements in weight outcomes.

To find out whether exercise-induced mood change may mediate the relationship of exercise with weight loss (Annesi, 2010), conducted a study "Relationship of physical activity and weight loss in women with Class II and Class III obesity: Mediation of exercise-induced changes in tension and depression" which

was published in the international journal of clinical and health psychology. In that experimental study, women with Class II and III obesity (N = 75) participated in a 24-week moderate exercise and nutrition education program at south-eastern U.S. Young Men‟s Christian Association (YMCA) centres. Attendance at the exercise session was significantly associated with weight loss (β = -.47) but directly accounted for only an estimated 17% of the loss in weight. Using the Baron and Kenny approach, significant partial mediation was found for changes over 24 weeks in both tension and depression scores. The results indicated that exercise indirectly affected weight change through psychological pathways, and supported tenets of social cognitive theory. After replications and extensions, findings may help to improve explanatory theory and weight management treatments.

In research by (Pourabdi et al., 2013) on the effects of short-term interval training courses on fitness and weight loss of untrained girls with the aims to study the effect of 30 minutes interval short courses of running (4 rounds × 7:30 minutes) with a mean intensity of 60% – 75% of heart rate reserve (HRR) for 6 weeks on body composition and aerobic capacity (VO_2max) in untrained girl university students. Twenty-six untrained female university students aged 19 to 23 years old with a percentage of body fat (PBF) of more than 30 and a Vo2max of fewer than 40 ml/kg/min were randomly selected and divided into two groups including the training group (n = 16) and the control (n = 10). Weight, body mass index (BMI), percentage of body fat (BF %), lean body mass (LBM), and maximal oxygen uptake (VO_2max) were measured as indicators of health before and after six weeks of trial. Findings of the study showed that 6 weeks of interval running improved body composition and aerobic capacity of untrained girls. This means that there was a significant decrease in PBF, weight, and BMI of untrained girls. Also, maximal oxygen consumption showed

a significant increase ($p \leq 0.05$), while no significant change was observed in lean body mass. Findings of the present study indicate the importance of combining the short courses of work and rest for 30 min in a day. The study merely discussed the effective role of interval short course training in stimulating and changing physiological adaptations and consequently improving the performance of the cardiovascular system and body composition in untrained girls.

A study on the effects of changing exercise levels on weight and age-related weight gain was conducted by (Williams & Wood, 2006) to determine prospectively whether physical activity can prevent age-related weight gain and whether changing levels of activity affect body weight. The study consisted of 8080 male and 4871 female runners who completed two questionnaires, an average (± standard deviation (s. d.) of 3.20 ± 2.30 and 2.59 ± 2.17 years apart, respectively, as part of the National Runners‟ Health Study. Changes in the running distance, were inversely related to changes in men‟s and women‟s body mass indices (BMIs) (slope ± standard error (s. e.): − 0.015 ± 0.001 and − 0.009 ± 0.001 kg/m2 per Δkm/week, respectively), waist circumferences (− 0.030 ± 0.002 and − 0.022 ± 0.005 cm per Δkm/week, respectively) and percent changes in body weight (− 0.062 ± 0.003 and − 0.041 ± 0.003% per Δkm/week, respectively, all $P < 0.0001$). The regression slopes were significantly steeper (more negative) in men than women for ΔBMI and Δ% body weight ($P < 0.0001$). A longer history of running diminished the impact of changing running distance on men‟s weights. When adjusted for Δkm/week, years of aging in men and years of aging in women were associated with increases of 0.066 ± 0.005 and 0.056 ± 0.006 kg/m2 in BMI, respectively, increases of 0.294 ± 0.019 and 0.279±0.028% in Δ% body weight, respectively, and increases of 0.203 ± 0.016 and 0.271 ± 0.033 cm in waist circumference, respectively (all $P < 0.0001$). These regression slopes suggest

that vigorous exercise may need to increase 4.4 km/ week annually in men and 6.2 km/week annually in women to compensate for the expected gain in weight associated with aging (2.7 and 3.9 km/week annually when correct for the attenuation due to measurement error). To conclude, age-related weight gain occurs even among the most active individuals when exercise is constant. Theoretically, vigorous exercise must increase significantly with age to compensate for the expected gain in weight associated with aging.

In 2000, a study was conducted by the American College of Physicians, and American Society of Internal Medicine and published in Annals of Internal Medicine, on the effects of losing weight through diet or exercise programs on obesity. The study aimed to compare the effects of diet-induced weight loss with those of exercise-induced weight loss, and the effects of an exercise program without weight loss, in obese persons. The study included 52 men who had abdominal obesity. The researchers randomly assigned each man in the study to weight loss by diet, an exercise intended to produce weight loss, exercise not designed to result in weight loss, or no special diet or exercise program (the control group). At the beginning of the study and after 12 weeks, the researchers measured the men's weight, total body fat, the proportion of body fat in the abdomen, body muscle, and physical fitness. All of the study patients also had special blood tests for early signs of diabetes (glucose tolerance and insulin resistance). The results outlined that, men in both the diet and the exercise–weight loss programs lost an average of about 16 pounds. The weight did not change in the control group or in the group assigned to exercise without weight loss. Body fat decreased in both weight loss groups, but men in the exercise–weight loss program lost more body fat than men in the diet–weight loss program. Men assigned to exercise without weight loss lost some abdominal fat. Physical fitness

improved in both exercise groups. The tests for early signs of diabetes improved in both weight loss groups.

The study included only men with abdominal obesity and was therefore unclear whether the results would also apply to women, to persons with non-abdominal obesity, or less obese persons. Besides, the study lasted only 12 weeks; the effects of longer periods of diet or exercise was therefore not known. Researchers concluded that some health conditions related to obesity may improve with modest weight loss from either diet or exercise. Exercise without weight loss can decrease abdominal fat and may prevent further weight gain but seems to have little effect on the early signs of diabetes.

Thorogood, et al., (2011) investigated isolated aerobic exercise and weight loss: A systematic review and meta-analysis of randomized controlled trials. The review aimed to evaluate the efficacy of isolated aerobic exercise programs in overweight and obese populations. Researchers searched for published randomized controlled trial reports of aerobic exercise through January 20, 2010. Trials with an isolated aerobic exercise intervention were included. A random-effect model was used to synthesize the results of each intervention.

14 trials involving 1847 patients were identified. The duration of aerobic exercise programs ranged from 12 weeks to 12 months. Results were pooled for programs with a 6-month duration and programs with a 12-month duration. Six-month programs were associated with a modest reduction in weight (weighted mean difference [WMD] 1.6 kg; 95% confidence interval [CI], 1.64 to 1.56) and waist circumference (WMD) 2.12 cm; 95% CI, 2.81 to 1.44). Twelve-month programs also were associated with modest reductions in weight (WMD 1.7 kg; 95% CI, 2.29 to 1.11) and waist circumference (WMD 1.95 cm; 95% CI, 3.62 to 0.29). The

assumption made was; moderate-intensity aerobic exercise programs of 6-12 months induce a modest reduction in weight and waist circumference in overweight and obese populations. Results show that isolated aerobic exercise is not an effective weight loss therapy in these patients. Isolated aerobic exercise provides modest benefits to blood pressure and lipid levels and may still be an effective weight loss therapy in conjunction with diets.

The effects of high-intensity intermittent exercise training on fat loss and fasting insulin levels of young women were conducted by (Trapp et al., 2008) to determine the effects of a 15-week high-intensity intermittent exercise (HIIE) program on subcutaneous and trunk fat and insulin resistance of young women. Forty-five women with a mean BMI of 23.2 ± 2.0 kgm_2 and age of 20.2 ± 2.0 years were selected and randomly assigned to one of the three groups: HIIE (n¼15), steady-state exercise (SSE; n¼15), or control (CONT; n¼15). HIIE and SSE groups underwent a 15-week exercise intervention. Outcomes revealed that both exercise groups demonstrated a significant improvement (P<0.05) in cardiovascular fitness. However, only the HIIE group had a significant reduction in total body mass (TBM), fat mass (FM), trunk fat, and fasting plasma insulin levels. There was significant fat loss (P < 0.05) in legs compared to arms in the HIIE group only. Lean compared to overweight women lost less fat after HIIE. Decreases in leptin concentrations were negatively correlated with increases in VO2peak (r¼ - 0.57, P < 0.05) and positively correlated with decreases in TBM (r¼0.47; P < 0.0001). There was no significant change in adiponectin levels after training. Deductions made were; HIIE three times per week for 15 weeks compared to the same frequency of SSE exercise was associated with significant reductions in total body fat, subcutaneous leg, and trunk fat, and insulin resistance in young women.

Donnelly, et al., (2009) conducted a study to explore appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults, which was written for the American College of Sports Medicine. Their study was to re-examine the evidence from 1999 to determine whether there is a level at which PA is effective for the prevention of weight gain, weight loss, and prevention of weight regain. They stated that overweight and obesity affects more than 66% of the adult population and is associated with a variety of chronic diseases. Weight loss reduces health risks associated with chronic diseases and is therefore encouraged by major health agencies. Guidelines of the National Heart, Lung, and Blood Institute (NHLBI) encouraged a 10% reduction in weight, although considerable literature indicated a reduction in health risk with a 3% to 5% reduction in weight. Physical activity (PA) was recommended as a component of weight management for the prevention of weight gain, weight loss, and prevention of weight regain after weight loss. In 2001, the American College of Sports Medicine (ACSM) published a Position Stand that recommended a minimum of 150 min/wkj1 of moderate-intensity PA for overweight and obese adults to improve health; however, 200–300 min/wkj1 was recommended for long-term weight loss. More recent evidence has supported this recommendation and has indicated more PA may be necessary to prevent weight regain after weight loss. Cross-sectional and prospective studies indicate that after weight loss, weight maintenance is improved with PA 9250 minIwkj1. However, no evidence from well-designed randomized controlled trials exists to judge the effectiveness of PA for the prevention of weight regain after weight loss. Resistance training does not enhance weight loss but may increase fat-free mass and increase the loss of fat mass and is associated with reductions in health risk. Existing evidence indicates that endurance PA or resistance training without weight loss improves health

risk. To this end, the researchers concluded that moderate-intensity PA between 150 and 250 min/wkj1 to be effective to prevent weight gain. Moderate-intensity PA between 150 and 250 minIwkj1 will provide only modest weight loss. Greater amounts of PA (9250 minIwkj1) have been associated with clinically significant weight loss. Moderate intensity PA between 150 and 250 minIwkj1 will improve weight loss in studies that use moderate diet restriction but not severe diet restriction.

In a research conducted by Strasser and Dietmar (2016) on Diet versus Exercise in Weight Loss and Maintenance Focus on Tryptophan to study the association between mood disturbance, the inability to lose or to stop gaining weight, and a craving for carbohydrates as manifested by many people who are overweight or are becoming so. In a recent study, it was observed that a low-calorie weight loss diet lowered not only levels of lepton but also levels of essential amino acid tryptophan (TRP) significantly. The disturbed metabolism of TRP might affect the biosynthesis of serotonin and could thereby increase the susceptibility for mood disturbances and carbohydrate craving, increasing the cessation probability of weight reduction programs. Alternatively, moderate physical exercise – a potent stimulus to modulate (reduce/normalize) pro-inflammatory cytokines, which may affect TRP levels – could help improve mood status and prevent uncontrolled weight gain. In contrast, excessive physical exercise may induce the breakdown of TRP when pro-inflammatory cascades together with TRP-degrading enzyme indoleamine 2, 3-dioxygenase-1 are stimulated, which may lead to neuropsychiatric symptoms such as fatigue and low mood.

In a study (Clark, 2015) conducted a systematic review and meta-analysis focused on comparing changes from a treatment program for adults who are overfat based on analysis of aggregated effect size (ES) of inducing changes by comparing

diet, exercise or diet with exercise: and compared the effectiveness of treatment options for weight-loss and changes in fitness for adults (18 – 65 years old) who are overfat, or obese and published in the Journal of Diabetes & Metabolic Disorders. A tiered meta-analysis of 66-population based studies, and 162-study wise groups, a clear pattern of ES being established across and within treatments. First, hypo-caloric balance is necessary for changing body composition, but the effectiveness of establishing imbalance does not equate with the effectiveness of body compositional changes, or any biomarkers associated with metabolic issues. With analysis showing that there is a necessity to include exercise in combination with diet effectively elicit changes in body composition and biomarkers of metabolic issues.

More importantly, the combination, resistance training (RT) was more effective than endurance training (ET) or a combination of RT and ET, particularly when progressive training volume of 2 – to - 3 sets for 6 – to – 10 reps at an intensity of ≥ 75% 1RM, utilizing the whole body and free-weight exercises, at altering body compositional measures (ES of 0.47, 0.30, and 0.40 for loss of BM, FM, and retention of FFM respectively) and reducing total cholesterol (ES = 0.85), triglycerides (ES = 0.86) and low-density lipoproteins (ES = 0.60). Additionally, RT was more effective at reducing fasting insulin levels (ES = 3.5) than ET or ET and RT. Even though generally lower ES than RT, the inclusion of ET was more effective when performed at a high intensity (e.g. ≥ 70% VO_2max or HRmax for 30-minutes 3 – 4x‟s/wk), or in an interval training style than when utilizing the relatively common prescribed method of low-to-moderate (e.g., 50 – 70% VO_2max or HRmax for at least equal time) steady-state method, ES of 0.35, 0.39, and 0.13 for BM, FM, and FFM respectively. Thus indicating that the focus of treatment should be on producing large

metabolic stress (as induced by RT or high levels of ET) rather than an energetic imbalance for overfat adults.

In 2009, the National Nutrition Surveillance Centre in partnership with the Health Service Executive (HSE) conducted a study to explore key findings from national and international research relating to obesity, and the interrelationship between obesity, physical activity and nutrition, and other determinates. The literature reviewed was drawn from data reported from cross-sectional studies, prospective studies, clinical trials, meta-analysis, Cochrane reviews, and national and international report papers. The results of the study indicated that combined diet and regular exercise does appear to be the most effective therapy for weight loss and also weight loss maintenance. The synergistic relationship appears to be that weight loss through dietary restriction alone results in a reduction in energy expenditure, while physical activity increases energy expenditure, and the combination of the two leads to a reduction in body mass, without a subsequent reduction in resting energy expenditure. Regular physical activity also appeared to be critical specifically for the reduction of obesity-related and other chronic diseases. Behavioural change is now recognised as an important component of any response to obesity and should be incorporated into treatment for weight loss and weight maintenance. In conclusion, the study revealed that more national and international research is required to determine the best strategies for obesity prevention and treatment. Widespread promotion of regular physical activity is essential not only for weight loss and maintenance but for many aspects of health.

In a systematic review for the behavioural weight management review group (Johns et al., 2014) examined the clinical effectiveness of combined behavioural weight management programs (BWMPs) targeting weight loss in comparison to

single-component programs, using within-study comparisons on the topic Diet or Exercise Interventions versus Combined Behavioural Weight Management Programs: A Systematic Review and Meta-Analysis of Direct Comparisons. Researchers included randomized controlled trials of combined BWMPs compared with diet-only or physical activity-only programs with at least 12 months of follow-up, conducted in overweight and obese adults (body mass index – 25). Systematic searches of nine databases were run and two reviewers extracted data independently. Random effects meta-analyses were conducted for the mean difference in weight change at 3 to 6 months and 12 to 18 months using a baseline observation carried forward approach for combined BWMPs versus diet-only BWMPs and combined BWMPs versus physical activity only BWMPs.

In total, eight studies were included, representing 1,022 participants, the majority of whom were women. Six studies met the inclusion criteria for combined BWMP versus diet-only. Pooled results showed no significant difference in weight loss from baseline or at 3 to 6 months between the BWMPs and diet-only arms (e0.62 kg; 95% CI e1.67 to 0.44). However, at 12 months, a significantly greater weight-loss was detected in the combined BWMPs (e1.72 kg; 95% CI e2.80 to e0.64). Five studies met the inclusion criteria for combined BWMP versus physical activity-only. Again, results showed significantly greater weight loss in the combined BWMPs at 3 to 6 months (e5.33 kg; 95% CI e7.61 to e3.04) and 12 to 18 months (e6.29 kg; 95% CI e7.33 to e5.25). It was concluded that weight loss is similar in the short-term for diet-only and combined BWMPs but in the longer-term weight loss is increased when diet and physical activity are combined. Programs based on physical activity alone are less effective than combined BWMPs in both the short and long term.

2.3.3 Gender and Weight Loss

Men have an easier time burning calories and, subsequently, losing weight because they tend to have the height, weight, and muscle-to-fat ratio advantage over women. Men are generally larger than women that require more calories and therefore can create larger calories deficits. A larger body‟s organ will take more calories than a smaller person‟s organs, so the basic burn rate of calories is larger, to begin with. A small female‟s body will not burn as many calories a day as a larger man‟s, and any calorie deficit she creates will not be as large as a man‟s caloric deficit.

Testosterone is a powerful hormone, and men have more of it than women. This hormone increases protein synthesis and lean body mass, which will then increase the resting metabolic rate. Meaning, boys will be burning more calories all day. By nature, women tend to have a lower metabolic rate than men. This means their body uses fewer calories (units of energy) to fuel normal body functions like breathing, thinking, and circulating blood. The leftover calories are stored as fat. Females‟ body composition usually exceeds males. Men tend to have more muscles than fat, lowering their body index (BMI), and also burns more calories than fat, even at rest. Women‟s fat stores are typically more spread out, which is partly why they tend to lose weight at a slower pace than men. While women are better at storing fat, they also tend to burn more body fat during exercise than men do.

According to a study by (Ridley, 2018) and published in the Diabetes, Obesity and Metabolism Journal, researchers tracked 2,200 overweight, pre-diabetic adults in Europe, Australia, and New Zealand. For eight weeks, participants stuck to an 800-calorie per day plan, consisting of soups, shakes, hot cereals, and vegetables. After two months on a low-calorie diet, men lost an average of 26 pounds, while women shed just 22. Not only were men the biggest losers, but they also got healthier than

women too. By the end of the study, male participants had lower heart rates, less body fat, and lower diabetes risk than their female counterparts.

In a study conducted by Donnelly et al., (2003), on the effects of 16 months randomized controlled exercise trial on body weight and composition in young, overweight men and women: the Midwest Exercise Trial examined the long-term effects of a supervised program of moderate-intensity exercise on body weight and composition in previously sedentary, overweight and moderately obese men and women. The results of the test revealed that exercise prevented weight gain in women and produced weight loss in men.

In an article, (Tsai et al., 2016) researched gender differences in weight-related attitudes and behaviours among overweight and obese adults in the United States to examine gender differences in weight-related outcomes across the body mass index spectrum in overweight and obese adults. Weight-related outcomes were accurate with weight perception, weight dissatisfaction, attempted weight loss, successful weight loss, and weight loss strategies. Compared with women, overweight and obese men were less likely to have accurate weight perception (odds ratio [OR] = 0.36; 95% confidence interval [CI] = 0.30 – 0.44), weight dissatisfaction (OR = 0.39; 95%, CI = 0.32 – 0.47), and attempted weight loss (OR = 0.55; 95%, CI = 0.48 – 0.63). Their study‟s results indicated that men who attempted weight loss were more likely than women to lose and maintain ≥ Ib over 1 year (OR = 1.41; 95%, CI = 1.20 – 1.65) and increase exercise and eat less fat as weight loss strategies; women were more likely to join weight loss programs, take prescription diet pills, and follow special diets.

A study by (Crane et al., 2017) on exploring gender differences in a randomized trial of weight loss maintenance. The study aimed to explore gender differences in reasons for losing weight, weight loss methods, and weight loss

behaviours before and during a weight loss maintenance trial. The outcome revealed that women were more likely than men to report having used an organized weight loss program to lose weight (55.9% versus 24.7%, p = .01). Men were more likely than women to report eating food from convenience stores at baseline (22.1% versus 13.2%, p = .05) and throughout the study but otherwise reported similar meal patterns (ps > .05). Men reported higher energy intake than women while physical activity was similar. Although more men self-directed their initial weight loss and more women utilized organized weight loss programs, behaviours reported during weight loss maintenance were similar.

Kuan et al., (2011) conducted similar research on gender differences in body mass index, body weight perception, and weight-loss strategies among undergraduates at the University of Malaysia, Sarawak. The purpose of the research was to examine gender differences in body mass index (BMI), body weight perception, eating attitudes, and weight-loss strategies. The study showed 52.8% of students had normal BMI, with approximately an equal number of both sexes. More males than females were overweight (33.7%), while more females were underweight (25.3%). Males were more likely to perceive themselves as overweight and fail to see themselves as underweight. More than half of the females preferred their ideal figure to be underweight, whereas about 30% of males chose an overweight figure as their ideal model. Females were generally more concerned about body weight, body shape, and eating than males. They diet more frequently, had self-induced vomiting, and used laxatives and exercise as their weight-loss strategies. In conclusion, issues about body weight perception, eating attitudes, and weight loss strategies exist with differences among male and female undergraduates.

Anderson, et al., (2001) conducted a study on weight loss and gender: An examination of Physician Attitudes. The purpose of this study was to investigate physician attitudes toward the treatment of overweight and obese individuals and to evaluate potential gender differences in treatment recommendations. A survey describing several hypothetical patients was sent to 700 randomly selected physicians; 209 (29.9%) returned the survey. Two versions of the questionnaire (one for men and one for women) described three hypothetical patients at three levels of body mass index (BMI) (32, 28, and 25 kg/m). One- half of the physicians received a version of the questionnaire describing the patients as women, and one- half received a version describing the patients as men. Respondents answered questions about attitudes toward treatment and specific interventions and referrals they would view as appropriate. Results revealed that physicians were more likely to encourage women with a BMI of 25 kg/m to lose weight than men with the same BMI, and indicated that they would suggest more treatment referrals for women than men. Men with a BMI of 32 kg/m were more likely to be encouraged to lose weight than women with identical BMI. Physicians were more likely to encourage weight loss and see treatment referrals as appropriate for patients with higher BMIs. This study further indicated that physicians treat male and female patients differently, with physicians more likely to encourage weight loss and provide referrals for women with a BMI of 25 kg/m than for men with an identical BMI and less likely to encourage weight loss for women than men with a BMI of 32 kg/m.

Noh et al., (2016) conducted a study on age and gender differential relationship between employment status and body mass index among middle-aged and elderly adults: a cross-sectional study. The objective was to determine the influence of age and gender, respectively, on the association between employment

status and body mass index (BMI) in Korean adults using a large, nationally representative sample. A cross-sectional study was employed. Participants were 7228 from the fourth wave of the Korean Longitudinal Study of Aging (KLoSA), the survey‟s short form and year: „KLoSA 2012‟. The main outcome that was measured was BMI. Results revealed that BMI among the employed was higher than among the unemployed for those under 60. In terms of gender, employed men reported higher BMI than their unemployed counterparts, whereas employed women reported lower BMI than did unemployed women. Researchers concluded that employment status showed varying impacts on obesity by age and gender. Both unemployment at or after 60, as well as unemployment among women, is associated with increased BMI compared with unemployment among younger individuals or men, respectively.

Atlkovic et al., (2014) conducted a study on gender differences in body mass index and physical activity of students of the University of Tuzla to examine gender differences in the body mass index (BMI) and the level of Physical Activity (PA) among respondents. The study was conducted to determine the body mass index (BMI) and the average weekly number of hours of sports activity in the last six months (PA). A research sample was made of female students (n = 330) in the chronological age of 19.3+1.5 years, 60.7%, and of male students (n = 213) in the chronological age of 20.0+1.8 years, 39.2%. Results of the study revealed that, on average, the students (both female and male) spend 5.60 (5.03) hours on physical activity per week. Female students spend 4.05 (4.32) hours, while male students dedicate 8.11 (5.30) hours to physical activities. It can be concluded that in principle the students practice physical activities and recreation, but still 1/5 of all students are inactive. The obtained results for the BMI show that the majority of students are in the zone of normal values: female – 278 (84.2%); male – 157 (73.7%). Correlations

between BMI and PA amount to (R = .214; p < 0.01) and (R2 = .046; p < 0.01). The results of the T-test show a more significant statistical variable of differences between female and male students at the level of p < 0.05. In comparison to female students, male students have 2.35 kg/m2 higher BMI, and they are more active in physical activities for 4.06 hours in comparison to women. In conclusion, the focus should be directed to the education of young people, because they can easily adopt healthy habits that should be maintained for life. These results point out the necessity of an integrated approach to the prevention and control of risk factors, particularly among youth.

2.3.4 Age and Weight Loss

The body changes its shape naturally as you age. Some of these changes are unavoidable however, lifestyle choices may slow or speed the process. The human body is made up of fat, lean tissue (muscles and organs), bones, and water. After age 30, some people tend to lose lean tissue. Muscles, liver, kidney, and other organs may lose some of their cells. This process of muscle loss is called atrophy. The amount of body fat goes up steadily after age 30 (U.S. Department of Health and Human Services National Institutes of Health, February 2018). Older people may have almost one third more fat compared to when they were younger. For middle-aged and older individuals, poor lifestyle habits and changes in metabolism can make weight loss difficult. In teens, 20s, and 30s, you may notice that excess weight came off easily. Losing weight requires more effort as you reach middle age due to some factors. To build a strong fitness foundation, it is recommended that training should include a mix of cardio and weight training, with a focus on core and leg strength and stretching regularly.

Micallef (2015) researched associations of weight loss concerning age and body mass index in a group of Maltese overweight and obese women during an 8-week Zumba programme to showed that age could play an inverse effect on weight reduction and higher values of weight loss were associated with higher levels of body mass index (BMI). Based on this evidence, an 8-week Zumba study examined possible relationships that could exist among the variables of weight loss and age, and weight loss and BMI in 36 females, with a mean age of 34.25 ± 8.50 years and a mean BMI of 32.98 ± 5.32 kg/m2. An intervention involving 16 hourly Zumba sessions held twice weekly over 8 weeks was designed for participants of this study. The exercises comprised a mixture of meringue, salsa, reggaeton, and bachata with warm-up and cool-down activities. They were of low-impact style but were maintained at a vigorous intensity that was still bearable for the obese subjects. The weight and height of participants were recorded before and after the programme with a Seca 807 scale and a Seca 213 stadiometer. The age of last birthday was also taken. Spearman‟s correlations results of the study showed a very strong negative and statistically significant association between the participants‟ mean weight loss and their respective age groups: q = - 0.83, P = 0.04, and a very strong positive but statistically insignificant association between their mean weight loss and respective BMI categories: q = 0.80, P = 0.20. The researcher, therefore, concluded that between-subjects variations, including the investigated variables of age and BMI, acted as confounders in the interpretation of the correlation results. Despite these extraneous factors, this was the first study that investigated how weight loss during a Zumba programme for women could vary separately with age and BMI.

A systematic review and evaluation of conservative, non-pharmacological obesity treatment programs were conducted on weight loss in children and

adolescents by Mühlig et al., (2014). The review aimed to re-evaluate the available evidence on the efficacy of conservative weight-loss, with particular attention to the methodological quality of clinical trials, to derive information that might be a useful guide for treatment.

A systematic literature search of Medline for the period May 2008 (final inclusion date for a 2009 Cochrane Review) to December 2013, identified studies were analysed qualitatively. Effects showed 48 randomized controlled clinical trials with a total of 5025 participants who met the predefined inclusion criteria for this analysis. In the ones that met predefined criteria for methodological quality, conservative weight-loss treatments led to weight loss in amounts ranging from 0.05 to 0.42 BMI z score (standard deviation score of the body mass index) over 12–24 months. Information on trial dropout rates was available for 41 of the 48 trials; the dropout rate was 10% or higher in 27 of these (66%), and 25% or higher in 9 (22%). Inference and suggestion made were that, available evidence consistently shows that only a modest degree of weight loss can be expected from conservative treatment. Families seeking treatment should be informed of this fact. Future research should focus on determining predictive factors for therapeutic benefit, and on the evaluation of additional types of psychological intervention to promote coping with obesity.

Dong et al., (2014) conducted a study on the effects of age and gender on short-term weight loss and long-term weight maintenance. The objective of the research was to determine if there are differences in short-term weight loss and long-term weight maintenance success by age or gender. Patients were enrolled in a Midwestern weight loss clinic. The primary outcome measures were short-term weight loss success (achieving ≥ 10% of the initial body weight loss (IBWL) at three months) and long-term weight maintenance success (maintaining ≥ 10% IBWL at one

year). Results of the study indicated that patients 18 – 45 years were more likely to achieve short-term weight loss success compared to those in the two other age categories (45-64 and ≥ 65 years). However, age was not a significant predictor for long-term weight maintenance success. Females had decreased odds (OR=0.47, 95% CI 0.38, 0.59) of achieving short-term weight loss success, but had increased odds (OR=1.94, 95% CI 1.02, 3.67) of achieving long-term weight maintenance success. The researcher concluded that age and gender effects were different for short-term weight loss and long-term weight maintenance success.

2.3.5 Effects of Aerobic Dance on Weight Loss

Aerobic dance has gained popularity among physical exercise enthusiasts in recent times. It has become a major symbol of the fitness craze and is still one of the most popular ways to get and stay fit around the world. Its origin can be traced to the early 1960s. This form of exercise was by far highly effective for weight loss. Aerobic activity is a physical activity of low to high intensity that depends primarily on the aerobic energy-generating process. Aerobic means "relating to, involving, or requiring free oxygen" (Cooper, 2020) and refers to the use of oxygen to adequately meet energy demands during exercise via aerobic metabolism. Aerobic activity also called endurance activity moves your large muscles, such as those in your arms and legs. Running, swimming, walking, bicycling, dancing, playing some games and jumping jacks are some examples. Aerobic dance is very effective for sedentary people. Research has proven that this exercise was also very beneficial to people with cardiac issues as well (Çakmakçi et al., 2011)

According to (Patel, et al., 2017), aerobic dance had been proven to enhance the metabolic and cardiovascular levels of individuals. Such that when it was performed at target rates between 50% and 80%, there were increases in the maximal

consumption of oxygen as other forms of exercises also showed. The aerobic dance exercise is characterised by the oneness of tempo, rhythm, and intensity of the music and activities used. It is primarily focused on cardiorespiratory fitness improvement. Nevertheless, there were other goals like „the satisfaction of a motive for the preservation of health, improvement of one's physical appearance and the reduction of body mass" (Patel, et al., 2017).

Among the recognized benefits of doing regular aerobic activities are; strengthening the muscles involved in respiration, to facilitate the flow of air in and out of the lungs, strengthening and enlarging the heart muscle to improve its pumping efficiency, and reduce the resting heart rate known as aerobic conditioning, improving circulation efficiency and reducing blood pressure, increasing the total number of red blood cells in the body, facilitating the transport of oxygen, improved mental health including reducing stress and lowering the incidence of depression, as well as increased cognitive capacity and reducing the risk for diabetes. Aerobic activity makes you breathe harder and your heart beat faster, as a result, increases heart and lung fitness (Bilich, 2018). Aerobic activity can reduce the risk of death due to cardiovascular problems. Besides, high-impact aerobics activities (such as jogging or using a skipping rope) can stimulate bone growth, as well as reduce the risk of osteoporosis for both men and women. In addition to the health benefits of aerobic exercise, there are numerous performance benefits:

Research conducted by (Better Health Channel, 2006) found that since aerobics dance was not expensive to carry out, it became very popular, especially in the urban centres. He opined that aerobic dance contributed to weight loss since there is a rise in the estimated daily energy expenditure in aerobic dancers relative to "working women". That according to him created a slightly negative energy balance

in aerobic dancers, resulting in calorie expenditure and finally in weight losses. This is his opinion led to reduced body fat.

Ahmad and Rosli, (2015) conducted a study on the effects of aerobic dance on the cardiovascular level and body weight among women with the intends to prove that aerobic dance activity can bring the same if not better impacts on health than other types of cardiovascular exercise such as jogging and cycling. The objective of this study was to evaluate and identify the effect of six weeks of aerobic dance on cardiovascular fitness and weight loss among women. A quasi-experimental design and a total of 14 women (n = 14) with age (32.4 years old ± 9.1), weight (65.93 kg ± 11.24), and height (165.36 ± 3.46) who joined the Seremban Fit Challenge Season 13 were selected for the study. Subjects were asked to join an aerobic dance class with a duration of one hour for six weeks in a row. The result showed that there was a significant difference between pre and post-test for cardiovascular fitness when $p = 0.02 < 0.05$ and weight loss when $p = 0.00 < 0.05$. Researchers concluded that a six-week long aerobic dance program would have a positive effect on cardiovascular fitness and weight. Aerobic dance may therefore be used as an alternative for people who wish to lead a healthy lifestyle in a fun way.

Suman (2016) researched on Aerobic Exercise Programme and Reduction in Body Weight and Body Mass Index (BMI). He aimed to investigate the effect of eight weeks aerobic exercise training programme to reduce body weight and body mass index (BMI). 40 participants were randomly recruited into two groups- the experimental group and the control group with 20 participants in each group. Eight weeks of aerobic exercise training was administered to participants of the experimental group while the control group refrained from the aerobic exercise training programme. The result indicated a statistically significant reduction ($p <$

0.05) in body weight and body mass index in the experimental group as compared to the control group after eight weeks of aerobic exercise programme. The researcher, therefore, concluded that aerobic exercise significantly reduces body weight and body mass index (BMI).

A study in 2012, by Willis et al., revealed the effects of aerobic and/or resistance training on body mass and fat mass in overweight or obese adults. The study aimed to compare aerobic training, resistance training, and a combination of the two to determine the optimal mode of exercise for obesity reduction. Participants were 119 sedentary, overweight, or obese adults who were randomized to one of three 8-mo exercise protocols: 1) RT: resistance training, 2) AT aerobic training, and 3) AT/RT: aerobic and resistance training (a combination of AT and RT). Primary outcomes included total body mass, fat mass, and lean body mass. The AT and AT/RT groups reduced total body mass and fat mass more than RT ($P < 0.05$), but they were not different from each other. RT and AT/RT increased lean body mass more than AT ($P < 0.05$). While requiring double the time commitment, a program of combined AT and RT did not result in significantly more fat mass or body mass reductions over AT alone. Balancing time commitments against health benefits, it appears that AT is the optimal mode of exercise for reducing fat mass and body mass, while a program including RT is needed for increasing lean mass in middle-aged, overweight/obese individuals.

A study on the effectiveness of aerobic and strength training in causing weight loss and favourable body composition in females by Lehri and Mokha (2006) was conducted on 120 females ranging in age from 20 to 40 years to determine the effectiveness of different exercise programmes in causing weight loss and favourable body composition. Based on the results of the study, it is concluded that both strength

training and aerobic exercise programs exhibit great potentials for weight management. Aerobic training has been observed to decrease body weight from both the fat and muscle compartments while strength training conserved the lean body mass and reduced the fat compartment and thus caused favourable body composition in females.

A study by Jaywant (2013) on the effect of aerobic dance on body fat distribution and cardiovascular endurance in middle-aged women seeks to evaluate the effect of dance aerobics on cardiovascular endurance and body fat percentage in middle-aged women. Cooper Protocol, a standardised protocol for dance aerobics was followed, ensuring optimal exercise intensity and minimal musculotendinous damage. 120 middle-aged women divided into two groups were examined for VO2max and body fat percentage. Group I comprised 60 women engaged in regular aerobic dance sessions, for 6 months. Group II did not engage in any exertional physical activity. The unpaired t-test was used, $p = 0.001$ considered significant. Results showed that aerobic dancers exhibited no significant difference in VO2max ($p = 0.00201$) and lower fat percentage ($p = 0.01462$), indicating aerobics is highly effective in weight loss, but effects on cardiovascular endurance are not pronounced. He, therefore, concluded that increasing the intensity of the existing protocol to achieve increased VO2max may hasten musculotendinous damage. This should be considered before an individual selects aerobic dancing as a fitness activity.

In 2007, Akdur et al researched the effect of walking and step-aerobic exercise on physical fitness parameters in obese women. The purpose of the study was to examine the effects of three different exercise regimens on physical and physiological fitness parameters in 60 sedentary obese female subjects without hypertension, diabetes, or cardiovascular disease. The study groups consisted of groups whose

interventions were diet and step-aerobic exercise (trice weekly, 1 hour period for 10 weeks) (n = 20), diet and walking exercise (trice weekly, one hour walk, 10 weeks) (n = 20), and diet only. The cases were followed up for changes in body weight, body mass index, body fat percentage, circumference measurements, measures of flexibility, total cholesterol, and other biochemical parameters before and after the interventions. Results of the study revealed body weight, body mass index and total cholesterol changed significantly at the end of the study in step aerobic exercise and walking exercise groups. Circumference measurements and low-density lipoprotein (LDL) cholesterol were decreased without reaching statistical significance. Flexibility parameters increased in all groups including the controls without reaching statistical significance. It was concluded that step-aerobic exercise with a low caloric diet seemed the most effective treatment modality.

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Ahmad and Rosli (2015) conducted a study on the effects of aerobic dance on the cardiovascular level and body weight among women with the intends to prove that aerobic dance activity can bring the same if not better impacts on health than other types of cardiovascular exercise such as jogging and cycling. The objective of this study was to evaluate and identify the effect of six weeks of aerobic dance on cardiovascular fitness and weight loss among women. A quasi-experimental design with a total of 14 women ($n = 14$) with age (32.4 years old ± 9.1), weight (65.93 kg ± 11.24), and height (165.36 ± 3.46) who joined the Seremban Fit Challenge Season 13 were selected for the study. Subjects were asked to join an aerobic dance class with a duration of one hour for six weeks in a row. The result showed that there was a significant difference between pre and post-test for cardiovascular fitness when p =

0.02 < 0.05 and weight loss when p = 0.00 < 0.05. Researchers concluded that a six-week long aerobic dance program would have a positive effect on cardiovascular fitness and weight. Aerobic dance may therefore be used as an alternative for people who wish to lead a healthy lifestyle in a fun way.

Arslan (2011) conducted a study and published in the International SportMed Journal. The purpose of this study was to investigate the effects of an eight-week step-aerobic dance exercise programme on weight loss and body composition parameters in middle-aged sedentary obese women. This study comprised an eight-week randomised controlled trial with a total of 49 healthy sedentary obese women participating in this study voluntarily. Participants were randomly divided into two groups: those undertaking a step-aerobics dance exercise programme (n=29) and a control group (n=20). The subjects took part in a step-aerobic dance exercise programme for one hour per day, three days a week for eight weeks. The subjects‟ Body Mass Index (BMI), weight, waist circumference, waist-hip ratio, four-site skinfold thickness, fat percentage, basal metabolic rate, and lean body mass were assessed before and after the completion of the step-aerobic dance exercise programme. Results revealed that, after the eight weeks of the step-aerobic dance exercise programme, significant differences were found in the subjects‟ weight, BMI, body composition parameters, waist-hip ratio (WHR), waist circumference (WC), fat percentage, lean body mass (LBM) and basal metabolic rate (BMR) in the experimental group ($p<0.05$). There were no significant differences in the control group after the experiment in terms of the same measures ($P>0.05$). The researcher concluded that step aerobic dance programme proved to be a useful exercise modality for weight loss and in terms of body composition. There was a clear response to the

eight-week step aerobic dance programme in terms of central obesity in sedentary obese Turkish women.

2.3.6 Strength/Resistant/Weight Training

Strength/Resistant/Weight training works your muscles by using resistance, like a dumbbell or body weight. This type of exercise increases lean muscle mass, which is particularly important for weight loss because lean muscle burns more calories than other types of tissue (Rettner, 2016). Strength training is a type of physical exercise specializing in the use of resistance to induce muscular contraction which builds the strength, anaerobic endurance, and size of skeletal muscles. When properly performed, strength training can provide significant functional benefits and improvement in overall health and well-being, including increased bone, muscle, tendon, and ligament strength, and toughness. It will also improve joint function, reduce the potential for injury, increase bone density, increased metabolic, increased fitness, and improved cardiac function (Shaw, 2005). Strength training is primarily an anaerobic activity, although some advocates have adapted it to provide the benefits of aerobic exercise through circuit training.

Strength activity will increase bone strength and muscular fitness. Such activities should work all the major muscle groups of your body, that is, the legs, hips, back, chest, abdomen, shoulders, and arms, examples include bodyweight exercises (e.g. push-ups, pull-ups, sit-ups, and squats), working with a resistant band and weight training. It helps to improve the physical attractiveness of men. There is evidence that a body type consisting of broad shoulders and a narrow waist, attainable through strength training, is the most physically attractive male attribute according to women participating in research (Mautz et al., 2013). They further explained that most

women lack the testosterone to develop such physical appearance, but they can develop a firm, physique, and can also increase their strength by the same proportion as that achieved by men but usually from a significantly lower starting point.

Further, strength training provides functional benefits. Thus, stronger muscles improve posture, provide better support for joints, and reduce the risk of injury from everyday activities. Older people who take up weight training can prevent some of the loss of muscle tissue that normally accompanies aging and even regains some functional strength and by doing so become less frail (Peterson & Gordon, 2011). Weight-bearing exercise also helps to prevent osteoporosis and to improve bone strength in those with osteoporosis (Body et al., 2011). Strength training may be important for metabolic and cardiovascular health. Evidence suggests that resistant training may reduce metabolic and cardiovascular disease risk. Overweight individuals with high strength fitness exhibit metabolic/cardiovascular risk profiles similar to normal-weight, fit individuals rather than overweight unfit individuals (Roberts et al., 2015). Finally, strength training works your muscles by using resistance, like a dumbbell or body weight. This type of exercise increases lean muscle mass, which is particularly important for weight loss because lean muscle burns more calories than other types of tissue (Rettner, 2016).

A study on the effectiveness of aerobic and strength training in causing weight loss and favourable body composition in females by Lehri and Mokha (2006) was conducted on 120 females ranging in age from 20 to 40 years to determine the effectiveness of different exercise programmes in causing weight loss and favourable body composition. It is concluded that both the strength training and aerobic exercise programs exhibited great potentials for weight management. Aerobic training has been observed to decrease body weight from both the fat and muscle compartments

while strength training conserved the lean body mass and reduced the fat compartment and thus caused favourable body composition in females.

A study by Willis et al., (2012) revealed the effects of aerobic and/or resistance training on body mass and fat mass in overweight or obese adults. The study aimed to compare aerobic training, resistance training, and a combination of the two to determine the optimal mode of exercise for obesity reduction. Participants were 119 sedentary, overweight, or obese adults who were randomized to one of three 8 – mo exercise protocols: 1) RT: resistance training, 2) AT aerobic training, and 3) AT/RT: aerobic and resistance training (a combination of AT and RT). Primary outcomes included total body mass, fat mass, and lean body mass. The AT and AT/RT groups reduced total body mass and fat mass more than RT ($P < 0.05$), but they were not different from each other. RT and AT/RT increased lean body mass more than AT ($P < 0.05$). While requiring double the time commitment, a program of combined AT and RT did not result in significantly more fat mass or body mass reductions over AT alone. Balancing time commitments against health benefits, it appears that AT is the optimal mode of exercise for reducing fat mass and body mass, while a program including RT is needed for increasing lean mass in middle-aged, overweight/obese individuals.

2.3.7 Outdoor Activities

There are very many ways to lose weight apart from hitting a gym. Exercising outdoors is linked with good things such as greater vitality, enthusiasm, pleasure, self-esteem, and lower levels of the stress hormone cortisol and less bad things such as tension, depression, and fatigue (Supperskinnyme, 2018). Outdoor activities have many advantages when it comes to weight loss. Outdoor activities burn a significant amount of calories and add enjoyment to life. According to Harvard Health, outdoor

activities raise vitamin D levels and boost the immune system. Also, participating in a new activity that includes physical exertion floods the brain with dopamine and serotonin. These chemicals improve mood, elevate the sense of well-being, and motivate to participate again (Ryan, 2017).

Outdoor activities, such as bicycling, hiking and jumping rope, etc. are all excellent ways to lose weight. Bicycling works on muscle groups of calves, thighs, and back to aid weight loss. It is estimated that a moderate pace of 15 kilometers an hour helps burn close to 300 calories. Whereas, speed of 15 kilometers an hour could burn up to 600 calories per hour. First, hiking can either be done individually or in groups and helps burn calories when properly done. Jumping Rope can be done almost anywhere, either at home or gym, or even at the workplace. It helps to increase cardiovascular fitness by improving blood circulation and makes one less breathless during exercise. An average person of 200 pounds can burn up to 1,074 calories per hour (Sharma, 2018). Swimming allows one to work on stiff muscles, especially for overweight people. It helps to tone chest, back, arms, abdominals, legs, and shoulders muscles. An average adult burns 476 calories in an hour of swimming.

Furthermore, Outdoor circuit training is bodily conditioning training, which involves resistance training and high-intensity aerobics. Besides running and jogging, it involves various cardio and weight training exercises which help to burn calories. Exercises like bench push-ups, squats, jumping jacks, and crunches can be done with less equipment required. Water activities, such as rowing and canoeing, and kayaking, helps you burn plenty of calories by working on muscles of the legs, arms, back, abdominal, and buttocks. It also helps you improve and maintain the flexibility of joints. Engaging in several yard work activities, such as mowing, raking, clean

gutters, sweeping, washing clothes, weeding, and turning a compost pile are various chores that one does to burn calories.

Lastly, playing certain games like tennis and basketball helps burn more calories faster than doing aerobics. While playing the sport, one builds muscle and body strength which helps to improve both aerobic and anaerobic fitness at the same time (DoW Staff Writer, 2017). Most outdoor activities are good to help lose weight because they keep the body active and on the move. The entire body happens to work out when engaging in outdoor activities. Outdoor activities are done in their naturalness as they are confined to within the walls of gyms, are simple and easy to plan, and joyous.

2.3.8 Stretching

Stretching is a form of physical exercise in which a specific muscle or tendon (or groups of muscle) is deliberately flexed or stretched to improve the muscle's felt elasticity and achieve comfortable muscle tone (Weerapong et al., 2004). In its most basic form, stretching is a natural and instinctive activity; it is performed by humans and many other animals. Stretching often occurs instinctively after waking from sleep, after long periods of inactivity, or after exiting confined spaces and areas. Increasing flexibility through stretching is one of the basic tenets of physical fitness. It is common for athletes to stretch before (for warming up) and after exercise in an attempt to reduce the risk of injury and increase performance (Prentice, 2003). Studies have shed light on the function of a large protein within the myofibrils of skeletal muscles named Tintin in stretching (Hsin et al., 2011). A study performed by Magid and Law (2008) demonstrated that the origin of passive muscle tension (which occurs during stretching) is actually within the myofibrils, not extracellular as had previously been supposed (University of California Regents). Due to neurological safeguards

against injury, it is normally impossible for adults to stretch most muscle groups to their fullest length without training due to the activation of muscle antagonists as the muscle reaches the limit of its normal range of motion (Tsatsouline, 2001).

There are five different types of stretching: ballistic, dynamic, SMF stretching, PNF stretching, and static stretching. Ballistic stretching is a rapid bouncing stretch in which a body part is moving with the momentum that stretches muscles to a maximum. Muscles respond to this type of stretching by contracting to protect itself from overextending. Dynamic stretching is a walking or movement stretch. By performing slow controlled movements through a full range of motion, a person reduces the risk of injury. Proprioceptive neuromuscular facilitation (PNF) is a type of stretch for a particular muscle and its specific job, so resistance should be applied, and then the muscle should be relaxed. Static stretching is a type of stretch whereby a person stretches the muscle until a gentle tension is felt and then holds the stretch for thirty seconds or until a muscle release is felt, without any movement or bouncing (Prentice, 2003).

In an article by Lindberg, 2018, the following were outlined as benefits that can be achieved through regular stretching. Regular stretching can help increase flexibility, which is crucial for overall health which helps to perform everyday activities with relative ease and also help delay the reduced mobility that comes with aging. Being able to move a joint through its full range of motion gives more freedom of movement. Further, stretching regularly can help increase the range of motion. Performing dynamic stretches before physical activities have been shown to help prepare muscles for the activity. Performing stretches regularly will improve circulation which increases blood flow to muscles, can shorten recovery time, and also reduce muscle soreness. A study found that a combination of strengthening

and stretching specific muscle groups can reduce musculoskeletal pain and encourage proper alignment which in turn, may help improve your posture. Tight muscles can lead to a decrease in range of motion. When this happens, you increase the likelihood of straining the muscles in your back. Stretching can help heal an existing back injury by stretching the muscles. A regular stretching routine can also help prevent future back pain by strengthening back muscles and reducing the risk for muscle strain. A great stretch is a good stress reliever. When you are experiencing stress, there is a good chance your muscles are tense. That is because your muscles tend to tighten up in response to physical and emotional stress. A good stretch should therefore focus on areas of your body where you tend to hold your stress, such as your neck, shoulders, and upper back. Participating in a regular stretching program not only helps increase flexibility, but it can also calm the mind. While you stretch, focus on mindfulness and meditation exercises which give your mind a mental break. Tension and stress headaches can interfere with daily life. In addition to a proper diet, adequate hydration, and plenty of rest, stretching may help reduce the tension that is felt from headaches.

In an article by Health Fitness Revolution (March 2016) the following was also outlined as some benefits of stretching. A build-up of stress causes muscles to contract, making them feel tense and uneasy which can lead to hurting the mind as well as the body. Stretching exercises have powerful stress-busting abilities.

Stretching soon after waking up can help jump-start the mind and body. Stretching loosens tight muscles which help muscles both relax and increase blood flow. It also encourages the release of endorphins, providing a sense of tranquillity and euphoria. Stretching directly before bed will even give a more comfortable sleeping experience. Again, it was stated that stretching loosens muscles and tendons

which relieves muscle fatigue and increases blood flow. The longer the exercise, the more energy will be burnt, typically causing one to grow fatigued. Stretching can delay the onset of muscle fatigue by ensuring oxygen is efficiently flowing through the blood, thereby increasing the endurance level. Stretching is a form of exercise that involves controlled lengthening and shortening of various muscles in your body. It is frequently performed in association with more strenuous forms of exercise such as aerobics or strength training.

Stretching helps weight loss by pumping blood to the body, not in a way that increases adrenaline but will help to improve mood and lower stress levels. This may be especially helpful for dieters who are trying to curb emotional eating by replacing the trip to the refrigerator with 5 minutes of healthy stretching. Stretching also helps to keep one active and likely to help move more throughout the day if the joints and limbs feel good. Furthermore, aerobic activity and strength training that is geared towards weight loss is more effective when each exercise is performed fully. Stretching therefore helps keep the body in top shape so that more calories are burnt during workouts and less time is spent recovering from injuries or soreness (Frey, 2019). While stretching alone may not typically contribute to significant weight loss, it does help prepare the body for exercises that do help weight loss. A few minutes of stretching each day will help to improve the range of motion in your joints, help to decrease the risk of injury during exercise, and reduce stress. Consistent stretching of about 2-3 times per week is important to boost flexibility (Frey, 2019).

2.7 Summary

Although several works were done on weight loss, gender, and age about the rate of weight loss, none has been able to state whether eight weeks of physical activity is enough for overweight and obese senior high students in the Asuogyaman District to lose excess weight. All other works were conducted with different participants, methods, and in a different part of the world.

This study had therefore added to existing knowledge, and literature which would also guide policymakers in their decisions.

CHAPTER THREE

METHODOLOGY

This chapter discussed the research design, population, sample, and sampling techniques. Also, it covered the processes employed throughout this research, the instrument used to collect research data, and how data was analysed.

3.1 Research Design

A one-group experimental pre-test, post-test design was employed for this research. This technique was more feasible to use because it often does not have the time and logistical constraints associated with many true experimental designs (Black, 2010). Reactions of test subjects are more likely to be genuine because it is not an artificial research environment (Ayres, 2019). This technique also helped to reduce the difficulty and ethical concerns that may surround the pre-selection of test subjects. Besides, the results generated can often be used to reinforce the findings of case studies by conducting research that may lend itself to statistical analysis. Lastly, pre-experimental approaches may reduce the time and resources required because extensive pre-screening and randomization are not required or utilized (Black, 2010).

3.2 Population of the Study

The population of this study comprised all boarding students of Akwamuman Senior High School in the Asuogyaman District of the Eastern Region, Ghana. A total of 2844 (Headmaster, 2019) makes the schools‟ population of which 2,309 (81.19%) are in the boarding house. Out of the boarding population, 1,062 (46.00%) comprising both Green and Gold students are in the first year. The remaining 689 (29.84%) and 558 (24.16%) are in the second and third year respectively. The population for the study therefore comprised all boarding students of Akwamuman Senior High School

which stood at 2309. There were 979 (42.40%) and 1330 (57.60%) boys and girls boarders respectively.

3.3 Sample and Sampling Technique

A total of 2309 students were tested. Out of these, 113 of which 72 (63.72%) overweight and 41 (36.28%) obese students were purposively sampled for the study. the remaining 2196 were excluded from the study because they were either underweight or had a normal weight. The technique was used to include all students who fell within the overweight and obesity category when their Body Mass Index (BMI) was calculated. This sampling technique employed was the appropriate method available if there are only a limited number of primary data sources who can contribute to the study (Black, 2010). The purposive sampling technique was used to include all students whose BMI was within the overweight and obese categories are also one of the most cost-effective and time-effective sampling methods available since the researcher can easily pick participants who are relevant to the study without extra cost or time. Further, this technique gave better results if the investigator is unbiased and has the capacity of keen observation and sound judgment (Saunders et al., 2012). Lastly, this sampling technique can be effective in exploring anthropological situations where the discovery of meaning can benefit from an intuitive approach (Dudovskiy, 2018).

3.4 Data Collection Instrument

Standardized measurement of Body Mass Index BMI which included a measurement of the height and weight was used to categorise participants. An electronic weighing scale, well-calibrated and manufactured in China by Crown Star Electronics Company in 2010, model number: CS-3019, was used to measure the

weight of each participant. A locally manufactured, well-calibrated stadiometer was then used to measure the height of participants. These devices were ideal to be used for the measurement since both are used for routine medical examination purposes, clinical tests, and field experiments and were therefore valid and reliable for this purpose.

The data collected on the weight and height of participants were calculated using the BMI scale and classified into their appropriate BMI classes as Underweight = (<18), Normal weight = (18 – 24.9), Overweight = (25 – 29.9), and Obese = (≥ 30). Placing participants into these categories helped the researcher select only those who fell within the overweight and obese category for the study.

Body Mass Index (BMI) is a value derived from the mass (weight) and height of a person. BMI is defined as the body mass divided by the square of the body height and is universally expressed in units of kg/m^2, resulting from mass in kilograms and height in meters. The BMI is a convenient rule of thumb used to broadly categorize a person as underweight, normal weight, overweight, or obese based on tissue mass (muscle, fat, and bone) and height.

Adolphe Quetelet, a Belgian astronomer, mathematician, statistician, and sociologist, devised the basis of the BMI between 1830 and 1850. The modern term "body mass index" (BMI) for the ratio of human body weight to squared height was coined in a paper published in the 1972 edition of the Journal of Chronic Diseases by Ancel Keys.

BMI provides a simple numeric measure of a person's thickness or thinness, allowing health professionals to discuss weight problems more objectively with their patients. BMI was designed to be used as a simple means of classifying average sedentary (physically inactive) populations, with average body composition. For such

individuals, the value recommendations as of 2014 are as follows: a BMI from 18.5 up to 24.9 kg/m2 may indicate the optimal weight, a BMI lower than 18.5 suggests the person is underweight, a number from 25 up to 29.9 may indicate the person is overweight, and a number from 30 upwards suggests the person is obese.

3.5 Validity of the Instrument

BMI is widely used to assess a person‟s weight. However, its reliability as a health measure is often criticized, as it does not distinguish fat from muscle and does not tell where body fat is stored. A new study from the University of Bristol supports body mass index (BMI) as a useful tool for assessing obesity and health. Using body scans from 2,840 young people aged 10 and 18 in Bristol's Children of the 90s population study, researchers examined BMI findings against more detailed measures of fat. Bell, (2018) an epidemiologist at the University of Bristol who led the study, commented that even though many studies have criticised the use of BMI as a tool to classify weight, their study asked how useful it is for detecting the health effects of obesity by pitching it against more objective body scan measures (University of Bristo, 2018). Their study found simple BMI gives very similar answers to more detailed measures. They, therefore, encourage the use of BMI since is widely measured and costs virtually nothing.

3.6 Reliability of the Instrument

Body Mass Index (BMI) provides an easy way to measure and classify participants‟ into weight categories even though some researchers are questioning its accuracy and usefulness. In recent years, some researchers have argued that it‟s not the most accurate way to measure body weight because it cannot distinguish between fat and muscle and also doesn‟t take into account where body fat is stored. However,

it is more complimenting than anything. BMI has a high rate of false negatives (obese people being classified as normal or overweight) encroaching on 50% in some studies, particularly among females (Patel, 2012).

3.7 Research Procedure

With permission from the Institutional Research Board (IRB), UEW, and an introductory letter from the Head, Department of Health, Physical Education, Recreation and Sports, permission was sought from the Headmaster and the Head of Department-PE (HOD) to commence the study. The researcher as well explained what the study is and its‟ objectives, the type of data to be collected, how data will be collected, and the duration of the study.

Two research assistants were taken through a one-day training on the purpose of the study, questions the study will answer, how participants will be sampled for the study, and the roles they were expected to play as research assistants. They were also trained on equipment handling, how to take each measurement, and how the information will be recorded and calculated.

An informed consent explaining what and how data would be collected, and their permission to be involved in the study was given to each participant to endorsed. Furthermore, it also informed participants how instruments were to be used for the test, the duration of the research, and the implications of the results. Each participant‟s weight and height were taken and with a BMI calculator application manufactured by Open Source Libraries in 2013 and licensed under Apache License, Version 2.0, the researcher and his assistants calculated the BMI of all data collected from participants and compared the data to the BMI standards to categorize participants into “Underweight,” “Normal weight,” “Overweight,” and “Obesity.”

3.8 Intervention Procedure

Interventions for the study were selected based on FITT principles of exercise and the WHO (2018) recommendation for overweight and obese adolescents. The initial session of 30 minutes for 6 days was remoulded into 3 days of 60 minutes each. This came about as a result of limited days for participants who were students and needs time for other activities including learning. Interventions, therefore, lasted 60 minutes and were held thrice each week making a total of 180 minutes, 1440 minutes for the whole period.

Exercise sessions were held on Wednesdays, 4:00 pm – 5:00 pm, Fridays, 4:00 pm – 5:00 pm, and Saturdays, 6:00 am – 7:00 am started with a warm-up which normally lasts 10 minutes including stretching. Activities were led by the researcher to be sure the intended activity was given. Following closely after the warm-up was the main activity of either aerobic dance session, jogging, running, outdoor activities, and/or playing games such as gardening and draining choked gutters, strength training last 20 – 25 minutes, a water break of between 5 – 10 minutes for participants, research assistants, and researcher to replenish dehydration and also to rest. The second session of 20 minutes followed the break after which the last 10 minutes were used for cool down activities including stretching. During these sessions, the researcher demonstrates activities whereas trained assistants assisted participants to perform them.

Data of participants including weight and height were measured at both pre-test and post-test. These data were used to calculate BMI which were used to categorised participants. However, weight was only considered at the post-test stage since that was the dependent variable being measured.

3.9 Training of Research Assistants

Two research assistants were taken through three hours of training on the research questions, purpose and objectives of the study, conceptual and theoretical frameworks, research methodology including population, sample, and data collection instruments. Further, they were trained on how to handle instruments, how data will be taken, calculated, and categorised as well as their roles during the intervention period.

3.10 Data Analysis Plan

Data collected was sorted, coded, and analysed. An inferential statistics of independent t-test and one-way ANOVA were calculated to test the hypothesis at 0.05 alpha level of significance for questions two and three respectively whilst descriptive analysis of group means was employed to answer question one. Diagrams and charts were used where appropriate to represent and explain the data collected.

The three research questions were answered with the following:

Research Question 1

Simple means in defined groups were calculated to investigate the effect of physical activity (exercise) programme on weight loss.

Research Question 2

An independent sample t-test was calculated to investigate the difference in the weight of boys and girls in their participation in an eight-week physical activity.

Research Question 3

To investigate the relationship between students‟ ages on weight management, Anova was calculated.

CHAPTER FOUR

RESULTS, ANALYSIS, AND DISCUSSION

4.0 Introduction

The chapter covered the results of the study and how each was analysed. It further discussed the results of the study.

4.1 Results

Table one revealed the number of participants that were sampled for the study as either overweight or obese. In all, 113 students were purposively sampled as participants. There were 72 (63.72%) overweight participants whilst the remaining 41 (36.28%) were obese. As shown in table two, 85 (75.2%) and 28 (24.8%) females and males participants respectively were sampled as either overweight or obese. Table three presents the age-groups of the participants that started and completed the study. There were 21(18.6%) entailing 11 females and 10 males who were between 14 – 15 years, 37(32.7%) between ages 16 – 17 years consisting of 30 females and 7 males. 55(48.7%) involving 44 females and 11 males constituted the majority of the sample, represented students aged above 17 years.

Data in table four showed the gender distribution of overweight and obese participants at the pre-test stage. The 28 (24.8%) male participants were categorised as 20 overweight and 8 obese participants whilst 85 (75.2%) females consisted of 52 overweight and 33 obese participants. The data clearly showed that there were more females than male participants and also more overweight than obese participants. Table five provided data of pre-test age distribution of participants that started as either overweight or obese. 14 overweight and 7 obese participants were aged between 14 and 15 years, representing 18.6% of the sampled size. 37 (32.7%) were within the age group 16 – 17 and had 23 overweight and 14 obese participants. There

were also 35 overweight and 20 obese participants a total of 55 (48.7%) for participants above 17 years of age.

Participants were further placed in weight-groups of 50 – 59, 60 – 69, 70 – 79, 80 – 89, 90 – 99, 100 – 109, 110 – 119, and 120 – 129 as indicated in Table 4. Out of the 113 participants, 1 (0.88%), a female was in the 50 – 59 weight group. 26 females and 9 males totalling 35 (30.97%) of the sampled size, represented participants who were in the 60 – 69 weight-groups also formed the majority of the overweight and obese students. 33 (29.20%) participants consisting of 22 females and 11 males made weight-group 70 – 79 as the second bulk group. In weight-group 80 – 89, there were 24 females and 7 males making 31 (27.43%) participants. 7 (6.19%), 3 (2.65%) and 1 (0.88%) all-female participants were grouped into the 90 – 99, 100 – 109 and 110 - 119 weight-groups respectively. The last group had two (1.77%) participants consisting of one male and one female as shown in table six.

Even though no participant started as normal weight, table eight revealed 5 (4.42%) males and 19 (16.81%) females lost enough weight to drop their BMI category to normal weight. There were 12 (10.62%) males and 39 (34.51%) females who were categorised as overweight at the post-test stage and 11 (9.73%) males and 27 (23.90%) females‟ participants that ended the study as obese. Table eight showed the post-test age distribution of weight for all 113 participants. 3 (2.65%), 8 (7.10%) and 13 (11.50%) sampled students aged 14 – 15, 15 – 16 and above 17 years respectively completed the study as normal weight. As an overweight, there were 12 (10.62%), 16 (14.16%), and 24 (21.24%) participants for age groups 14 – 15, 15 – 16, and above 17 years respectively.

Post-test weight-groups distribution was presented in table ten. The researcher recorded one (0.88%) female participant in weight group 50 – 59. 35 (30.97%)

comprising 25 females and 10 males participants weighed within 60 – 69 weight-group. In group 70 – 79, there were 24 females and 10 males totalling 34 (30.09%) participants. 29 (25.66%) sampled students comprising 22 females and 7 males were in weight-group 80 – 89. There were 8 (7.08%), 3 (2.65%) and 1 (0.88%) females in weight-groups 90 – 99, 100 – 109 and 110 – 119 respectively. The remaining two (1.77%) participants comprising a female and a male made weight-group 120 – 129.

Table 1: Participants' Information

Participants	Frequency	Percent
Overweight	72	63.72
Obese	41	36.28
Total	113	100.0

Source: Researcher, 2019

Table 2: Gender of Participants

Gender	Frequency	Percent %
Female	85	75.2
Male	28	24.8
Total	113	100.0

Source: Researcher, 2019

Table 3: Age-groups of Participants

Ages	Frequency	Percent %
14 – 15	21	18.6
16 – 17	37	32.7
Above 17	55	48.7
Total	**113**	**100.0**

Source: Researcher, 2019

Table 4: Pre-test gender distribution of overweight and obese participants

Gender	Overweight %	Obese %	Percent %	Total
Male	20 (17.70)	8 (7.08)	24.8	28
Female	52 (46.02)	33 (29.20)	75.2	85
Total	**72**	**41**	**100**	**100**

Source: Researcher, 2019

Table 5: Pre-test age distribution of overweight and obese participants

Age	Overweight %	Obese %	Percent %	Total
14 – 15	14 (12.39)	7 (6.19)	18.6	21
16 – 17	23 (20.35)	14 (12.39)	32.7	37
Above 17	35 (30.97)	20 (17.70)	48.7	55
Total	**72**	**41**	**100**	**100**

Source: Researcher, 2019

Table 6: Pre-test weight-groups of participants

Weight Groups	Number	Percent
50 – 59	1	0.88
60 – 69	35	30.97
70 – 79	33	29.20
80 – 89	31	27.43
90 – 99	7	6.19
100 – 109	3	2.65
110 – 119	1	0.88
120 – 129	2	1.86
Total	**113**	**100**

Source: Researcher, 2019

Table 7: Pre-test, Post-test Weight of Participants

Number	Pre-Test (KG)	Post-Test (KG)	Weight Difference (KG)
1	64	61	-3
2	78	75	-2
3	64	60	-4
4	69	66	-3
5	67	62	-5
6	69	65	-4
7	75	74	-1
8	120	121	-1
9	68	66	-2
10	92	90	-2
11	84	81	-3
12	67	66	-1
13	71	69	-2
14	89	87	-2
15	78	75	-3
16	67	64	-3
17	75	71	-4
18	63	63	0
19	82	83	+1
20	74	73	-1
21	87	85	-2
22	67	65	-2
23	64	60	-4
24	62	60	-2
25	87	87	0
26	67	64	-3
27	64	60	-4
28	62	60	-2
29	84	84	0
30	77	78	+1
31	68	67	-1

32	75	72	-3
33	75	71	-4
34	111	111	0
35	87	87	0
36	63	60	-3
37	96	94	-2
38	83	80	-3
39	57	57	0
40	89	90	+1
41	78	75	-3
42	71	70	-1
43	75	75	0
44	79	75	-4
45	94	90	-4
46	78	75	-3
47	82	80	-2
48	76	73	-3
49	90	90	0
50	62	62	0
51	68	66	-2
52	67	67	0
53	81	77	-4
54	88	86	-2
55	93	90	-3
56	81	80	-1
57	74	70	-4
58	66	62	-4
59	85	85	0
60	69	69	0
61	71	70	-1
62	84	83	-1
63	98	95	-3
64	74	74	0

65	63	60	-3
66	82	82	0
67	74	74	0
68	71	70	-1
69	129	126	-3
70	88	86	-2
71	85	83	-2
72	72	70	-2
73	74	71	-3
74	83	83	0
75	75	73	-2
76	68	65	-3
77	105	105	0
78	74	71	-3
79	85	85	0
80	66	66	0
81	78	78	0
82	106	106	0
83	105	102	-3
84	88	86	-2
85	86	85	-1
86	75	75	0
87	62	60	-2
88	69	70	+1
89	65	64	-1
90	84	81	-3
91	96	95	-1
92	86	82	-4
93	78	73	-5
94	88	84	-4
95	89	89	0
96	87	84	-3
97	67	64	-3

98	64	67	+3
99	72	70	-2
100	84	84	0
101	78	78	0
102	66	62	-4
103	67	63	-4
104	75	75	0
105	84	84	0
106	66	67	+1
107	67	67	0
108	74	74	0
109	75	72	-3
110	66	64	-2
111	82	82	0
112	84	83	-1
113	77	77	0
Mean Weight	**77.91**	**76.27**	

Source: Researcher, 2019

Table 8: Post-test gender distribution of weight

Gender	Normal Weight %	Overweight %	Obese %	Percent %	Total
Male	5 (4.42)	12 (10. 62)	11 (9.73)	24.8	28
Female	19 (16.81)	39 (34.51)	27 (23.90)	75.2	85
Total	**24**	**51**	**38**	**100**	**113**

Source: Researcher, 2019

Table 9: Post-test age distribution of weight

Age	Normal Weight %	Overweight %	Obese %	Percent %	Total
14 – 15	3 (2.65)	12 (10.62)	6 (5.31)	18.58	21
15 – 16	8 (7.10)	16 (14.16)	12 (10.62)	31.86	36
Above 17	13 (11.50)	24 (21.24)	19 (16.81)	49.56	56
Total	**24**	**51**	**38**	**100**	**113**

Source: Researcher, 2019

Table 10: Post-test weight-groups of participants

Weight groups	Number	Percent %
50 – 59	1	0.88
60 – 69	35	30.97
70 – 79	34	30.09
80 – 89	29	25.66
90 – 99	8	7.08
100 – 109	3	2.65
110 – 119	1	0.88
120 – 129	2	1.77
Total	**113**	**100**

Source: Researcher, 2019

4.2 Analysis of the results

To investigate the effect of physical activity on weight loss, group means of participants were calculated to compare pre-test and post-test data weights of participants. The data revealed that, participant at weight-group 50 – 59 did not show any difference in weight at both pre-test *(M = 57, SD = 0.0)* and post-test *(M= 57, SD = 0.0)* stage. Participants in weight-group 60 – 69 showed a pre-test of *(M = 65.80, SD = 2.25)* and a post-test of *(M = 63.80, SD = 2.83).* In the 70 – 79 weight-group, a

pre-test of *(M = 75.03, SD = 2.35)* and a post-test of *(M = 73.35, SD = 2.58)* were recorded. At weight-group 80 – 89, participants showed a pre-test of *(M = 85.10, SD = 2.48)* and a post-test of *(M = 83.83, SD = 2.32).* There was a pre-test of *(M = 94.14, SD = 2.53)* and a post-test of *(M = 91.75, SD = 2.28)* for participants at weight-group 90 – 99. Participants at weight-group 100 – 109 also recorded a pre-test of *(M = 105.33, SD = 0.58*) and a post-test of *(M = 104.33, SD = 2.08).* A participant at weight-group 110 – 119, showed a pre-test of *(M = 111.0, SD = 0.0)* and a post-test of *(M = 111.0, SD = 0.0)* whilst the final weight-group, 120 - 129 revealed a pre-test of *(M = 124.50, SD = 4.5)* and a post-test of *(M = 123.50, SD = 2.5).*

Analysing the results, it suggested that apart from participants at weight-groups 50 – 59 and 110 – 119, there were differences in the pre-test and post-test weight for participants in the other groups. These were groups made up only one participant each who missed some of the intervention sessions. As participant in weight-group 50 – 59 missed the first two weeks of the intervention period due to extra lessons with other teachers. Participant in weight-group 110 – 119 left school to participate in other duties at home and was not participate fully in the intervention sessions. Participants at weight-group 90 – 99 recorded the highest weight loss difference of *(M = 2.39, SD = 0.25)* followed by those in 60 – 69 with a weight loss difference of *(M = 2.0, SD = 0.83).* At weight-group 70 – 79, there was a difference of *(M = 1.68, SD = 0.23)* as the third best weight loss group. There was also a weight loss difference of *(M = 1.27, SD = 0.16)* for participants at weight-group 80 – 89 whilst participants at 100 – 109 and 120 – 129 recorded a weight loss difference of *(M = 1.0, SD = -1.5)* and *(M = 1.0, SD = 2.0)* correspondingly.

Similarly, there were differences in the pre-test and post-test weights in relation to gender. Females participants recorded a pre-test weight of *(M = 78.40, SD*

= 12.50) and a post-test of *(M = 76.74, SD = 12.88)* as males showed a pre-test of *(M = 76.43, SD = 12.86)* and post-test of *(M = 74.83, SD = 12.69).* This revealed a weight difference of *(M = 1.66, SD = -0.38)* for females and *(M = 1.60, SD = 0.17)* for males to indicate that males in the study lost more weight than females.

Among age groups, there was a pre-test weight of *(M = 74.68, SD = 10.96)* and a post-test of *(M = 73.29, SD = 11.21)* for participants aged 14 – 15 years with a difference of *(M = 1.39, SD = -0.25).* At age 16 – 17 years, there was weight of *(M = 77.55, SD = 11.68)* and *(M = 75.81, SD = 11.75)* for pre-test and post-test respectively. This also revealed a difference of *(M = 1.74, SD = -0.07)* between their pre-test and post-test weights. Participants above 17 years showed a pre-test of *(M = 79.38, SD = 13.61)* and *(M = 77.71, SD = 13.99)* for post-test and also revealed a difference of *(M = 1.67, SD = -0.38).* This indicated that, participants in age group 16 – 17 lost more weight than those above 17 and 14 – 15 years.

Table 11: Rate of weight loss by gender

	Gender	N	Mean	Standard Deviation
Pre-test	Female	85	78.40	12.50
	Male	28	76.42	12.86
Post-test	Female	85	76.74	12.88
	Male	28	74.83	12.70

N= number of participants.

An independent sample t-test was conducted to compare rate of weight loss in males and females senior high school students at Akwamuman S.H.S. The result showed no statistical significant difference between the pre-test score for males *(M = 76.42, SD = 12.86)* and females *(M = 78.40, SD =12.88)* participants, *t (111) = 0.47, p > 0.43* and the post-test score of *(M = 74.83, SD = 12.69)* and *(M = 76.74, SD = 12.88)*, *t (111) = 0.50, p > 0.313* for males and females participants respectively (see

tables 11). The result therefore suggested that males did not differ significantly in their rate of weight loss from their female participants as both recorded p values that are greater than 0.05 *(p > .05).*

A one-way between participants‟ ANOVA was conducted to compare the effect of age on weight loss.

Table 12: Differences between ages and weight loss

Age	N	Mean	Standard Deviation
14 – 15	21	74.68	10.96
16 – 17	37	77.55	11.68
Above 17	55	79.38	13.61
Total	**113**	**28.94**	**6.719**

Legend: N = total number of participants

The result from table 12 indicated no statistical significant difference between the ages of students and weight loss, in both the pre-test, *F (2 110) = 1.09, p > .34*, and post-test, *F (2 110) = .94, p > .39* since data showed p values that are more than 0.05 *(p > .05).* This shows that participants did not differ in weight loss in relation to age.

4.3 Discussion

4.3.1 Physical Activity and Weight Loss

Comparing the results of this study on weight loss among various weight groups, age groups and gender revealed some differences and similarities. Even though some weight-group recorded no difference in their pre-test and post-test weights, participants in other groups observed some differences in weight. Changes in participants‟ weight were possibly due to the following factors: Physical activity which requires energy in its execution needs to burn more calories than consumed to lose weight. Even though some researchers believe that exercise is not effective for

weight loss on its own because exercise increases hunger in people, making them eat more calories than they burned during the workout (West, 2016), a lot more believe otherwise as this study has revealed. Weight loss occurs because of decreased caloric intake. Participants that had initial weights between 50 – 59 and 110 – 119 recorded no differences in the post-test weights whereas participants in the other weight-group 70 – 79, 80 – 89, 90 – 99, 100 – 109, and 120 – 129 recorded some weight loss difference.

The result of this study was contrary to similar works. Salimin, Elumalai, Shahril, & Subramaniam (2015), investigated the effectiveness of eight weeks physical activities programme on obese pupils of SJK Barathi, Hutan Melintang using a quasi-experiment and 40 participants. The results of their study revealed that the obesity level of the respondents reduced obviously and therefore advocated that, physical activities be applied consistently in all schools to prevent students‟ obesity. Another study by Jakicic et al (2003), researched the effect of exercise duration and intensity on weight loss in overweight, sedentary women. The results showed that 184 out of 196 participants completed 12 months of intervention. In intention-to-treat analysis, mean (SD) weight loss following 12 months of treatment was statistically significant (P = .001) in all exercise groups (vigorous intensity/high duration = 8.9 [7.3] kg; moderate intensity/high duration = 8.2 [7.6] kg; moderate intensity/moderate duration = 6.3 [5.6] kg; vigorous intensity/moderate duration = 7.0 [6.4] kg), with no significant difference between groups. Mean (SD) cardiorespiratory fitness levels also increased significantly (P = .04) in all groups (vigorous intensity/high duration = 22.0% [19.9%]; moderate intensity/high duration = 14.9% [18.6%]; moderate intensity/moderate duration = 13.5% [16.9%]; vigorous intensity/moderate duration = 18.9% [16.9%]), with no difference between groups. Post hoc analysis revealed that

percentage weight loss at 12 months was associated with the level of physical activity performed at 6 and 12 months. Women reporting less than 150 min/week had a mean (SD) weight loss of 4.7% [6.0%]; inconsistent (other) pattern of physical activity, 7.0% [6.9%]; 150 min/week or more, 9.5% [7.9%]; and 200 min/week or more of exercise, 13.6% [7.8%]. It was established that significant weight loss and improved cardiorespiratory fitness were achieved through exercise.

Slentz, et al., (2004) conducted a study on the effects of the amount of exercise on body weight, body composition, and measures of central obesity. The results of their study discovered that out of 302 subjects screened, 182 met the criteria and were randomized with 120 completing the study. There was a statistically significant (P<.05) dose-response relationship between the amount of exercise and amount of weight loss and fat mass loss. The high-amount/vigorous-intensity group lost significantly more body mass (in mean [SD] kilograms) and fat mass (in mean [SD] kilograms) (-2.9 [2.8] and -4.8 [3.0], respectively) than the low-amount/moderate-intensity group (-0.9 [1.8] and -2.0 [2.6], respectively), the low-amount/vigorous-intensity group (-0.6 [2.0] and -2.5 [3.4], respectively), and the controls (+1.0 [2.1] and +0.4 [3.0], respectively). Both low-amount groups had significantly greater improvements than controls but were not different from each other. Compared with controls, all exercise groups significantly decreased abdominal, minimal waist, and hip circumference measurements. There were no significant changes in dietary intake for any group. Deductions made showed that non-dieting, overweight subjects, the controls gained weight, both low-amount exercise groups lost weight and fat, and the high-amount group lost more of each in a dose-response manner. These findings strongly suggest that, absent changes in diet, a higher amount of activity is necessary for weight maintenance and that the positive caloric imbalance

observed in the overweight controls is small and can be reversed by a modest amount of exercise. Most individuals can accomplish this by walking for 30 minutes every day.

Pourabdi, Shakeriyan, Pourabdi, & Janbozorgi (2013) conducted research on the Effects of Short-Term Interval Training Courses on Fitness and Weight Loss of Untrained Girls to study the effect of 30 minutes interval short courses of running (4 rounds × 7:30 minutes) with a mean intensity of 60-75% of heart rate reserve (HRR) for 6 weeks on body composition and aerobic capacity (VO_2max) in untrained girl university students. Findings of the study showed that 6 weeks of interval running improved body composition and aerobic capacity of untrained girls. This means that there was a significant decrease in PBF, weight, and BMI of untrained girls. Also, maximal oxygen consumption showed a significant increase ($p \leq 0.05$), while no significant change was observed in lean body mass. Findings of the present study indicate the importance of combining the short courses of work and rest for 30 min in a day. The study merely discussed the effective role of interval short course training in stimulating and changing physiological adaptations and consequently improving the performance of the cardiovascular system and body composition in untrained girls.

In 2000, a study conducted by the American College of Physicians, and American Society of Internal Medicine on the effects of losing weight through diet or exercise programs on obesity had the aim of comparing the effects of diet-induced weight loss with those of exercise-induced weight loss, and the effects of an exercise program without weight loss in obese persons. The results outlined that, men in both the diet and the exercise–weight loss programs lost an average of about 16 pounds. The weight did not change in the control group or in the group assigned to exercise

without weight loss. Body fat decreased in both weight loss groups, but men in the exercise–weight loss program lost more body fat than men in the diet–weight loss program. Men assigned to exercise without weight loss lost some abdominal fat. Physical fitness improved in both exercise groups.

In another study conducted, the American College of Sports Medicine (ACSM) examined different recommendations for the amount of exercise to lose weight. The organization recommends between 150 and 250 minutes of moderate to vigorous exercise each week to lose weight, Frey (2018).

West (2016), wrote an article in the Healthline magazine that, one of the most popular types of exercise for weight loss is aerobic exercise, also known as cardio activity. Examples include walking, running, cycling, playing most outdoor games, and swimming. Aerobic exercise doesn't have a major effect on muscle mass, at least not compared to weight lifting. However, it is very effective at burning calories.

In another research to evaluate the efficacy of isolated aerobic exercise programs in overweight and obese populations, Thorogood, et al (2011) concluded that aerobic exercise alone is not an effective weight loss therapy in overweight and obese populations. However, it is noted that more physical activity increases the number of calories the body uses for energy or burns off. The burning of calories through physical activity, combined with reducing the number of calories you eat, creates a calorie deficit that results in weight loss.

In line with the results of this study, Jakicic, et al. (2003), conducted a study to investigate the effect of exercise duration and intensity on weight loss in overweight, sedentary women which were published in the Journal of American Medical Association volume 290. Their study revealed that significant weight loss and

improved cardiorespiratory fitness were achieved through the combination of exercise and diet during the 12 months but not exercise alone.

Even though some participants in this study lost some amount of weight which moved them from either overweight to normal weight and from obese to normal weight, a few also recorded some weight gains which equally moved them from overweight to obese. This could be due to the inability of participants to be always present throughout the intervention period, participants‟ eating and sleeping habits as well as controlling their emotions. This, therefore, suggested that overweight and obese students of Akwamuman Senior High School could not lose significant weight in eight weeks but most saw changes in their weights.

Participants were advised on their eating to get the necessary and required energy needed for school work and play, and also prevent their desire to eat unhealthy and junk foods which could increase their weight. They were told to eat a lot of fruits and vegetables, and also take a lot of water. The fibre in the fruits as well as the water help fill their tummy and prevent them from overeating and eating in-between meals. Participants were further advised to eat healthy diets, cut the intakes of foods with little or no nutritional value and avoid emotional eating weight, a balance between the calories taken in and the calories burnt would be lost when calorie burnt is more than calorie took in. The right amount of food and physical activity was enough to allow more calories to be burnt than dieting alone (Gavin 2018). Any weight-loss plan that includes regular exercise is not only more successful but also healthier. Eating a healthy diet and exercising, will keep bones, muscles, and heart strong and decrease the risk of developing some diseases (Gavin 2018). Choosing a healthy diet is an effective first step to losing weight, and meals eaten on time can speed the process. Students are often exposed to junk and unhealthy foods as well as eating in-between

meals, and close to bedtime were some reason for the accumulation of excess weight and overweight or obese.

Enjoying a varied diet plan is more likely a recipe for success than a restrictive diet. While there are no special foods to eat to lose weight in the sense that they will magically melt fat, some foods are more helpful to the hopeful dieter than others. Participants were again advised to consume a lot of fruits and vegetables since they are low calorie and will therefore add fewer calories than some other foods. The fruits and vegetables would also help to lower blood cholesterol, as the fibre in the diet also fills the tummy and gives the feeling of fullness which may prevent overeating and help maintain weight. Watermelon, for example, is water-dense, and helps to keep one hydrated, and can also help prevent the craving for sugar and water.

The researcher further recommended that participants have enough sleep during and after the intervention period as the amount of sleep may be just as important as diet and exercise during the weight-loss period. A study of US adults (Pullen, 2017) revealed that 30% of adults are sleeping fewer than six hours most nights and therefore recorded a higher body mass index (BMI) and weight gain. Even though people's sleep requirements vary, research has observed weight changes when people get fewer than seven hours of sleep a night. A major review found that short sleep duration increased the likelihood of obesity by 89% in children and 55% in adults (Cappuccio et al, 2008). In another study that followed, about 60,000 non-obese nurses for 16 years were observed. At the end of the study, the nurses who slept five or fewer hours per night were 15% more likely to be obese than those who slept at least seven hours a night (Pullen, 2017). One study allowed 16 adults just five hours of sleep per night for five nights. They gained an average of 1.8 pounds (0.82 kg) over the short course of this study (Shomon, 2020). Additionally, the study

discovered that many sleep disorders, like sleep apnoea, are worsened by weight gain (Shomon, 2020). It's a vicious cycle that can be hard to escape. Poor sleep can cause weight gain, which can cause sleep quality to decrease even further.

Many studies have found that people who are sleep-deprived report having an increased appetite (Taheri, Lin, Austin, Young & Mignot, 2004). This is likely caused by the impact of sleep on two important hunger hormones, ghrelin, and leptin. Ghrelin is a hormone released in the stomach that signals hunger in the brain. Leptin is a hormone released from fat cells. It suppresses hunger and signals fullness in the brain. When you do not get adequate sleep, the body makes more ghrelin and less leptin, leaving you hungry and increasing your appetite. A study of over 1,000 people found that those who slept for short durations had 14.9% higher ghrelin levels and 15.5% lower leptin levels than those who got adequate sleep. The short sleepers also had higher BMIs.

Furthermore, studies on sleep deprivation have found that a large portion of the excess calories was consumed as snacks after dinner. Poor sleep can increase calorie intake by affecting the ability to control portion sizes. This was demonstrated in a study on 16 men. Participants were either allowed to sleep for eight hours or kept awake all night. In the morning, they completed a computer-based task where they had to select portion sizes of different foods. The ones who stayed awake all night selected bigger portion sizes, reported they had increased hunger and higher levels of the hunger hormone ghrelin.

Lack of sleep can cause daytime fatigue, which makes one less likely and motivated to exercise. Also, it is likely to get tired earlier during physical activity. A study done on 15 men found that when participants were sleep-deprived, the amount and intensity of their physical activity decreased (Schmid et al, 2009). Getting more

sleep may help improve athletic performance in sportsmen. In a study, college basketball players were asked to spend 10 hours in bed each night for five to seven weeks. They became faster, their reaction times improved, their accuracy increased and their fatigue levels decreased (Mah et al, 2011).

Poor sleep can cause cells to become insulin resistant (Breus, 2018). Insulin is a hormone that moves sugar from the bloodstream into the body's cells to be used as energy. When cells become insulin resistant, more sugar remains in the bloodstream and the body produces more insulin to compensate (Breus, 2018). The excess insulin causes hungrier and tells the body to store more calories as fat. Insulin resistance is a precursor for both type 2 diabetes and weight gain. In another study, 11 men were allowed only four hours of sleep for six nights. After this, their bodies' ability to lower blood sugar levels decreased by 40%. This suggests that only a few nights of poor sleep can cause cells to become insulin resistant (Spiegel et al, 2005). Along with eating right and exercising, getting quality sleep is an important part of weight maintenance. The less sleep, the more weight gain, and the more weight gain, the harder it is to sleep.

4.4 Gender on Weight Loss

Even though the result of this study showed no statistical significant difference in participants‟ weight which indicates that, males and females participants in this study did not differ in their initial and final weight significantly, male participants loss more weight than females. [Pre-test: males *(M = 76.42, SD = 12.86)* and females *(M = 78.40, SD =12.88)*, *t (111) = 0.47, p > 0.43* and post-test: males *(M = 74.83, SD = 12.69)* and females *(M = 76.74, SD = 12.88)*, *t (111) = 0.50, p > 0.313]*.

Some researchers have the opinion that because men naturally have more muscles than females, especially in the upper body, and since muscle burns more

calories than fat, men have a faster metabolism rate 5% to 10% faster than the woman (Young et al. 2012). Additionally, testosterone in men increases protein synthesis and lean body mass, which will then increase the resting metabolic rate (Tipton, 2001). Meaning, men will be burning more calories than women. Women have a higher percentage of body fat than men, usually 6% to 11% more, which makes them keep more fat than men (Young et al. 2012).

Results of this study supported a study at Brookhaven National Laboratory that found that women are more emotional eaters than men and geared up with the sight and smell of pizzas and cakes (Young et al. 2012). According to their researcher, men were much better at turning off their cravings while women fixated on their favourite foods, even after being told to think of something else. Other research suggests that women are more likely to eat in response to stress, while men are more likely to turn to alcohol. Men's bodies respond faster to diets: In a British Journal of Nutrition study (2016), when men and women were put on popular weight loss programs like Atkins, Slim-Fast, and Weight Watchers, men lost twice as much weight and three times as much body fat after 2 months (Young, 2016).

The study also shared similar results with a publication by Brazier, 2018. He explains that, by nature, females tend to have a lower metabolic rate than males. This means female bodies uses fewer calories to fuel normal body functions like breathing, thinking, and circulating blood (UPMC, 2018). The unused calories are therefore stored as fat. Female‟ body composition usually exceeds males‟. As men tend to keep excess weight made of more muscle than fat, lowering their body mass index BMI, females keep excess weight through fat which increases their BMI (Brazier, 2018). Muscle, conveniently for men, burns more calories than fat even at rest. Physiologically, women have an easier time keeping excess weight (UPMA, 2018).

A study by Ridley (2018) also supported the results of the study. The researcher tracked 2,200 overweight, pre-diabetic adults in Europe, Australia, and New Zealand. For eight weeks, participants stuck to an 800-calorie per day plan, consisting of soups, shakes, hot cereals, and vegetables. After two months on a low-calorie diet, men lost an average of 26 pounds, while women shed just 22 pounds. Not only were men the biggest losers, but they also got healthier than women, too. By the end of the study, male participants had lower heart rates, less body fat, and lower diabetes risk than their female counterparts.

In another study conducted by Donnelly et al. (2003) on the effects of a 16-month randomized controlled exercise trial on body weight and composition in young, overweight men and women: the Midwest Exercise Trial examined the long-term effects of a supervised program of moderate-intensity exercise on body weight and composition in previously sedentary, overweight and moderately obese men and women. The results of the test revealed that exercise prevented weight gain in women and produced weight loss in men.

A study was conducted on gender differences in weight-related attitudes and behaviours among overweight and obese adults in the United States to examine gender differences in weight-related outcomes across the body mass index (BMI) spectrum in overweight and obese adults. Weight-related outcomes were accurate with weight perception, weight dissatisfaction, attempted weight loss, successful weight loss, and weight loss strategies. Compared with women, overweight and obese men were less likely to have accurate weight perception (odds ratio [OR] = 0.36; 95% confidence interval [CI] = 0.30–0.44), weight dissatisfaction (OR = 0.39; 95% CI = 0.32–0.47), and attempted weight loss (OR = 0.55; 95% CI = 0.48–0.63). Tsai, Lv, Xiao & Ma (2015) indicated that men who attempted weight loss were more likely

than women to lose and maintain ≥10 lb over 1 year (OR = 1.41; 95% CI = 1.20–1.65) and increase exercise and eat less fat as weight loss strategies; women were more likely to join weight loss programs take prescription diet pills, and follow special diets.

In a study, (Crane, Jeffery, & Sherwood, 2017) explored gender differences in a randomized trial of weight loss maintenance. The study aimed to explore gender differences in reasons for losing weight, weight loss methods, and weight loss behaviours before and during a weight loss maintenance trial. The outcome revealed that women were more likely than men to report having used an organized weight loss program during their weight loss (55.9% vs. 24.7%, $p < .001$) and to report improving personal esteem as a motivator (51.2% vs. 35.1%, $p = .01$). Men were more likely than women to report eating food from convenience stores at baseline (22.1% vs. 13.2%, $p = .05$) and throughout the study but otherwise reported similar meal patterns ($p > .05$). Men reported higher energy intake than women while physical activity was similar. Although more men self-directed their initial weight loss and more women utilized organized weight loss programs, behaviours reported during weight loss maintenance were similar.

In another study, (Kuan, Ho, Shuhaili, Siti, & Gudum, 2011) researched the Gender Differences in Body Mass Index, Body Weight Perception, and Weight Loss Strategies among Undergraduates in University Malaysia Sarawak. The purpose of the research was to examine gender differences in body mass index (BMI), body weight perception, eating attitudes, and weight-loss strategies. The study showed, 52.8% of students had normal BMI, with approximately an equal number of both sexes. More males than females were overweight (33.7%), while more females were underweight (25.3%). Males were more likely to perceive themselves as overweight

and fail to see themselves as underweight. More than half of the females preferred their ideal figure to be underweight, whereas about 30% of males chose an overweight figure as their ideal model. Females were generally more concerned about body weight, body shape, and eating than males. They diet more frequently, had self-induced vomiting, and used laxatives and exercise as their weight-loss strategies. In conclusion, issues about body weight perception, eating attitudes, and weight-loss strategies exist with differences among male and female undergraduates.

Atlkovic, Hodzic, Bilalic, & Mehinovic, (2014) conducted a study on gender differences in Body Mass Index and physical activity of students of the University of Tuzla to examine gender differences in the body mass index (BMI) and the level of Physical Activity (PA) among respondents. The study was conducted to determine the body mass index (BMI) and the average weekly number of hours of sports activity in the last six months (PA). A research sample was made of female students (n = 330) in the chronological age of 19.3+1.5 years, 60.7%, and of male students (n = 213) in the chronological age of 20.0+1.8 years, 39.2%. Results of the study revealed that, on average, the students (both female and male) spend 5.60 (5.03) hours on physical activity per week. Female students spend 4.05 (4.32) hours, while male students dedicate 8.11 (5.30) hours to physical activities. It can be concluded that in principle the students practice physical activities and recreation, but still 1/5 of all students are inactive. The obtained results for the BMI show that the majority of students are in the zone of normal values: female – 278 (84.2%); male – 157 (73.7%). Correlations between BMI and PA amount to ($R = .214$; $p < 0.01$) and ($R2 = .046$; $p < 0.01$). The results of the T-test show a more significant statistical variable of differences between female and male students at the level of $p < 0.05$. In comparison to female students, male students have 2.35 kg/m2 higher BMI, and they are more active in physical

activities for 4.06 hours in comparison to women. In conclusion, the focus should be directed to the education of young people, because they can easily adopt healthy habits that should be maintained for life. These results point out the necessity of an integrated approach to the prevention and control of risk factors, particularly among youth.

However, in a study on weight loss and gender, Anderson et al. (2001) examined physician attitudes revealed a different result from this study. The purpose of this study was to investigate physician attitudes toward the treatment of overweight and obese individuals and to evaluate potential gender differences in treatment recommendations. A survey describing several hypothetical patients was sent to 700 randomly selected physicians; 209 (29.9%) returned the survey. Two versions of the questionnaire (one for men and one for women) described three hypothetical patients at three levels of body mass index (BMI) (32, 28, and 25 kg/m). One- half of the physicians received a version of the questionnaire describing the patients as women, and one- half received a version describing the patients as men. Respondents answered questions about attitudes toward treatment and specific interventions and referrals they would view as appropriate. Results revealed that physicians were more likely to encourage women with a BMI of 25 kg/m to lose weight than men with the same BMI, and indicated that they would suggest more treatment referrals for women than men. Men with a BMI of 32 kg/m were more likely to be encouraged to lose weight than women with identical BMI. Physicians were more likely to encourage weight loss and see treatment referrals as appropriate for patients with higher BMIs. This study further indicated that physicians treat male and female patients differently, with physicians more likely to encourage weight loss and provide referrals for women

with a BMI of 25 kg/m than for men with an identical BMI and less likely to encourage weight loss for women than men with a BMI of 32 kg/m

Even though some research works have concluded that males generally will lose weight faster than females, the result of this study has provided otherwise in the sense that weight loss is not significant in eight weeks to move an overweight or obese person to a normal weight even though some amount of weight was lost. In eight weeks, overweight and obese students of Akwamuman Senior High School did not record any statistically significant difference in their pre-test and post-test weight.

4.5 Age and Weight Loss

Concerning participants‟ ages and rate of weight loss, the result from this study revealed that weight loss did not differ significantly among participants‟ ages even though there were differences in weight loss. The results indicated no statistical significant difference between the ages of participants and their weight in both the pre-test, $F\ (2\ 110) = 1.09,\ p > .34$, and post-test, $F\ (2\ 110) = .94,\ p > .39$. These results, therefore, support works by other researchers that weight loss differs significantly mostly from age 30.

The human body does not respond the same way to weight loss efforts as we get older. Weight is gain to the tune of 1 to 2kg per year, according to a review published in 2013 by the Agency for Healthcare Research and Quality. This increase in weight over time can lead to significant weight gain and, in some cases, obesity, a condition marked by a BMI of 30 or higher (Lawler, 2019).

A lean muscle which uses more calories than fat naturally begins to decline by 3 to 8 percent per decade after age 30 (Lawler, 2019). Muscles are also lost through inactiveness due to age-related health conditions, such as arthritis, an injury, or surgery for several days (Booth, et al., 2014). This makes weight gain likely as the

same number of calories is consumed just as when younger. Most people will keep eating the same amount of calories when they are older, but with less muscle mass to burn those calories coupled with less activity, they end up gaining weight over time.

While studies have clarified that the rate of weight loss decreases as we age especially above 30 years, other research works have supported with evidence. Micallef (2015) researched associations of weight loss about age and body mass index in a group of Maltese overweight and obese women. An 8-week Zumba programme was designed to show that age could play an inverse effect on weight reduction and higher values of weight loss were associated with higher levels of BMI. Results of the study showed a very strong negative and statistically significant association between the participants‟ mean weight loss and their respective age groups: q = - 0.83, P = 0.04, and a very strong positive but statistically insignificant association between their mean weight loss and respective BMI categories: q = 0.80, P = 0.20.

In another study, a systematic review and evaluation of conservative, non-pharmacological obesity treatment programs were conducted on weight loss in children and adolescents and was published in Dtsch Arztebl International by Mühlig et al (2014). The review aimed to re-evaluate the available evidence on the efficacy of conservative weight-loss, with particular attention to the methodological quality of clinical trials, to derive information that might be a useful guide for treatment. Effects showed 48 randomized controlled clinical trials with a total of 5025 participants who met the predefined inclusion criteria for this analysis. In the ones that met predefined criteria for methodological quality, conservative weight-loss treatments led to weight loss in amounts ranging from 0.05 to 0.42 BMI z score (standard deviation score of the body mass index) over 12–24 months.

On the other hand, Dong et al, (2014) conducted a study on the effects of age and gender on short-term weight loss and long-term weight maintenance. The objective of the research was to determine if there are differences in short-term weight loss and long-term weight maintenance success by age or gender. Patients were enrolled in a Midwestern weight loss clinic. The primary outcome measures were short-term weight loss success (achieving ≥ 10% of the initial body weight loss (IBWL) at three months) and long-term weight maintenance success (maintaining ≥ 10% IBWL at one year). Results of the study indicated that patients 18 – 45 years were more likely to achieve short-term weight loss success compared to those in the two other age categories (45-64 and ≥ 65 years). However, age was not a significant predictor for long-term weight maintenance success. Females had decreased odds (OR=0.47, 95% CI 0.38, 0.59) of achieving short-term weight loss success, but had increased odds (OR=1.94, 95% CI 1.02, 3.67) of achieving long-term weight maintenance success. The researchers, therefore, concluded that age and Gender effects were different for short-term weight loss and long-term weight maintenance success.

Although some studies have provided data to support that, weight loss is dependent on age and other factors, age as dependent on weight loss mostly affects people who are 30 years and above. All participants in this study are students below the age of 30 and therefore could not be affected significantly by age to determine their rate of weight loss. The researcher, therefore, concludes that participants who went through the eight-week physical activity programme did not statistically significantly differ in their rate of weight loss by age.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATION

5.1 Summary

Overweight and obesity are gradually increasing among senior high school students in Ghana. Students of Akwamuman Senior High School, in the Asuogyaman District of the Eastern Region, Ghana are no exception to this situation. Inadequate physical activity coupled with low intensity of exercise given to overweight and obese students and excess intake of junk foods is the major cause of such situation.

This study investigated the effect of an eight-week physical activity programme on weight loss among students of Akwamuman Senior High School. The study was carried out to investigate if eight weeks is enough time for overweight and obese students to lose weight. If possible, the study also investigated if gender and participants‟ ages have any influence on the rate of weight loss.

Chapter one discussed the background of the study, statement of the problem, the purpose of the study, objectives of the study, and research questions. Also, it discussed the hypothesis, significance of the study, delimitations and limitations, assumptions made by the researcher, defined terms and acronyms used in the study, and how the rest of the study was organised.

The second chapter dealt with theories and concepts that backed the study. It also focused on related literature by other researchers and other writers. Theories were used to support this study. The F.I.T.T. Principles of Exercise were involved to determine the frequency (how often), intensity (how easy or hard), time (when), and type (particular exercise to do) of intervention activities design for this study. Also, a conceptual framework that showed the main themes underlying the research was developed for the study. This concept showed the relationship between different types

of exercises such as aerobics activities, strength training, and stretching, and how each is linked to weight loss.

Chapter three discussed the research design, population of the study, sample, and sampling techniques. It also covered the procedures that were employed through this research, the instrument used to collect the research data, and how data was analysed were also discussed. A pre-test, post-test experimental design with 113 participants who were all boarding students were employed for the study. Participants were purposely sampled to include all those who were overweight or obese. Measurements of weight with a digital weighing scale and height using a locally made stadiometer were calculated to find participants‟ BMI at both the pre-test and post-test stage.

Results and analysis of the study were clearly shown and discussed in Chapter four. Even though the results of the study presented no significant statistical difference in the weight of participants although some recorded some amount of weight loss. It also revealed that even though males were made of more muscles which burn calories faster than females who have more fatty tissues, their rate of weight loss is not significantly different to females however males lost more weight than females. Lastly, participants‟ age did not affect their rate of weight loss significantly but participants in the age-group of 16 – 17 lost more weight than the others.

Chapter five, explained the summary of the study, conclusions that were drawn from the study, and various recommendations that were made.

5.2 Conclusion

To effectively reduce body weight, it is widely accepted that a negative energy balance needs to be present; whereas, to maintain weight loss and prevent weight gain, energy balance needs to be present. Thus, physical activity can be an important intervention to achieve desired body-weight regulation. Physical activity (exercise) is a major factor in weight loss although some other factors can affect the rate at which it is done.

Findings indicated that the weights of students differ in their initial and final weight after the eight-week physical activity (exercise) programme although it was not statistically significant. The results further justified that overweight and obese males do differ but not statistically significant in the rate at which they lose weight than overweight and obese females even though the rate of weight loss was a bit higher among the males. Lastly, the results revealed that, even though age affects weights, it‟s very obvious from age 30 and above. Participants were all youth and fell within the ages of 14 and 20 and therefore did not show any difference in the rate of weight loss about their ages but a slight difference among the age-groups.

5.3 Recommendations

Findings from the study revealed that overweight and obese students can shed excess weight when given extra time on the field, with the right activities, and supervision. Physical education teachers, fitness instructors as well as coaches are required to give students and clients who find themselves in the overweight and obese category additional physical activity days and hours, and not only during the regular physical education periods or training sessions. Furthermore, overweight and obese females should be made to work very hard to meet their target since keeping excess weight is linked to other defects and diseases.

Parents at home and school authorities need to offer and monitor the kind and amount of foods served to their wards as well as the amount of sleep they require since both are factors that will cause an increase in weight. Eating poor foods and outside the scheduled time will harm weight altogether.

The researcher lastly recommends that policy planners and decision-makers need to consider the health needs of overweight and obese students/youth in our schools and communities and provide an adequate opportunity in terms of time, space, and supervision for such people. Schools should be made to adhere to the allocated time offered physical education on the time and also made extra time available to cater to students with excess weight.

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APPENDICES

APPENDIX A

Informed Consent

UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF HEALTH, PHYSICAL EDUCATION, RECREATION AND SPORTS

INFORMED CONSENT

I ……..……, haven been informed of the details of this study, give my consent to be a participant in the research. I have also been told that the data collected will be used solely for the study purpose only and nothing else.

If at any time I feel not to continue to be part of the study, I can opt-out without any further consequence.

I hereby promise my full participation throughout the study period and assure the researcher of my availability during this period.

Name: ……

Gender: ……

Class: ……

Signature: ……

UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF HEALTH, PHYSICAL EDUCATION, RECREATION AND SPORTS

PARTICIPANT DEMOGRAPHIC INFORMATION

EFFECT OF EIGHT-WEEK PHYSICAL ACTIVITY (EXERCISE) PROGRAMME ON WEIGHT LOSS

Participants‟ No……

This participant demographic information is designed to obtain your details as a participant for this study. Your information will be confidential and will be for academic purposes only.

Instructions: Circle the appropriate choice objectively.

Gender Female Male

Age 14-15 16-17 Above 17

Waist Circumference:……

Hip Circumference:……..……

WHR:…….…..….

Weight:……

Height:……

BMI:…….…..

APPENDIX B

Introductory Letter

RECEIVED
11/2/19

15th January, 2019

Eastern Region

INTRODUCTORY LETTER: MR. EBENEZER KOFI OFOSU

Physical Education Recreation and Sports of the University of Education, Winneba. He is undertaking a Dissertation on the topic "*Effect of Eight – Week Physical Activity (Exercise) Programme on Weight Loss*".

Yours faithfully,