UNIVERSITY OF CAPE COAST

EFFECT OF LONG-DURATION AEROBIC EXERCISES AND EXERCISE-SCHEDULING ON PHYSIOLOGICAL AND ANTHROPOMETRIC HEALTH MARKERS: A CASE STUDY OF A KEEP-FIT CLUB MEMBERS IN ACCRA, GHANA

NATHANIEL ATIKUMI

2022

UNIVERSITY OF CAPE COAST

EFFECT OF LONG-DURATION AEROBIC EXERCISE AND EXERCISE SCHEDULING ON PHYSIOLOGICAL AND ANTHROPOMETRIC HEALTH MARKERS: A CASE STUDY OF A KEEP-FIT CLUB MEMBERS IN ACCRA, GHANA

BY

NATHANIEL ATIKUMI

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

MAY, 2023

DECLARATION

Candidate's Declaration

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

Signature …………………………………… Date ……………………………

Name: Nathaniel Atikumi

Supervisors' Declaration

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

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

Name: Prof. Daniel Apaak

Co-Supervisor's Signature ……………………….. Date ………………………

Name: Prof. Charles Domfeh

ABSTRACT

Due to perceived lack of time, people have resorted to participation in physical exercise once per week. The purpose of the study was to determine whether long duration aerobic exercise will have any effect on physiological and anthropometric health markers of a keep fit club members in Accra. A total of 64 respondents, 32 in each training group, were used for the analyses. A longitudinal data of 6 weeks intervals were collected on three different occasions to track the changes in the variables overtime and across groups. The MANOVA, correlational analysis and paired sample t-test were used for the inferential analyses. The results showed a relatively strong positive association between percent body fat and BMI; a moderate positive association was found between diastolic and systolic blood pressure. Exercise training was confirmed to be effective at improving participants' physiological and anthropometric variables irrespective of the type of exercise schedule. Continuous exercise improved most of the physiological variables more effectively than single exercise, although sex and age significantly moderate such effects. Males mostly responded to continuous exercise more than females, while females responded better to single training than males. Younger participants could improve their physiological variables with either multiple or single training exercises, but older participants benefited more from continuous training. The study recommends that the prescription of a training exercise for participants needs consideration of the client's sex and age for a more effective outcome on anthropometric measure improvements. Multiple training sessions are recommended for older participants, while OTT is ideal for female participants.

KEY WORDS

Aerobic Exercise

Anthropometric variable

Continuous Training Exercise

Exercise Scheduling

Long duration aerobic exercise or single or one time training

Physiological variable

Variables

ACKNOWLEDGEMENTS

I owe great gratitude to Prof. Daniel Apaak, my principal supervisor and mentor on this project. His direction and assistance were vital in finishing this project. Once again, I appreciate Prof. Charles Domfeh's help as my co-supervisor. I am thankful to my wife, Dorcas Osei Atikumi, for the support she gave me to complete the thesis. I am grateful to my parents, Mr. Manfred Kofi Kumi and Mrs. Gladys Abra Atikumi, for their advice. I am grateful to all my family members, especially my siblings, Stellah, Foster, Christine, Jeremiah, Evelyn and Rev. E. E. Attu, for their support. I appreciate everyone who helped me in any manner, shape, or form. I thank the manager of the Keep Fit Centre for permitting and assisting me to conduct the study at his keep fit centre. To my research assistants, thank you all. To the study participant, thank you for volunteering to be part of the study and making my third degree a reality.

DEDICATION

To my wife, Dorcas Osei Atikumi and Children, Jessica, Yaaneta, Yaanebla, Yaaniba Atikumi. And to the memory of my father Mr. Manfred Kofi Kumi.

TABLE OF CONTENTS

Page

DECLARATION ii

ABSTRACT iii

KEY WORDS iv

ACKNOWLEDGEMENTS v

DEDICATION vi

TABLE OF CONTENTS vii

LIST OF TABLES x

LIST OF FIGURES xii

LIST OF ACRONYM xv

CHAPTER

ONE: INTRODUCTION 1

Background to the Study 1

Statement of the Problem 11

Purpose of the Study 13

Hypothesis 13

Significance of the Study 14

Delimitations 15

Limitations 16

Definition of Terms 16
Organization of the Study 18
TWO: LITERATURE REVIEW 19
Definitions and Types of Physical Exercise 19
Aerobic Exercise 25
A brief history of the development of aerobic exercise 27
Types (Mode) of aerobic exercise 28
Aerobic / Aerobics dancing 30
Exercise Protocol Schedules of Aerobic Exercise 36
Effect of Aerobic Exercise on Physiological Variables 43
Theories of Exercise Participation 78
Conceptual Framework 83
Principles and Guidelines of Physical Exercise 86
Frequency of Aerobic (Cardiorespiratory Endurance) Exercise 89
Concept of Fitness and Fitness Club 94
Importance of Physical Fitness 96
Physiological Benefit 97
Reasons for not Exercising 104
Summary 106
THREE: RESEARCH METHODS 107
Research Design 107
Study Area 110
Population 110
Sampling Procedure 111
Data Collection Instrument 114
Data Collection Procedure 121
Data Processing and Analysis 125

FOUR: RESULTS AND DISCUSSION 131

Hypothesis 1: There are No Relationships among the Physiological and Anthropometric Health Markers after Aerobic Exercise Programme of a Keep Fit Club Members in Accra after 12 Weeks of Exercise. 131

Hypothesis 2: There will be No Significant Difference between the Effects of Long Duration and Trice Per Week Aerobic Exercise Programmes on Physiological and Anthropometric Health Markers of a Keep Fit Club Members in Accra after 12 Weeks of Exercise. 136

Hypothesis 3. There will be No Gender Differences on the Effect of a Single Duration and Multiple Session Exercise Programme on Physiological and Anthropometric Health Markers of a Keep Fit Club Members in Accra after 12 Weeks of Exercise. 170

Hypotheses 4: There will be No Age Differences on the Effect of Single duration and Multiple Session Exercise Programme on Physiological Health Markers of a Keep Fit Club Members in Accra after 12 Weeks of Exercise. 184

FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS 201

Summary 201

Main Findings 203

Conclusions 206

Recommendations 206

Suggestion for Further Studies 207

REFERENCES 207

APPENDICES 257

A ADULT PRE-EXERCISE SCREENING TOOL (COMPULSORY) 258

B FORM FOR MONITORING AND COLLECTING DATA 260

C ETHICAL CLEARANCE 262

D INTRODUCTORY LETTER 263

E APPLICATION LETTER FOR ETHICAL CLEARANCE 265

LIST OF TABLES

Table Page

1. "A". A 30 minute 12 week aerobic exercise workout schedule for a keepfit centre 37
2. "B". A 90 minute 12 week aerobic exercise workout schedule for a keepfit centre 40
3. Exercise and Data collection Time Table 124
4. Multivariate Normality Test Results using Doomik-Hansen and Mardian Skewness 129
5. Correlations among Physiological Variables in the Entire Sample Before 12 Weeks Organised Training 132
6. Correlations among Physiological Variables in the Entire Sample

after 12 Weeks of Organised Training 133

7. MANOVA Outputs of SBP Based on Training Schedule Groupings 139

8. MANOVA Outputs of DBP Based on Training Schedule Groupings 146

9. Paired sample t-test Results of Training Among Participants 151

10. MANOVA Outputs of HR based on Training Schedule Groupings 152

11. Margins Comparison between the CTT and OTT on HR 154

12. Paired sample t-test Results of Training among Participants 157

13. MANOVA Outputs of % Body-Fat based on Training Schedule Groupings 158

14. Margins Comparison between the CTT and OTT on %BF 160

15. Paired sample t-test Results of Training among Participants 165

16. MANOVA Outputs of BMI based on Training Schedule Groupings 166

17. Margins Comparison between the CTT and OTT on BMI 168

LIST OF FIGURES

Figure Page

1. Theory of Planned Behaviour (Ajzen, 1986) 81
2. Conceptual Framework 84
3. Mean Plot of SBP and Nature of Training Schedule 136
4. Mean Plot of SBP (percent) and Nature of Training Schedule 138
5. Margins Plot of SBP for each group for the first and second six weeks 140
6. Mean plot of DBP and Nature Training Schedule 143
7. Mean plot of DBP (percent) and Nature Training Schedule 145
8. Margins-plot of DBP for each group for the outcomes of sixth and twelve weeks. 147
9. Mean plot of participants HR (actual) for the three occasions 149
10. Mean plot of participants HR (percentage) for the three occasions 150
11. Margins-plot of HR for each group for the three measures 153
12. Mean plot of participants% Body-Fat (actual)

for the three occasions 155

13. Mean plot of participants' %BF for the three occasions 156

14. Margins-plot of % Body Fat for each group for the measures taken 159

15. Mean plot of participants BMI (actual) for the three occasions 163

16. Mean plot of participants' BMI (percent) for the three occasions 164

17. Margins-plot of BMI for each group for the six and twelve weeks 167

18. Mean plot of SBP over Gender and Exercise protocol 171

19. Mean plot of SBP (percent) over Gender and Training 172

20. Mean plot of DBP over Gender and Exercise protocol 173

21. Mean plot of DBP (percent) over Gender and Training 175

22. Mean plot of HR over Gender and Exercise protocol 176

23. Mean plot of percentage BF over Gender and Exercise protocol 178

24. Mean plot of %BF over gender and training 180

25. Mean plot of BMI over gender and exercise protocol 182

26. Mean plot of BMI (percent) over gender and training 183

27. Mean plot of SBP over age category and exercise protocol 185

28. Mean plot of SBP (percent) over age category and exercise protocol 187

29. Mean plot of DBP over age category and exercise protocol 189

30. Mean plot of DBP (percent) over age category and exercise protocol 191

31. Mean plot of HR over age category and exercise protocol 192

32. Mean plot of HR (percent) over age category and exercise protocol 194

33. Mean plot of %BF over age category and exercise protocol 196

34. Mean plot of %BF over age category and exercise protocol 197

35. Mean plot of BMI over age category and exercise protocol 198

LIST OF ACRONYMS

%BF: percent body fat

BMI: body mass index

CTT: continuouse training exercise

DBP: diastolic blood pressure

HR: heart rate

OTT: one time training exercise

SBP: systolic blood pressure

CHAPTER ONE

INTRODUCTION

Background to the Study

It is established that physical exercise is the most cost-effective public health preventive measure against diseases and a powerful auxiliary medicine in many cases (Naci & Loannidis, 2015). Approximately 60% of all deaths and 47% of the global burden of diseases were attributed to mortality, morbidity, and disability due to major non-communicable diseases in 2002, according to the World Health Report (World Health Organization, [WHO], 2010). By 2025, those percentages are projected to increase to 73% of all deaths and 60% of the global burden of diseases (WHO). Alarmed by these rising figures, a request was made from member states to develop a strategy that would help stop the increasing incidence of deaths and diseases. The 57th World Health Assembly (WHA), a branch of the WHO, established a Global Strategy on Diet, Physical Activity, and Health in 2004 to serve this purpose. Almost two years after the first request from member states, the strategy was produced after extensive consultations with all relevant parties (WHO, 2012).

The WHO established the overall purpose of the Global Strategy on Diet, Physical Activity, and Health as the promotion and protection of health through the development of an enabling environment for sustainable actions at the individual, community, national, and global levels. That way, the two can work together to improve people's eating habits and get them moving more often. This helped achieve the Millennium Development Goals set by the United Nations

(WHO, 2019). These were succeeded by the Sustainable Development Goals (United Nations Development Plan, 2015). There are four main objectives outlined to achieve the goal. These objectives are to lower the risk factors of non-communicable diseases brought on by poor diet and inactivity; increase public awareness of the benefits of diet and exercise for health; promote the creation, strengthening, and application of global, regional, national, and local policies and plans to improve diet and increase physical activity; and decrease the prevalence of unhealthy behaviours (WHO, 2019).

Each member state was then asked to formulate policies and programmes to help achieve the above-stated objectives. As part of the efforts to increase people participating in regular physical activity programmes, the United States of America launched “Active Aging, Quality of Life, and Physical Activity as Medicine” as well as the “Exercise is Medicine” initiative in 2007 (Cardinal, Park, Kim, & Cardinal, 2015). The “Exercise is Medicine” programme was co-launched by the “American Medical Association (AMA)” and “The American College of Sports Medicine (ACSM),” which has been coordinated by ACSM (United States Department of Health and Human Services [USDHHS], 2008; Berryman, 1995). The initial purpose of “Exercise is Medicine” was to make the scientifically proven benefits of physical activity the standard in the United States health care system (Berryman, 1995). The “Exercise is Medicine” initiative was made a global effort two years after its launch (Cardinal et al., 2015).

Internal public health, medical, and scientific association officials asked ACSM to broaden its focus to include countries outside the United States. The goal of the initiative was to have medical professionals evaluate their patients' levels of physical activity at each and every office visit to see if they comply with the United States National Physical Activity Guidelines, offer brief counselling to help patients get in shape for the guidelines, or refer them to other medical facilities or community organisations that could offer more extensive help (Tipton, 2014). Thus, creating an avenue aiming at getting many people to engage in regular physical exercise to get its full benefits. As a result, "Exercise is Medicine" emphasises encouraging individuals to become more physically active, which may be the most effective and least expensive therapy for enhancing health outcomes (Cardinal et al, 2015). For widespread adoption of physical activity assessments and exercise prescriptions for the prevention and treatment of disease, the American College of Sports Medicine (ACSM) is at the forefront with its "Exercise is Medicine" programme (Pratt, Epping, & Dietz, 2009).

Although the exercise is medicine initiative was intended to increase the number of people engaging and meeting recommended levels of regular physical activity, it turns out that the numbers were not increasing as expected. Most available global comparative estimates from 2010 indicate that worldwide, 81% of adolescents (aged 11 – 17 years) and 68% of adults (18+ years) do not meet the WHO global recommendation on physical activity for health (WHO, 2019). It is also worth noting that the rate of inactivity varies greatly from country to country, and in some adult subpopulations, it can be as high as 80% (WHO, 2021).

More than half of respondents (57.4%) did not participate in physical exercise when Wallace, Buckworth, Kirby, and Sherman (2010) examined the exercise rate in 15 European Union countries. Statistics from North America show that just 33.6% of adults in the United States exercise for 20 minutes or more on at least 5 days each week (USDHHS, 2012; Wallace et al., 2010). Research of a similar nature conducted in African countries found low rates of physical activity participation, though rates varied across populations. According to the WHO, just 6.9% of adults in Benin, Cote d'Ivoire, Cameroon, Ghana, Kenya, Nigeria, and Togo engage in regular physical activity. This number rises to 30.7% in Ghana, 20.5% in Kenya, 25.4% in Nigeria, and 19.6% in Togo (WHO, 2021).

Adulthood especially seems to be a very critical period for the decreased physical exercise level (Leslie, Fortheringham, Owen, & Banman, 2009). Opportunities for physical activity vary by gender, socioeconomic status, and country, all of which explain differences in the proportion of the population that engages in regular physical exercise (WHO, 2021). The public sector pays 57% of the total direct healthcare cost associated with physical inactivity, projected to be $54 billion. An additional $14 billion is related to lost productivity (Ding et al., 2016). Health care costs in high, low, and middle-income nations are estimated to be 2-3% higher due to a lack of physical activity (Bull, Goenka, Lambert, & Pratt, 2017). Adult inactivity rates are high across a range of populations and countries. The growth rates result from a confluence of factors, including a more robust economy, the impact of shifting mobility habits, the application of technology, the growth of cities, and shifting cultural norms and values (Sallis et al., 2016).

The over-dependence on machines for several activities and mediums of transportation has compounded the populace's health. To save time and energy, many people abandon pedestrian and bicycle transportation in favour of private motor vehicles, leading to increased inactivity (Li, Wang, Yang, & Ding, 2017; Woodward & Lindsay, 2010). In addition, built environments have also led to the burden of diseases and hindered free space for a natural walk. Security threats have also led many not to engage in regular physical activities such as walking and jogging. Road safety and personal safety issues have prevented people from other forms of mobility as they are being attacked (United Nations Conference on Housing and Sustainable Urban Development [Habitat III], 2016; WHO, 2022).

The world of technology, urbanisation, security threats, lack of space, affluence and decreased regular physical exercise due to sedentary jobs and lifestyles have increased morbidity and mortality (Dominic et al., 2019). Technological gadgets used for doing things have reduced the physical exertion of energy for the same activities over time. With urbanization, the physical activity level has decreased tremendously, with about 70% of the population in urban areas not attaining the recommended level of physical activity (Sallies et al., 2016). WHO (2012) set a target for the world to reduce the prevalence of insufficient regular physical activity by 10% by 2025, however a recent analysis of progress towards this goal found that progress has been slow and unequal among high, middle, and low-income nations (WHO, 2017). Given these numbers, there is no progress in encouraging more adults to engage in regular physical activity.

Broad policy suggestions to increase physical activity were offered to member states by the Noncommunicable Diseases (NCD) Global Action Plan

2013-2020. However, implementation and involvement with the necessary sectors outside of health have constituted a substantial hurdle in most countries (WHO, 2021). The worldwide trend of declining rates of regular physical exercise calls for fresh perspectives and strategies to encourage more people to get moving. The moment has come to build on prior pledges and hasten the realisation of increased involvement in regular physical exercise (WHO, 2018).

The World Health Organization member states meeting concluded that a strategic combination of policy responses is needed to effectively reverse the trends of inactivity and address inequities in opportunities to be physically active. These responses should be selected and implemented based on country content, carried out across key settings, and adapted to meet the needs of different subnational jurisdictions and populations. The member nations have asked the World Health Organization to improve communication and cooperation on a global, regional, and national level, and they have also called for a social movement and a paradigm shift in how people view physical activity (WHO, 2018). A worldwide action plan on physical activity for the years 2018–2030 was developed by the WHO based on the above. In April 2018, this was finalised to increase people's likelihood of engaging in regular physical activity (WHO, 2018a).

More active people for a healthier society is the goal of the Global Action Plan on Physical Activity 2018– 2030. All people must be provided with safe and enabling surroundings to realise the Global Action Plan on Physical Activity ambition. In addition, it should be made easier for people to engage in daily physical activity to boost health at all levels of society and aid in the world's economic, cultural, and political advancement (WHO, 2018).

The proposed global action plan aims to reduce the prevalence of physical inactivity among adults and adolescents worldwide by 15% relative to 2026. (WHO, 2018). In order to combat the many social, environmental, and personal factors that contribute to inactivity, the draft global action plan outlined a series of prioritised policy initiatives that member states might pursue in collaboration with other groups. It will be carried out according to the seven guiding principles. Among these include a focus on universality and evidence-based practice, a focus on equity across the lifespan, and a focus on proportionality. Cohesion and health in all policies, participation and agency, sectoral and cross-sectoral collaboration, and concerted effort to realise the 2030 agenda for sustainable development are the remaining ingredients (WHO, 2018). Regardless of age, all adults and seniors can continue to live an active lifestyle if they can access and take advantage of the opportunities and programmes most suited to them (WHO, 2011). Four primary goals and twenty policy initiatives are included in the draft global action plan. Detailed action plans are provided for each of the four goals (WHO, 2018).

Strategic objective 3 is to encourage and facilitate regular physical activity among people of all ages and abilities through developing and disseminating opportunities and programmes offered in various contexts. Measures have been mapped out to aid in accomplishing this aim. Strengthening the creation and delivery of programmes and services in a range of community contexts is one of the concrete steps toward achieving this strategic goal. The involvement should provide access to physical activity for the least active populations, including seniors while welcoming the constructive contributions of all individuals to promote healthy ageing (WHO, 2018). Increasing the benefits of physical activity participation and decreasing the risk associated with sedentary behaviour among adults requires developing and implementing evidence-based and acceptable programmes. The effectiveness of the programme is to help build health-related fitness to help support healthy aging and independent living. Developing an appropriate programme includes exercise guidelines to bring the desired benefits (Das & Horton, 2012).

Regular exercisers also have reduced rates of absenteeism and presenteeism at work, as well as lower medical costs and higher levels of productivity (Poobalan, Aucott, Clarke, & Smith, 2012). A study by Domfeh and Atikumi (2016); documented a moderate positive relationship between good health and physical exercise participation, especially in relation to the type of physical exercise and participation. These scientific findings highlight the relevance of targeted exercise (Estabrooks, Lee, & Gyursik, 2011).

To get the full benefits of exercise, it is appropriate to follow physical exercise guidelines. Exercise engagement considers four aspects: duration, frequency, intensity and mode. The term “exercise volume” refers to the sum of all aspects mentioned above. How often or how many times per week one commits to an exercise routine is the frequency of physical activity. It plays a significant role in fitness improvements from working out (Garbar, Blissmer, & Deschenes, 2011). Intensity is how strenuous the exercise is. The exercise capacity of an individual is classified as low, moderate and high intensity. Duration is how long the exercise is and is described as a measure of the time physical activity is performed (USDHHS, 2008). Finally, the exercise mode is the presentation format for a given exercise programme or movement structure (Thompson, 2007). In this case, the attainments of such full benefits of regular physical exercise of people who engage in it rest predominantly on the duration, frequency, intensity, and mode of the exercise referred to as volume.

The ACSM, the AHA, and the CDC refined physical activity recommendations for the general public during the past 40 years. From physical activity to public health consequences of obesity, the standards covered it all (USDHHS, 2010). Three prominent groups issued fitness and health guidelines or suggestions in the early to mid-1970s. The American Heart Association released "Exercise Testing and Training for Apparent Health: A Handbook for Physicians" in 1972. Starting three times a week, for 15 to 20 minutes, the recommended HR (HR) max was 75% (AHA, 2015). Similarly, "The Y's Way to Physical Fitness" was initially released by the YMCA in 1973. The recommended exercise regimen consisted of three weekly sessions of 40-45 minutes of work at 80% of one's VO_2 max (Armstrong, Brubaker, Whaley, & Otto, 2005). The first edition of "ACSM's Guidelines for Exercise Testing and Prescription" was released that same year. Three to five times a week, for 30 to 45 minutes, exercising at 70% to 90% of one's VO_2 max was recommended (ACMS, 2014). Higher-intensity exercise was emphasised in the scenarios mentioned above because of its positive effects on cardiorespiratory fitness and health outcomes.

There was a growing body of evidence in the 1980s linking regular exercise to a reduced risk of chronic disease. More study of the correlation between regular exercise and better health was required (Haskell et al., 2007). The American College of Sports Medicine and the Centre for Disease Control and Prevention issued a public health exercise recommendation in 1995. For individuals in the United States, they suggested at least 30 minutes of moderate-intensity physical activity on most or all weekdays. The importance of exercise volume (total kilocalories spent) over intensity was emphasised (Pate, Pratt, & Blair, 1995). The American College of Sports Medicine (ACSM) updates its Guidelines for Exercise Testing and Prescription every five years to account for the public health benefits of exercise (USDHHS,1996). It is clear from this quick journey through the history of exercise advice that guidelines alter throughout time as more is learned about the positive impacts of regular physical activity.

Currently, for health maintenance and development, an individual, especially an adult, is expected to participate in moderate-intensity, aerobic physical exercise for a minimum of 120 minutes or vigorous-intensity aerobic physical activity for a minimum of 50 minutes in a week (WHO, 2018). As a follow-up, the CDC and ACSM also issued a recommendation that to promote and maintain health, all adults aged 18 to 65 years need aerobic physical activity of moderate intensity of a minimum of 120 minutes five days a week and vigorous – intensity aerobic physical exercise for a minimum of 50 minutes on three days each week (ACSM, 2014).

Statement of the Problem

Despite the positive effects of physical exercise on health, it has not been very successful in helping individuals begin and maintain a physically active lifestyle. It has been documented that 68% of the population does not practice the recommended physical exercise (WHO, 2018). Not meeting the recommended level of physical exercise has been established as a risk factor for non-communicable diseases (WHO, 2021). In the United States of American, only about 33.6% of the adult population meets the current recommended level of exercise longer than 20 minutes three or more times per week (USDHHS, 2010). About 64% of the population in Africa does not meet the recommended level of physical exercise, while 66% of deaths in Africa are attributed to non-communicable diseases (WHO, 2021). In Ghana, about 60% of the population does not meet the recommended level of physical exercise, and of this figure, about 30% are obese (Ghana Health Service, 2015). This might have implications for high morbidity and mortality due to physical inactivity, a sedentary lifestyle, and non-communicable disease.

Several factors have been deduced to influence participation in physical exercise for health. Some factors include attitude, knowledge, workload, skills, motivation, social support, facilities, and equipment (Domfeh & Atikumi, 2016). Also, lack of available leisure time is often expressed as a primary barrier to physical exercise participation and a hindrance to meeting the required minimum level of physical exercise participation. In addition, physical exercise participation rates show a trend of decline throughout one's lifespan (Dishman, Heath, & Lee, 2013).

However, due to a perceived lack of time, people have resorted to engaging in physical exercise once per week and prolonging the duration, which is usually seen in the "weekend warrior" pattern of exercise, instead of the recommended three times per week of physical exercise (Troiano et al., 2020). The effectiveness of this type of intervention towards meeting the recommended volume of exercise could only be ascertained when driven by empirical research evidence hence this research.

Some studies have been conducted on low-intensity exercise in adults, demonstrating that low-intensity exercise can have some effect on the body (De Vito, Hernandez, Gonzalez, Felici, & Figura, 2010). Another study conducted on short-term, aerobic training among women indicated that short-term aerobic exercise was effective on women, but there was no comparison between men and women as well as long-term exercise (Katyal, Freeman, Miller, & Thomas, 2011).

A study also comparing short-term cardiorespiratory adaptation among children and adults showed that short-term exercise was more effective in adults than in children (Kriemler et al., 2014). Another study examining the effects of circuit resistance exercise on young adult women at various stages of their development found that varying intensities elicited distinct adaptations (Damuesh, 2015). Although such studies were conducted to compare the effects of different exercise intensities on different populations, none of these studies focused on how long-duration aerobic exercise will affect the physiological variables of adults, especially among the Ghanaian population where the "weekend warrior" pattern of exercise is practiced, mostly by keep fit club members. From the review of the literature, it was noticed that the previous studies done (Damuesh, 2015; Kriemler et al., 2014; Katyal et al., 2011; De Vito et al., 2010) were without a control group which this study introduced. There was, therefore, the need to conduct this study to fill the gaps in the literature identified.

Purpose of the Study

The purpose of the study was to determine whether long-duration aerobic exercise will have any effect on physiological and anthropometric health markers of a keep fit club members in Accra.

Hypotheses

1. There are no relationships among the physiological and anthropometric health markers after aerobic exercise programme of a keep fit club members in Accra after 12 weeks of exercising.
2. There will be no significant difference between the effects of long-duration and thrice per week aerobic exercise programmes on selected physiological and anthropometric health markers of a keep fit club members in Accra after 12 weeks of exercising.
3. There will be no gender differences on the effect of long duration and thrice per week aerobic exercise programmes on selected physiological and anthropometric health markers of a keep fit club members in Accra after 12 weeks of exercising.

4. There will be no age differences on the effect of long duration and thrice per week aerobic exercise programme on selected physiological and anthropometric health markers of a keep fit club members in Accra after 12 weeks of exercising.

Significance of the Study

This research is of great significance in sports science, education, health, sports and the economy of our dynamic society of Accra. The findinds is beneficial to coaches, physical fitness specialists, health professionals as well keep fit club members in Accra, Ghana, who are interested in aerobic exercise programmes with the knowledge and skills required to successfully design such programmes with the feedback showing whether long duration exercise programmes are effective or not.

Students and professionals in Accra, Ghana studying exercise and sport science, physical and health educators, and related fields, especially those who will do an internship or practicum at the selected keep fit club, will find this research useful when developing aerobic exercise programmes for their clients. The findings will help keep fit club members in Accra, Ghana, make informed decisions on fitness, health and exercise programme design. Members of the the keep fit club who make educated decisions will improve their health and fitness, as well as their families and communities.

Physical and health educators in similar situations could benefit from the study by gaining a better grasp of aerobic exercise programmes. By this study, teachers, fitness instructors, coaches, exercise and sport science specialists in

Keep Fit Clubs in Accra, Ghana, would come up with easier and more effective programmes based on gender and age to improve health and fitness for people who have tight schedules and are not able to participate in regular exercise for the recommended frequency. There is limited literature exploring long-duration aerobic exercise in Accra. Additionally, there is limited available literature on the long-duration aerobic exercise programme at the selected Keep Fit Club in Accra, Ghana. Hence this study has produced information that will serve as the basis for similar facilities in Accra, specifically on keep fit club members participation in long-duration aerobic exercise.

Delimitations

The study was conducted among adults between the ages of 25 to 45 years who are Gymike keep fit club members in Accra because accessibility to participants is key to quasi-experimental studies of this nature, and the exercise protocol used was for this category of people. In addition, these participants are organized and have leadership that keeps records of the participants. The study was delimited using a pretest-posttest design to explore the effects of long-duration exercise on physiological variables. It was further delimited to using stopwatches, blood pressure monitors, electronic weighing scales, meter rules, and standard tailors measuring tape as data collection tools. In addition, means, standard deviation, t-test and MANOVA were statistical tools used for the data analysis. The research was also delimited to the effects of long-duration and continuous aerobic exercise on resting blood pressure, percent body fat, HR, and BMI, which are considered health markers. The study occurred in and around an actual fitness centre, providing indoor and outdoor training environments. The training before post-experimental data collection lasted for twelve weeks.

Limitations

Physiological and anthropometric health markers of an individual are not determined by exercise alone. The researcher had no control over their diet since they all lived in various homes and planned their menu. Diet affects some physiological variables, and that may have affected the results. Apart from diet, other factors such as where participants live, their occupation, or physical activity level, which could affect the results, were not considered in the research. The result may be affected by the variables mentioned above by the influence on human health. The groups were intact or in place before the study; therefore, the base variables were not identical from the beginning of this study. These limitations of diet, occupation and physical activity will affect the generalizability of the finding beyond the sample.

Definition of Terms

Adults: Individuals between the ages of 31 and 40 years.

Aerobic Exercise: Workouts that require oxygen to produce the necessary energy to improve the efficiency of the respiratory and cardiovascular systems to produce healthy heart and lungs for working muscles.

Aerobics /Group Aerobics Exercise Classes: This aerobic activity typically follows the instructor's prompts to step rapidly in sync with music. The aerobic dance consists of various dance-based workout routines set to upbeat musical accompaniment

Antropometric indices: Health markers that defines physical measures of a persons size, forms and functional capacity such as percent body fat and BMI (Astrand, Rodahl, Dahl & Stromme, 2003).

Continuous Time Training (CTT) or multiple sessions is a 90minutes exercise programme performed 30minutes, three times in a week. .

Gymike Keepfit Club Members: All those who registered at the centre

Long Duration Exercise or single or One Time Training (OTT) exercise or once per week exercise: This is a 90 minutes exercise programme done as a single session in a day.

Protocol: exercise design

Physiological variables: are health markers in relation to the normal functioning of an individual body (Astrand, Rodahl, Dahl & Stromme, 2003).

"Weekend warrior" pattern of exercise: participating in once a week exercise programme especially on weekends and staying long (about 150minutes) in the exercise.

Youth: Individual between the ages of 20 and 30 years.

Organization of the Study

This study was organised under five separate chapters, one, two, three, four and five. Chapter one laid the background for the study and provided the statement of the problem, the purpose of the study and the hypothesis. Moreover, it defined key concepts and explained the study's limiting factors and defining scope. Chapter Two consists of a literature survey of the relevant works. It took a critical look at the concept of aerobic exercise, basic principles and guidelines of physical exercise, effects of aerobic exercise on physiological variables and cardiorespiratory fitness, factors affecting exercise participation, theories on exercise participation promotion, and conceptual framework. The plan for this research was provided in chapter three. This chapter involved the design, including the philosophical approach underpinning the study, population and sample descriptions, data collection instrument with its validity and reliability indices, data collection procedures, and end with statements about how data was processed and analyzed. Chapter four presented the results of the analyses and the discussions thereof, while chapter five covered a summary, the main findings, conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW

The purpose of the study was to determine whether long-duration and thrice per week aerobic exercise will have any effect on physiological and anthropometric health markers of a Keep Fit Club Members in Accra. A summary of the relevant literature that served as the study's foundation is provided here. Following are some of the headings used in the literature review:

1. Definitions and Types of Physical Exercise
2. Aerobic Exercise
3. Effects of Aerobic Exercise on Physiological Variables
4. Theories on Exercise Participation
5. Principles and Guidelines of Physical Exercise
6. Concept of Fitness and Fitness Clubs
7. Importance of Physical Exercise
8. Reasons for Not Exercising
9. Conceptual Framework
10. Summary.

Definitions and Types of Physical Exercises

WHO (2018) defines physical exercise as a physical activity that is planned, structured and competitive for conditioning any part of the body. This enables the body to be active so that it can always be ready for an activity. In addition, physical exercise is a leisure activity conducted to develop physical fitness (Bouchard & Shepherd, 1994). The United States Department of Health and Human Services (1996) agreed, describing physical exercise as "leisure-time physical activity that is planned, structured, and conducted regularly to acquire, improve, or maintain one or more components of physical fitness." Similarly, physical activity refers to any skeletal-muscle-generated movement resulting in oxygen consumption, increased metabolic rate, and other health advantages (Hoeger & Hoeger, 2009).

Types of Physical Exercise

A wide range of biological demands are placed on the body during exercise, and these demands can be roughly categorised by the repetitions, intensity, and speed of the exercise (Edington & Edgerton, 1996). The appropriateness of a certain form of exercise can only be grasped through an in-depth familiarity with the activity's unique molecular effects and its systemic and biomechanical consequences. According to the Consumers Union (2000), the health benefits of various types of exercise vary. Therefore, it is essential to engage in different exercises to gain the most benefits that impact differently on the various systems in the body. According to Howley (2001), there are three types of physical exercise: aerobic, strength or weight training, and stretching or flexibility and can also be classified as aerobic, resistance, flexibility, and neuromotor exercises. Martins (2012) also classified physical exercise into four categories, namely, aerobic or cardiovascular, strength or resistance, flexibility, and balance and coordination.

For this study, the types of physical exercises are limited to aerobic or cardiorespiratory, resistance or strength, flexibility or stretching, and neuromotor.

The term “sports exercise” refers to physical activity that is part of a planned, structured programme that may or may not include elements of competition. For this reason, sports are often categorised as a form of physical activity (Gilson, Cooke, & Mahoney, 2005).

Resistance or strength exercise

McMillan (2001) defined strength or resistance exercise as an exercise aiming to develop strength in the body. Strength exercises are of higher intensity than aerobic exercises. This is done by increasing stress on muscle groups over a while. The resistance loading is progressive and gradual. Rhea, Alvar, Burkett, and Ball (2003) suggested that caution should be taken when prescribing sets of resistance training to those who have not been training consistently for at least one year. The progressive overload principle should be adhered to by changing the exercise programme in various ways. These include a change in the weight of the lifting object, exercises performed, the order in which they are performed, the number of sets or repetitions, and the amount of recovery time taken between exercises (Hunter, McCarthy, & Bamman, 2004).

A regular resistance training programme helps strengthen bones by increasing bone mass index, improving balance, and increasing major skeletal muscle strength in participants (Vincent et al., 2002). Increased strength from resistance training may encourage sedentary overweight and obese people to become more physically active, which, according to the American College of Sports Medicine (2003), has a number of potential health benefits, including the prevention of weight, and regaining after weight loss. Bryner et al. (1999) in their review found that resistance exercise may aid in keeping lean body mass and resting energy expenditure normal during weight loss, even when following a calorie deficit of 800 per day.

Strength training, in general, can easily be done at home with minimum time (McMillan, 2001). Activities like chin-ups, chest-press, seated row push-ups, over-head shoulder presses, and one-legged stances are upper-body exercises that can help build muscle mass. Lower-body strength exercises include dumbbell squats, seated hamstring curls, lunges, step-ups, prone hamstring curls, calf presses, and toe pulls (McMillan, 2000). Even though strength exercise contributes significantly to participants' health, many people do not see it as their priority (Rhea, 2004). Others see this type of exercise as an exercise that makes them put on weight, therefore, shunning away from strength exercise (Kraemer & Fleck, 2007). It is best to space out your workouts throughout the week. Weight training for 30 minutes per day is recommended by the CDC (2008) to improve muscle and bone density. Those not in danger should engage in resistance training at a moderate to intense level.

Flexibility exercise (stretching)

Flexibility exercises can improve joint range of motion or flexibility across all age groups (Garber et al., 2011; Nelson, Rejeski, & Blair, 2007). Flexibility exercises have the added benefit of increasing a joint's range of motion almost instantly. After 3-4 weeks of stretching at least twice a week, one may notice a lasting change (Winters, Blake, & Trost, 2004).

When paired with weight training, flexibility exercises have been shown to further boost postural stability and balance (Garber et al., 2011). Musculotendinous injuries, low back pain, and muscle soreness may all be mitigated or prevented with consistent flexibility training (Sharman, Cresswell, & Riek, 2006). Warming up the muscles with active movement or passively using treatments like wet heat packs or hot baths maximises the benefits of flexibility training. This benefit may, however, not be uniform among muscle-tendon units (Winters et al., 2004). There may be a temporary drop in muscle strength, power, and performance immediately following flexibility activities like stretching (Garber et al., 2011; McHugh & Cosgrave, 2010). Flexibility training can be a part of a comprehensive fitness regimen, performed after other forms of exercise like cardio and strength training, or it can be done independently (Woolstenhulme, Griffiths, Woolstenhulme, & Parcell, 2006).

Numerous stretching methods exist. When stretching, exerciser should focus on the major tendon units in the shoulders, chest, neck, trunk, lower back, ankles, hips, and posterior and anterior legs (Utter et al., 2004). Adults may benefit from ballistic stretching if performed correctly, especially for those who participate in sports requiring rapid, bouncing motions, such as basketball (Woolstenhulme et al., 2006). Static stretching with a partner, as practiced in proprioceptive neuromuscular facilitation (PNF), is more effective than dynamic or gradual stretching at an increasing range of motion around a joint (Garber et al., 2011). Contracting a muscle or group of muscles isometrically and then holding that contraction while stretching the same muscles or groups of tendons is the basis of PNF procedures. A "bouncing" stretch is performed using the forward motion of a body part to create the stretch, hence the name (McMillian, Moore, Hatler, & Taylor, 2006; Woolstenhulme et al., 2006).

Flexibility training should be done frequently and for an extended period to achieve maximum benefits. The joint range of motion is improved by stretching for 10-30 seconds to the point of tightness or minor discomfort. Except for the elderly, maintaining strength for longer time duration does not appear to have any added benefit. Better flexibility gains may be achieved in the elderly by stretching for the 30s to 60s instead of shorter durations (Rees, Murphy, Watsford, McLachlan, & Coutts, 2007; Sharman et al al., 2006). All ages benefit from performing PNF stretches, which consist of a 3- to 6-second light-to-moderate contraction (20% to 75% of maximum voluntary contraction) followed by a 10- to 30-second aided stretch. It is also suggested that each flexibility exercise be performed two to four times for a cumulative total of sixty seconds of stretching. Two 30-second stretches or four 15-second stretches will get an exerciser to the target of 60 seconds of stretch time. The best results from stretching exercises can be achieved daily, but even doing them twice a week will help increase flexibility and range of motion. Most people can do a stretching programme according to these instructions in under ten minutes (Winters et al., 2004).

Neuromotor exercise

Functional fitness training can also be considered neuromotor exercise training because it focuses on developing motor abilities, including balance, coordination, gait, agility, and proprioception (Sharman et al al., 2006). Yoga is one example of a multidimensional physical activity that incorporates neuromotor exercise, resistance training, and flexibility training. The advantages of neuromotor fitness training for the elderly are clear. Neuromotor exercise training has been shown to increase older individuals' balance, agility, and muscle strength, as well as decrease their risk of falls and fear of falling (WHO, 2013; Garber et al., 2011; Nelson et al., 2007). Some research suggests that improving balance and agility through training will lessen the likelihood of athletic injury, but this research is limited to older persons. This may benefit those whose chosen physical pursuits demand quick reactions and the use of various motor abilities (Sharman et al al., 2006). Adults of all ages lack information about the most beneficial combinations of neuromotor exercise, exercise intensity, and training schedules. In order to reap the benefits of neuromotor exercise, it is recommended that an individual engages in training two to three times per week for a total of sixty minutes of activity per week (Garber et al., 2011; Nelson, Rejeski, & Blair, 2007).

Aerobic Exercise

Aerobic or cardiovascular exercise refers to any repetitive, fair and low-intensity exercise involving large muscle groups with the help of air (Martins, 2012). Aerobic exercise improves the cardiovascular system's capacity to provide oxygen to the working muscles. Aerobic exercise enhances the body's ability to provide and utilise essential oxygen for life. Mercer (2011) noted that aerobic exercise positively affects cardiovascular and respiratory health, stamina, fat loss, and blood flow. Mercer chimed in, saying that consistent exercise throughout a long enough period would benefit the heart. It has been shown that aerobic exercise aids in calorie expenditure, as stated by Poehleman and Melby (1998) and Davis et al., (2007) They also mentioned that aerobic exercise's major role in weight loss programmes is to boost energy expenditure and help tip the caloric equation in favour of energy output over energy input.

Focht and Hausenblas (2001) demonstrated that aerobic exercise reduces anxiety and increases calmness. The study also linked aerobic exercise to greater feelings of positivity and energy. Berger and Motl (2001) found that rhythmic, repeated activity, like walking and running, promotes introspective and creative thought while engaging the body. By diverting one's thoughts in this way, one might avoid ruminating on the things that would otherwise upset one's disposition. Again, referencing Berger and Motl, we know that moderately intense exercise of at least 20 minutes in length is recommended (two to three times per week). Aerobic exercises include walking, jogging, running, bicycling, stair climbing, treadmill walking, dancing, swimming, and skipping rope (McMillan, 2001).

Popular forms of aerobic training often entail following an instructor's prompts to do a series of quick stepping patterns to upbeat music. There are two primary categories of group aerobic exercise: freestyle or pre-choreographed aerobics and aerobic dance. The aerobic dance consists of various dance-based workout routines set to upbeat musical accompaniment (Hoeger & Hoeger, 2009).

A brief history of the development of aerobic exercise

A cardiologist at the San Antonio Air Force Hospital in Texas named Dr. Kenneth Cooper developed an exercise regimen that reduced the risk of heart disease. The term he coined for this setup was “aerobic” (Cooper Institute, 2007). This gave people a new way of talking about and thinking about exercise worldwide. The original intent of the activities was to improve astronauts’ fitness. Later, it became clear that the general public might benefit from these same workouts. Aerobics encompasses various practices, from dance to step aerobics (Cooper Institute, 2007).

Jacki Sorenson is credited with starting this massive fitness trend since she put the first aerobic training style established by Cooper to music (Monroe, 2007). Consequently, the field of aerobic dance emerged. Over time, it has morphed into various classes offered at gyms worldwide. Cooper laid the groundwork for the various aerobic exercise modalities, and now a worldwide industry is devoted to a particular exercise method with set routines and goals. Because of his work in preventative medicine, millions of people began exercising. Aerobic exercise evolved into various formats and styles, using novel tools to elevate the participant’s experience.

Types (Modes) of aerobic exercise

To enhance cardiorespiratory fitness, there is the need to do rhythmic, aerobic activities that focus on using big muscle groups (Garber et al., 2011). The modes of physical activity that improve and maintain cardiorespiratory fitness are classified as groups A, B, C, and D (Bassett et al., 2010). The principle of specificity of training must be kept in mind when selecting exercise modalities to be included in the exercise prescription. According to the concept of specificity, different types of exercise elicit different sets of physiological responses (Bassett et al.,).

Cardiorespiratory endurance training can be broken down into subsets defined by the difficulty and expertise required (Armstrong et al., 2005). Type A activities are appropriate for people of all fitness levels because they do not demand much expertise from the participant and can be easily adjusted to meet the needs of various fitness levels. Walking, riding slowly, aqua-aerobics, and slow dancing are all great examples. Exercises of the Type B variety are performed at a high intensity and are appropriate for people who are at least moderately fit and have been working out consistently. Cardiovascular exercises include jogging, running, rowing, aerobics, elliptical training, stepping, and fast dance. It is recommended that those with reasonably developed motor skills and physical fitness practise Type C exercises, as they demand competence. Skating and swimming are just two examples. Type D activities include recreational sports that can boost fitness but are best done as a supplement to the suggested conditioning activities. Physical activities classified as Type D should only be attempted by those with the necessary motor skills and degree of fitness to safely complete the activity, while many sports can be adapted for those with fewer capabilities. Sports such as racquetball, basketball, soccer, skiing, and hiking are all good examples.

Studies show that the most energy is used during weight-bearing aerobic exercise performed at a level of difficulty that the individual chooses since there is a wide variety of aerobic exercises and tools available, many people who like to exercise now cross-train (Kravtiz & Vella, 2002).

Various forms of physical activity are described in the following paragraphs. The researcher has compiled a list of common forms of exercise that may be found in most modern gyms. Included in this structure are the following details on a specific form of physical activity: its formal name or type, the required skill level for participation, and a literature study of the exercise mode. The exercise mode's name or type, along with a brief description of the mode's primary focus and the exercise covered in the gym, make up the exercise's mood. Exercise participants are advised to have the appropriate level of knowledge for the exercise indicated by the participation level indicator (Beginner, Intermediate, Advanced). To review an exercise modality, one must look at the literature that has been published on the topic and identify the unique benefits and contributions of the mode in question.

Aerobics / aerobic dancing

It is a type of aerobic workout that ranges from light to vigorous, depending on the intensity of ones motions to the beat of the music. The exercise concentrates on cardio-based training for strength and stamina in the major muscle groups. Traditional aerobic exercises are combined with modern variations to provide a full-body fitness programme. To enhance mobility at the joints and promote overall flexibility, there is the need to incorporate a stretching component. This is a great workout for all skill levels. In 1972, Jacki Sorensen pioneered the genre of group aerobic exercise known as aerobic dancing by creating a series of strenuous dance sequences set to music. Aerobic dancing workouts have given rise to a plethora of dance forms (Bishop, 2002).

Long-term weight loss and healthy energy expenditure maintenance is due to efficient use of energy from fatty acids stored in the body during aerobic exercise in obese people. Therefore making it possible to reduced obesity in individuals exercisers (Ashutosh, Menthotra, & Fragale-Jackson, 1997). It also raises upbeat emotions and lowers downbeat ones (Bartholomew & Miller, 2002). In many parts of the world, aerobics and aerobic dancing are the gold standards for getting women in shape. These exercises are enjoyable and highly effective in improving cardiorespiratory fitness. Injuries sustained when participating in aerobics are quite common, but unfortunately, high-impact aerobics is the leading cause of such injuries (Hoeger & Hoeger, 2009).

Aerobics (Low impact)

Movement routines set to moderately tempo music is called exercises and facilitate expansive arm, body, and leg motions. Individuals can readily adapt their exercise routines to their current fitness levels. This exercise was developed to give participants the benefits of aerobic exercise without the associated dangers. When doing low-impact aerobics, one uses many muscle groups in a rhythmic, continuous motion while keeping at least one foot planted firmly on the ground at all times. If one have not exercised but want to start an aerobics programme, this is a great way to get started (Indianetzone, 2008b).

The simple-to-follow workouts and body conditioning routines are designed to strengthen and tone all the major muscle groups. When there is the need to talk about low-impact exercise, it refers to a type of workout designed to minimise or eliminate the force with which the body strikes the ground. To further enhance mobility, a stretching element is used. Ability levels range from novice to expert. When the music stands still, participants can raise their HR by moving their arms (Bishop, 2002). Functional capacity in women has been greatly improved with regular attendance at an appropriately intense, length, and timing recreational aerobic exercise class (Pantelic et al., 2007).

Because of the success of aerobic dancing courses, other forms of aerobic exercise have emerged. These adapted forms are now widely used. Aero-step, sports aerobics, cardio-tone, and aero-skip are just a few examples of the many hybrid class formats offered at these facilities.

Aero-step

Aero-step is a type of group exercise that fuses the routines of traditional aerobics and step with the accompaniment of choreographed dance routines. The exercise primary goals are to increase cardiovascular fitness and strengthen the lower body (legs and buttocks). Traditional aerobic dance moves and step combinations, both on and off the bench/step, make for a fun and novel alternative to the more standard classes while posing a fresh physical and mental challenge to the participant. Various arm, body, leg, and footwork routines achieve complete body training. The group stretching component helps exercise participants become more mobile and adaptable. Any skill level is welcome, from novice to expert. Gin Miller is credited with creating and popularising step aerobics in the late 1980s. She worked with Reebok to develop their Step Reebok fitness plan. With step aerobics, various patterns of stepping on and off a bench is done, the height of which is modified for different users (Bishop, 2002).

Bench/step training is frequently used because of the widespread belief that it enhances many aspects of physical fitness, particularly extremely muscular fitness and body composition (Engels, Currie, Luek, & Wirth, 2002). Directional adjustments in the basic step actions, along with typical high and low-impact choreography of movements, make for a fantastic strength and cardiovascular improvement workout (Virgin Active, 2004). In terms of the magnitude of its effects, step aerobics falls into the “high intensity” category. Those who have issues with their ankles, knees, or hips may be harmed by this activity even though they have at least one foot firmly planted on the ground or a seat (Hoeger & Hoeger, 2009).

Dance dynamics

Aerobic exercise classes use dance-like motions and other dance and exercise genres for added enjoyment. It is a highly efficient workout where dancing is the lesson's main focus. Classes like these are great for increasing one's fitness level and enhancing one's ability to express themselves through movement. Flexibility is improved, and the joint range of motion is expanded by including a stretching component. People of all skill levels are welcome to join in. Furthermore, dance and related movements are very effective in accomplishing a wide range of goals, including but not limited to stimulating the physical body, expanding the participant's imagination, relieving stress, enhancing coordination, and fostering the growth of a positive self-image (Kavanaugh, 1995).

Since dancing is about letting go and moving to the beat, everyone can do it. Every civilization throughout history has shared the joy of dance. This dance exercise style is one of the best options to get in shape healthily. It builds up the abdominal, back, and glutes muscles for a solid core (King, 2007).

Jogging

Jogging is a common kind of aerobic exercise. Jogging can be done in various settings, including on a treadmill or track indoors or in the open air. It is a simple and easy approach to getting in shape. The flexibility of muscles and joints is enhanced when a stretching session is performed at the end of a running session. Those at any stage of their learning journey, from beginners to experts, are welcome to join. One of the quickest strategies to boost cardiorespiratory fitness is to go for a jog three to five times a week. However, there is a higher danger of damage for novices than when walking (Hoeger & Hoeger, 2009).

When comparing running with walking from the perspective of caloric expenditure, running wins because of the higher intensity of the exercise. The extra effort improves energy output but also raises the danger of hurting yourself on your feet, ankles, knees, or back (Kravitz & Vella, 2002). Aerobic exercise with a low risk of injury, typically done on a step or bench, to music. Lower body workouts, including those for the legs and buttocks, are emphasised to enhance physical strength and endurance in those areas (La Torre et al., 2005; Sutherland, Wilson, Aitchison, & Grant, 1999).

Walking

Walking is one of the most accessible forms of aerobic exercise since it can be done almost anywhere at any time with minimal equipment and no risk of injury. It can be performed in various settings, including on a treadmill, in an indoor circuit, and in the great outdoors. It is possible to add strain to the act of walking by quickening the pace, swaying the arm, or keeping the upper body rigidly erect. Adding a stretching session at the end of the walking period is crucial to boost overall flexibility and joint range of motion. When practicing stretches, it is important to pay extra attention to the legs. Performers of all skill levels are welcome. This type of workout is common since it does not cost much, is easy on the wallet, and is safe for just about everybody. For whatever reason, this is one of the most commonly reported female behaviours. This exercise method has been shown to reduce the risk of heart attack and other coronary events. The risk of developing type 2 diabetes is also reduced in those who regularly engage in moderate-to-vigorous walking. Brisk or quick walking can help an individual reach a moderate fitness level linked to a lower risk of dying from any cause (Hardman, 2001).

Some people wear hand weights to burn more calories when on foot. While this may make the workout feel harder, studies show that it does nothing to boost energy expenditure (Kravitz & Vella, 2002). Increased energy expenditure and reduced stress levels last up to two hours after a brisk 10-minute walk (Bartholomew & Miller, 2002). Millions of people worldwide like walking as a form of exercise since it is one of the most accessible, affordable, and sustainable ways to stay fit. Evidence suggests that walking at a pace of 6.4 kilometres per hour or higher positively affects cardiorespiratory fitness. Consistent walking has considerably increased longevity (Hoeger & Hoeger, 2009).

Weight workout

This is a musically-guided, low-impact group exercise class. Common exercises involving the use of a solid bar and free weights of varying sizes is covered in this group. The exercise programme enhances cardiovascular fitness, general flexibility, and joint range of motion by exercising all the body's major muscle groups. To achieve the last two objectives, a stretching session is included. It is a group exercise that combines the scientific principles of resistance training with the fun atmosphere of aerobics (Virgin Active, 2004). When it comes to preserving bone health and warding off osteoporosis, strength training is an essential tool. These workouts should be performed at least, twice weekly and contain 8-10 strength training activities. People with type 2 diabetes have better glucose control when they engage in resistance training, whether alone or in conjunction with other aerobic exercises (Vincent et al., 2002).

Exercise Protocol Schedules of Aerobic Exercise

In this exercise protocol which the researcher developed and used for the study, there are two different schedules namely "A" and "B". A is an exercise protocol schedule for three time per week aerobic exercise programme also known as Continuous Training exercise. "B" on the other hand is an exercise protocol where exercise is done 90 minutes in a day. It is also referred to as long duration exercise or one time training in this study.

Summary of exercise protocol "A"

Exercise type	:	Aerobics
Programme Duration	:	12 Weeks
Frequency Per Day	:	3 Days in a week
Target Gender	:	Male and Female (20 – 40 Years)
Workout Level	:	Beginners to Intermediate
Daily workout Duration	:	30 Minutes
Programme Goal	:	Enhance physiological and Anthropometric Health markers

Table 1: (A) A 30 minutes, 12 weeks aerobic exercise workout schedule for a keep fit center

WEEK 1	WEEK 2	WEEK 3
Monday (Cardio)	*Monday (Cardio)*	*Monday (Cardio)*
Exercise Duration Rest	**Exercise Duration Rest**	**Exercise Duration Rest**
Treadmill 10 Minutes 2 Minutes Stationary Bicycling 5 Minutes 2 Minutes Jumping Jacks 5 Minutes 2 Minutes	Shuffle Woodchop 10 Minutes 2 Minutes Jumping Rope 10 Minutes 2 Minutes Jabs uppercuts 5 Minutes	Plyometric Cardio 25 Minutes
Wednesday (Strength)	*Wednesday (Strength)*	*Wednesday (Strength)*
Exercise Dur/Rep Rest	**Exercise Dur/Rep Rest**	**Exercise Dur/Rep Rest**
Rowing 15x3 2 Mins. Front lateral Pulldown 13x2 2 Mins. Rock Pull 12x3 2 Mins. Side Lunge 12x3 2 Mins.	Barbell Push Press 10x3 2 Mins. Barbell Squat 10x3 2 Mins. One-arm Dumbell Row 10x3 2 Mins Cable face pull 12x3 2 Mins.	Push up 15x3 3 Mins. Leg Press 15x3 3 Mins. Lunges 15x3 3 Mins. Hip Trust 15x3 3 Mins.
Friday (Cardio)	*Friday (Cardio)*	*Friday (Cardio)*
Exercise Dur/Rep Rest Aerobics 25 Mins.	**Exercise Dur/Rep Rest** Sport jogging 15 Mins. 2 Mins. Scissors jump 10 Mins.	**Exercise Dur/Rep Rest** Bodyweight Cardio 25 Mins. 2 Mins. Burpee + tuck + squat + Step crossover + Knee to elbow, repeat until 25 minutes
WEEK 4	**WEEK 5**	**WEEK 6**
Monday (Cardio)	Monday (Cardio)	Monday (Cardio)
Exercise Duration Rest	**Exercise Duration Rest**	**Exercise Duration Rest**
Treadmill 10 Minutes 2 Minutes Stationary Bicycling 5 Minutes 2 Minutes Jumping Jacks 5 Minutes 2 Minutes	Shuffle Woodchop 10 Minutes 2 Minutes Jumping Rope 10 Minutes 2 Minutes Jabs uppercuts 5 Minutes	Plyometric Cardio 25 Minutes

Wednesday (Strength)	*Wednesday (Strength)*	*Wednesday (Strength)*
Exercise Dur/Rep Rest	**Exercise Dur/Rep Rest**	**Exercise Dur/Rep Rest**
Rowing 15x3 2 Mins. Front lateral Pulldown 13x2 2 Mins. Rock Pull 12x3 2 Mins. Side Lunge 12x3 2 Mins.	Barbell Push Press 10x3 2 Mins. Barbell Squat 10x3 2 Mins. One-arm Dumbell Row 10x3 2 Mins Cable face pull 12x3 2 Mins.	Push up 15x3 3 Mins. Leg Press 15x3 3 Mins. Lunges 15x3 3 Mins. Hip Trust 15x3 3 Mins.
Friday (Cardio)	*Friday (Cardio)*	*Friday (Cardio)*
Exercise Dur/Rep Rest	**Exercise Dur/Rep Rest**	**Exercise Dur/Rep Rest**
Aerobics 25 Mins.	Sport jogging 15 Mins. 2 Mins. Scissors jump 10 Mins.	Bodyweight Cardio 25 Mins. 2 Mins. Burpee + tuck + squat + Step crossover + Knee to elbow, repeat until 25 minutes
WEEK 7	**WEEK 8**	**WEEK 9**
Monday (Cardio)	*Monday (Cardio)*	*Monday (Cardio)*
Exercise Duration Rest	**Exercise Duration Rest**	**Exercise Duration Rest**
Treadmill 10 Minutes 2 Minutes Stationary Bicycling 5 Minutes 2 Minutes Jumping Jacks 5 Minutes 2 Minutes	Shuffle Woodchop 10 Minutes 2 Minutes Jumping Rope 10 Minutes 2 Minutes Jabs uppercuts 5 Minutes	Plyometric Cardio 25 Minutes
Wednesday (Strength)	*Wednesday (Strength)*	*Wednesday (Strength)*
Exercise Dur/Rep Rest	**Exercise Dur/Rep Rest**	**Exercise Dur/Rep Rest**
Rowing 15x3 2 Mins. Front lateral Pulldown 13x2 2 Mins. Rock Pull 12x3 2 Mins. Side Lunge 12x3 2 Mins.	Barbell Push Press 10x3 2 Mins. Barbell Squat 10x3 2 Mins. One-arm Dumbell Row 10x3 2 Mins Cable face pull 12x3 2 Mins.	Push up 15x3 3 Mins. Leg Press 15x3 3 Mins. Lunges 15x3 3 Mins. Hip Trust 15x3 3 Mins.
Friday (Cardio)	*Friday (Cardio)*	*Friday (Cardio)*
Exercise Dur/Rep	**Exercise Dur/Rep**	**Exercise Dur/Rep**

Rest Aerobics 25 Mins.	**Rest** Sport jogging 15 Mins. 2 Mins. Scissors jump 10 Mins.	**Rest** Bodyweight Cardio 25 Mins. 2 Mins. Burpee + tuck + squat + Step crossover + Knee to elbow, repeat until 25 minutes
Week 10	**Week 11**	**Week 12**
Monday (Cardio)	*Monday (Cardio)*	*Monday (Cardio)*
Exercise Duration Rest	**Exercise Duration Rest**	**Exercise Duration Rest**
Treadmill 10 Minutes 2 Minutes Stationary Bicycling 5 Minutes 2 Minutes Jumping Jacks 5 Minutes 2 Minutes	Shuffle Woodchop 10 Minutes 2 Minutes Jumping Rope 10 Minutes 2 Minutes Jabs uppercuts 5 Minutes	Plyometric Cardio 25 Minutes
Wednesday (Strength)	*Wednesday (Strength)*	*Wednesday (Strength)*
Exercise Dur/Rep Rest	**Exercise Dur/Rep Rest**	**Exercise Dur/Rep Rest**
Rowing 15x3 2 Mins. Front lateral Pulldown 13x2 2 Mins. Rock Pull 12x3 2 Mins. Side Lunge 12x3 2 Mins.	Barbell Push Press 10x3 2 Mins. Barbell Squat 10x3 2 Mins. One-arm Dumbell Row 10x3 2 Mins Cable face pull 12x3 2 Mins.	Push up 15x3 3 Mins. Leg Press 15x3 3 Mins. Lunges 15x3 3 Mins. Hip Trust 15x3 3 Mins.
Friday (Cardio)	*Friday (Cardio)*	*Friday (Cardio)*
Exercise Dur/Rep Rest Aerobics 25 Mins.	**Exercise Dur/Rep Rest** Sport jogging 15 Mins. 2 Mins. Scissors jump 10 Mins.	**Exercise Dur/Rep Rest** Bodyweight Cardio 25 Mins. 2 Mins. Burpee + tuck + squat + Step crossover + Knee to elbow, repeat until 25 minutes

(B) Exercise Protocol is exercise schedule where exercise is done for 90 minutes in a day. It is also referred to as long duration exercise or one time training in this study.

Summary of exercise protocol "B"

Exercise type	:	Aerobics
Programme Duration	:	12 Weeks
Frequency Per Day	:	3 Days in a week
Target Gender	:	Male and Female (20 – 40 Years)
Workout Level	:	Beginners to Intermediate
Frequency per Week	:	1 Day a week
Daily workout Duration	:	90 Minutes
Programme Goal	:	Enhance physiological and Anthropometric

Health markers

Table 2: (B). A 90 minutes, 12 weeks aerobic exercise workout schedule for a keep fit center

WEEK 1	WEEK 2	WEEK 3
Saturday (Cardio/Strength)	*Saturday (Cardio/Strength)*	*Saturday (Cardio/Strength)*
Exercise Duration Rest	**Exercise Duration Rest**	**Exercise Duration Rest**
Treadmill 10 Minutes 2 Minutes Stationary Bicycling 5 Minutes 2 Minutes Jumping Jacks 5 Minutes 2 Minutes **Exercise Dur/Rep Rest** Rowing 15x3 2 Mins. Front lateral Pulldown 13x2 2 Mins. Rock Pull 12x3 2 Mins. Side Lunge 12x3 2 Mins.	Shuffle Woodchop 10 Minutes 2 Minutes Jumping Rope 10 Minutes 2 Minutes Jabs uppercuts 5 Minutes **Exercise Dur/Rep Rest** Barbell Push Press 10x3 2 Mins. Barbell Squat 10x3 2 Mins. One-arm Dumbell Row 10x3 2 Mins Cable face pull 12x3 2 Mins.	Plyometric Cardio 25 Minutes **Exercise Dur/Rep Rest** Push up 15x3 3 Mins. Leg Press 15x3 3 Mins. Lunges 15x3 3 Mins. Hip Trust 15x3 3 Mins. **Exercise Dur/Rep Rest**

Exercise Dur/Rep **Rest** Aerobics 25 Mins.	**Exercise Dur/Rep** **Rest** Sport jogging 15 Mins. 2 Mins. Scissors jump 10 Mins.	Bodyweight Cardio 25 Mins. 2 Mins. Burpee + tuck + squat + Step crossover + Knee to elbow, repeat until 25 minutes
WEEK 4	**WEEK 5**	**WEEK 6**
Saturday (Cardio/Strength)	*Saturday (Cardio/Strength)*	*Saturday (Cardio/Strength)*
Exercise Duration Rest	**Exercise Duration** **Rest**	**Exercise Duration** **Rest**
Treadmill 10 Minutes 2 Minutes Stationary Bicycling 5 Minutes 2 Minutes Jumping Jacks 5 Minutes 2 Minutes **Exercise Dur/Rep** **Rest** Rowing 15x3 2 Mins. Front lateral Pulldown 13x2 2 Mins. Rock Pull 12x3 2 Mins. Side Lunge 12x3 2 Mins. **Exercise Dur/Rep** **Rest** Aerobics 25 Mins.	Shuffle Woodchop 10 Minutes 2 Minutes Jumping Rope 10 Minutes 2 Minutes Jabs uppercuts 5 Minutes **Exercise Dur/Rep** **Rest** Barbell Push Press 10x3 2 Mins. Barbell Squat 10x3 2 Mins. One-arm Dumbell Row 10x3 2 Mins Cable face pull 12x3 2 Mins. **Exercise Dur/Rep** **Rest** Sport jogging 15 Mins. 2 Mins. Scissors jump 10 Mins.	Plyometric Cardio 25 Minutes **Exercise Dur/Rep** **Rest** Push up 15x3 3 Mins. Leg Press 15x3 3 Mins. Lunges 15x3 3 Mins. Hip Trust 15x3 3 Mins. **Exercise Dur/Rep** **Rest** Bodyweight Cardio 25 Mins. 2 Mins. Burpee + tuck + squat + Step crossover + Knee to elbow, repeat until 25 minutes
WEEK 7	**WEEK 8**	**WEEK 9**
Saturday (Cardio/Strength)	*Saturday (Cardio/Strength)*	*Saturday (Cardio/Strength)*
Exercise Duration Rest	**Exercise Duration** **Rest**	**Exercise Duration** **Rest**
Treadmill 10 Minutes 2 Minutes	Shuffle Woodchop 10 Minutes 2 Minutes	Plyometric Cardio 25 Minutes

Stationary Bicycling 5 Minutes 2 Minutes Jumping Jacks 5 Minutes 2 Minutes **Exercise Dur/Rep Rest** Rowing 15x3 2 Mins. Front lateral Pulldown 13x2 2 Mins. Rock Pull 12x3 2 Mins. Side Lunge 12x3 2 Mins. **Exercise Dur/Rep Rest** Aerobics 25 Mins.	Jumping Rope 10 Minutes 2 Minutes Jabs uppercuts 5 Minutes **Exercise Dur/Rep Rest** Barbell Push Press 10x3 2 Mins. Barbell Squat 10x3 2 Mins. One-arm Dumbell Row 10x3 2 Mins Cable face pull 12x3 2 Mins. **Exercise Dur/Rep Rest** Sport jogging 15 Mins. 2 Mins. Scissors jump 10 Mins.	**Exercise Dur/Rep Rest** Push up 15x3 3 Mins. Leg Press 15x3 3 Mins. Lunges 15x3 3 Mins. Hip Trust 15x3 3 Mins. **Exercise Dur/Rep Rest** Bodyweight Cardio 25 Mins. 2 Mins. Burpee + tuck + squat + Step crossover + Knee to elbow, repeat until 25 minutes
WEEK 10	**WEEK 11**	**WEEK 12**
Saturday (Cardio/Strength)	*Saturday (Cardio/Strength)*	*Saturday (Cardio/Strength)*
Exercise Duration Rest	**Exercise Duration Rest**	**Exercise Duration Rest**
Treadmill 10 Minutes 2 Minutes Stationary Bicycling 5 Minutes 2 Minutes Jumping Jacks 5 Minutes 2 Minutes **Exercise Dur/Rep Rest** Rowing 15x3 2 Mins. Front lateral Pulldown 13x2 2 Mins. Rock Pull 12x3 2 Mins.	Shuffle Woodchop 10 Minutes 2 Minutes Jumping Rope 10 Minutes 2 Minutes Jabs uppercuts 5 Minutes **Exercise Dur/Rep Rest** Barbell Push Press 10x3 2 Mins. Barbell Squat 10x3 2 Mins. One-arm Dumbell Row 10x3 2 Mins Cable face pull 12x3	Plyometric Cardio 25 Minutes **Exercise Dur/Rep Rest** Push up 15x3 3 Mins. Leg Press 15x3 3 Mins. Lunges 15x3 3 Mins. Hip Trust 15x3 3 Mins.

Side Lunge 12x3 2 Mins. **Exercise Dur/Rep Rest** Aerobics 25 Mins.	2 Mins. **Exercise Dur/Rep Rest** Sport jogging 15 Mins. 2 Mins. Scissors jump 10 Mins.	**Exercise Dur/Rep Rest** Bodyweight Cardio 25 Mins. 2 Mins. Burpee + tuck + squat + Step crossover + Knee to elbow, repeat until 25 minutes

Effects of Aerobic Exercise on Physiological Variables

There are some effects of exercise on various physiological variables of the exerciser.

Effect of aerobic exercise on blood pressure

Blood pressure is the pressure that the blood exerts against the walls of the blood vessels. When the left ventricle contracts, it forces blood into the aorta, creating what is known as SBP or force. When the heart is at rest after pumping blood into the body, arterial pressure is measured to be at its lowest, or diastolic. SBP in a healthy adult is around 120 mm Hg, and DBP is around 80 mm Hg. A sphygmomanometer is used to measure arterial blood pressure and is reported in terms of systolic/diastolic BP in mmHg (Anne & Allison, 2001). Normal blood pressure is when the readings are 120 over 80mmHg. One is considered to have elevated blood pressure when the readings are between 120-129 and less than 80. A person with blood pressure between 130-139 and 80-89 is considered hypertensive (stage 1), and a reading of 140 or higher and 90 or higher is considered hypertensive (stage 2). A person with readings higher than 180 and/or

120 is considered a hypertensive crisis. Low blood pressure (hypotensive), on the other hand, is the pressure that is so low, 100/60 or less and that it causes a lack of oxygen to vital organs such as the brain because of the low flow of blood through the arteries and veins (Powers et al., 2018).

Regular aerobic exercise can lower blood pressure and save money while minimising pharmaceutical side effects. Hypertension therapy must take a multipronged strategy due to the high medication load and the substantial effort required to sustain lifestyle improvements (James, Oparil, & Carter, 2014). So, antihypertensive medicine may be responsible for decreasing the blood pressure (BP) impact typically seen after exercise (s). Among non-pharmaceutical methods, physical activity has been identified as one of the most promising. Studies have compared the effectiveness of antihypertensive medicines (co-amilozide and amlodipine) with aerobic exercise "(dance for 12 weeks, 3 days/week, intensity of 50%-70% of HR reserve)" in reducing blood pressure. It was found that in a group of people with uncontrolled BP, a combination of medicine and exercise for 12 weeks dramatically reduced BP and decreased the need for antihypertensive drugs (Maruf, Akinpelu, Salako, & Akinyemi, 2016).

It is important to note that exercise can reduce blood pressure in hypertensive people even if they are not on antihypertensive drugs (s). "In middle-aged people with stage 1 or 2 hypertension who were not taking antihypertensive medications, 12 weeks of high-intensity interval (HIIT) and moderate-intensity CTT (MICT; 4.5 and 3.5mm Hg for SBP and DBP, respectively)" reduced 24-hour ambulatory BP by 12 and 8 mm Hg, respectively.

These participants had their medication stopped one month before enrollment in the trial. The potential of exercise to produce acute and chronic BP-lowering effects may account for the impact described above. After a vigorous workout, blood pressure (BP) drops suddenly, a phenomenon known as post-exercise hypotension (PEH) (Costa, Dantas, & de Farias, 2016). In a controlled laboratory setting (Costa et al., 2016) and real-life situations, post-exercise hypotension can drop blood pressure (BP) levels compared to pre-exercise values and last for many hours (Dantas, de Farias, & Frazao, 2017).

Regular exercise training has been shown to have a long-term beneficial effect on blood pressure, with participants reporting decreased resting and/or ambulatory BP (Cornelissen & Smart, 2013; Sosner et al., 2017). It is crucial to remember that the physiological changes that result from persistent exercise cause the chronic antihypertensive effect of exercise training (da Nobrega, 2005). The degree of the decrease in resting blood pressure (also known as the chronic BP-lowering impact) and the quantity of post-exercise hypotension (that is., the acute BP-lowering effect) have an interesting positive association (Kiviniemi, Hautala, & Karajalainen, 2014; Hecksteden, Grutters, & Meyer, 2013). Hypertensive patients who engage in aerobic or dynamic resistance training have post-exercise hypotension or a temporary drop in blood pressure (Carpio-Rivera et al., 2016).

It should be highlighted that the hemodynamic causes of hypotension after aerobic exercise appear to vary between those with normal blood pressure and those with hypertension. Although Brito, Queiroz, and Forjaz (2014) demonstrated that decreased systemic vascular resistance is the main hemodynamic factor influencing post-exercise hypotension, it was discovered that post-exercise hypotension in older adults, overweight people and hypertensive people were more strongly correlated with a decrease in cardiac output post-exercise, particularly due to a reduction in stroke volume. Reduced post-exercise vascular resistance, a propensity for reduced stroke volume, and a lower cardiac output have all been linked to the increased arterial stiffness, peripheral vascular resistance, and endothelial dysfunction associated with age and hypertension in the elderly.

Additionally, a strong correlation between blood pressure and body composition was discovered by Schwingshakl et al., (2013). Blood pressure was inversely proportional to waist circumference, while BMI was found to be strongly linked with blood pressure. Weight loss is commonly recommended to lower blood pressure because of the link between obesity and hypertension. Exercise does lower blood pressure through a reduction in body fat weight; however, the reduction in blood pressure following exercise treatment is not associated with reduced body weight (Cornelissen & Smart, 2013). It is generally agreed that training causes a decrease in blood pressure by:

1. Maximizing the distribution of blood to muscles and organs by expanding the network of capillaries;

2. Capillary dilation improves blood flow during rest,

3. Drop in Heart Rate (HR) at rest;

4. Vascular resistance to blood flow in the periphery is decreased, mostly due to vasodilation when the body is at rest; and

5. Lowering blood levels of the stress hormones known as catecholamines. Vascular constriction is another result of stress hormones;

Much less is understood about how resistance training affects the hemodynamic determinants of post-exercise hypotension (Rêgo1, Cabral, Costa, & Fontes, 2019). Over the past two decades, numerous Randomly Controle Trials (RCTs) have shown that exercise training has a long-term, positive effect on resting and ambulatory blood pressure (BP) (Sosner et al., 2017; MacDonald et al., 2016 Cornelissen & Smart, 2013). Aerobic exercise training (moderate to high intensity, 210 minutes/week) decreases resting SBP (SBP) by 8.3 mm Hg and DBP by 5.2 mm Hg in people with hypertension, according to a meta-analysis by Cornelissen and Smart (2013).

Aerobic exercise training reduced 24-hour ambulatory SBP and DBP by 4 and 3mm Hg, respectively (Sosner et al., 2017). This effect is true regardless of the intensity, frequency, or duration of the workouts. People whose resting blood pressure is already higher than 130/85 mm Hg will benefit more from this decrease. Dynamic resistance training (moderate intensity 65%-75% of 1 repetition max, 3 days/week) has been shown to reduce resting systolic and DBP by 6 and 5mm Hg, respectively, in people with hypertension (MacDonald et al., 2016). Overwhelming data suggests that regular aerobic and dynamic resistance exercise training leads to a significant and lasting reduction in blood pressure in patients with hypertension. Both systolic and DBPs are affected by more than 5 mm Hg at rest.

Clinically, a reduction of just 5 mmHg in SBP is associated with a 14% reduction in stroke mortality, a 9% reduction in coronary heart disease mortality, and a 7% reduction in all-cause mortality; a reduction of just 10 mmHg in SBP is associated with a 27% reduction in stroke risk, a 17% reduction in coronary heart disease risk, a 28% reduction in heart failure risk, and a 13% reduction in overall mortality. When people with pre-hypertension and hypertension engage in aerobic exercise for an extended period (>12 weeks) and/or when their SBP (SBP) drops significantly (>7.6 mmHg), they experience a reduction in arterial stiffness in addition to the specific effects on BP levels (Montero, Roche, & Martinez-Rodriguez, 2014).

The results of a study by Abu, Irshad, Faizan, and Shadabuddin (2013) accord with the findings of other studies showed that moderate-intensity aerobic exercise training can lower blood pressure in patients with stage 1 and 2 hypertension. “The average reduction in blood pressure is 10- 5 mmHg for systolic and 7- 6 mmHg for DBP, and these reductions do not appear to be gender- or age-specific (Lim et al., 2011; Gang et al., 2004; Schwartz & Hirth, 1995; Braith et al.,1994). It was found that the SBP decreased by 3 mm/hg, which was said to be significant. A similar decrease of 21 mm/Hg was seen, which was significant. In addition, a study by Abu et al. (2013) found that mean SBP of 137mmHg (group a) and 158.75mmhg (group b) seen pre-test was reduced to 134.35 (group a) and 137.75 (group b) post-test by aerobic exercise. Also, it was found that mean DBP of 85.35 (group a) and 94.25 (group b) seen pre-test was decreased to 85 (group a) and 88.1(group b) post-test”. A reduction in SBP/DBP (mean) was 13 mm Hg found in 50% of the patients after 10 weeks and in 78% after 20 weeks of exercise.

More recently, another study by Cornelissen and Smart (2013) examined participants' blood pressure response to aerobic training sessions over a 10-week exercise programme. One hundred and forty men and women had their blood pressure measured before and within one minute after completing the exercise during the programme's third, sixth, and ninth weeks. The post-exercise systolic pressure decreased about 1mmHg during the third-week workout, almost 3mmHg during the sixth-week workout and approximately 5mmHg during the ninth-week workout. These findings suggested positive and progressive cardiovascular system adaptations to aerobic training sessions with respect to SBP. Nonetheless, over the 10-week training period, the programme participants recorded a 6.3mmHg mean reduction in resting SBP and a 2.2mmHg mean decrease in resting DBP. Improvements in the individuals' resting blood pressure are consistent with those seen in the thousands of people who have completed basic aerobic exercise training courses. Both insulin-dependent and non-insulin-dependent diabetic patients at Murtala Muhammad Specialist Hospital, Kano, saw significant reductions in SBP, DBP, and resting HR following 16 weeks of aerobic activity (Wokoma, 2011).

A study by Meikle, Al-Sarraf, Li, Grierson and Frohlich (2013) indicating a comparison between the exercise group (group 1) and control group (2) showed that the mean values of both systolic and DBPs decreased as 4 mmHg, between the two groups. The same study further found that there was a statistically significant difference in DBP between the male and female groups, systolic -5 ± 17; diastolic -4 ± 11 for men and systolic -1 ± 17; diastolic -6 ± 12 for females. The same study found improvements in exercise habits beneficial for people of all ages, including those under and over 60. Neither group significantly differed from the other in terms of age.

In men, both systolic and diastolic BP dropped dramatically, but in women, only diastolic BP dropped significantly (Reckelhoff, 2001). This was attributed to the disparities in their initial workouts. Another study found that people with normal body mass index (BMI) also benefit from the blood pressure-lowering effects of aerobic exercise. The average intervention-related weight gain or loss was just 0.42 kilogrammes (kg), which was insufficient to warrant further study in a meta-analysis. In addition, the study found no statistically significant correlation between the drop in mean blood pressure and the reduction in mean body weight. In contrast, even in studies where patients did not lose weight overall, blood pressure was significantly lowered. These results indicate that aerobic exercise may lower blood pressure regardless of whether or not the participant gains or loses weight (Seamus, Ashley, Xue, & Jiang, 2002).

Carpio-Rivera et al., (2016) found that resting systolic and diastolic blood pressure (SBP) was considerably reduced after an acute bout of exercise ($p < .00$ and $p < .02$, respectively). It was also noted that the values returned to their baseline after the 24 hours had passed. The reduced sympathetic activity linked to lower resting blood pressure from physical exercise is one possible explanation for the drop in resting B.P. reactivity levels. SBP was shown to decrease in both the single-session group (6.66 mmHg, [95% C.I. = 1.44-11.88], $p < .05$) and the multiple-session group (3.38 mmHg, [95% C.I. = 1.44-5.88], $p < .01$).

Lim et al. (2011) found that among middle-aged obese women, the risk of metabolic syndrome and the atherogenic index were reduced most when participants engaged in a continuous activity instead of many shorter bouts of exercise. However, they suggested that shorter, more frequent exercise sessions may be preferable to longer ones, especially when the goal is to lower blood sugar or decrease the waist size. Guidelines recommend 150 minutes of moderate exercise each week, broken down into 5 sessions of 30 minutes, with no more than 48 hours in between (Pedersen & Saltin, 2015). While some research suggests that the conditions mentioned above must be met before exercise can influence physiological variables, other research contradicts this. Researchers Silva et al. (2020) set out to determine the effects of an aerobic exercise programme of 90 minutes per week on a number of different factors, and they found that even modest exercise reduced fasting hyperglycemia, blood pressure, and body fat percentage. Hyperglycemia and blood pressure levels decreased during exercise beginning with the second workout. In addition, following 4 weeks of training and comparing the taught participants with untrained individuals at the end of the trial, it was seen that fasting glycaemia and blood pressure were reduced, showing the efficiency of the proposed protocol.

A meta-analysis by Clark (2021) indicated various effects of duration on exercises. Three exercises were used to find their influence on Type 2 diabetes, blood pressure, cytokines and cardiorespiratory fitness. Concerning blood pressure, the following were observed regarding endurance and resistance exercises: it appears that shorter duration (≤ 8 weeks) training is more effective than moderate to long duration 9-15 weeks, 2.09 (1.08, 3.10) and 1.2 (0.98, 1.92), 16-23 weeks, 1.33 (0.60,1.93) and 1.17 (0.32, 1.90), or 52-weeks, 1.63 (0.48, 2.78) and 0.76 (0.41, 1.11), of training for eliciting changes in SBP and DBP respectively (Booth, Roberts, & Laye, 2012). For SBP specifically, 52 weeks of endurance and resistance exercise training was less beneficial than all shorter durations -0.54 (-1.04, -0.06), while 9-15 and 16-23 weeks of training were more effective than any longer length 0.55 (0.24-0.86), and 1.13 (0.82-1.44), respectively. When it comes to endurance exercise, a training period of 16-23 weeks is the least successful, with a -0.64 (-1.03, -0.13) relative to all other durations, while a training time of 8 weeks is the most beneficial, with 0.50 relative to the measurements at 16-23 weeks (0.01, 0.99). The efficiency of resistance exercise is highest after 24–36 weeks of training (1.13; 0.65; 1.62), with 9–15 weeks of training being superior to longer periods of training (0.55; 0.08; 1.02), and specifically 52 weeks of training (0.77).

Similar trends were observed when comparing the efficacy of various training durations on modifying blood pressure (DBP): 8 weeks of training had a stronger force than training periods of 9-15 weeks (1.02), 16-23 weeks (1.17), and 52 weeks (0.97). (0.15, 1.62). At 9-15 weeks of training, endurance and resistance workouts were less beneficial than any other period, 1.03 (0.53, 1.53), and especially less effective than the 52 weeks of training, 1.57. (0.85, 2.12). Resistance training was most effective between the ages of 24 and 36, with a relative effectiveness of 0.52 (0.05, 0.98), and between 8 and 52 weeks, with an efficacy of 0.50 (0.03, 0.97). (Clark & Goon, 2015; Clark, 2015; Booth et al., 2012).

It was found that after eight weeks of CTT, resistance exercise was more effective than endurance exercise on all measures of interest (except SBP and maximal oxygen consumption) and that there was little difference between the responses elicited by endurance and resistance exercises (aside resistance exercises being more effective for altering positive changes in fat-free mass within overall body composition). It is interesting to note, given the prevalence of advice, that after 16 weeks of training, those who were not previously engaging in endurance exercise seem to benefit from the change in insulin levels brought about by their newfound fitness regimen (Clark & Goon, 2015; Gebel, 2010).

It was determined that within these efficacy-based duration continuums, there is evidence of disparities between exercise approaches. In this regard, resistance exercise, or a combination of endurance and resistance exercises, is more effective than endurance exercise over the various timeframes in causing beneficial changes to measures of body composition (such as fat mass and fat-free mass), DBP, markers of inflammation, and type 2 diabetes. The most striking contrasts across training approaches appear at shorter and middle durations (8-to-24 weeks). Longer training periods (> 24 weeks) are required to observe the beneficial effects of endurance exercise on SBP and VO_2 compared to resistance or both endurance and resistance exercises together. Furthermore, it appears that switching which metrics are of interest makes little difference in the overall efficacy of resistance or endurance exercise based on the training period.

Effects of aerobic exercise on percent body fat

Daily consumption of staple food, especially carbohydrates and fatty foods, without the proportional burn-out of such foods, inactivity and long-time sitting create a way to accumulate body fat (Dominic et al., 2019; Engeda et al., 2016). Hoeger (1988) viewed percent body fat as referring to fat and nonfat components of the human body. The fat component is referred to as fat percentage (%BF), fat mass (FM), and fat-free mass (FFM). The nonfat part is referred to as lean body mass. Therefore, the proper way to determine ideal body weight is through body composition, that is, by determining what percentage of total body weight is fat and what amount is lean tissue.

"Muscle," "bone," "fat tissues," "water," "minerals," and other components of total body mass make up what is known as a person's "body composition," which includes both absolute and relative amounts of these tissues (Heyward, 1998). According to scientific literature, there are three different measures of body composition: fat percentage (%BF), fat mass (FM), and fat-free mass (FFM) (Wilmore & Costill, 2004). Exertion-consumption ratios are directly correlated with BMI and weight. Maintaining a low percentage of body fat and a high percentage of lean mass are indicators of good fitness and health, respectively. Humans are made up of water, protein, minerals, and fat, with the ratio of fat-free mass to total body mass being the most important factor in determining a person's functional ability, health, wellness, and survival (Akindele, et al., 2016).

Considering the total body weight of human beings, studies have shown (Janssens et al., 2016; Vipene & Ogunleye, 2013) that the body fat of adults constitutes 14–17% of the total weight of men and 21–24% of the total weight in women. Body fat percentage (BF%) classification, according to health status and gender, indicates that essential fat is 10-13% (females) and 2-5% (males); athletes 14-20% (females) and 6-13% males; fitness 21-24% (females) and 14-17% males; acceptable (healthy) 25-31% (females) and 18-25% males; obese ≥32% (females) and ≥25% males (USDHHS, 2010). Women require higher amounts of body fat than men because of the sex characteristics necessary for childbearing functions. When these body fat ranges are exceeded in both men and women, the disease risk threshold becomes overstretched with an increased risk of becoming overweight and obese. Research has shown that, on average, being overweight is liable to reduced attention and working memory and increases the risk of early dementia (cognitive and intellectual deterioration) (Shuval et al., 2014; Ogunmola, Olaifa, Oladapo, & Babatunde, 2013).

In addition, too much body fat may result in health problems like hypertension, elevated blood lipids (fats and cholesterol), diabetes mellitus, cardiovascular disease, respiratory dysfunction, gall bladder disease, insulin resistance, cancer (colon, prostate, oesophagus, ovaries, endometrium, breast, and cervix), arthritis, gout, back pain, osteoporosis, complications during pregnancy, menstrual abnormalities, sleep, apnea and impaired immune functions (Pescatello, Arenea, Riebe, & Thompson, 2014; Chinedu, Ogunlana & Azuh, 2013; Vipene & Ogunleye, 2013).

Essential body fat serves enormous functions for the body (Figley, Asem, Levenbaum, & Courtney, 2016; Oke & Agwubike, 2015). These include improved metabolism, strength, appearance, brain functions, and daily movement. Others include the maintenance of healthy skin and hair, maintenance of the right body temperature, storehouse for energy in the body, smooth functioning of cells, cushioning effects on organs and tissues, bone marrows, lungs, liver, spleen, kidneys, intestines, cardiac muscles, lipid-rich tissues throughout the central nervous system and skeletal muscles fueling. In addition, essential fat serves as a shock absorber for bones (Office of Disease Prevention and Health Promotion [ODPHP], 2014) and aids in the assimilation of vitamins A, E, D, and K, all of which play an important role in boosting immunity and warding off disease (Juraschek, Blala, & Whelton, 2014; Ukegbu & Nwaegbute, 2012).

According to Gunen (2010), there are several procedures for determining body fat percentage. The most common techniques are (a) hydrostatic or underwater weighing, (b) bioelectrical impendence, (c) skin fold thickness, and (d) girth measurement. Bioelectric impendence analysis ranks quite favourably for accuracy and has an overall ranking similar to skin fold measurement techniques. It is based on measuring resistance to current flow. Electrodes or plates are applied to the hands or feet, and a little current is sent through the body. This is because muscles contain more water than fat, making them stronger conductors and presenting less resistance to electrical current. Estimates or measurements of relative body fat based on bioelectric impendence strongly correlate with hydrostatic weighing (r=.90-.94) (Corbin et al., 2008; Werner & Sharon, 2007).

The BMI is a metric used to compare individuals of different sizes. The BMI is the most widely used indicator of obesity and general body fatness; it is determined by dividing a person's weight (in kilogrammes) by the square of their height (in metres). Individuals are categorised according to their BMI (BMI) as healthy/normal (BMI 18.5-24.9), overweight (BMI 25.0-29.9), class 1 obesity (BMI 30.034.9), class II obesity (BMI 35.0-39.9), class III obesity (BMI 40.0-49.9), class IV obesity (BMI 50.0-59.9), and class V obesity (BMI 60.0) (WHO, 2019). The waist-to-hip ratio can also be used as an indicator of overall health and fitness (WHR). Classification of WHR for health purposes varies between men and women (WHO, 2019). A ratio of >9.0 and women>8.0 is one of the definitive criteria for metabolic syndrome in men. The waist-to-hip ratio was the most accurate clinical measure for predicting death from cardiovascular disease, while hip circumference was inversely related to the risk of gaining weight (Talabi, 2016; Odo, Ezeanyika, & Uchendu, 2015). Women are at increased risk for health problems if their waist-to-hip ratio (WHR) exceeds 0.80.

Analyzing WHR and BMI combined is helpful. WHR measures how much of one's total body fat is in the waist and hip areas. There are two common places where people keep extra weight: (a) the midsection and (b) the hips. Extra weight carried in the midsection is more hazardous than extra weight carried in the thighs and hips. It has been connected to several deadly diseases and conditions, including high blood pressure, diabetes, heart disease, and cancer

(American Heart Association, 2015). Cardiovascular disease, type II diabetes, metabolic syndrome, obesity, weakness, falls, and weariness is all linked to fat buildup, especially visceral fat (that is, abdominal fat that surrounds the essential organs on the trunk and stomach area of the body) (Sohler, Lubetkin, Levy, Soghomonian, & Rimmerman, 2009; Colditz, Willett, Rotnitzky, & Manson, 1995). Gaining weight in one's middle is a major health risk. More and more evidences from scientific research on body composition suggests that being overweight is harmful to health. There may be no significant difference between potential holding locations. A study reveals an increase if one is overweight or obese, regardless of one's shape, dispelling the notion that central fat storage is worse than fat dispersed elsewhere, such as the arms or hips. Women with a WHR of 0.7 tend to be healthy and have high conception rates. The optimum oestrogen level for women is between 0.7 and 1.0, and those who fall within this range have a lower risk of developing serious illnesses. Regardless of BMI, the likelihood of pregnancy is decreased in women with high WHR values (0.80 or higher) compared to those with lower WHR values (0.70-0.79) (Talabi, 2016). The ratio of a woman's waist to her hips can be used as an indicator of how much fat she carries around in her hips, and it was found to be connected with her child's performance on cognitive tests. Youngsters whose mothers had a low waist-to-hip ratio and full hips did best. According to Talabi, foetal brain development is aided by the long-chain polyunsaturated fatty acids in hip fat.

Regular aerobic exercise can improve both lean body mass and fat proportion. Aerobic exercise has a number of good effects on weight loss, including boosting energy expenditure during the workout and, to a lesser extent, after recovery, preserving or enhancing fat-free body mass, and promoting fat and weight loss (Young & Steinhard, 1995). According to the study's authors, aerobic exercise was found to lower fat mass and body weight (Stasiulis, Mockiene, Vizbaraite & Mockus, 2010). In addition to decreasing triglycerides (TG), total cholesterol (TC), and low-density lipoprotein (LDL), as well as lowering the BMI (BMI), increasing muscle mass, and lowering the percentage of body fat, regular exercise also increases high-density lipoprotein (HDL), muscle mass, and the (BMR). Also, when combined with exercise, a low-calorie diet improves lipid profile and enhances body composition (Talanian et al., 2007).

Figley et al. (2016) revealed that aerobic training is more effective in decreasing fat in the body. "After 12 weeks of supervised aerobic exercise, participants reduced their mean abdominal girth by 3.5cm. Another study by Dominic et al. (2018) revealed that there were significant differences in the lipid profiles (a mean low-density lipoprotein [LDL]-C decrease of 0.8 mmol/L, a mean high-density lipoprotein [HDL] increase of 0.14 mmol/L, and a mean triglyceride decrease of 1.0 mmol/L) between the first and last visit of aerobic exercise programme. The experimental group had better weight control (mean weight of 0.25 kg). However, there was a statistically significant difference in RHR between the first and the last day of the exercise (a mean decrease of 5.9 bpm)".

Donnelly, Hill, Jacobsen, Potteiger, and Sullivan (2003) further analysed data regarding gender and age differences between the male and female groups. In general, women have healthier characteristics than males regarding weight, resting HR, high-density lipoprotein levels, and blood pressure. The resting HR (RHR) was similarly affected by exercise in both sexes, but males also saw beneficial changes in their total and LDL cholesterol, while women saw these changes in their HDL cholesterol.

Studies by Suman (2016) and Williams et al. (2015) showed that participants body weight and BMI decreased after eight weeks of aerobic exercise. Body weight was significantly reduced (p=0.00) from 77.95 kg to 71.20 kg in the experimental group after eight weeks of the aerobic exercise programme. Similarly, the experimental groups BMI value was highly significant (p=0.00), from 29.77kg/m2 to 27.16kg/m2 at the end of the aerobic training programme. This finding is in line with the advice given by Nicklas et al. (2009), who suggested a 30-minute exercise session on most days of the week to combat obesity. Aerobic exercise may lead to even more significant fat loss when added to a calorie-restricted diet. The ability of our bodies to utilise fat as a substrate is enhanced during aerobic activity, and overall fat oxidation is also increased (Talanian et al., 2007). According to a study, persons whose diets and VO_2 max was improved by 60–90 minutes of aerobic activity 5–7 days per week saw a reduction in their waist sizes (De Souza et al., 2009). Further research confirm that aerobic exercise alone leads to clinically significant weight loss in both men and women (Joseph & Donnell, 2013).

Another study by Merrick, Bacher, Carmeli, and Kodesh (2013) showed significant changes in body weight and composition. Participants randomized to the physical exercise group during the intervention lost significant weight (mean = 4.35 ±0.8 kg, p = 0.005), whereas the subjects in the control group did not (P = 0.32). Consequently, the mean BMI of the experimental group declined from 29.3±3.4 kg/m2 to 27.8±3.8 kg/m2. The average pelvic size shrunk (95% CI, p 0.005). (from 101.2 cm to 98.6 cm). The decrease in the percentage of subcutaneous fat from 36.74 to 34.13 was statistically significant (95% CI, p= 0.005). There was no change in the percentage of visceral fat, however. Mean differences between pre-and post-measurements of body fat were 2.11% and 0.33% for the control and intervention groups, respectively. The average body fat percentage increased significantly in the control group but decreased in the experimental group.

The findings by Adeagbo and Bolarinwa (2017) also indicated that the mean scores of primary school children taken through an aerobic exercise training programme after 12 weeks and those not exposed to percent body fat showed a level of significance (p = 0.000 < 0.05 at 0.05). The results also showed that the aerobic exercise training group had an adjusted mean score of 12.31, whereas the control group had a score of 14.02. After 12 weeks of aerobic exercise instruction, participants saw a significant decrease in body fat percentage compared to controls. Therefore, this evidence agrees with the findings of Young and Steinhard (1995) that aerobic exercise can lessen %BF. Alterations in body composition were also seen in the ten-week Senbanjo and Oshikoya (2010) trial in which individuals trained twice weekly. Aerobic exercise training decreases fat and enhances lean body mass, as has been shown in other studies (Byrne &

Wilmore, 2001a; Treuth et al., 1994). Increases in aerobic exercise levels lead to reductions in body fat, as reported by Catenacci and Wyatt (2007). Aerobic exercise training has been shown to enhance body composition (Ross, Freeman, & Janssen, 2000; Kohrt, 1996), and it has been shown to reduce abdominal visceral fat in particular (Irwin, 2003; Ross, et al., 2000). According to Armstrong and Welsman (1997), a school-based study by Moody found that after 15 weeks of a daily exercise programme, the skin fold thickness of the obese group decreased significantly. The study included 28 obese girls and 12 normal girls.

Visceral adipose tissue (VAT) content is positively influenced by the combination of aerobic exercise training and calorie restriction when a weight reduction of around 4-9% of body weight is accomplished, as measured by serial CT and MRI quantification of VAT content/volume (Kay & Fiatarone, 2006). Extensive research shows that a 10% weight loss leads to a reduction in general body fat and visceral adipose tissue (Ross & Rissanen, 1994). To maintain a healthy weight, experts say one need at least 250 minutes a week of aerobic exercise (Haskell et al., 2007; Donnelly et al., 2003). The actual weight (and body fat) loss with this amount of regular activity in overweight and obese persons is frequently minor (between 2-3 kg) but increases (between 5-7.5 kg) with exercise levels up to 420 min/week (Donelly et al., 2009; Franz et al., 2007; Diabetes Prevention Program Research Group, 2002). There is a growing realisation; however, that weight loss of more than a few pounds (around 3–4 kg) is challenging to maintain, even with rigorous programmes (Hansen et al., 2007; Shaw et al., 2007).

Aerobic training and a combination of aerobic and resistance training were superior to resistance training for reducing body weight and fat mass, whereas resistance training alone did not have this effect. Aerobic exercise was found to have a greater impact on these variables. Bodyweight shifts of (2.32 kg), (3.00 kg), and (3.17 kg) were seen during and after strength exercise, aerobic exercise, and the combination of the two, respectively. For fat percentage, resistance exercise changed by 1.70; for aerobic exercise, it changed by 7.17; for combined resistance and aerobic exercise, it changed by 8.12. This study's comparison between aerobic exercise and resistance exercise groups suggested that aerobic exercise decreases both body weight and fat mass significantly more than resistance exercise. A meta-analysis of the effects of aerobic exercise against resistance exercise on visceral fat concluded that a trend increased by 0.08 toward a greater reduction in visceral fat with aerobic exercise compared with resistance exercise (Ismail, Keating, Baker, & Johnson, 2012).

Davidson et al. (2009) examined aerobic exercise, resistance exercise, and a combination of the two, where the resistance exercise group performed one training set three times a week for a total of 60 min of training in a week, the aerobic exercise group exercised for 150 min in a week. The time difference between the groups in the study by Davidson et al. prevented the comparison of the effectiveness of the two exercise modes on body composition. Due to the inclusion of rest periods and transition times between machines in the total time spent on resistance exercises, the total time spent on these activities did not correspond to the total amount of energy expended during exercise. However, comparing the overall amount of time spent, exercising helps highlight which exercise was most effective at influencing the variables of interest. Differences between the groups were seen in the Targeted Risk Reduction Intervention Study via Defined Exercise-Aerobic and Resistance Training (STRRIDE-AT/RT). Time spent training was not confusing because the aerobic training group trained for 133 minutes per week while the weight training group trained for 180 minutes per week. Consequently, the STRRIDE AT/RT data, which prescribed identical amounts of exercise time, indicated that aerobic training was superior for producing beneficial reductions in body fat.

On the study on effects of aerobic exercise programmes on body composition and other physical parameters in the Pre-Obese Class 1 by Gökyürek, Sökmen, and Usta (2016), on both sexes, there was a statistically significant change between pre and post-scores for all factors among overweight high school students aged 15–17. While there was a statistically significant gain in height, other indicators showed a significant decline. When looking at the correlation between scores and gender, we found that only weight (2-4kg) and BMI (BMI) (3k/m2) differed significantly between the sexes. Compared to the decline in the female population, the decline in the male population was larger. There was a statistically significant difference between before and after scores in both sexes across all variables.

O’Donoghue, Cunningham, Lennon, and Perrotta (2021) conducted a meta-analysis and found that moderate aerobic activity led to a higher reduction in body fat percentage (0.39% [CI = 0.5, 0.3]) than in body weight (0.3 kg [CI = 0.5, 0.2]). Combined high, vigorous-intensity aerobic/high-load resistance (COMHI or COMLM) training is the most indicator for lowering WC and %BF and raising CRF, even without appreciable weight reduction. These findings provide credence to a comprehensive study by Bray, Frühbeck, and Ryan, (2016) that exercise could positively affect glucose homeostasis independent of any changes in adipose tissue volume.

According to research by Rivellese, Riccardi, and Vaccaro (2010), cardiovascular disease is a major killer of people with diabetes. Therefore, regular exercise is crucial because it raises levels of good cholesterol (HDL-c) and lowers levels of bad cholesterol (LDL-c) via increasing lipoprotein lipase activity and uptake of very low-density lipoprotein cholesterol VLDL-c (Kiens & Lithell, 2009). The study's results showed that following a 30-minute, three-times-a-week exercise routine with 48-minute recovery periods did not bring about a significant drop in levels of very low-density lipoprotein (VLDL-c) or high-density lipoprotein (HDL-c). However, both LDL-c and total cholesterol levels were reduced with the same approach. LDL-c, one of the fractions of total cholesterol, is closely correlated with cardiovascular disease mortality rates and plays a crucial role in the progression of cardiometabolic disorders (Strasser & Schobersberger, 2011).

Due to the role of cholesterol on cardiometabolic disorders, it is crucial for people with dyslipidemia to participate in exercise routines that lower these lipoproteins. Similar findings in the area of serum lipid profile demonstrated that less time spent exercising (90 minutes weekly) did not yield the same benefits as more time spent exercising (150 minutes weekly). Compared to those who did not exercise, people with diabetes saw a significant improvement in their cardiovascular health after just 90 minutes per week of moderate exercise reduced their total cholesterol and LDL-c. Aerobic exercise training may be responsible because it alters aerobic capacity, lipid profiles, and insulin sensitivity. Adipose tissue accumulation can be slowed due to decreased leptin synthesis, especially in obese adults. Growth hormone and adiponectin levels rise, reducing belly fat and free fatty acids in the bloodstream (Castro et al. 2017; Dinas, Markati, & Carrillo 2014).

According to a number of studies, exercise seems to have a greater effect on %BF than on BW. There is some evidence that body fat percentage could be a more useful indicator of health improvement when comparing the effects of different exercise programmes. For instance, a meta-analysis conducted by Millstein (2014) on the effects of aerobic exercise on %BF and BW revealed a substantially higher effect on %BF (0.39% [CI = 0.5, 0.3]) than on BW (0.3 kg [CI = 0.5, 0.2]). Despite differences in method, frequency, and intensity, exercise was recorded as a single modality, and the impact size reported for both outcomes was minimal. Analysis showed that the most effective strategy for reducing percent body fat was a combination of high-intensity and extended-duration exercise. The percentage of body fat loss as a result of this intervention was much higher (2.15 [CI = 4.0%, 0.3%]) compared to that of only aerobic or resistance training alone (Kim et al., 2019).

Sykes, Choo, and Cotterrell (2004) also found that middle-aged women who engaged in extensive bouts of aerobic activity intending to burn 400 kcal per day lost weight and fat mass. Consistent with this outcome was the observation that several brief exercise sessions over eight weeks had no beneficial effects on obesity-related parameters in middle-aged obese women. However, it was determined that eight weeks might be too short for several short sessions to alter such parameters. Therefore, fewer, longer exercise sessions coupled with a calorie-restricted diet are more effective in lowering fat mass and improving body composition in obese persons than are more frequent, shorter exercise sessions coupled with a calorie-restricted diet. Alizadeh et al., (2013) found that exercise sessions of 150 minutes or more spread out over the week were more successful than longer sessions at helping people who were already overweight or obese to lose weight.

In conclusion, the risk for metabolic syndrome in middle-aged obese women was positively influenced by both one long-duration and repeated short-duration exercise sessions with equal energy losses for both modes during 12 weeks. Metabolism syndrome and atherosclerosis risk were reduced with prolonged periods of calorie restriction. Still, a calorie-restricted diet combined with repeated brief workouts can lower blood glucose and waist circumference.

Effect of exercise training on Heart rate (HR)

HR is affected by the intensity and duration of exercise. HR is most commonly expressed as a rate in beats per minute. The volume of blood expelled by the heart during each systole is known as stroke volume. An increase in stroke volume leads to a reduction in HR. Exercising, neurological and hormonal factors, food, and medicine can affect stroke volume and HR (Harmsen et al., 2017; Sydo et al., 2014; Strasser & Schobersberger, 2011).

Increased demand for blood supply to active muscles due to an increase in cardiac output during acute exercise is a due to heart rate. The walls of the heart grow larger and stronger with consistent exercise, increasing blood flow with each heartbeat. Each ejection is accompanied by sufficient oxygen and blood, so even a little increase in HR can give the muscles all the necessary nutrients. This means that aerobically trained exercisers have higher stroke volumes and lower resting HR than those who are not as well conditioned.

The central nervous system and hormone secretion influence stroke volume and HR. The brain sends signals through the nervous system, leading to a rise in cardiac output. When people are under emotional or mental stress, their HR increases, and they secrete the hormone cortisol to get them ready to take action. Moreover, adrenaline, a hormone released in response to excitement, causes blood vessels to contract, reducing stroke volumes and heightening HR (Strasser & Schobersberger, 2011).

Other factors such as age, gender and the environment can either boost or diminish cardiac output. Humans beings have reduced maximal HR and stroke volumes with increased age. In addition, females have higher cardiac outputs because of the reduced absolute heart capacity in the female body. Finally, noise, temperature extremes, pollution and altitude might produce changes in normal HR and stroke volumes (McMorris, Tomporowski, & Audiffren, 2009).

Body mass index (BMI) and exercise effect

Clark (2015) found that exercise as a stand-alone intervention, regardless of prescription, only moderately reduced weight loss, although weight loss and, by extension, a reduction in BMI is typically the main aims in the treatment of obesity (mean weight loss ranged from 0.05 to 1.01 kg). Resistance training as a single modality was less successful than interventions involving aerobic components, whether used alone or in combination (AEV, AEM, COMHI and COMLM). These results support earlier meta-analyses' findings that exercise alone is ineffective therapy because a hypocaloric balance is required. Therefore, nutritional consumption is essential for losing weight and should be combined with exercise to maximise its effectiveness in treating obesity.

Since the variations in various measures of interest generated vary on both duration and exercise, the response continuum also implies variances in effectiveness. This bolsters the notion that there is a continuum of effectiveness for exercise (with and without diet modification) depending on the degree of muscle stimulation, regardless of length. Additionally, it supports the notion that responses can vary due to the intricate interactions between various factors, with exercise as one of many regulatory factors in the emergence and resolution of the sick health condition impacting the overweight person (Clark, 2015).

According to Jakicic et al. (2001), men are more likely than women to lose weight when engaging in physical activity. The study protocol's application of extreme lifestyle adjustments to the participants may be to blame for the striking loss of follow-up. In the short-bout programme, BMI values for both men and women decreased compared to that seen in their longer-bout counterparts. Over the course of 24 weeks, there were no discernible differences in the means of the various regimes within each sex.

In various populations, Pontzer et al. (2016) showed that exercise can cause drops in baseline energy expenditure, resulting in efficient energy control. These findings support the systematic review by Bray et al. (2016), which highlights that physical activity directly impacts the body and positively affects glucose homeostasis even when there are no changes in the volume of fatty tissue.

Effects of exercise duration on physiological and anthropometric variables

Blood pressure

A study by Carpio-Rivera et al., (2016) showed that an acute bout of exercise could significantly decrease the resting level of SBP at $P < 0.01$ level and DBP at $P < 0.02$ level. It was also observed that the change in values was temporary, and the values returned to a basal level within 24 hours. The physical activity-associated decrease in resting BP reactivity levels observed may be a downregulation of sympathetic activity between the association of physical activity and a decrease in resting blood pressure. Other studies by Gavish et al., 2008; Lim et al., 2011) discovered that SBP dropped in the single-session group (6.66 mmHg, [95% C.I. = 1.44-11.88], p < .05). DBP dropped in the multiple-session group (3.38 mmHg, [95% C.I. = 1.44-5.88], p < .01). A study also found a moderate linear association between diastolic and SBPs as an a priori expectation since the two have a common source and are related to artery compliance and stiffness, respectively (Schillaci & Pucci, 2010). Both Cornelissen and Smart (2013) and Batacan et al., (2017) contend that training and exercise have a SBP-lowering effect that is resistant to the majority of outside influences.

According to Schwingshakl et al (2013) research, sustained exercise reduces the risk of metabolic syndrome and the atherogenic index in middle-aged obese women more effectively than in many brief exercise sessions. However, they said several brief workouts could be advised as an alternative to intense exercise, particularly when lowering blood sugar levels or reducing waist circumference. 150 minutes of moderate exercise per week, broken up into 5 sessions of 30 minutes each, with no more than 48 hours rest in between is recommended for optimal health benefits (Pedersen & Saltin, 2015). Other research contends that exercise can affect physiological factors even when it does not adhere to the abovementioned recommendations. Silva et al. (2020) state that moderate exercise reduces blood pressure, body fat percentage, and fasting hyperglycemia. It was discovered that hyperglycemia and blood pressure decreased during activity compared to baseline levels. After 4 weeks of training, there was a decrease in fasting glycaemia, comparing the trained participants with the untrained demonstrating the efficiency of the suggested procedure.

After 8 weeks of CTT, resistance exercise outperformed endurance exercise in all important metrics, except SBP and VO_2max, and it was found that there were few differences between the responses elicited by the two types of exercise overall. Positive improvements in fat-free mass within total body composition were also more effectively influenced by resistance exercise. Surprisingly, considering the prevalence of advice, persons not already engaging in endurance exercise tend to benefit from it once their training has gone on for more than 16 weeks in modifying their insulin concentrations (Clark & Goon, 2015; Gebel, 2010). The results from Imamura, Shibuya, Uchida, Teshima, and Miyamoto (2004) indicated that CTT training leads to a significantly broader drop in DBP for females and males when all other factors are constant.

Exercise factors

Due to the increased demand for blood supply to working muscles during acute exercise, cardiac output tends to increase. Over time, sustained exercise causes the heart to grow bigger and stronger, enabling it to pump out more blood with each beat. Only a slight increase in HR is required to provide the muscles with all the nutrition they require if sufficient oxygen and blood supply are provided with each ejection. As a result, both during exercise and rest, aerobically trained exercisers have higher stroke volumes and lower HR (Harmsen et al., 2017; Sydo et al., 2014).

Neural and hormonal factors

According to research published in 2014 by Sydo et al., neurotransmitters and hormones can also affect cardiac output. The brain's impulses can boost cardiac output, as reported by Harmsen et al. (2017).

Other factors

According to Harmsen et al. (2017), there are a variety of other variables that have a role in determining both HR and stroke volume. Moreover, they found that factors such as age, gender, and setting can positively or negatively affect cardiac output. Both the maximum HR and the stroke volume often decrease with age. Because of the relative reduction in heart size in females, females often have greater cardiac outputs than males.

Waist-to-hip ratio

In addition to total body fat, abdominal adiposity is a more accurate predictor of obesity-related diseases than either body weight or BMI (Crump et al., 2017; de Koning, Merchant, Pogue, & Anand, 2007; Blumberg et al., 2019). Changes in waist circumference are connected with shifts in intraabdominal fat and, by extension, shifts in the health risk profile; hence they are frequently utilised as a surrogate marker of abdominal fat accumulation (de Koning et al., 2007). In a major meta-regression study of waist circumference and cardiovascular disease risk, it was found that a 2% increase in risk for CVD was associated with every additional centimetre of waist circumference (de Koning et al.,). These results are inverted to show that a combination of low and moderate intensity exercise was most effective in reducing waist circumference, and this is associated with a 5.5% reduction in CVD risk, followed by aerobic vigorous and aerobic moderate with a 4.5% and 4% reduction, respectively (Hosseinpanah, Barzin, Mirmiran, & Azizi, 2010). Furthermore, compared to low or moderate-load resistance training, the combination of low to moderate intensity exercise was more than two times effective in changing CVD risk, a finding that is consistent with Schwingshakl et al. (2013) but contradictory to Ismail et al. (2012).

Borg, Kukkonen-Harjula, Fogelholm, and Pasanen (2002) found a correlation between a lower WHR and a reduced risk of cardiovascular disease and other metabolic syndrome-related diseases. The percentage of men and women whose WHR stayed above the 0.5 cut-offs during a 24-week follow-up period after short sessions decreased, according to a study by (Bonfante et al., 2017). Those whose ratios stayed above 0.5 also saw a decrease in their average values. No matter the type of exercise regimen or whether or not the subjects reached a mean value of 0.5, all participants showed a decrease in their WHR. This decrease was statistically significant when comparing the beginning and ending points, although it showed no clear pattern of being faster or slower depending on the exercise protocol. Therefore, there is no difference between the two workout routines regarding modifying central adiposity and overall body composition when sex is considered.

It was also noted that the percentage of men and women whose WHR remained above the WHO cut-off of 0.9 and 0.85 during the short and long bouts of activity decreased by more than half. However, there was little to differentiate the two sorts of bouts (Donges et al., 2013). Short bouts were observed to reduce absolute values in the same way that long bouts did, even for persons whose values remained over the WHO criterion. Therefore, there was no discernable difference between the two workout programmes regarding WHR. Shorter sessions were just as beneficial as longer ones at lowering WHR and, by extension, the risk associated with abdominal obesity. Additionally, it was noticed that there was no statistically significant difference between the cases and controls in terms of the total thickness of the skinfolds or waist measurements. After adjusting for sex, there were no notable differences between the short and long regimes (Alizadeh et al., 2013).

Effect of exercise on physiological and anthropometric variables of men and women and age

HR (HR) responses to exercise were found to be significantly different in men and women in a study looking into the influence of exercise on HR. For men, the HR response was quite similar to the classic (220 - age) formula, while for women, the peak HR had a lower intercept and declined more slowly with age. It seems reasonable to use a different method to determine a woman's peak HR in females (Sydo et al., 2014). It has been observed that training results vary depending on one's gender (Marfell-Jones et al., 2006).

Long-term exercise stimulates the parasympathetic nervous system, leading to an increase in stroke volume and a decrease in resting HR. Myocardial oxygen consumption is a good predictor of HR (HR) during exercise because it reflects the heart's contractile condition (Thompson, Arena, Riebe, & Pescatello 2013). Themistocleous et al (2021) found that the relative pulsatility index (RPI) was lower in the CT group compared to the control group, with concomitant alterations in HR (HR), SBP (SBP), and DBP (DBP).

Long-term exercise was more effective than several shorter sessions in reducing the risk of metabolic syndrome and the atherogenic index in middle-aged obese women, according to a separate study. When reducing blood sugar or waist size, however, shorter exercise sessions were found to be just as effective as longer ones (Chung et al., 2017). Both single and multiple training sessions were equally effective at lowering body fat percentage by Alizadeh et al., (2021).

O'Donoghue et al. (2021) highlight the effectiveness of different types of training in lowering the percentage of body fat and urge for the combination of various exercise programmes to ensure a significant reduction in body fat. They believe that various exercise strategies may be useful for controlling body fat. When the trainer's body fat percentage drops below a certain threshold, taking into account their height, their BMI (BMI) decreases naturally since the numerator, weight, in calculating their BMI decreases (Kelley et al., 2015). Empirical research from studies like Min et al. (2019), Sattler et al. (2018), Xu et al. (2017) and Bhattacharyya, Dasgupta and Das (2015), and Atikovic et al. (2014) have shown that males and females react to exercise differently in terms of motivation and responses to weight-stigma. It has been discovered that training results vary depending on a person's gender (Sydo et al., 2014; Marfell-Jones et al., 2006). It was confirmed that more exercise leads to a lower body fat percentage (Bradbury et al., 2017). For an African urbanite, studies by Akindele et al. (2016), Ranasinghe et al. (2013), Meeuwsen et al. (2009), and Mills (2007) found a positive and statistically significant correlation between percent body fat and BMI (BMI) when controlled for gender and age ($r=0.81$, $P<0.01$).

Gender moderates the effects of training on DBP but only affects women in terms of SBP, according to studies by Paoli et al. (2013) and Lim et al. (2011).

According to research by Woo et al. (2006), training results vary depending on the participant's age.

Researching the linear dynamic link between SBP and DBP has a fairly straightforward justification. SBP is predicted to rise slightly for a given increase in DBP in a compliant artery. Therefore, the ratio of the rise in SBP to the rise in DBP provides a measure of arterial stiffness. In contrast, the rise in DBP (DBP) for a given rise in SBP (SBP) may be viewed as an indicator of arterial compliance (Gavish, Ben- Dov & Bursztyn 2008; Schillaci & Pucci., 2010). According to a related study by Kim et al. (2019) conducted on obese women, indicated that a Control Trial programme of sufficient duration and intensity can induce biochemical adaptations.

Donnelly, Hill, Jacobsen, Potteiger, and Sullivan (2003) found that the results of a study on body composition varied depending on the participant's gender. Research from Donnelly et al shows that even while both sexes benefit from exercise, men show a bigger body weight loss than women when the calorie deficit is the same, and the intensity is the same. While previous research on the benefits of ongoing exercising on body composition mainly involved males, this latest study covered both sexes.

Although the results of the meta-analyses by Schwingshackl, Dias, Strasser, and Hoffmann (2013) and Sykes, Choo, and Cotterell (2004) were not consistent, they both concluded that CTT improves body composition in the obese/overweight population. Similar improvements in body weight, BMI, and WHR were observed in the male participants of a study by Kim, Ko, Seo, and

Kim (2018) that lasted 8 for weeks. However, among the female participants, exercise did not affect body composition results. Once again, it was found that high-intensity, long-term training altered the body composition of overweight and obese males after 4 and 12 weeks of training (30-mins and 50-min per session, respectively). Overweight middle-aged males saw improvements in body composition after 8 weeks of moderate CTT (60 minutes per session) combined with green tea extract supplementation, and obese women had improvements in body composition after 12 weeks of moderate CTT. Longer exercise sessions result in a larger body fat loss in obese and overweight people, according to other research (Cornelissen & Smart, 2013).

Batacan et al. (2017); Vella, Taylor, and Drummer (2017); White et al. (2010) and showed that 2weeks of sprint interval training (6 sessions of 4-6 × the 30s and 4-5 mins recovery) improved insulin sensitivity, waist circumference and SBP (SBP) in overweight and obese men. Moreover, it was shown that overweight and obese women had a 12% increase in VO_2max, an 11.4% increase in stroke volume, and an 8.1% reduction in HR at rest following 4 weeks of sprint interval training (4-7 × 30s "all out" sprints and 4 mins recovery).

Controlled trials with progressive resistance [3x/week, 65-85% of 1 RM] (Kolahdouzi et al., 2019) or control trials protocols with greater intensities and frequencies were also associated with significant improvements in the lipid profile of obese men and overweight/obesity women. Middle-aged, overweight men improved their lipid profiles after participating in high-intensity CTT for 12 weeks at three or more weekly sessions (Paoli et al., 2013; Seo, Noh, & Kim, 2019).

Theories of Exercise Participation

The foundation of study for centuries, theories and models are based on tested assumptions. Research hypotheses might then be stated and tested based on these results (Sharples et al., 2016). Theories offer a foundation for comprehending the motivations for and barriers to exercise participation of individuals. Health and fitness experts, public health officials, clinical exercise therapists, and medical doctors can all benefit from utilising relevant theoretical frameworks when formulating interventions designed to encourage patients to embrace and maintain regular physical activity (Rothman, 2014). A wide variety of fields use behavioural theories, and studying people's motivation to exercise is no exception (Locke & Latham, 2019). The "social cognitive theory," the "transtheoretical model," the "health belief model," the "self-determination theory," the "social-ecological theory," and the theory of planned behaviour are only a few examples.

Social cognitive theory

Bandura's Social Cognitive Theory (SCT) was first proposed in 1986. The SCT is a thorough theoretical framework widely applied to the study, description, and modification of physical activity patterns. Individual "(emotion, personality, cognition, biology), behaviour (past and present achievement), and environment (physical, social, and cultural)" interact to impact future behaviour; this is the basis of “Social Cognitive Theory (SCT)” (Bandura & Hall, 2018). For example: if you start exercising and feel good about yourself, you might feel motivated to keep going.

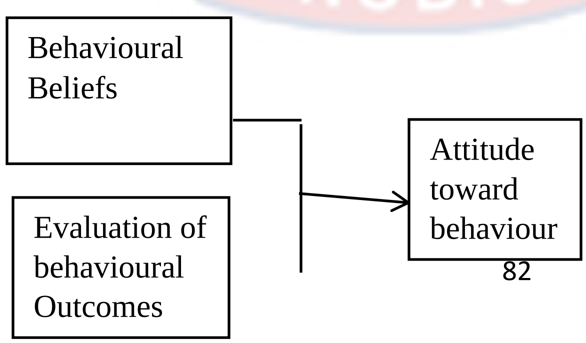
Moreover, it motivates them to alter their surroundings to make working out easier (for example, buying home exercise equipment). SCT revolves around self-efficacy, which is confidence in one’s ability to carry out a desired action (Bandura & Hall, 2018). If we are talking about exercise behaviour, there are two main kinds of self-efficacy to consider (McAuley & Blissmer, 2000). When someone has high task self-efficacy, they are confident in their ability to perform the desired behaviour. The term “self-efficacy” describes a person’s confidence in their ability to consistently exercise despite typical obstacles. An individual’s effort, persistence, and resilience will increase in proportion to their belief in their abilities. The way one feels and acts is also influenced by their sense of self-efficacy (McAuley & Blissmer, 2000).

One of the key ideas of SCT is outcome expectation, which involves looking ahead to the consequences of a behaviour (Wojcicki, White, & McAuley, 2009). Valued consequences increase the likelihood of adopting new behaviours (Williams, Anderson, & Winett, 2005). Consider the case where, for instance, gains in muscular strength and size are desired. Resistance training, rather than cardiorespiratory fitness, is more likely to be followed in such a situation. Individuals who successfully start and maintain a regular physical activity programme have high levels of self-efficacy and positive outcome expectations. That is, individuals need to believe they can complete the physical action, both in terms of their current physical condition and their ability to overcome barriers, and that the behaviour will result in something they value (Bandura & Hall, 2018).

Theory of planned behaviour

It was proposed in 1986 by Ajzen and Madden and is known as the Theory of Planned Behaviour (TPB), which states that the key factor is whether or not an individual acts with an intention to do so (Ajzen, 2012). One's likelihood of really exercising might be inferred from their stated intentions. Unfortunately, problems with behavioural control mean that intentions do not always lead to actions (Cooke & Sheeran, 2004). Attitudes, subjective norms, and an individual's sense of agency all shape their plans. One's attitude toward exercise is thought to be a reflection of the TPB's affective and evaluative aspects. Individuals' thoughts that others want them to exercise and the incentive to comply with the demands of significant others are the two variables used to calculate or determine subjective norms, the social component tested by surveys.

An individual's perception of his or her ability can regulate his or her behaviour in a given situation. Put another way; someone plans to be physically active if they think it will improve their health, make them happy, be respected by people whose opinions they hold in high regard, and be within their power to implement. While intentions are the most important predictor of behaviour, it has been hypothesised that a person's sense of agency directly affects their actions. For this correlation to have any meaning, it is hypothesised that perceived control must accurately reflect actual control over a nonvolitional behaviour. For instance, when the weather is bad, people tend to feel less in control of their workout routines. Individuals may intend to exercise frequently, but if rain is in the forecast, that sense of control over the environment may prevent them from doing so. The TPB's capacity to foretell future exercise decisions and habits have been empirically confirmed (Blue, 1995). An improvement in the correlation between exercise-related thoughts and actions may result from developing implementation goals. Individuals' implementation intentions reveal their particular exercise plans, including when, where, and with whom they intend to work out (Armitage & Sprigg, 2010). Figure 1 represents the theory of planned behaviour:



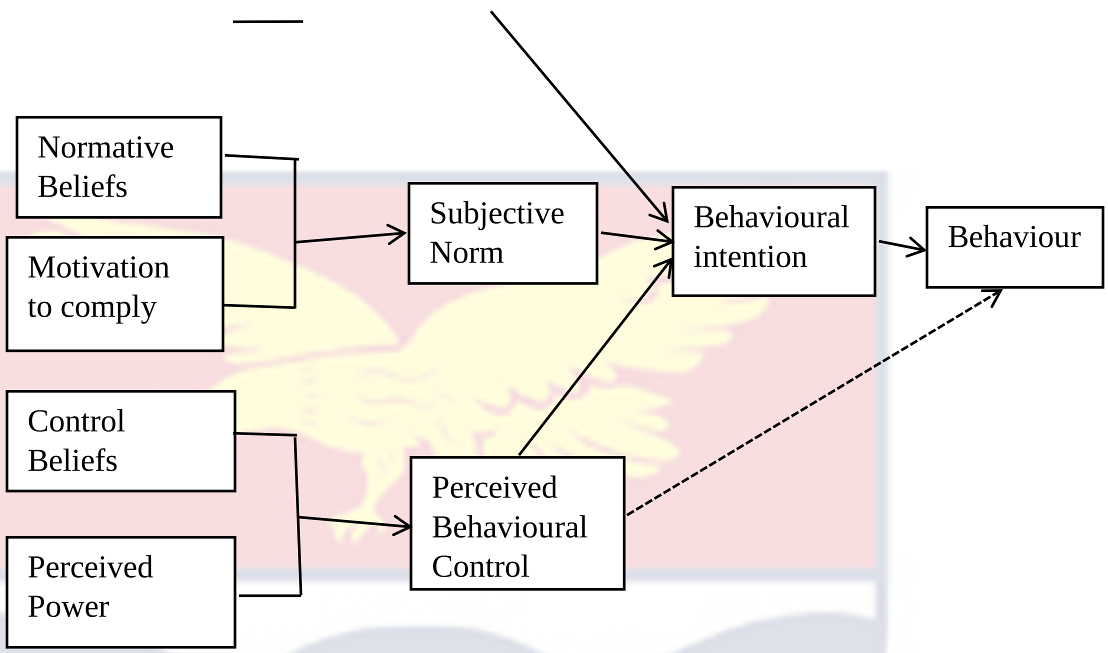


Figure 1: Theory of Planned Behaviuor (Ajzen, 2012)

Social-ecological

Ecological models are conceptualizations rather than formulas since they focus on the relationships between ecological factors (Dishman, Washburn, & Heath, 2004). Due to their emphasis on the interdependence of humans and their ecosystems, social-ecological models are crucial. Ecological models are distinguished by their recognition of the connections between people and their surroundings (Sallis & Owen, 2002). The premise of this study is that personal variables, elements in the social environment, factors in the physical environment, and policies all play a role in shaping people's health-related behaviours.

Knowledge, attitudes, behaviours, beliefs, perceived hurdles, motivation, enjoyment, skills, and self-efficacy are all parts of one's inner world that contribute to their success in a given situation (age, sex, education, and socioeconomic and employment status). The elements of the physical environment include things like the local climate and topography, the ease with which one can get to fitness centres, the beauty of the area and how it is perceived, the security of the neighbourhood in terms of things like crime rates and traffic patterns, and the accessibility of public transportation. Things like weather and topography, for instance, can have an impact on people's propensity to go for regular runs and vice versa. Family, friends, classmates, schools, workplaces, and community organisations play a role in a person's social environment, as do the availability of social support, the sway held by medical experts, social conventions, and cultural background. The policy comprises urban planning, health, environmental, employment legislation and educational initiatives like mandatory physical education.

One's actions can be affected by the environment in both direct and indirect ways. The use of multiple intervention levels is highlighted by this methodological approach (Sallis & Owen, 2002). Although it is essential to focus on specific individuals, an exercise intervention will fail if the surrounding environment does not support a healthier way of life. If a person feels uncomfortable in their neighbourhood, it may not help to suggest that they take three walks around the block each week. Alterations to the physical setting (such as the addition of walking pathways) that fail to take into account the unique qualities of each exerciser (such as an elderly person with limited mobility) are unlikely to succeed in changing their behaviour.

Conceptual Framework

Physical exercise is one of the components of the acquisition, maintenance, improvement, or restoration of health and fitness (Tipton, 2014). The FITT theory of exercise prescription emphasises the need to exercise at the right frequency, intensity, duration, and format. The FITT principle allows exercise prescriptions to be tailored to a certain demographic; thus, it is important to know how different prescription versions might affect people's likelihood of regularly becoming or being physically active. The frequency and time/duration of workouts can be mixed and matched at the prescriber's discretion. Adjustment in recommended time/duration and exercise volume was widely believed to help people overcome the most common reason for not exercising regularly: a lack of time (Pate et al., 1995).

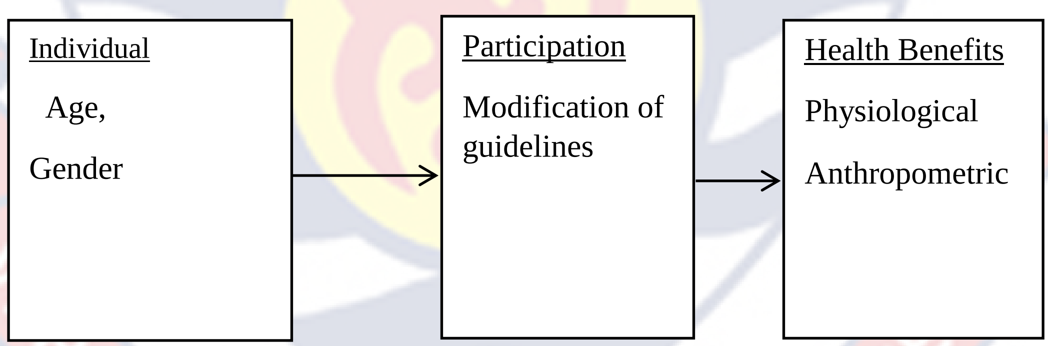


Figure 2: Conceptual Framework

However, the physiological characteristics of maintaining fit in club members are depicted in this study's conceptual framework, which aims to understand the effect of exercise of longer durations on these individuals (see Figure 2). The model depicts the connections between the individual characteristics and participating in an exercise programme and enjoying its benefits. The framework have three boxes with arrows connecting them in a linearly.

The first box is indicated as individual with age and gender as its characteristics. Within the individual, the researcher is looking at how age and gender influence exercise participation and the benefits of engaging in exercise participation and the benefits of engaging in exercise. It will indicate wether the age and gender of the individual play a role in the outcome of health benefits.

The second box depicts participation in an exercise programme. It is established that an individual must follow the required guidelines in terms of frequency and duration in order to get health benefits of exercise. However, individuals modify the approved guidelines of time and frequency due to various reasons to participate in exercise programme. Therefore in participating in an exercise programme, one may follow the approved guidelines or modify the approved guidelines. The second arrow leads to the third box that is characterized by the health benefits of exercise. An exercise produced results that may be classified as physiological and anthropometric. These are the health benefits that one is able to acquired when participate in an effective exercise programme. It is the health benefits that motivates individuals to participate in an exercise programme.

The first Hypothesis examines the association between the physiological and anthropometric health markers among the participants. Physiological variables were used to assess the subjects' health. Dominic, Abolarin, Seidina, Atikumi, and Ahmed (2019) studied the body composition and health of civil servants in Efon local government, Ekiti State, Nigeria, and discovered that there was a substantial interaction between physiological markers in predicting body composition and health. On top of that, there is a strong correlation between exercise and better health. Hypothesis 2 seeks to find if there was any significance difference between the approved guidelines and the modified guidelines in relation to health markers. Hypothesis 3 seeks to find the effects of age on the health makers after modifying the guidelines on the individuals. Hypothesis 4 also examined wether gender had any influence on the health makers. The results were expected to show if there is any significant difference. Changing the workout's duration, intensity, or both can boost participation and adherence to the practice (Wineett, Williams, & Davy, 2009). Figure 2 above is a diagrammatic representation of the connections between these hypotheses.

Principles and Guidelines of Physical Exercise

Exercising consistently is one of the most crucial things one can do for one's general health. It is preferable for an individual's exercise training programme to be tailored to the person's specific needs. Cardiorespiratory fitness (aerobic fitness), muscular strength and endurance, flexibility, body composition, and neuromotor fitness are all aspects of physical fitness that relate to health (Owen et t al., 2010). The individual must comply with the fundamental principles to gain the benefits of physical exercise (Robergs & Roberts, 2000).

How often, how intensely, for how long, and what kind of activities are used in the edition of the Guidelines (mode or what kind)? The American College of Sports Medicine (2014) endorses the guidelines given in its complementary evidence-based position stance, which include the Frequency Intensity Type Time – Volume and Progression (FITT-VP) principle of exercise prescription, or the total volume (quantity) and progression (advancement) (Garber et al., 2011). The United States Department of Health and Human Services, the National Institute on Aging, and the United States National Institutes of Health (USDHHS, 2008) all have exercise recommendations that are compatible with the provided standards.

The physiologic, psychological, and health effects of exercise are accounted for in the FITT-VP principles of exercise prescription (Ehrman, 2009). However, due to significant inter-individual variability in the degree of responsiveness to a given exercise programme, the expected reaction in some people may not be realised in others (Garber et al., 2011). It is also possible that factors unique to each person, such as their health, physical capacity, age, and performance objectives, preclude the application of the FITT-VP principle of exercise prescription. Therefore, it is recommended that modifications be made to the exercise prescription for people with clinical disorders and healthy people with unique considerations.

However, a few more overarching concepts in exercise prescription can help one get the most out of one's exercise routine and get the advantages one is hoping for. One of the tenets is using the exercise prescription in a standard way to cut down on musculoskeletal problems and injuries. The warm-up, cool-down, stretching, and steady increase in volume and intensity are all part of a wellrounded workout (Garber et al., 2011). Another principle is to reduce the high risk of cardiovascular disease (CVD) complications, which is of utmost importance in middle-aged and older adults, by (a) performing the necessary preparticipation health screening and evaluation procedures, (b) starting a new exercise programme at a light to moderate intensity, and (c) using a gradual progression in the quantity and quality of exercise (Garber et al.). Loading exercise, or weight-bearing and resistance exercise, is recommended by the American College of Sports Medicine (ACSM) to keep bones healthy, especially in people who are at risk for low bone density (WHO, 2013; ACSM, 2009: 1995; McMillian et al., 2006), a problem that affects both younger and older people. The FITT-VP principle of exercise prescription should be tailored to the specific needs of each client or patient in terms of their goals, physical ability, physical fitness, health condition, timetable, physical and social environment, and available equipment and facilities.

Components of the exercise training session

Each workout should consist of a warm-up, some form of conditioning or sports-specific training, an active cool-down, and a stretching period (Garber et al., 2011). During the warm-up, exerciser should do some light to moderate aerobic and muscular endurance work for at least 5-10 minutes. The body needs time to adapt to the new physiologic, biomechanical, and bioenergetic demands of an exercise session's conditioning phase, which is what the warm-up is for. Warming up is recommended to lessen the likelihood of injury and increase ROM (Bassett et al., 2010). A dynamic cardiorespiratory endurance exercise warm-up is essential for improving performance in cardiorespiratory endurance, sports, or resistance exercise, especially with several repetitions (Armstrong, Brubaker, Whaley, & Otto, 2005). Aerobic, resistance, flexibility, neuromotor, and/or sports activities are part of the conditioning phase. The exercise program's pillars are carried out in this stage per the FITT-VP principle's guidelines. After the conditioning portion, the cool-down phase consists of 5-10 minutes of low-to-moderate intensity aerobic and muscular endurance activities. The HR (HR) and blood pressure (BP) can recover, and metabolic waste products from the working muscles can be flushed out during the cool-down phase of a more strenuous exercise routine. Since warming the muscles increases ROM, the stretching phase comes after the warm-up or cool-down phase or even after applying heat packs (Garber et al., 2011).

Frequency of Aerobic (Cardiorespiratory Endurance) Exercise

Exercise's health and fitness benefits depend critically on how often one work out (WHO, 2021; USDHHS, 2008). Frequency refers to how often one engages in physical activity, usually expressed as a percentage of the total number of days in a given week. On average, adults should engage in aerobic activity three to five days per week, base on the fitness goals of the participants (Physical Activity Guidelines Advisory Committee Report, 2018; Nelson et al., 2007). Three days per week of exercise slows the improvement in cardiorespiratory fitness, while five days per week increases the improvement altogether. Most adults are not recommended to engage in vigorous-intensity physical activity five days per week due to the risk of musculoskeletal damage (Garber et al., 2011).

However, the workout plan could incorporate activities like running and cycling, or the use of separate muscle groups, as in the case of a swimming and running routine. Another option is to exercise 3–5 days a week at moderate and intense intensities (Haskell et al., 2007). Some people may see health/fitness benefits by exercising twice weekly at a moderate-to-vigorous intensity, especially with large quantities of exercise, as is common in the "weekend warrior" pattern of exercise (Garber et al., 2011). The risk of musculoskeletal injury and unfavourable cardiovascular events is higher in people who are not physically active consistently and in those who engage in unaccustomed exercise, hence prescribing exercise 1-2 times per week is not suggested for most adults despite the potential advantages (Owen et t al., 2010)

Intensity of aerobic exercise

Intensity is how hard an exercise programme is. Intensity is classified as light, moderate and vigorous (Garber et al., 2011). Aerobic exercise intensity recommendation is as follows: light is 30%-40% of HR reserve (HRR) or VO_2R, moderate is 40%–60% of HRR or VO_2R, vigorous is 60%–90% HRR or VO_2R and "near maximal" 95%–100% of HRR or VO_2max) (ACSM, 2014). Aerobic exercise should be performed at a moderate to vigorous intensity by most adults and a light intensity by those who are out of shape.

Increasing the intensity of your workout has a favourable dose-response on health and fitness (Peterson, Rhea, & Alvar, 2005). According to the overload concept of training, changes in physiologic parameters, such as an increase in maximal oxygen consumption (VO_2max), cannot occur with the exercise below a certain threshold (Garber et al., 2011). However, new research shows that the intensity threshold at which the body begins to reap benefits from exercise varies with each individual's baseline cardiorespiratory fitness. Furthermore, exercise intensity is affected by age, health, physiologic variances, heredity, levels of a sedentary lifestyle, and social and psychological factors (Swain & Franklin, 2002; Swain & Leutholtz, 1997). As a result, pinpointing a specific threshold at which cardiorespiratory fitness begins to improve may prove extremely challenging. "For example, individuals with an exercise capacity of 11–14 metabolic equivalents (METs) seemingly require an exercise intensity of at least 45% oxygen uptake reserve (VO_2R) to increase VO_2max, but no threshold is apparent in individuals with a baseline fitness of 11 METs (Peterson, et al., 2005). In addition, highly trained athletes may need to exercise at near maximal (that is, 95%–100% VO_2max)" training intensities to improve VO_2max, whereas 70%–80% VO_2max may provide a sufficient stimulus in moderately trained athletes (Swain, & Franklin, 2002; Swain, & Leutholtz, 1997).

In interval training, the intensity of an exercise is progressively decreased and then increased at regular intervals throughout a single workout. The goals of the training session and the client's or patient's current fitness level will determine the optimal interval length and intensity. Interval training is a great way to boost workout's overall volume and/or average intensity. In healthy adults and people with metabolic, cardiovascular, or pulmonary disease, short-term interval training improves CRF and cardiometabolic biomarkers comparable to or greater than those seen with single-intensity exercise (Swain, 2014). As a result, it seems that interval training is useful for adults.

Methods of estimating the intensity of exercise

Different effective methods for prescribing exercise intensity to improve cardiorespiratory fitness can be recommended for individualised exercise prescriptions (Swain, 2014). No study has directly examined all of the ways used to gauge exercise intensity simultaneously so that different approaches may yield different results. Furthermore, exercise test protocol, exercise mode, exercise intensity, and characteristics of the client, that is, resting HR, physical fitness level, age, and body composition, can significantly alter the relationships between measures of actual energy expenditure and the absolute (that is, VO_2 and METs) and relative methods to describe exercise intensity (that is, %HRR, %HRmax [maximum HR], and %VO_2max) (Swain, & Franklin, 2002). Because the HR (that is., %HRmax) and VO_2 (that is, %VO_2max) methods might under- or overestimate exercise intensity, the HRR and VO_2R approaches may be preferred for exercise prescription (Swain, 2000). When estimating one's maximum HR, the "220-age" formula is often utilised (Fox, Naughton, & Haskell, 1971). Although straightforward, this approach has the potential to either under- or overestimate the true HRmax (Gellish et al., 2007; Gulati et al., 2010; Tanaka, Monahan & Seals, 2001; Zhu, Suarez-Lopez, & Sidney, 2010). For some people, at least, specialised regression models may provide more accurate estimates of HRmax than the conventional 220-age formula (Gellish et al., 2007; Hawkins & Wiswell, 2003). Directly measuring HRmax is preferable to estimated methods for evaluating exercise intensity when writing an exercise prescription due to its superior accuracy; nonetheless, the calculation of exercise intensity is acceptable in cases where direct measurement is impossible.

Absolute exercise intensity can be approximated or evaluated through kilocalories burned per minute, millilitres or litres of oxygen consumed per minute, and metabolic equivalents of effort (METs). Due to the fact that they do not account for contextual variables like a person's size, gender, or degree of fitness, absolute measures might lead to incorrect classification of exercise intensity (for exmple, moderate and vigorous intensity) (Howley, 2001; Ainsworth et al., 2000; Ainsworth et al., 1993). For instance, a senior citizen working at 6 METs may exercise vigorously to maximum effort. A younger worker will only get a mild workout at the same absolute intensity level. Therefore, a relative measure of intensity, and thus the energy cost of the activity compared to the individual's maximal capacity, such as % VO_2 [that is, VO_2 mL.kg-1.min-1], HRR, and VO_2R are more appropriate for individual exercise prescribers, particularly older and deconditioned individuals (Howley, 2001; Nelson et al., 2007). Because exercise training intensity is typically determined as a range, it is necessary to perform the aforementioned calculations twice: once for the lower limit of the desired intensity range and once for the upper limit.

Exercise time (duration)

The amount of time spent exercising is typically recommended by doctors (time sessions per day and week). Exercises of moderate intensity should be performed for 30-60 minutes per day (150 minutes per week) by adults, whereas exercises of strong intensity should be performed for 20-60 minutes per day (75 minutes per week) by adults alone or in combination (Garber et al., 2011; USDHHS, 2008). A research suggests, however, that even less than 20 minutes of exercise every day can have positive effects, especially for sedentary people (Garber et al., 2011). Those who engage in many sedentary behaviours may benefit from exercising for extended periods (60–90 minutes a day) to maintain their current weight (Donnelly et al., 2009). In other words, the physically active time/duration can be completed in one continuous session or broken into multiple shorter sessions. Daily exercise need only be performed in bouts of at least 10 minutes each. Beneficial changes may occur in severely under-conditioned people after only 10 minutes of exercise (Garber, Blissmer, & Deschenes, 2011).

Concept of Fitness and Fitness Clubs

A person's level of physical fitness reflects their general health and capacity for physical activity. As stated by the President's Council on Physical Fitness and Sports (2005), these aspects of fitness can be grouped into two categories: health and competence. Cardiorespiratory endurance, body composition, muscular strength, muscular endurance, and flexibility are all aspects of physical fitness that contribute to one's overall health. One's cardiorespiratory endurance can be defined as their heart and lungs' capacity to maintain a steady flow of oxygen during extended exercise. The proportions of muscle, fat, bone and other tissues that make up an individual's body composition are a fascinating topic of study. The capacity of muscle groups to apply force is what is meant by "muscular strength." Muscular endurance refers to a muscular group's resistance to fatigue while exertion. Increased range of motion at a joint is what we mean when discussing someone being flexible.

Agility, coordination, balance, power, response time, and speed are all physical fitness factors directly associated with a person's skill level. Quickly shifting one's body position while in motion is a hallmark of agility. Coordination integrates sensory information from different sources, such as vision and hearing, with motor actions to achieve a unified goal. The capacity to keep from tipping over in either a standing or moving position is known as balance. The ability or speed with which a task can be completed is what we mean by "power." "Reaction time" is the time between when something triggers a response and when that response begins. Speed is the time it takes to complete a certain movement (USDHHS, 2008).

The primary goal is health-related fitness, defined as the components of physical activity that impact a person's functional health or the efficient functioning of all body systems to maintain health. "Degenerative diseases such as coronary heart disease, obesity, and a wide range of musculoskeletal disorders, cardiovascular disease, cardiovascular disease, low back pain, ischemic heart disease, renal failure, and hypertension are thought to be prevented by certain aspects of physiological and psychological functioning." Low energy expenditure typical of a sedentary lifestyle is thought to have a role in the development of many disorders, hence the term "hypokinetic" (Cardinal, 2016). The health benefits of physical fitness include a reduced risk of chronic disease and other health issues, improved capacity to conduct daily activities, and enhanced quality of life (President's Council on Physical Fitness and Sports, 2000).

The primary function of a fitness club is to provide clients with exercise and weight loss programmes, including the sale of instruction, training, or assistance in these endeavours. These programmes may or may not include whirlpool baths, weight lifting rooms, massage rooms, steam rooms, or other exercise weight reduction machines or devices (Siedentop, 2004). The act of working out together is something that many individuals enjoy doing. If you want to boost your physical activity, joining a group is a great way to meet other people and get the motivating feedback you need to get started. Professional trainers can guide, inform, and inspire their clients to execute the right exercises at the right times, increasing the likelihood of positive results. Another perk of group programmes is that participants are more likely to stick to the programme's established routine, which increases the likelihood that they would include physical activity in their daily lives (President's Council on Physical Fitness and Sports, 2005).

Importance of Physical Exercise

The advantages of exercise are undeniable, and the hazards are minimal compared to the benefits for the vast majority of individuals, according to the scientific literature (Garber et al., 2011; Physical Activity Guidelines Advisory Committee Report, 2018). Exercising regularly is associated with numerous health benefits, which have been extensively studied. Exercise has been shown to improve physical and mental health, as well as increase longevity (Pescatello et al., 2014; ACSM, 2010; McCarley & Salai, 2007; Mainous et al., 2007; Berry, Mayer et al., 2007; Figuero et al., 2007; Naylor & Whart-Higgins, 2005; Bhui, 2002). Regular exercise encourages healthy habits and decreases risky ones, like smoking, drinking, and drug use (Lankenau, Solari, & Pratt, 2004). Therefore, in many industrialised countries, including the “United States,” the “United Kingdom,” and “New Zealand,” encouraging regular physical exercise participation has been a public health priority (Sinclair, Hamlin, & Steel, 2005; USDHHS, 2010). According to ACSM (2003), the best strategy to get individuals to start exercising is to highlight the numerous advantages of doing so.

The benefits of exercise extend beyond the body and into the mind, as stated by Morgan and Dishman (2001). According to the Canadian Fitness and Lifestyle Research Institutes [CFLRI] (2005), physical activity is associated with positive psychological and interpersonal outcomes. According to the WHO (2018), regular exercise has monetary and health benefits. The World Health Organization summed up the significance of exercise by listing its positive effects on one’s body, mind, wallet, and emotions.

Physiological benefits

Numerous studies have linked regular exercise to a lower risk of death from any cause, heart disease, type 2 diabetes mellitus, colon cancer, and osteoporosis (Kesäniemi et al., 2001). Several studies have found that high levels of physical activity reduce mortality rates in the elderly (Bijnen et al., 1999; Glass, de Leon, Marottoli, & Berkman, 1999). Regular exercise reduces the risk of cardiac arrhythmias after strenuous activity (Mittleman et al., 1999; Willich et al., 1999). In addition, cardiovascular disease, hypertension, and diabetes are just some of the many physical ailments that can be prevented or treated with a regular exercise routine (Berlin & Colditz, 2000; Gordon, Scott, Wilkinson, Duncan, & Blair, 2000; Morris, Clayton, Everitt, Semmence, & Burgess, 2000). The health benefits of regular physical activity are enormous and persist throughout a person's life, regardless of age or level of physical ability. For people in their middle years and beyond, physical activity presents some of the best chances to live a healthy, independent life for longer, to lessen the likelihood of impairment, and to enhance their quality of life (Atienza, 2001; Eakin, 2001; Linnan & Marcus, 2001; Stewart, 2001; USDHHS, 1996). The human body responds to the stress of exercise by undergoing a cascade of coordinated changes in function involving virtually all of its physiological subsystems (including the cardiovascular, neurological, musculoskeletal, endocrine, immunological, and metabolic networks) (USDHHS 2010).

Benefits of exercise on cardiorespiratory system

The cardiorespiratory system's principal role is to deliver oxygen to the body's tissues and organs. Nutrients function to rid the body of carbon dioxide and other metabolic wastes, regulate body temperature and acid-base balance and carry hormones from the endocrine system to their intended tissues (Guyton & Hall, 2000; Tanaka, Monahan, & Seals, 2001). Increased demands on the cardiovascular and respiratory systems are met predictably. Oxygen absorption increases linearly with increasing work rates; hence it is directly related to the oxygen demands of skeletal muscle (McArdle, Katch, & Katch, 2000).

Engagement in physical exercise inproves the cardiorespiratory system. Efficiency of the cardiorespiratory system leads to better oxygen supply to working muscles therebypromoting cardiac hypertrophy, increase in alveoli and capillaries members involving in gaseious exchange as well as increase in stroke volume and beller ventilator capacities. Physical activity and exercise programmes or lifestyle influence cardiovascular health.

It has been shown that cardiovascular disease risk can be lowered by engaging in regular physical activity. In addition, it can ameliorate the effects of traditional cardiovascular disease risk factors such as diabetes, hypertension, obesity, dyslipidemias, and endothelial dysfunction (Mainous et al., 2007). Ischemia in the heart muscle and a decline in ventricular pumping ability are consequences of coronary atherosclerosis, which reduces blood flow through the coronary arteries. During exercise, skeletal muscles in heart-failure patients exhibit low amounts of creatine phosphate, excessive lactate, and low percentage Hydrogen (pH) values (Wilson, McCully, Mancini, Boden, & Chance, 2000). Hyperkinetic cardiovascular reactions heightened sympathetic drive, and weakened skeletal and respiratory muscles are all symptoms of heart failure (Chua, Anker, Harrington, & Coats, 1995; Lindsay et al., 1996; Meyer et al., 2001). Patients with respiratory problems often have a low resting pulmonary capacity, making it hard to predict how they will respond to exercise (Jones & Killian, 2000). Therefore, lowering blood cholesterol through exercise is one-way physical activity benefits the cardiorespiratory system (Mainous et al., 2007).

Musculoskeletal system and exercise interaction

Muscles and the skeleton's connective tissue elements comprise the musculoskeletal system, part of the motor system's periphery (Rees et al., 2007). Muscle serves to shape and propel the human body, as well as to provide efficient and effective force. In order to fulfil your needs, the requested muscle group will adjust its oxygenation, substrate preference, and waste elimination. "Nutrient fatigue," a result of repeated, strenuous muscular contractions, is virtually directly proportional to the rate of muscle glycogen depletion (Guyton & Hall, 2000; McArdle et al., 2000). Therefore, the majority of cases of muscle fatigue are brought on by the contractile and metabolic processes of the muscle fibres becoming unable to keep giving the same level of work output. However, with severe and sustained muscle activity, the neuromuscular junction's ability to transmit nerve signals might deteriorate, further lowering muscle contraction and leading to "neural exhaustion" (Guyton & Hall, 2000; McArdle et al., 2000). In order to keep up the necessary force production for the activity, the body must recruit more motor units when muscle function declines throughout the continuous exercise (McArdle et al., 2000; Rees et al., 2007).

Therefore, regular exercise can help strengthen muscles and bones, which is essential for maintaining the bodily functions that rely on them. During vigorous exercise, muscle contractions can be maintained at a high rate for extended periods, producing additional energy to sustain bodily functions. Although osteoporosis is more common as people age, a healthy skeleton can help preserve muscle mass and slow the disease's progression (Pi-Sunyer, 1999). It is not uncommon for people with musculoskeletal diseases to be overweight, with correspondingly low muscle strength, endurance, and cardiovascular fitness (Ries, Philbin, & Groff, 1995). Samaras, Kelly, Chiano, Specrov, and Campbell (1999) concluded that a lack of physical activity is the most common cause of obesity.

Endocrine system and exerciseinteraction

At rest and during activity, the endocrine system plays an important role in sustaining homeostatic conditions by integrating physiological responses (Guyton & Hall, 2000). The pituitary, thyroid, parathyroid, adrenal, pineal, and thymus glands are all examples of endocrine organs. Endocrine tissue is not limited to the endocrine glands; it can also be found in other organs. The hypothalamus, gonads, and pancreas all fall within this category (McArdle et al., 2000). The pace at which hormones are secreted varies. It has to be tweaked on the fly to keep up with the ever-evolving body needs. The amount of a given hormone in the blood depends on how much of that hormone is synthesised in the host gland and how much is secreted into the bloodstream.

The endocrine system can be triggered hormonally, comedically, and neurally (McArdle et al., 2000). Hormonal responses in the bloodstream to exercise might be swift, moderate, or slow (Viru, 2000). Rapid activation of endocrine function is associated with the activities of nerve centres and a rapid transfer of neural influences to the endocrine glands. Some hormones, such as catecholamines, are secreted at a higher rate in reaction to physical activity (USDHHS, 1996). The regulation of the circulatory system and the metabolism of the working tissues are linked to secretion. The hypothalamus-pituitary-adrenal (HPA) axis is responsible for maintaining and regulating cortisol production and secretion in the central nervous system (CNS). Adrenocorticotropic hormone (ACTH) rises in reaction to physical exercise, which causes cortisol to rise 20-30 minutes after the stimulus has ended (Schwartz & Kindermann, 2000; Kuhn, 1999). Intense and prolonged exercise elevated plasma ACTH and cortisol concentrations. Researchers, Pestell, Hurley, and Vandongen (1999) showed that the key mediators of the stress response—catecholamines and the hypothalamic-pituitary-adrenal axis—were considerably altered as a model of persistent physical stress. Unlike untrained people, whose levels of conjugated catecholamines drop and ACTH rise in response to intense exercise, trained people's responses are quite different. Possible hormonal response to stress over time.

Changes in testosterone levels due to exercise result from either a shift in production rate or a shift in binding or clearance. There may be more than one mechanism here (haemoconcentration, decreased hepatic blood flow, etc.). (Tremblay, Chu, & Muneika, 2003). Changes in serum testosterone concentration during prolonged exercise can result from either direct testicular suppression or mediation at the hypothalamic-pituitary level (Tremblay et al., 2003). Therefore, according to Tanaka, Cléroux, de Champlain, Ducharme, and Collu (1999), regular exercise promotes optimal endocrine system performance by keeping all gland ducts in good condition (Guyton & Hall, 2000).

Immune system and exercise interaction

According to Brandes, Klauschen, Kuchen, and Gemain (2013), regular exercise promotes health and, by extension, a robust immune system. According to Brandes et al., the immune system is the body's coordinated response to invading organisms. Infectious agents like bacteria, parasites, and fungi are the most common types of foreign bodies. The immune system creates antibodies in response to antigens. The immune system benefits from both external and internal causes. Exercising is one way to improve the immune system. The effects of exercise are immediate (USDHHS, 2012). Workouts have a short-term detrimental effect on cell strength. In order to compensate for the deficit, the body exhibits signs of weakness. The immune system is bolstered by constant adaptation following exercise and rest. Continuous antibody production in response to physical weariness allows some resistance to develop. The body's capacity for super-compensation ultimately makes it so powerful. According to Branders et al (2013), regular exercise can boost a person's immunity by as much as 18%. Chemicals and other external elements both help with immunity.

Metabolic system response to exercise

The term "metabolism" refers to the biological process by which the body metabolises food and other organic molecules (Gibbs, 2006). The prevalence of metabolic health issues such as Type 2 diabetes has skyrocketed during the previous decade (Trayhurn & Beattie, 2001). Diabetes is a disease in which insulin resistance prevents the body from using sugar as energy. There is a correlation between obesity and Type 2 diabetes. According to Gibbs (2006), obese adults have a higher risk of hypertension and dyslipidemias (high total cholesterol, triglycerides, low-density lipoproteins, and low high-density lipoproteins) and insulin resistance. According to Trayhurn and Beattie (2001), the likelihood of developing diabetes increases with body fat. According to Trayhurn and Beattie, adipose tissue secretes a chemical called resistin, which is said to produce insulin resistance, connecting diabetes and obesity. Obesity is associated with an increased risk of developing Type 2 diabetes, as pointed out by Stephens, Cai, Evenson, and Thomas (2002). When it comes to lowering one's chance of developing diabetes, Bryner et al. (1999) found that exercise was particularly effective. Obesity can be lowered with regular exercise, which is one of the best ways to burn calories. This aids weight loss and maintenance by decreasing the amount of resistant fat tissue.

Exercise may provide substantial health benefits, as suggested by Sjodin, Forslund, Westerterp, Anderson, and Hambraeus (2006) and WHO, 2011. USDHHS (1996) reported in the Surgeon General's Report on how exercise is becoming vital in the prevention and treatment of many chronic diseases. According to a study conducted on obese individuals, Joyner (2003) found that weight loss brought on by exercise had the potential to alleviate metabolic syndrome symptoms. There is a strong correlation between physical activity and weight reduction regarding health advantages. Regular exercise is highly suggested for people of normal weight as a preventative measure, both for the prevention of weight gain and the prevention of regaining lost weight during a weight-maintenance programme. Preventing obesity or excess weight is preferable to treating it, as is often acknowledged.

Reasons for not Exercising

Many people opt out of exercising because they claim they do not have the time, energy, or motivation to do so, despite the many positive outcomes that can result from regular physical activity on social, physical, and mental health (Canadian Fitness and Lifestyle Research Institute, 2005). "There are considerable discrepancies in the reasons people give for not exercising based on age and gender, according to a population-based survey of nearly 2,200 people aged 18-78 (Netz, Zeev, Arnon, & Tenenbaum, 2008). Older adults (60 – 78) cited more health-related reasons (for example, bad health, injury or disability, potential damage to health) for not exercising than their younger counterparts. Furthermore, compared to men, women selected more internal barriers (e.g., lack of self-discipline); since these are not readily amenable, this poses a difficult problem regarding adherence to exercise programmes for these women.

For an adolescent, some significant barriers to participation in physical activity involve other factors such as lack of parental support, previous physical inactivity, siblings' non-participation in physical activity, and being female (Sallis, Prochoska & Taylor, 2000). In addition, an analysis of 47 studies investigating exercise behaviour that included special populations (Downs & Hausenblas, 2005), concluded that the main reasons for not exercising were (a) health issues such as physical limitations, injury, poor health, pain or soreness, and psychological problems; (b) inconvenience (lack of access to facilities, facility too crowded, lack of transportation, other commitments); (c) lacking motivation and energy (feeling lazy, feeling unmotivated, believing that exercise requires too much effort)"; (d) lacking social support (no exercise partner, no support from spouse); (e) insufficient time; and (f) lacking money (finding exercise program too expensive).

Summary

Different physical exercises have different biological requirements and effects. Physical exercises differ in terms of type, intensity, and time. There are some effects of exercise on various physiological variables of the exerciser. Some effects are on blood pressure, HR, BMI, and waist-to-hip ratio. These parameters or variables are, to some extent, key determinants of an individual's health status. Individuals with the above-stated good parameters are said to be healthier, while those with bad parameters are said to have poor health. Therefore, the relationship between good health and exercise participation cannot be underestimated.

However, there are real and perceived challenges confronting individuals. In attempts to overcome these challenges, people have adopted various ways. Some have been scientifically proven effective in participating in exercise programs and deriving the benefits thereof. Others, too, are yet to be proven scientifically as to their effectiveness. One such is that this study determined whether the prolonged duration of exercise once a week is as effective as three times a week. This might have led many people to exercise groups such as keep fit clubs. The premise of this study is that personal variables, societal factors, environmental factors, and governmental regulations all play a role in shaping people's health-related behaviours. This method emphasises that changing the exercise environment or principles maybe two of the most successful strategies to attract individuals to join an exercise programme and get its advantages.

CHAPTER THREE

RESEARCH METHODS

The purpose of the study was to determine whether long-duration and thrice per week aerobic exercise will have any effect on physiological and anthropometric health markers of a Keep Fit Club Members in Accra. This chapter discussed the research design used to carry out the study, the study area, the population, sampling procedure employed in studying the issues. The chapter also explained the data collection instruments, validity and reliability, data collection procedures, and data processing and analysis.

Research Design

To achieve the purpose of this study, a pre-test post-test control group quasi-experimental design was used to find the effect of long-duration aerobic exercise on blood pressure, HR, percentage of body fat, and BMI of a keep fit club members in Accra. In this design, quasi-experimental and comparison or control groups were used for the study because random sampling and assignment to the groups could not be done; rather, intact groups were used (Ofori & Dampson, 2011). There were two intact groups at the centre namely those who participated in once a week and those with 2 or more days participation in an exercise. Both groups were pre-tested on blood pressure, HR, percentage body fat, and BMI; before the experimental group was exposed to the intervention, a post-test was conducted on both groups to assess the effect of the treatment (Tabachnick & Fidell, 2001). Thus, the study concentrated on the impacts of weekly exercise participation, with the total time spent exercising each week added up to a minimum of 90 minutes. Participants' physiological characteristics were used to evaluate the effects. Because of these purposes, the pre-test, control group design was the best strategy to use in this investigation (Ogah, 2013).

It is equally important to note that several studies in the aerobic exercise used a pre-test, post-test control group design from specific populations such as adults (Kriemler et al., 2014), older adults (De Vito et al., 2010), women (Damuesh, 2015; Katyal et al., 2011). Some other studies used pre-test and post-test control group designs and focused on specific systems and organs in the body, which included skeletal muscle and cardiovascular system (Ngongang et al., 2017) and anthropometric variables (Kravitz, & Heyward, 2017; Marfell-Jones, Olds, Stewart, & Carter, 2006).

Some strengths are associated with the pre-test/post-test control group quasi-experimental design. Baumgartner, Strong, and Hensley (2002) believe that pre-test/post-test design may help to establish a cause-and-effect relationship. This design helps researchers evaluate quasi-independent variables' impact under naturally occurring conditions. This design is more appropriate for real-world natural settings than a true experimental design. Another advantage is that both groups experienced the same basic natural conditions, but the experimental group received the influence of the independent variable (treatment) in addition to the shared conditions of the two groups. Also, this design allowed using the pre and post-test differences in individual participants as a basis for assessing the effectiveness of the treatment (Ofori & Dampson, 2011).

There are also several weaknesses associated with pre-test/post-test quasi-experimental design. First, this design may be more complex than the traditional experiment design. Threats to internal validity may exist in the use of the design. Cause and effect cannot be determined as quickly as in experimental design. In addition, this design is weak in external validity. Finally, the design has limited ability to be generalized to a population. Most often, the number of participants is very few (Ogah, 2013).

This study was underpinned by positivist determinism and empiricism viewpoint. From my determinist viewpoint, events are caused by other circumstances, and understanding such causal links is necessary for prediction and control. The health benefits of aerobic exercise are well stated and exist depending on the participant's exercise frequency, intensity, and duration (Jackson, 2013). Thus, the determinism position is to find out how prolonged aerobic exercise duration predicts the health of the participants as well as what determinant factors account for participation in exercise programmes.

The study empiricism view is that true knowledge is based on sense experience and can be obtained by observation and experiment. Experimentation allows the collection of verifiable evidence in support of the hypothesis. With this, data were collected through the process of investigations. The participants were taken through different durations and frequencies of aerobic exercise, and data was generated to help test the formulated hypotheses. In effect, pre-test and post-test designs became the most appropriate research method (Hoeger & Hogger, 2002).

Study Area

This study was conducted at the Gymike Keep Fit Club centre at Adenta. The centre is located at Adentan Municipality, a suburb of Accra. Adentan Municipality is one of the municipalities of the Greater Accra Region of Ghana. Adentan Municipality is bounded to the South by La Nkantanan Municipality, to the North by Shai Osudoku District, to the West by Ga East Municipality, and to the East by Kpone Katamansu Municipality. As a municipality, it has commercial activities with diverse groups of people with different socio-economic statuses and employment opportunities. The centre is about 900m from Adenta Police Station on Adenta-Dodowa road. The centre is about 150m from the main Adenta-Dodowa road to the left, near Mother Love Hospital in Adenta.

Population

The target population was all participants in the Keep Fit Club in Adentan Municipality who were regular and active in their exercise programmes. The accessible population was adults in the Keep Fit Club at Adentan. Adults are people aged 18 years and above (WHO, 2018). Apparently healthy adults between the ages of 20 and 40 years were used for the study. Healthy adults are free from cardiac, pulmonary, and metabolic diseases. Keep Fit Club members were used for this study because they had some minimum fitness level, which is the basis for this study. Minimum fitness is essential because 90 minutes of exercise requires some fitness level to sustain the exercise duration without undue fatigue (Samson-Akpan, Eyo, & Joshua, 2013). In addition, keep fit club members made a conscious effort to stay fit in terms of exercise and were organized and accessible

(Gwani, 2009). Accessibility to participate was key to this research design; hence an intact group of gymnasia keep-fit club members (Baumgartner & Jackson, 1999). The age bracket was limited to 20-40 years because these people were mostly found within the gym environment and could reduced the dropout rate.

It is established that people who have not been in an exercise programme for 2 years should take caution when starting an exercise programme. Such people should start an exercise with low intensity. Those who have been active can progress to moderate intensity. The population of this study can engage in moderate-intensity exercise since they have been engaging in some level of physical exercise (ACSM, 2009). The population was made up of both males and females. The target population was 108, of which 23 were adolescents below the age of 19 years and 85 were adults. The accessible population was expected to be 85 adults comprising 45 males and 40 females (Gymike Fitness Centre, 2019). Adults were used because the ACSM protocol used in this study was designed for adults.

Sampling Procedure

A purposive sampling technique was used to select Gymike Keep Fit Club because the fitness centre had participants with unique characteristics of age and fitness level, which suit the purpose of the study. The fitness centre had a lot of patronage from people and was well known. It is also well organized and has written records of the participants, making monitoring easy. Out of the accessible population of 85 participants targeted, a sample of 64 volunteers representing 75% of the accessible population from the Keep Fit Club participated in this research after the participants were enlighttened about the purpose of the study. Recruiting the sample was conducted through the Keep Fit Club centre. The researcher asked participants who were already exercising in the centre either once a week and 2 or 3 times a week to volunteer to be part of the study. The participants were selected from the two groups of exercisers, that is, those who visited the keep fit centre once a week and those who visited the centre two or three times a week. Those who volunteered were 64 from both groups of exercing once a week and 2 or more times in a week hence the sample size. It was not possible to randomly select and assign the participants hence the intact groups of exercising once a week and 2 or 3 times a week were used. Fifty percent (n=32) of the participants in the study was from the intact group to exercise once a week, and the other 50% (n=32) of the participants were also from the other intact groups to exercise three times a week. The participants comprised 53% (n=34) males and 47% (n = 30) females. Each intact group had 17 males and 15 females.

The study used healthy adults by pre-screening to ascertain that they were healthy. The pre-exercise screening was done to determine those who qualified to participate in the research. The “Physical Activity Readiness Questionnaire (PAR-Q)” was adopted from the “Canadian Society for Exercise Physiology” (2002) and used for pre-exercise screening. The Questionnaire has seven questions to screen individuals with known diseases or signs or symptoms of diseases that may be at high risk of adverse effects during physical exercise. A ‘yes’ response to any of the seven questions on PAR-Q by a participant did not engage in an exercise programme without seeking guidance from a health professional. However, a ‘no’ response to all the seven questions on PAR-Q by a participant participated in the exercise programme without further consulting a health professional. The instrument's reliability was 0.9 by the "Canadian Society for Exercise Physiology" (2002) and was considered high (Fraenkel & Wallen, 2000). All the participants were informed of the purpose of the study and signed a written consent form.

The sample for the study comprised 64 adults. Gwani (2009) opined that the type of research determines the percentage of the population to be used. Based on this, since the study was quasi-experimental, 64 adults constituted the sample because there are other studies that indicated that the sample size was adequate and manageable in quasi-experimental research such as this one. This is supported by a similar study in exercise and sports science (De Vito et al., 2010; Mwangi & Rintaugu, 2017; Netfit, 2016a).

Those who visited the centre once per week were identified as group A. Those who visited two or three times per week were identified as Group B. Group A were those who participated in the exercise programme once a week referred to as Single or OTT Sessions (OTT). Group B participated in the exercise programme three times a week, referred to as Multiple or CTT Sessions (CTT). Each group performed the same volume of aerobic exercise but for different durations. Group A involved in the long-duration exercise, the single or OTT session, which the recommended time per week was fused into a one-day exercise programme. Group B was involved in the three-day-per-week exercise programme, the multiple or CTT sessions, where a minimum time of 30 minutes was observed. The training programme lasted for 12 weeks. The relevant and standardized instruments were used for each and every measurement. Each person took part in a pre-exercise screening, read an explanation of the study's goals, and signed a written consent form.

Non-probability sampling methods, such as purposive, convenient, and volunteering sampling, have been criticised by some early academics for producing less reliable results and conclusions (Babbie, 2007; Ogah,2013). However, these methods are standard in exercise and sports science research (Idris et al., 2015; Juarez- Garcia et al., 2015). Therefore, these previous studies' findings, and conclusions are valid and generalisable to a particular exercise population studied (Creswell, 2009; Idris & Dollard, 2011). For instance, among Kenyan Public University staff members, Mwangi and Rintaugu (2017) used both purposive and voluntary sampling procedures in choosing their sample. This means it is possible to extrapolate this study's results, findings, and conclusions to the entire population of Accra's Keep Fit Club members.

Data Collection Instruments

The instruments used to collect data for this research include the following. The stopwatch: Professional quartz timer (digital sports timer, ENCOKK-5853), used for timing during prolonged aerobic exercises, blood pressure monitor (Omron Health Care Hem-7134-E) was used for assessing the blood pressure and pulse of the participants. Weight, body percentage fat and BMI, (the electronic weighing scale Omron Body Composition Monitor, BF511), was used. The metallic stadiometer capacity of 200cm was used to measure the height of the participants. Waist and hip circumferences were measured with a standard non-elastic measuring tape (capacity: 150cm). Exercise Intensity was measured with wrist watch blood pressure monitor programmable smart band version BT 4.0

Resting blood pressure (BP) and HR (HR)

Both S and DBPs were taken with an automatic blood pressure monitor (Omron Automatic Digital Blood Pressure Monitor, Hem-7134-E) endorsed by American Heart Association, model M3 Basic, according to the procedures of the British Hypertension Society (Byrne & Wilmore, 2001a; Robertson, Goss, & Dube, 2004). Participants were comfortably seated and relaxed 15 minutes after they walked in to the fitness centre. The cuff of the monitor was wrapped evenly and snugly around the bare left arm at heart height or level, 2.5 cm above the site of the bronchial pulsation. Measurement was done automatically using the control functions (START button) to mark the onset of the inflation with a buzzing sound. On pressing the start button, the unit automatically inflates and deflates the cuff by increasing and gradually decreasing the pressure. The screen displayed the three readings (systolic, diastolic, and HR), which were then recorded in the data form. Each participants was assessed three times on each of the variables and the average was computed and recorded. During measurement, participants sat still and did not move or talk. Phones and other magnetic materials were kept far away during measurements. The blood pressure was recorded in millimeter Mercury (mmHg). The pre-tests and post-tests were measured same time of the day and place. As reported in the user manual, the automatic blood pressure monitor

(Omron Automatic Digital Blood Pressure Monitor) had a reliability coefficient of 0.98 (Kravitz & Heyward, 2017). The reliability was calculated from the pre-testing of the instrument, which yielded a reliability coefficient of 0.96 and was compared to the already established co-efficient of 0.98 reported in the user manual. This was considered to be high (Fraenkel & Wallen, 2000).

Height

Stadiometer readings were taken barefooted and in minimum athletic attire to the closest centimetre (0.1cm). They were directed to stand with their back against the vertical meter rule with feet together. The back of the feet (heels), buttocks, shoulders, and back of the head touch the meter rule looking straight ahead. This was to ensure that the body was as straight as possible. A flat ruler was placed on the head of the individual with sufficient pressure to compress the hair to the metre rule to do the readings. The measurement was taken and recorded. Each participant was assessed twice, and the average was computed. The stadiometer had a reliability coefficient of 0.96, as reported in the user manual (Marfell-Jones et al., 2006). Again, the reliability was calculated from the pre-testing of the instrument, which yielded a reliability coefficient of 0.95 and was also compared to the already established co-efficient of 0.96 reported in the user manual. This was also considered high (Fraenkel & Wallen, 2000).

Weight

The weight of the participants was measured with a weighing scale. A scale was placed on a level, hard and uncarpeted floor. Before each measurement, the scale was adjusted to zero to weigh accurately. The participants were instructed to take off their coats, shoes, and other bulky items. Then they were ask to stand still in the centre of the scale's platform, feet apart, arms at their sides. Weights were recorded to the closest 0.1kg. As reported by the user manual, the weighing scale has a reliability coefficient of 0.96 (Mwangi & Rintaugu, 2017). The reliability was calculated from the pre-testing of the instrument, which yielded a reliability coefficient of 0.95 and was also compared to the already established co-efficient of 0.96 reported in the user manual. This was considered to be high (Fraenkel & Wallen, 2000).

BMI (BMI)

The ratio of mass to stature was calculated. Weight (in kilogrammes) divided by height (in metres squared) is the conventional formula for determining BMI (BMI), which was used to assess health per WHO guidelines (Ucan, 2013). A person's height and weight were entered into an electronic weighing scale, Omron Body Composition Monitor, BF511 and by pressing the BMI button, the result is displayed on the screen. For example, a woman with a weight of 74kg and a height of 1.63m would have a BMI calculated as $74kg/1.63m^2 = 27.4kg/m^2$.

Percent body fat (%BF)

Body fat measurement was computed using an Bioelectrical Impedance, Omron Body Composition Monitor, BF511, made in Japan (Robertson, Goss, & Dube, 2004). Before the participants %BF was measured, the participants data (gender, weight, height, and age) were taken. The participants were directed one after the other to stand on the weighing scale, and the participants' data (gender, weight, height, and age) were imputed into the Bioelectrical Impedance machine by the researcher. The monitor then automatically analyzed the individual's data and displayed the fat percent on the screen (Utter et al., 2004). Values were also rated against the WHO (2010) and Netfit (2016a) recommendations. The weighing scale had a reliability coefficient of 0.96, as reported in the user manual (Katyal et al., 2011; Mwangi & Rintaugu, 2017). The reliability was calculated from the pre-testing of the instrument, which yielded a reliability coefficient of 0.96 and was also compared to the already established co-efficient of 0.96 reported in the user manual. This was considered to be high (Fraenkel & Wallen, 2000).

Waist-to-hip ratio (WHR)

The waist and hip circumferences were measured with a standard non-elastic measuring tape (capacity of 150 centimeters) following the guidelines recommended in the Anthropometric Standardization Reference Manual (Hivert, Laglois, Berard, Cuerrier, & Carpentier, 2007) and according to the procedures described by (Venkateswarlu, 2011). With the waist circumference, a tape measure was placed around the bare abdomen of the participants at the belly button, just above the hip bone, and it was ensured that the tape was snugged but did not compress the skin and was parallel to the floor. Participants were asked to relax and exhale. The waist circumference was recorded in centimeters (cm) to one decimal place (Ferreira et al., 2010; Gunen, 2010; Robertson et al., 2004).

Hip circumference was measured at the greatest posterior protuberance of the buttocks or the widest point of the buttocks and read at the side. It was recorded to the nearest centimetres (0.1cm) for body composition assessment (fat distribution patterns). WHR is the ratio of the waist circumference to the hip circumference. This ratio was determined by dividing the waist circumference by the hip circumference. WHR = Waist circumference (cm)/Hip circumference (cm). For example, for a woman with a WC of 96cm and an HC of 110cm, her WHR will be 0.87. The waist-to-hip ratio between 0.80 – 0.90 were considered safe (Centre for Disease Control and Prevention, 2008). The standard non-elastic measuring tape (capacity of 150 centimeters) has a reliability coefficient of 0.97, as reported by the user manual (Damuesh, 2015). The reliability was calculated from the pre-testing of the instrument, which yielded a reliability coefficient of 0.96 and was also compared to the already established coefficient of 0.97 reported in the user manual. This was considered to be high (Fraenkel & Wallen, 2000).

Exercise intensity

Exercise intensity was measured with a wristwatch smart band version BT 4.0 programmable to monitor HR, number of steps taken, calories burnt, and time.

The intensity of aerobic exercise training is usually determined as a range; 20%-40% of HR as light intensity, 40%-60% of HR as moderate intensity, 60%-90% of HR as vigorous intensity, and 91%-100% of HR as maximal intensity (Utter et al., 2004). Each participant was enlighten on the wristwatch, blood pressure monitor on the readings, and how to programme the watch. They were educated on how to use the HR Reserve (HRR) to calculate exercise intensity. The formula "220-age" is commonly used to predict HRmax (Gellish et al., 2007; Katch, Mcardle, & Katch, 2011) and is simple. For example, to calculate for moderate intensity exercise using HR Reserve (HRR) for a 40year man;

Maximal HR (HRmax) = 220-age

=220-40

=180beats.min^{-1}

40% HR Reserve (%HRR) =40÷100 ×180beats.min^{-1}

=72beat.min^{-1}

60% HRR = 60÷100×180beats.min^{-1}

= 108beats.min^{-1}

The range of %HRR for a 40year older man exercising at moderate intensity is 72 beats.min-1-108 beats.min-1. Participants can therefore exercise at moderate intensity after calculating the range of HRR and monitoring it on the digital wristwatch smart band version BT 4.0 with a reliability of 0.94 (Thompson, Gordon, & Pescatello, 2010).

The instruments mentioned above have been validated and confirmed to be reliable for this study by international standards. However, a pre-test of all the instruments was conducted, and reliability co-efficient compared to the already established values was found to be high as reported under each instrument. The pre-test of instruments was done at Bonds Fitness Centre, Adenta, which is in the same municipality as the research centre, and reliability was reported. This is to ascertain the reliability, calibration, and functioning of the instruments one week prior to data collection. The following procedures determined the reliability of the Research Protocol. A visit was paid to the selected fitness centre on three different occasions for videography of the training sessions to ascertain functional participation by the clients. These observations were ascertained, time (duration of exercise programme, which starts at 6:30 to 9:00 am), exercise routine which follows warm up, exercise programme with upper body activities, lower body activities, floor activities, and cool down. The day they attend the exercise programme is in the morning between 6:00 am and 9:00 am and the evenings between 4:00 pm and 6:30 pm. The number of participants ranged from 40-55 adults, of which females were about 20 and the rest were males. About 30 participants always start the programme before others join.

Data Collection Procedure

An introductory letter was obtained from the Department of Health, Physical Education and Recreation to University of Cape Coast Institutional Review Board (UCCIRB). Ethical clearance was given by UCCIRB after the necessary documents were presented and assessed by the Board. The approval with reference number UCCIRB/CES/2020/23 was given. Another introductory letter was obtained from the Department of Health, Physical Education and Recreation to the management of the keep fit centre where permission was granted to conduct the study.

Participants were also assured of confidentiality of their information and the researcher ensure that the figures were only disclosed to the individual concern. Numbers were used to identify the individuals and not the names for confidentiality purpose. The following biodata of participants was collected, age and gender. Participants in the study were tested by the following sequence for all the groups after they sign the informed concent form and their bio-data was collected.

-Measurement of blood pressure and HR

- Recording of weight

- Measurement of height

- Analysis of percent body fat

- Waist circumference

- Hip circumference

These tests were conducted in the morning preceding the commencement of the aerobic exercise section. The researcher explained the details concerning the 12 weeks training programme to the participants.

Only those who volunteered were screened using PAR-Q for the study. Physiological variables of measurements were taken on three different occasions: before exercise programme T1 (pre-test), on the 6th week, and after completing the 12-week aerobic exercise programme T2 (post-test). The procedures for measuring these variables were non-invasive.

The researcher with the research assistants conducted the pre-test and the post-test on the dependent variables, which were recorded according to exercise groups. Two days were used for the pre-test, a day for a particular group; after the pre-test, the researcher described to the participants all activities and procedures involved during the exercise programme for the various groups. In the 6th week, another measurement was taken on the variables of both groups.

At the end of week 12, all the participants in the different groups were tested (post-test), and the researcher, with the research assistants, conducted the post-test on the participants. The researcher and research assistants in each group administered the tests to the groups. The scores of the measurements were collected on the spot.

The following conditions were observed:

1. The researcher ensured that all measurements were conducted on the same day and time to ensure equal testing conditions for all participants.

2. The purposes of each test item were explained to the participants before the commencement of the test and exercise training programme.

3. The time and place for the commencement of the test range from 6.00 am to 9.00 am or 4.00 pm to 6.30 pm on each test and exercise day because this is the time of the day that is more convenient to exercise, and the temperature was suitable for physical activity.

4. All participants were asked to maintain their current lifestyle, including their normal meals, for a 3-month run-in period followed by pre-exercise testing.
5. All participants were encouraged to wear sports outfits appropriate for the test and training conditions.
6. All participants were assured of confidentiality of their records.

One physical education teacher, a nurse, and a fitness instructor served as research assistants for this research. The researcher adequately explained the purposes of each test item and the protocol involved to the research assistants. This was to guide them to effectively evaluat the different parameters of the participants assigned. In addition, they were involved in recording, taking measurements, and supervising participants during the training sessions.

Table 3: Exercise and Data Collection Time Table

Week	Exercise Schedule/Data Collection
1	Baseline Data Collection/Exercise
2	Exercise
3	Exercise
4	Exercise
5	Exercise
6	Data Collection/ Exercise
7	Exercise
8	Exercise
9	Exercise
10	Exercise

11	Exercise
12	Post Data Collection/ Exercise

Data Processing and Analysis

Before any analysis could be performed, the obtained data needed to be cleansed and organised properly. To ensure the data was complete, the researcher ran a frequency analysis to look for gaps and evaluate any unusually high or low readings (called "outliers"). The analysis was done research hypothesis by research hypothesis. Descriptive statistics calculated the mean and coefficient of variation (mean+ CV). Furthermore, MANOVA was used to test the hypotheses for there are repeated measurements (1st, 6th, and 12th week of exercise) on blood pressure, HR, percent body fat, and BMI of healthy young adults. This was to determine if there is any change or difference in the physiological parameters. An independent sample t-test was used to test the hypothesis to ascertain any difference between male and female; youths and adults physiological variables on long-duration exercise. The decision to reject or retain the null hypothesis was made at an alpha level of 0.05 (Frost, 2023). The use of the t-test was deemed appropriate because of the following assumptions: (i) the independent variables have two levels (male and female) and one dependent variable (physiological variables), which is quantitative, (ii) the scale of measurement is either interval or ratio. The statistical software (Stata/ SE/ 14.0 version) was used to analyze the data collected.

Hypothesis 1: **There are no relationships among the physiological and anthropometric health markers after aerobic exercise programme of a keep fit club members in Accra after 12 weeks of exercising.**

This hypothesis aimed to examine the possible association between the selected physiological and anthropometric variables in magnitude and direction. Since all the measures were measured on a continuous interval-ratio scale, it was possible to apply the Pearson Product Moment Correlation coefficient (r) and its extension, such as the Coefficient of determination. The pairwise correlational matrices with the respective significance level were estimated for all the variables before and after the intervention, mainly to determine the strength of association before and after the intervention. The Coefficient of determination was used to decide which variation in the variable set as dependent variables could be explained by the independent variable conditioned on the Coefficient of determination. Hence, correlational analysis was used to test this hypothesis (Frost, 2023).

Hypothesis 2: There will be no significant difference between the effects of long-duration and thrice per week aerobic exercise programmes on selected physiological and anthropometric health markers of a keep fit club members in Accra after 12 weeks of exercising.

This hypothesis aimed to examine how each training session significantly reduced/increased the average value of the selected physiological and anthropometric variables and identify which training type had the greatest effects on the mean value. First, the paired sample t-test was used for within-group comparison; eventually, the one-sample t-test was used to compare the means (Gleichmann, 2020). That is, the mean value of each training group was initially compared before using the paired sample t-test to ensure that a significant difference exists; hence the actual hypothesis test was:

Ho: difference (mean before-mean after)

Statistically, the paired sample t-test is a disguised one-sample t-test on two dependent samples, as in the case of measures before and after the intervention in the current study. After a significant difference has been observed or otherwise within the participants in a particular training type, for example, type CTT, then the one-sample t-test was used to test the significant difference between the means in the two groups by testing the hypothesis that:

HO: mean in the distribution of CTT group = mean of OTT group

This test differs from the independent sample t-test in that mean of the OTT group is entered as a point statistic against the actual distribution of the CTT group. If an insignificant result is obtained, then the two groups are said to have identical mean and different means otherwise. The major advantage or reason for this test is that it does not require that the two groups have the same initial conditions since the variances in the OTT group are not used in the test.

To allow the measures at the 1st, 6th week, and 12th weeks to be included in the analysis, the "Multivariate Analysis of Variance (MANOVA)" was used (Anderson, 2003). The MANOVA allows for the effects of the training types on the three different time measures to be explored in the analysis. That is, the generalization of the study's outcome is strengthened when the longitudinal aspect of the data is explored. The distributions were first tested for multivariate normality before the MANOVA analysis. Then, the predictive margin means and the margins plot were used to visualise the MANOVA results, just as the dot plot was used throughout the work to visualize the difference in mean values across groups.

Hypothesis 3: There will be no gender differences on the effect of long duration and thrice per week aerobic exercise programmes on selected physiological and anthropometric health markers of a keep fit club members in Accra after 12 weeks of exercising.

Hypotheses 4: There will be no age differences on the effect of long duration and thrice per week aerobic exercise programme on selected physiological and anthropometric health markers of a keep fit club members in Accra after 12 weeks of exercising.

Hypotheses 3 and 4 followed the same analytic framework in the analysis. The distributions were segregated along gender or age categories and training type to determine whether the observed mean difference could also be observed in the sub-samples. The paired sample and one-sample t-test were again used for these analyses. Furthermore, the power test was conducted to determine the sample size that could allow for a significant difference detected by paired sample t-test at the 5% significance level.

Pre-estimation test for the Paired sample t-test and MANOVA tests

Parametric tests such as paired sample t-test and MANOVA are valid under the same strict statistical assumption, which this study took seriously (Gleichmann, 2020). Three such assumptions were found to be binding for the consistency of the estimates. The power, multivariate normality, and equality of variance tests were conducted to ensure the results were valid and consistent (Frost, 2023). The power test was done to determine whether the sample size of

64 respondents could yield a good estimate when the means are compared. The test requires the specification of the expected mean difference, estimated after the data collection, to conduct the test for each of the five selected variables (Gleichmann, 2020). The descriptive statistics indicated that the five variables' differences were less than 20, with a spread difference (SD difference) of less than 2. The power test indicated that the paired sample t-test could detect a difference in means and reduce the tendency of committing type one error even if the mean difference was as large as 20 with a standard deviation difference of 2 at the 5% significance level (alpha=0.0500, N=32, delta=5.0000, d0=0.0000, da=10.0000, SD=2.0000; Estimated power: power=1.0000). The sample size of 32 was used instead of 64 because, in the analysis across genders and ages, the comparison for each exercise protocol also involved 32 respondents. The normality test was done jointly in the multivariate normality test framework using the Doornik-Hansen and Mardiam Skewness tests. The results for the multivariate normality test and the robust variance test are presented in Table 1.

Table 4: Multivariate Normality Test Result using Doomik-Hansen and Mardian Skewness

	Doornik-Hansen	Mardiam Skewness	Levenee's test
Variables	chi^2(p)	chi^2(1)	Robust variance test
SBP	5.810(0.2138)*	3.455 (0.0631)*	W0=1.7513193, df(1, 62) Pr > F = 0.19287008
HR	0.518 (0.4717)*	2.436 (0.1186)*	W0= 1.5500958, df(1, 62) Pr > F = 0.22002339
%BF	0.362(0.5473)*	1.291 (0.2559)*	W0= 3.4391897, df(1, 62) Pr > F = 0.07069687
BMI	7.574 (0.2710)*	3.296 (0.0695)*	W0=0.0067155, df(1, 62)

Pr > F = 0.93507707

Note: Figures in the bracket are probability values (p-values)

*** indicate symmetric distribution at a 5% significance level.**

Source: Field data, 2021

The two multivariate normality tests failed to reject the null hypothesis that the distributions of SBP (SBP), DBP (DBP), HR (HR), % body fat (% BF), and BMI (BMI) at the onset of the training, after 6 weeks and after 12 weeks was symmetric. The results suggested that some combination of the three measures for each of the five variables was normally distributed at the 5% significance level. The robust variance test of equality also indicated that the logarithmic transformations of all the variables had equal variance across training types. Though the variables did not have equal variance at the level until they were log-transformed, the t-test used the actual means for the analysis since a version of the test allows for unequal variance assumed. Only analysis in the MANOVA framework used the log-transformed variables since multivariate normality and equality of variances are very key to the consistency of the estimates.

CHAPTER FOUR

RESULTS AND DISCUSSION

The study aimed to determine the effects of once-per-week-long duration aerobic exercise on physiological variables of Gymike Keep Fit Club members in Accra. This chapter presents, interpreted, and discusses the results based on the primary data collected. Data was first organised into tables or charts, and the outcomes were compared and contrasted with responses to the stated research hypotheses.

Hypothesis 1: There are no relationships among the physiological and anthropometric health markers after aerobic exercise programme of a keep fit club members in Accra after 12 weeks of exercising.

This hypothesis assessed the relationships among the physiological and anthropometric variables. The analysis was done using pairwise Pearson's correlation coefficient (r) and the coefficient of determination (r^2) at the 5% significance level. The correlational matrix for the variable before and after the training session was estimated as presented in Tables 5 and 6.

Table 5: Correlations among Physiological and Anthropometric Variables in the Entire Sample before 12 Weeks of Organized Training

	DBP	SBP	BMI	%BF	HR
DBP	1.0000				
SBP	0.7470*	1.0000			
	[0.0000]				
BMI	0.0538	0.0464	1.0000		
	[0.7286]	[0.7646]			
%BF	-0.1958	-0.2944	0.7383*	1.0000	
	[0.2027]	[0.0524]	[0.0000]		
HR	-0.3960*	-0.2089	-0.0541	-0.0186	1.0000
	[0.0078]	[0.1735]	[0.7270]	[0.9047]	

Source: Field data, 2021

As presented in Table 5, the results suggested a moderate positive significant linear association between systolic and DBP at the 5% significance level. A moderate positive significant linear relationship was also observed between the percentage of body fat and BMI. In contrast, a negative significant weak linear correlation was observed between HR and DBP. No statistically significant linear association was observed between other measures before the organised training sessions.

Table 6 presents the pairwise correlation results on the same anthropometric and physiological variables after 12 weeks of training in the sample.

Table 6: Correlations among Physiological and Anthropometric Variables in the Entire Sample after 12 Weeks of Organized Training

	DBP	SBP	BMI	%BF	HR
DPB	1.000				
SBP	0.7089	1.000			
	[0.0000]**				
BMI	0.0163	0.0526	1.000		
	[0.9161]	[0.7343]			
%BF	-0.1680	-0.2234	0.7584	1.000	
	[0.2756]	[0.1449]	[0.0000]**		
HR	-0.3570	-0.2390	0.0007	0.0643	1.000
	[0.0174]**	[0.1182]	[0.9999]	[0.6784]	

N/B: Figures in parenthesis are p-values and ** indicates significance at 5%

Source: Field data, 2021

Table 6 presents the pairwise correlation coefficient of five selected physiological and anthropometric variables. The results suggest that, after the training intervention for the respondents, a statistically significant correlation could be observed between DBP and SBP, between %BF and BMI and between HR and DBP, at the 5% significance level (p-value<0.05). A moderate positive relationship was found between DPB and SBP (r=0.7089). If DBP is set as the dependent variable, then, about 50.25% of the variation in DBP could be explained by SBP, and the reverse is true. Also, a relatively strong positive correlation was observed between %BF and BMI, and BMI is set as a dependent variable. About 57.52% of variations in BMI could be explained by %BF, and the reverse is true. Finally, a weak but significant nagative association was observed between HR and DBP (r= -0.357), such that about 12.75% of the variation in DBP could be attributable to the individual's HR, and the reverse is true.

Though most other measures indicated the correct sign for the possible association with other physiological variables, the strengths were very weak, and the results were not statistically significant. Therefore, it was concluded that the organised training sessions slightly weakened the relationship between DBP and SBP but strengthened the relationship between %BF and HR and between HR and DBP.

The major implications of the observed significant associations are clear. First, one gains in both DBP and SBP whenever exercise plans are followed as expected, as well as gains in BMI and %BF as a result of consistent training. Hence, any one of the pairs could be monitored to estimate what is happening to the other, and a relatively accurate picture could emerge in most cases. Second, the negative association between DBP and HR suggested a possible low effective trade-off between DBP and HR. A significant rise in one may imply a relatively small increase in the other.

Akindele et al. (2016); Ranasinghe et al. (2013) and Meeuwsen et al. (2009) concluded for an urban resident of Africa that "there was a strong and positive statistical relationship between %BF and BMI when both were paired without controlling for gender and age (r=0.81, p<0.01"). The current study estimated a correlation coefficient of 0.7584, which could be approximated to 0.8, just as in the case of Akindele et al. (2016). Ranasinghe et al. (2013) also observed a solid statistically significant association between BMI and %BF among respondents from South Africa. Finally, Alizadeh (2016) summed the strong association between BMI and %BF by concluding that only one of the two matters at any point in time and that %BF is a more accurate proxy for the two than BMI.

The current study also found a moderate linear association between diastolic and SBPs as an apriori expectation since the two have a common source and are related to artery compliance and stiffness, respectively (Schillaci & Pucci, 2010). The finding is consistent with that of another study by Gavish et al., (2008) who estimated the correlation between SBP and DBP to be about 0.74. This figure is slightly higher than the 0.71 estimated in the current study, but both are moderate positive correlations between DBP and SBP.

Finally, a counter intuitive negative linear relationship was observed between HR and DBP. Earlier studies have mostly observed a positive but weak association between the two variables (Schillaci & Pucci, 2010; Gavish et al., 2008). These studies explained the need for a positive association between HR and blood pressure because the central nervous system controls both measures. However, the results of the current study could be attributed to truncation of age (excludes children below 20 years) and longitudinal outcomes as against the cross-sectional results of the studies of Bradbury et al. (2017). Also, it was evident from the literature that the HR was induced in most cases where direct relationships have been observed between HR and blood pressure, as against the actual instances used in the current study.

Hypothesis 2: There will be no significant difference between the effects of long-duration and thrice per week aerobic exercise programmes on selected physiological and anthropometric health markers of a keep fit club members in Accra after 12 weeks of exercising.

This hypothesis presents the analysis and comparison of the effectiveness of multiple or CTT or three times per week (CTT) and single or OTT or once per week exercises OTT. Both descriptive (mean) and inferential analysis (MANOVA) were used. The normality and equality of variance tests were conducted before settling on the parametric test. The test confirmed the variable's multivariate normality and the variances' relative equality. The descriptive statistics are presented in Figure 3. The skewness coefficient for all the sub-groups was within the bound of -1 and 1, which indicated that the distribution was relatively normal to allow for a parametric analysis involving means comparisons.

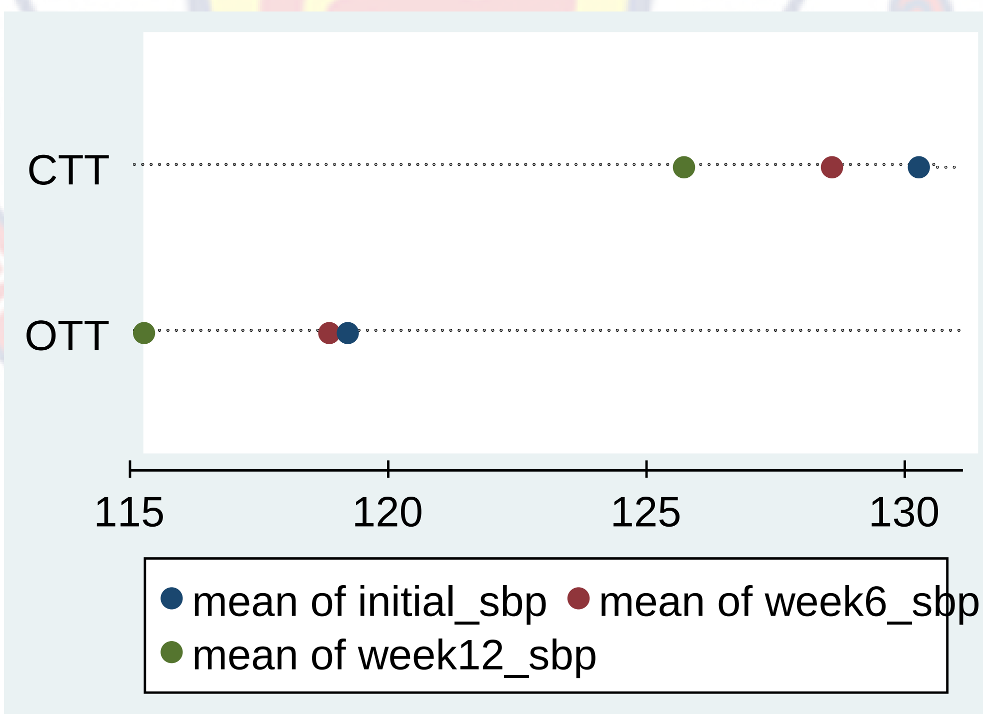


Figure 3: Mean Plot of SBP and Nature of Training Schedule

Source: Field data, 2021

The content of Figure 3 indicates that the members in the two groups began on different initial average SBPs (CTT: Mean = 130.2727, CV = 13.57%; OTT: Mean = 119.2273, CV = 7.47%). The comparison was, therefore, done within groups to determine the extent to which the CTT (CTT) schedule impacts SBP as against the OTT OTT schedule. The average SBP in the first six weeks suggested that members in the CTT group reduced in SBP by about 1.68 (from 130.27 to 128.59), while the SBP of the OTT group reduced by about 0.37 (from 119.23 to 118.86). The paired sample t-test of the initial SBP and the SBP in the first six weeks suggested that the mean value was significantly reduced in the CTT group ($t = 7.58$, $df = 31$, p-value = $0.00<0.05$) but not in the OTT group ($t = 2.01$, $df = 31$, p-value = 0.057). The result indicates that the CTT group is more effective at reducing the SBP of the participants within the first six weeks than OTT. The observed effectiveness of the CTT schedule is captured in the percentage mean of Figure 4, which places the two variables on the same scale for comparison.

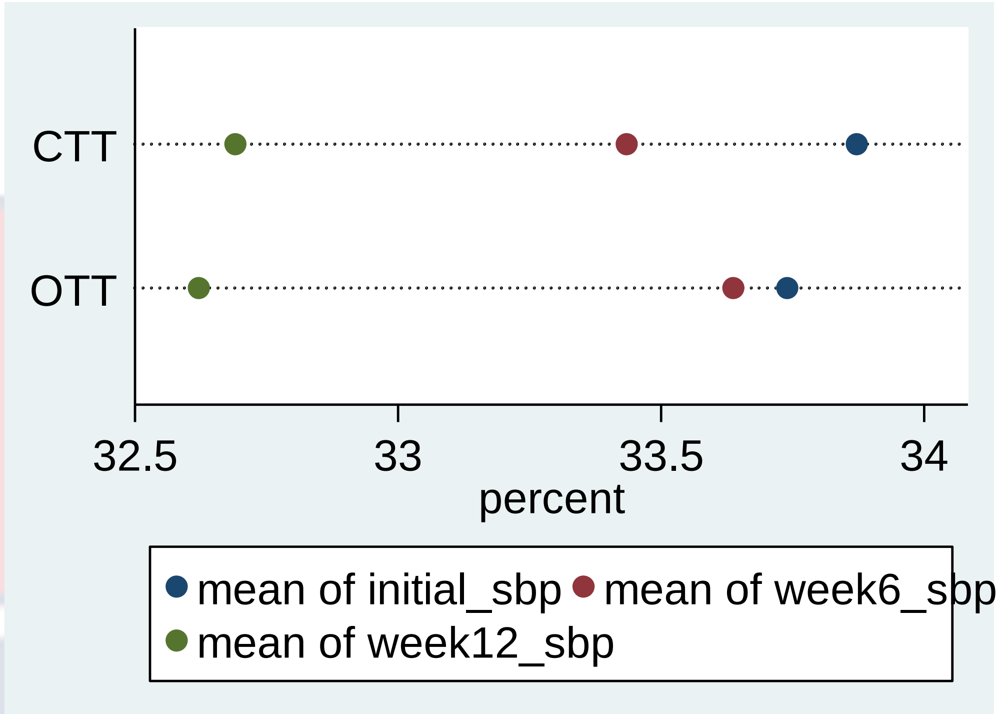


Figure 4: Mean Plot of SBP (percent) and Nature of Training Schedule

Source: Field data, 2021

The analysis of the mean SBP in the twelve weeks (next six weeks) found a reduction in SBP of the CTT group of about 4.55 relative to the initial SBP and 3.95 relative to the sixth week's SBP. The comparison within groups found a statistically significant difference between the initial SBP and the post-SBP among the participants in the CTT group (t = 8.05, df = 31, p-value = 0.00). Also, for the OTT group, the twelve-week SBP was reduced by about 3.95, compared to the initial SBP, and 3.59, compared to the sixth week's SBP. The paired sample t-test result indicated a significant difference between the sixth week's SBP and the twelve week's SBP for the OTT group (t = 1.89, df = 31, p-value = 0.03). The results suggested that irrespective of the training schedule, continuous or one-time, organised training significantly reduces the SBP of the participating members, but the CTT was more effective.

To ensure the validity of the estimated results, the three SBP measures were examined in the MANOVA framework to determine whether the type of training schedule significantly explains SBP.

Table 7: MANOVA Outputs of SBP Based on Training Schedule Groupings

Source	Statistic		df	F(f1,	df2) =	F	Prob>F	
groups	W	0.6587	1	3.0	40.0	6.91	0.0007	e
	P	0.3413		3.0	40.0	6.91	0.0007	e
	L	0.5181		3.0	40.0	6.91	0.0007	e
	R	0.5181		3.0	40.0	6.91	0.0007	e
Residual			62					
Total			63					

e = exact, a = approximate, u = upper bound on F

W=Wilks' lambda, L = Lawley-Hotelling trace, P = Pillai's trace, R = Roy's largest root

Source: Field data, 2021

The observation showed that all five independent variables (SBP, DBP, HR. %BF and BMI) found the training schedule significant in explaining the participants' SBP from the initial stage to the sixth and twelve weeks. The predictive margins plot, as presented in Figure 5, depicts the case of the average change in SBP within each group for the three measures taken.

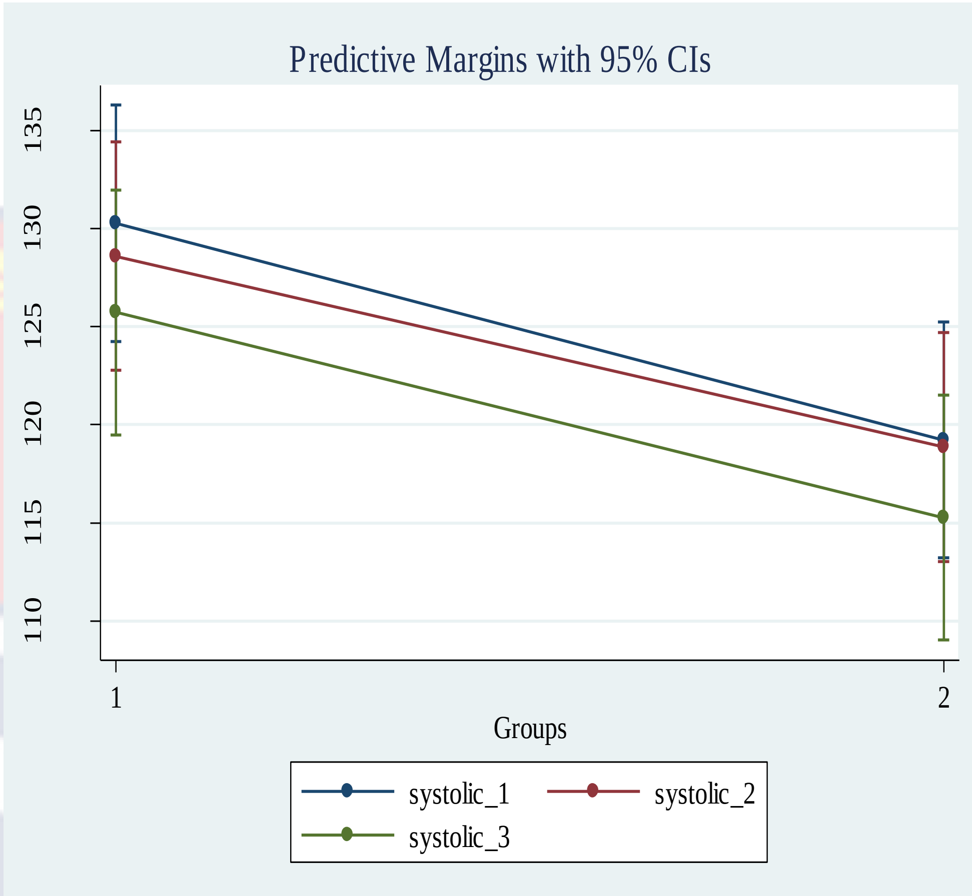


Figure 5: Margins Plot of SBP for each group for the first and second six weeks

The plot visualises the initial observation made on the average SBP for the initial stage, the first six weeks, and the twelve weeks. The plot depicts that SBP is significantly reduced among the CTT group but not in the OTT group in the first six weeks. The fact that the two extreme lines indicated a relatively parallel nature proved that CTT was more effective than OTT in the first six weeks of training, but the different levels were off after twelve weeks.

The major conclusion from the analysis was that, training in general, is significantly effective at reducing the SBP of the participating individuals, irrespective of the training schedule option, when enough time is allowed. The observation that exercise generally reduces blood pressure regardless of the mode of training supports earlier observations elsewhere. Training had positive benefits on blood pressure regardless of baseline BP, method of BP measurement, gender, level of physical activity, type of exercise performed, exercise training programme, or use of hypertensive drugs, as reported by Carpio-Rivera et al. (2016). Carpio-Rivera et al.'s findings, when added to those of Cornelissen and Smart (2013), provide more support for the idea that training/hypotensive exercise's effects on SBP are relatively immune to confounding environmental influences. According to Cornelissen and Smart (2013), aerobic endurance training lowers blood pressure by relaxing the blood vessels. On the list of ways training benefits physiological variables, Pontzer et al. (2016) noted that physical activity can lead to decreased basal energy expenditure, facilitating more precise regulation of energy intake. Exercise is likely to have direct effects on the body and promote benefits in terms of glucose homeostasis, as discussed further by Bray et al. (2016), even if there is no change in the volume of the adipose tissue.

Cornelissen and Smart (2013) reported that four weeks of training was enough to reduce SBP among participants and concluded that exercise is a non-pharmacologic therapy for hypertension. The result of Cornelissen and Smart adds credence to the outcome of the current study that six weeks was enough for both continuous and OTT in a week to significantly reduce SBP and other physiological variables used in the present study. Clark (2021) also observed that a short-duration training of about eight weeks is enough to cause a significant change in SBP; and concluded that training for 9-15 weeks and 16-23 weeks is more effective than any longer duration. The current study had its terminal week at 12 weeks which falls within the most effective duration and adds to the reasons why significant changes were observed.

The position of the current study is that even though tough training is generally effective, the type of training exercise could influence the extent or magnitude of the effects. The results of the analysis further revealed that within a short time (less than six weeks), CTT (three times per week) appeared to be more effective at significantly reducing SBP than OTT (once a week but with the equivalent training time). However, when enough time is available, the CTT and OTT could be relied upon to achieve equivalent results on SBP on average. The differences in the effectiveness of the type of training exercise are, therefore, a function of the time or duration of the training programme.

The observation that CTT could be more potent in the short run than OTT could be explained from the medical perspective that detraining could reverse the gains of training such that a OTT may suffer more of the adverse effects of detraining (Schwingshackl, Dias, Strasser, & Hoffmann, 2013). If training is done once a week, the initial gains may be partially lost before the next training exercise, compared to well-distributed three times within the week. This loss due to detraining is irrespective of the length and nature of training. There is evidence to suggest that detraining helps maintain the benefits of training. For instance, Schwingshakl et al., looked at the link between exercise-induced BP changes during training and detraining, and found that most people who saw a drop in systolic BP during training saw that number rise again after detraining.

Carpio-Rivera et al. (2016) empirically added why the CTT might be more effective than the OTT . Carpio-Rivera et al. found that exercise lowers blood pressure, but the changes are temporal, so the pressure returns to the basal level within 24 hours. If this fact is substantiated, almost all the gains made in a OTT may have vanished before the next exercise, but CTT can build on the gains made from previous exercises. Batacan, Duncan, Dalbo, Tucker, and Fenning (2017) used a similar period of 12 weeks of 3-times week training and observed that CTT could effectively reduce SBP for its participants.

The analyses of the comparison of the effectiveness of CTT and OTT on DBP was assessed. Both descriptive (mean and cv) and inferential analysis (MANOVA) were used. The mean diastolic and percentage mean diastolic for the initial, 6th, and 12th weeks are presented in Figures 6 and 7.

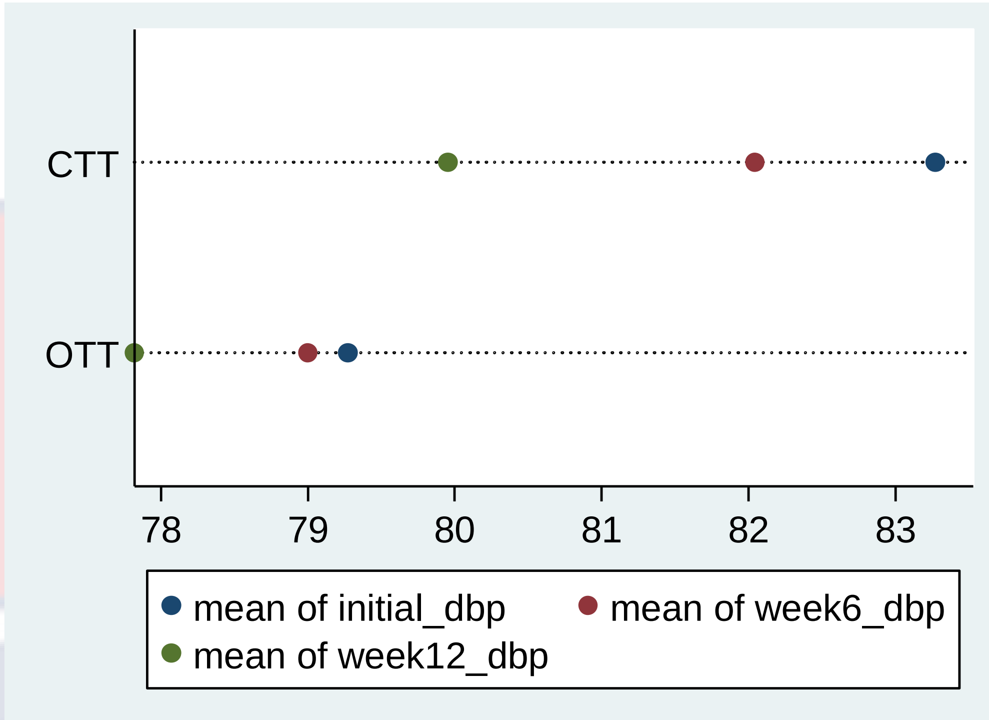


Figure 6: Mean plot of DBP and Nature of Training Schedule

Source: Field data, 2021.

Figure 6 suggests that the members in the two groups began on different initial average DBP (CTT: Mean = 83.272, CV = 10.30%; OTT: Mean = 79.272, CV = 7.98%). The comparison was, therefore, done within groups to determine the extent to which the CTT schedule impacts on the DBP as against the OTT schedule. The average DBP in the first six weeks suggests that the members in the CTT group experienced a drop in DBP by about 1.227 (from 83.272 to 82.045), while the DBP of the OTT group dropped by about 0.2727 (from 79.272 to 79.000). The paired sample t-test of the initial DBP and the DBP in the first six weeks suggests that the drop in DBP in the first six weeks was statistically significant at the 5% significance level for the members of the CTT group (t = 6.623, df = 21, p-value = 0.000) but not in the OTT group (t = 0.922, df = 21, p-value = 0.183>0.05). The result indicates that the CTT is more effective at reducing the DBP of the participants within the first six weeks than OTT. The observed effectiveness of the CTT schedule is captured in the percentage mean of Figure 7, which places the two variables on the same scale for comparison:

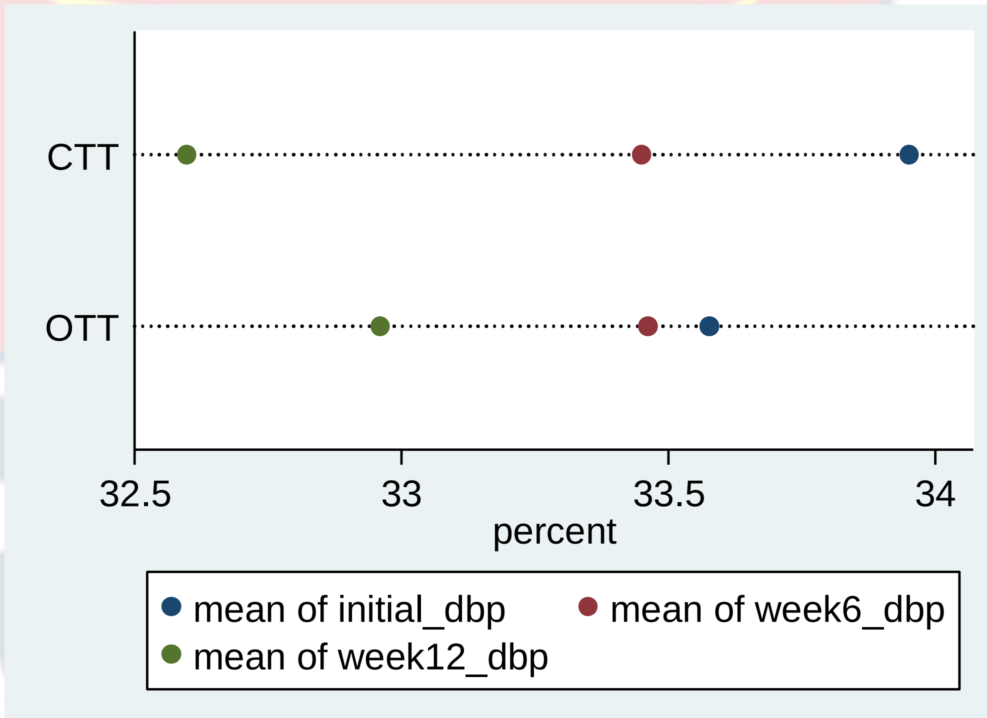


Figure 7: Mean plot of DBP (percent) and Nature Training Schedule

Source: Field data, 2021.

The mean DBP in the twelve weeks (next six weeks) indicates a drop in the CTT group of about 3.318 relative to the initial DBP and 2.090 relative to the sixth week's DBP. The comparison within groups showed a statistically significant difference between the initial DBP and the 12 weeks post-training DBP among the participants in the CTT group (t = 7.569, df = 21, p-value = 0.000). Also, for the OTT group, the twelve-week DBP dropped by about 1.454, compared to the initial DBP, and 1.181, compared to the sixth week's DBP. The paired sample t-test result indicated a significant difference between the sixth week's SBP and the twelve week's SBP for the OTT group (t = 7.482, df = 21, p-value = 0.000). The results suggests that irrespective of the training schedule, multiple or single, organised training significantly reduces the DBP of the participating members. Still, the CTT was found to be more effective. Also, within a short period of 6 weeks, the single training session had no statistically significant effect on the DBP of participants. To ensure the validity of the estimated results, the three DBP measures were examined in the MANOVA framework to determine whether the training schedule significantly explained the participants' DBP.

Table 8: MANOVA Outputs of DBP Based on Training Schedule Groupings

Source	Statistic		df	F(df1,	df2) =	F	Prob>F	
groups	W	0.7889	1	3.0	40.0	3.57	0.0223	e
	P	0.2111		3.0	40.0	3.57	0.0223	e
	L	0.2676		3.0	40.0	3.57	0.0223	e
	R	0.2676		3.0	40.0	3.57	0.0223	e
Residual			62					
Total			63					

e = exact, a = approximate, u = upper bound on F

W=Wilks' lambda, L = Lawley-Hotelling trace, P = Pillai's trace, R = Roy's largest root

Source: Field data, 2021

The test found the type of training schedule significantly explained the DBP of the participants from the initial stage to the sixth week and the twelve weeks' outcomes. The predictive margin split, as presented in Figure 8, shows the case of the average change in DBP within each group for the three measures taken.

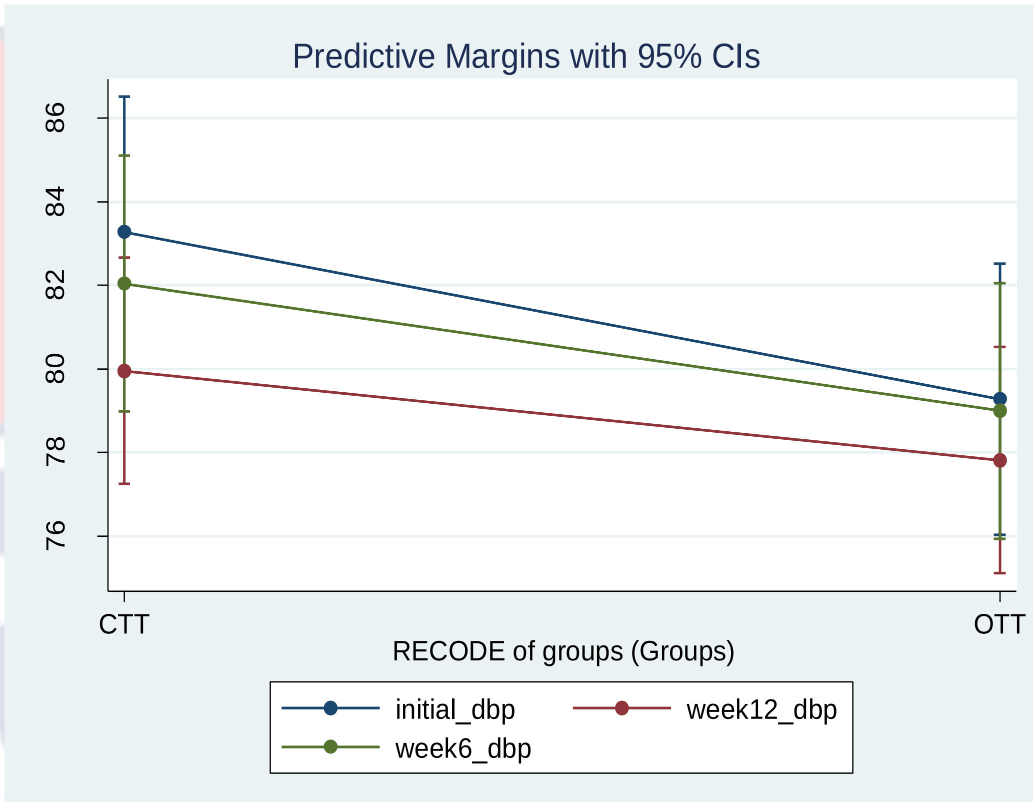


Figure 8: Margins-plot of DBP for each group for the outcomes of the sixth and twelve weeks.

Source: Field data, 2021.

The plot visualises the initial observation made on the average DBP for the outcomes of the initial stage, the first six weeks, and the twelve weeks. The plot depicts that DBP significantly dropped among the participants in the CTT group but not among those in the OTT group in the first six weeks. The fact that the two extreme lines closed up for OTT compared to CTT confirmed that the DBP drops more for the participants in the CTT group than those in the OTT group after twelve weeks of training.

The primary conclusion from the analysis was that, trainin, in general, is effective at significantly reducing the DBP of the participating individuals, irrespective of the training schedule option. Within a short period (less than six weeks), CTT (three times a week) was found to be more effective at reducing DBP significantly than the single or OTT (once a week but with an equivalent training time). When enough time is available, the CTT and OTT could be relied upon to reduce DBP, but CTT would give a better outcome than OTT. The result is consistent with some earlier studies. The observation that training or exercise generally reduces DBP was consistent with the findings of Kelley, Kelley, and Pate (2015), Paoli et al. (2013), Cornelissen and Smart (2013) and Owen et al. (2010). Batacan et al., (2017), observed that training has significant effects on diastolic and SBPs among Africans but were quick to acknowledge the low level of work done on the effects of exercise on anthropometric measures in Africa as compared to Asia. The observation that the type of training significantly influences the magnitude or level of effectiveness of training on DBP is in support of a study by (Cornelissen & Smart 2013).

This section also presents the analysis and comparison of the effectiveness of CTT and OTT in reducing the participants' HR. Figure 9 presents the mean plots of participants HR for the initial stage, 6 weeks, and 12 weeks after training in each schedule.

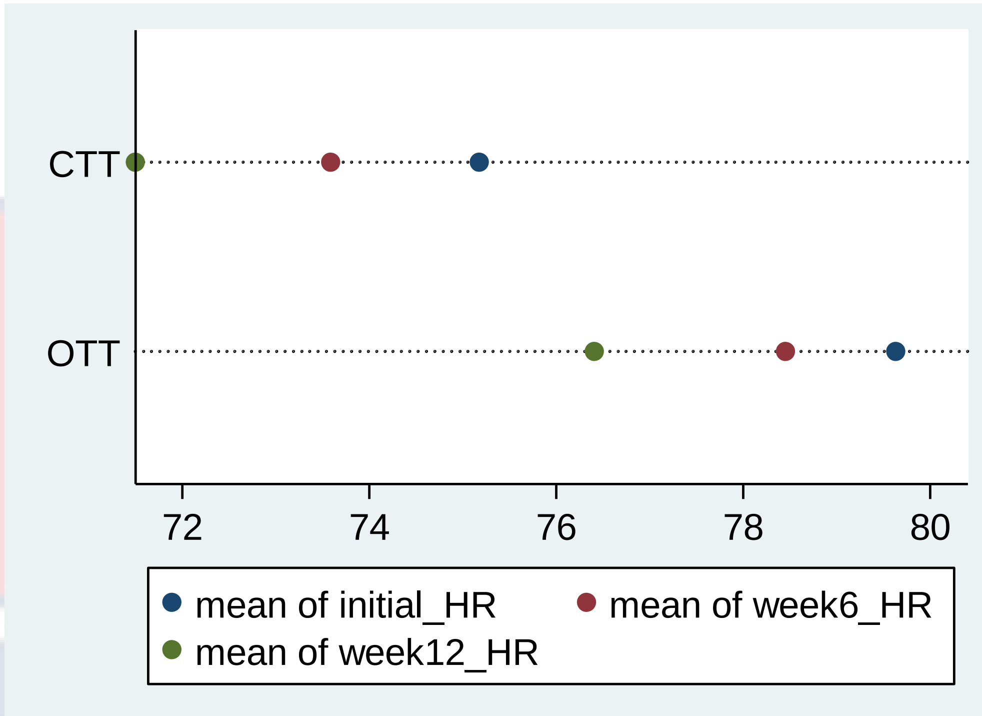


Figure 9: Mean plot of participants HR (actual) for the three occasions

Source: Field data, 2021

The gap between the blue and red dots measures the average reduction in the mean HR for the respective schedules in the first 6 weeks, while the blue and the green dot measures the average reduction in HR after 12 weeks of training. The results suggests that training reduced HR in both training schedules after the first 6 weeks and after the first 12 weeks. The mean plot was presented on a percentage scale to compare the reductions in the means for the two training schedules, as presented in Figure 10:

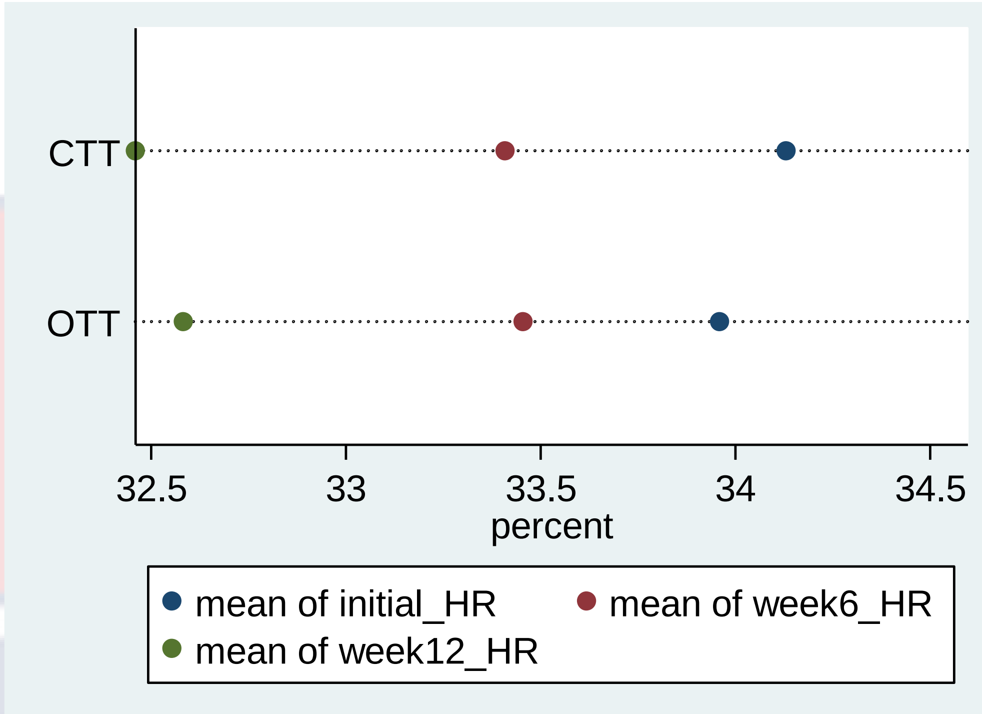


Figure 10: Mean plot of participants HR (percentage) for the three occasions

Source: Field data, 2021

The mean plot in Figure 10 compares the average reductions for participants involved in CTT and those involved in OTT. The plot suggests that the reduction in HR within the first 6 weeks and in the 12 weeks was greater for the participants in the CTT than those involved in the OTT. The results suggests that irrespective of the duration of the training, a CTT schedule was more effective in reducing HR than OTT in a week. The significance of the observed mean difference was tested using the paired sample t-test for the means in each schedule and the independent sample t-test for the comparison across the two groups.

Table 9: Paired sample t-test Results of Training among Participants

	Initial versus Week 6		Initial versus Week 12	
Schedule	Diff (initial–week 6)	t	Diff (initial–week 6)	t
CTT	1.59	5.45**	3.68	9.54**
OTT	1.18	9.42**	3.23	9.45**
Note:	**N=64, ** indicates significance at a 5% significance level**			

Source: Field data, 2021

The result, as presented in Table 9, revealed that the HR of the participants in the CTT group reduced by about 1.59 in the sixth week, compared to the initial HR. The statistical analysis showed a significant difference at the 5% level. Also, the HR of the OTT participants reduced by about 1.18 in the sixth week, compared to the initial HR, and the result was statistically significant at the 5% significance level. The reduction in HR suggested that the CTT schedule/protocol reduced the HR more than the OTT schedule/protocol within the first 6th weeks. When the training was extended to 12 weeks, the participants in the CTT group had their HR reduced by about 3.68, but that of the participants in the OTT group was reduced by about 3.23. Compared to the initial HR, the HR in the 12th week was significantly reduced in both training schedules, but the reduction in CTT was more.

To ensure the validity of the estimated results, the three HR measures were examined in the MANOVA framework to determine whether the type of training schedule significantly explained HR.

Table 10: MANOVA outputs of HR based on Training Schedule Groupings

Source	**Statistic**		**df**	**F(df1,**	**df2)=**	**F**	**Prob>F**	
Model	W	0.8295	1	2.0	41.0	41.0	0.0216	e
	P	0.1705		2.0	41.0	41.0	0.0216	e
	L	0.2056		2.0	41.0	41.0	0.0216	e
	R	0.2056		2.0	41.0	41.0	0.0216	e
Residual			62					
Total			63					

e = exact, a = approximate, u = upper bound on F

W=Wilks' lambda, L = Lawley-Hotelling trace, P = Pillai's trace, R = Roy's largest root

Source: Field data, 2021

The tests found the training schedule significant, as explained by HR from the initial stage to the sixth and twelve weeks. The predictive margins plot in Figure 11 presents the average change in HR within each group for the three measures taken.

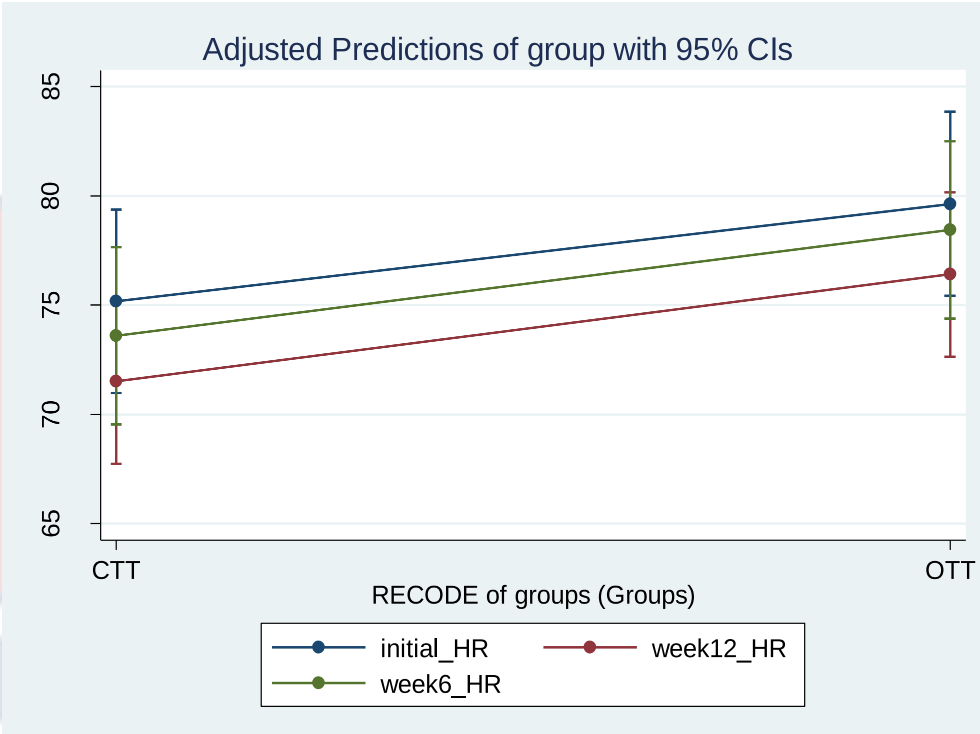


Figure 11: Margins-plot of HR for each group for the three measures

Source: Field data, 2021

The plot depicts a significant HR reduction among participants of the CTT and OTT groups in the first six weeks. The fact that the three lines indicated a relatively parallel nature proved that the two training schedules had relatively identical effects on HR in both the six and twelve weeks of training. The significance of the differences between the drops in the respective measure is summarized in Table 11.

Table 11: Margins Comparison between the CTT and OTT on HR

		Delta-method	Unadjusted
Interactions	Margin mean	Std. Err.	Groups
_predict#group			
Initial#CTT	75.18	2.08	DE
Initial#OTT	79.64	2.08	E
Week6#CTT	73.59	2.01	BC
Week6#OTT	78.45	2.01	C
Week12#CTT	71.50	1.86	A
Week12#OTT	76.40	1.86	AB D

Note: Margins sharing a letter in the group label are not significantly different at the 5% level.

Source: Field data, 2021

The results in Table 11 indicates that the initial margin means of the two groups were relatively identical. It could be observed that the average HR between the participants in both schedules and exercise protocol was relatively identical after six weeks and 12 weeks. Hence, it could be concluded that the difference between the HR of the participants in the CTT and the OTT was not statistically significant. The major conclusion from the analysis was that training, in general, is effective at reducing the HR of the participating individuals, irrespective of the training schedule option, but the longer the duration in terms of the number of weeks of the training schedule, the higher the drop in HR of the participants, keeping other factors constant. The outcome is consistent with the results of White et al. (2010), who observed that training effectively improves participants' HR, but the three-per-week exercise indicated no statistical superiority over other types of exercise. They further explained that training becomes important in improving HR because, during exercise, there is an increase in lipoprotein lipase activities. Consequently, regular exercise or training results in a larger and stronger HR over time, allowing for more significant blood supplies to be ejected with each beat, lowering the HR (Vella, Taylor & Drummer 2017).

Further, the result of analysis and comparison of the effectiveness of CTT and OTT in reducing the percent body fat (%BF) of the participants is also presented. Figure 12 presents the mean plots of participants' body fat for the initial stage, 6 weeks, and 12 weeks after training in each schedule.

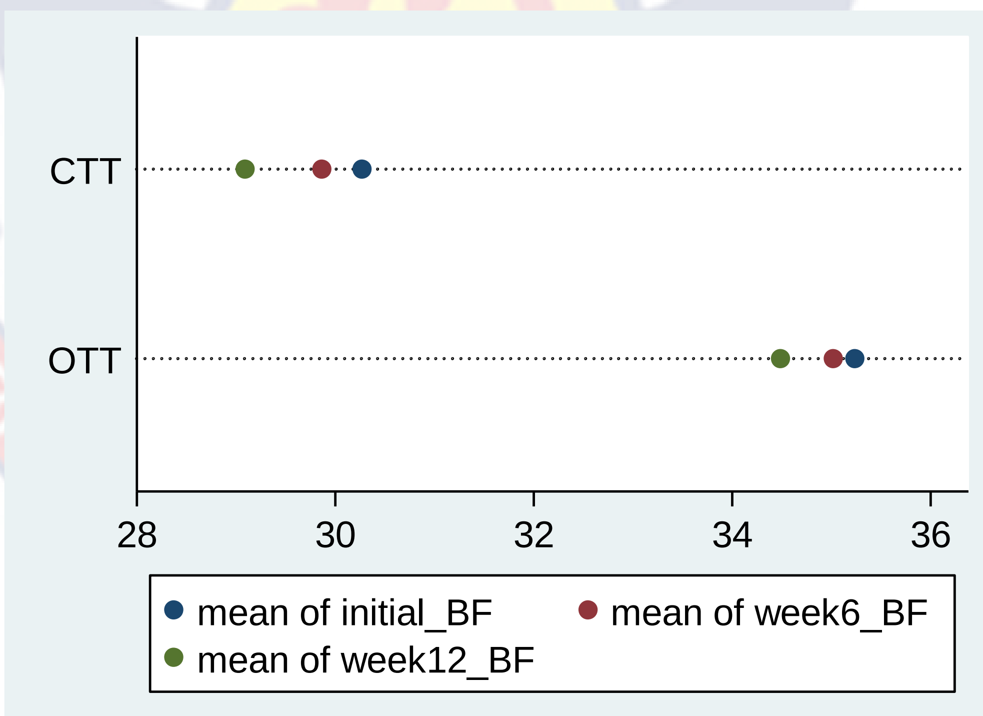


Figure 12: Mean plot of participants %Body Fat (actual) for 1st, 6th and 12th weeks on exercise training schedules

Source: Field data, 2021

The results suggests that the training reduced body fat percentage in both training schedules after the first 6 weeks and after the first 12 weeks. The mean plot was presented on a percentage scale to compare the reductions in the means for the two training schedules, as presented in Figure 13.

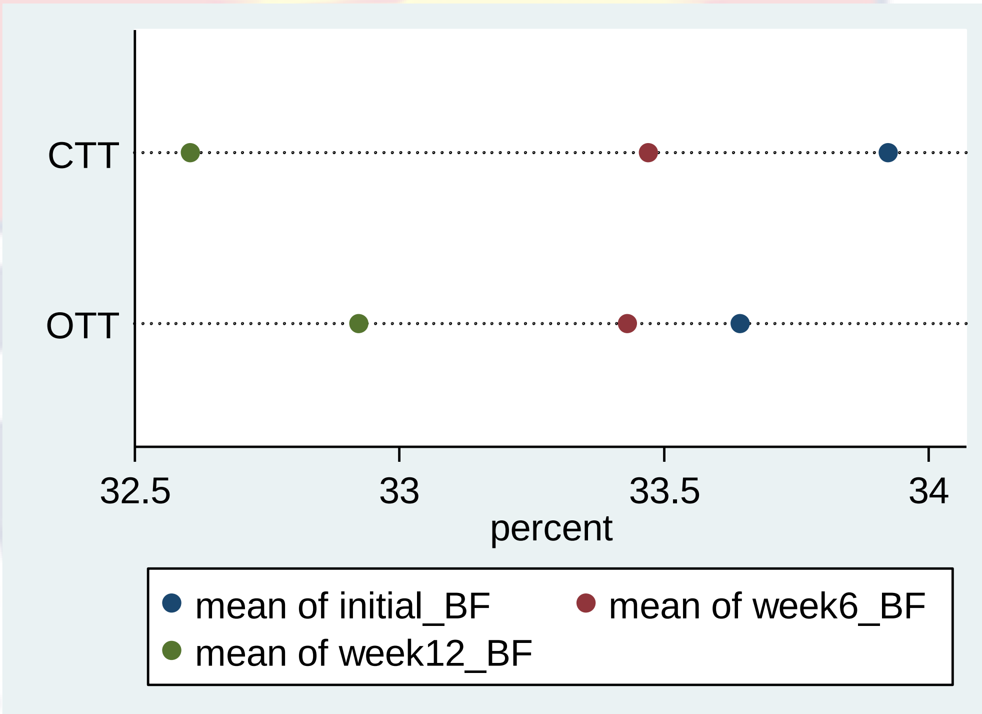


Figure 13: Mean plot of participants' %BF for the 1st, 6th and 12th weeks

Source: Field data, 2021.

The plot indicated that the reduction in percent body fat within the first 6 weeks and in the 12 weeks was greater for the participants in the CTT than those involved in the OTT. Furthermore, the results suggest that irrespective of the duration of the training, a CTT schedule was more effective in reducing body fat than OTT schedule and protocol a week. The significance of the observed mean difference was tested using the paired sample t-test for the means in each schedule and the independent sample t-test for the comparison across the two groups.

Table 12: Paired sample t-test Results of Training among Participants

	Initial versus Week 6		Initial versus Week 12	
Schedule	Diff (initial–week6)	t	Diff (initial–week 6)	t
CTT	0.40	7.66**	1.18	9.17**
OTT	0.22	4.99**	0.75	11.37**
Note:	**N=64, ** indicates significance at a 5% significance level**			

Source: Field data, 2021

The result, as presented in Table 12, suggested that the body fat percentage of participants in the CTT group was reduced by about 0.40 in the first six weeks compared to the initial percentage of body fat, and the difference was statistically significant at the 5% significance level. This implies that the percentage of body fat in the sixth week was significantly lower than the initial percentage body-fat level of the respondents. Also, the percentage of body fat of the OTT participants reduced by 0.22 in the sixth week compared to the initial body fat, and the result was statistically significant at the 5% significance level. The reduction in body fat suggests that the CTT schedule and protocol reduced the percentage of body fat relatively more than the OTT schedule and protocol within the first 6 weeks. When the training was extended to 12 weeks, the participants in the CTT group had their percent body fat reduced by about 1.18, but that of OTT group was reduced by about 0.75. Compared to the initial percentage of body fat, the percentage of body fat in the 12 weeks was significantly reduced in both training schedules, but the reduction in CTT was more.

To ensure the validity of the estimated results, the three body fat percentage measures were examined in the MANOVA framework to determine whether the training schedule significantly explained the participants' body fat percentage.

Table 13: MANOVA Outputs of % Body-Fat based on Training Schedule Groupings

Source	Statistic		df	F(df1,	df2) =	F	Prob>F	
Model	W	0.64	1	3.0	40.0	7.65	0.0004	e
	P	0.36		3.0	40.0	7.65	0.0004	e
	L	0.57		3.0	40.0	7.65	0.0004	e
	R	0.57		3.0	40.0	7.65	0.0004	e
Residual			62					
Total			63					

e = exact, a = approximate, u = upper bound on F

W=Wilks' lambda, L = Lawley-Hotelling trace, P = Pillai's trace, R =

Roy's largest root	

Source: Field data, 2021

All five independent tests indicated that the training schedule and protocols significantly explains the respondents' body fat percentage from the initial stage to the sixth and twelveth weeks. The predictive margins plot, as presented in Figure 14, shows the average change in percent body fat within each group for the three measures taken.

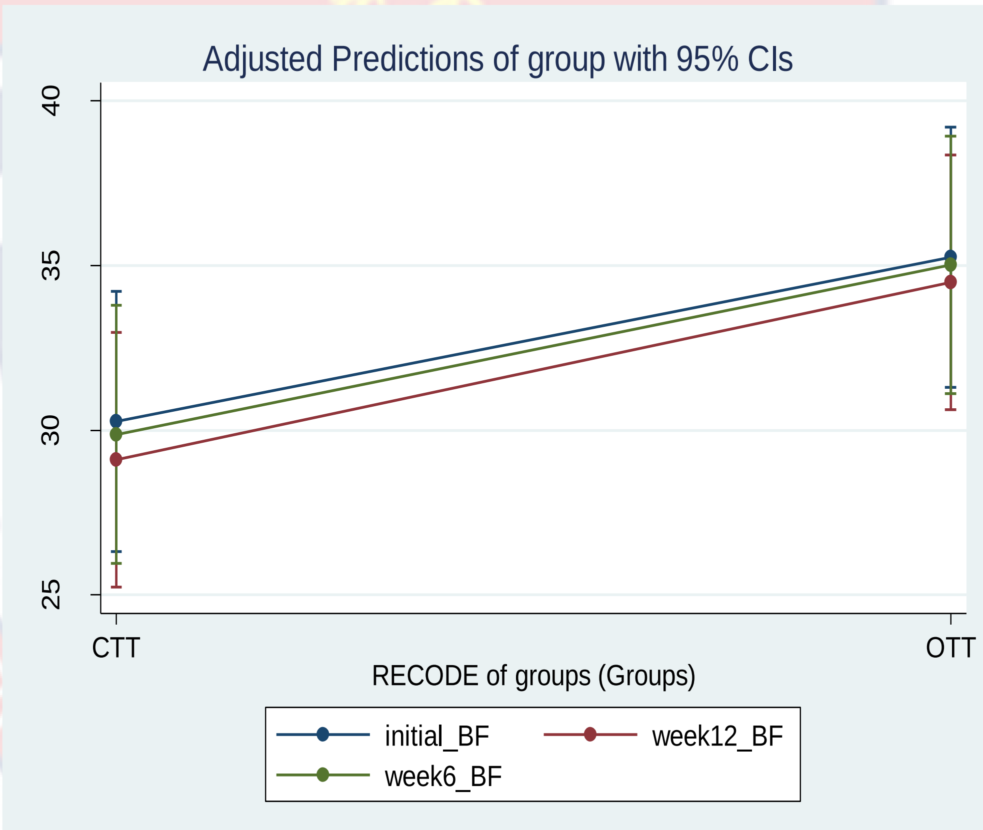


Figure 14: Margins-plot of % Body Fat for each group for the measures taken

Source: Field data, 2021

The plot depicts a significant percentage of body fat reduction among participants of the CTT group and the OTT group in the first six weeks, but the declines were very marginal. The plot suggests that the reduction in the 12th week was significantly wider for both training schedules and protocol. The significance of the differences between the drops in the respective measure is summarised in Table 14.

Table 14: Margins Comparison between the CTT and OTT on %BF

		Delta-method	Unadjusted
Interaction	Margin	Std. Err.	Groups
initial#CTT	30.27	1.96	E
initial#OTT	35.24	1.96	D
Week6#CTT	29.87	1.94	BCD
Week6#OTT	35.02	1.94	C
Week12#CTT	29.09	1.92	A
Week12#OTT	34.49	1.92	ABE

Note: Margins sharing a letter in the group label are not significantly different at the 5% level.

Source: Field data, 2021.

The results in Table 14 indicate that the initial margin of percent body fat means of the two groups was significantly different at the initial stages of the analysis (no repetition of a letter). After 6 and 12 weeks, it was clear that both groups had similar average body fat percentages. Accordingly, it was determined that, at the 5% significance level, there was no statistically significant difference between the CTT and OTT participants' body fat percentages. The primary finding of the analysis was that training is effective at decreasing participants' percent body fat regardless of the training schedule and protocol option, with the longer the duration in terms of the number of weeks of the training schedule and protocol, the greater the reduction in percent body fat of the participants in both exercise protocols. Research backs up the common sense finding that more exercise leads to less overall body fat (Bradbury, et al., 2017; Chung et al., 2017; Kolahdouzi et al., 2019) as demonstrated in the current study.

It was further observed that the success achieved in reducing body fat from training does not significantly depend on whether the training was thrice a week or once a week so faar the dose is adequate. The observation that training significantly reduces the participant's body fat supports the findings of Silva et al. (2020), who found that moderate exercise decreases blood pressure and body fat percentage. The finding of this study that, type of training matters less for the effectiveness of training on percent body fat is consistent with the results of Alizadeh et al., (2021), which found single and multiple training exercises equally effective at reducing body fat.

The outcome, however, contradicts the results of O'Donoghue et al. (2021), and Clark and Goon (2015) and Skyes, Choo, and Cotterell (2004), who, although found training to be effective at reducing body fat, also observed that type of training significantly influences the effectiveness of exercise on body fat. Clark and Goon found multiple or CTT to reduce body fat more effectively than OTT. In order to secure a substantial decrease in body fat percentage, O'Donoghue et al. (2021) advocated a combination of several exercise programmes. Training's efficacy in decreasing body fat was also proven by Bray et al. (2016), who highlighted the direct effects of exercise on the body and its positive effects on glucose homeostasis.

Skyes, Choo, and Cotterrell (2004) found the single-time exercise more effective at reducing body fat percentage among participants. They concluded that a single-time exercise increases the high-density lipoprotein (HDL) cholesterol more than multiple exercises, which explains its effectiveness in reducing body fat percentage. HDL is considered "good" cholesterol because it removes harmful cholesterol from circulation and transports it back to the liver, where it may be metabolized (Jakicic, 2001). In the Ghanaian context, the study of Osei-Tutu and Campagna (2005) also reached a conclusion that this current study contradicts. Their study concluded that the single-time training exercise was more effective than multiple training exercises in reducing body fat. This could be as a result of the type of sample used, age and the fitness level of the participants. Rodriguez-Hernandez and Wadsworth (2019) made a similar observation to that of Osei-Tutu & Campagna outside Ghana.

This session also presents the analysis and comparison of the effectiveness of CTT and OTT protocols in reducing the BMI of the participants. Figure 15 presents the mean plots of participants' BMI for the initial stage, 6 weeks, and 12 weeks after training in each schedule.

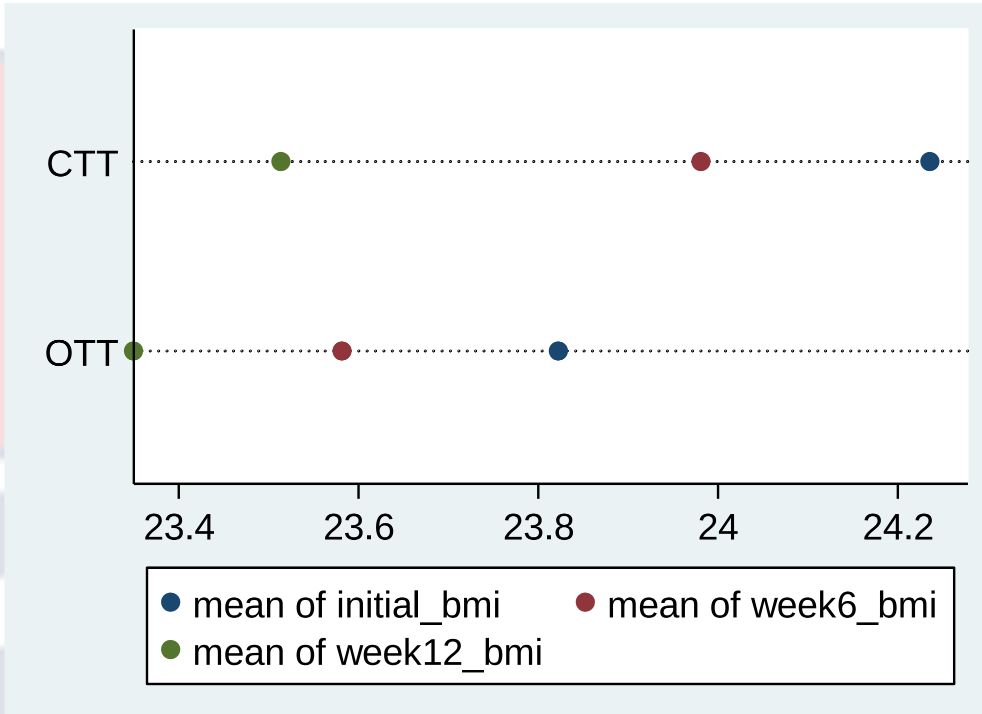


Figure 15: Mean plot of participants BMI (actual) for the 1st, 6th and 12th weeks

Source: Field data, 2021.

The results showed that the training process reduced BMI in both training schedules after the first 6 weeks and after the 12 weeks. To compare the reduction in the means for the two training schedules over the periods, the mean plot was presented on a percentage scale, as shown in Figure 16.

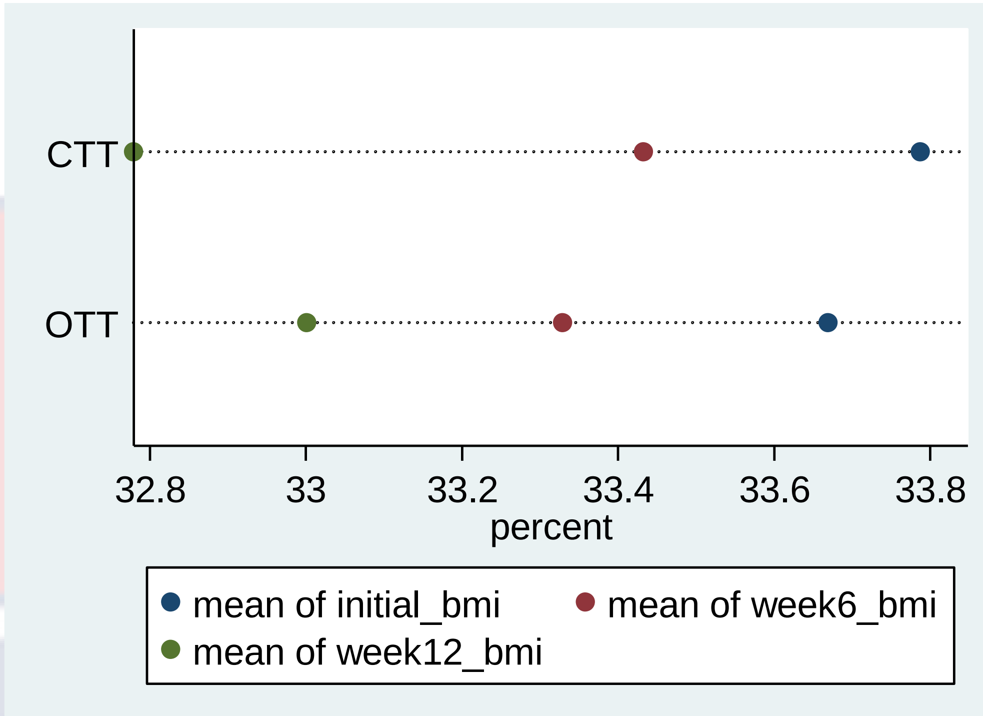


Figure 16: Mean plot of participants' BMI (percent) for the three occasions

Source: Field data, 2021

The plot revealed that the reduction in BMI within the first 6 weeks was relatively identical for the participants in the CTT and those involved in the OTT. However, the participants in the CTT group indicated a greater reduction in BMI than those in the OTT group after 12 weeks of training. The results suggest that in the short period, CTT and OTT resulted in a relatively identical reduction in BMI, but CTT was more effective at reducing BMI than OTT in the long period. The significance of the observed mean differences was tested using the paired sample t-test for the means in each schedule and MANOVA, margins, and margins-plot for the comparison across the two groups.

Table 15: Paired sample t-test results of Training among Participants

	Initial versus Week 6		Initial versus Week 12	
Schedule	Diff (initial–week6)	t	Diff (initial–week 6)	T
CTT	0.26	5.14**	0.72	10.67**
OTT	0.24	4.75**	0.47	7.78**
Note:	**N=64, ** indicates significance at a 5% significance level**			

Source: Field data, 2021

The result, as presented in Table 15, indicated that the BMI of the participants in the CTT group was reduced by about 0.26 in the first six weeks compared to the initial BMI. Statistical analysis showed a significant difference at the 5% level. Also, the participants in the OTT had their BMI reduced by about 0.24 in the sixth week compared to the initial BMI, and the result was statistically significant at the 5% significance level. The results imply that the BMI in the sixth week was significantly lower than that of the initial BMI level of the participants before the training started in both schedules. The comparison in the BMI figures of the participants suggests that the CTT schedule reduced the BMI relatively more than the OTT schedule within the first six weeks. When the training was extended to 12 weeks, the participants in the CTT group had their BMI reduced by 0.72, but that of the participants in the OTT group was reduced by 0.47. Compared to the initial BMI, the BMI in the 12th week was significantly reduced in both training schedules, but the reduction in CTT was relatively more.

The MANOVA model was fixed to compare the effectiveness of the two training schedules in reducing the BMI of the participants in terms of the magnitude of the reduction. Table 16 presents the MANOVA results used for the margin mean analysis.

Table 16: MANOVA Outputs of BMI based on Training Schedule Groupings

Source	**Statistic**		**df**	**F(df1,**	**df2)=**	**F**	**Prob>F**	
Model	W	0.81	1	3.0	40.0	3.21	0.0332	e
	P	0.19		3.0	40.0	3.21	0.0332	e
	L	0.25		3.0	40.0	3.21	0.0332	e
	R	0.25		3.0	40.0	3.21	0.0332	e
Residual			62					
Total			63					

e = exact, a = approximate, u = upper bound on F

W=Wilks' lambda, L = Lawley-Hotelling trace, P = Pillai's trace, R = Roy's largest root

Source: Field data, 2021.

The observation that all five independent tests found the training schedule to be significant explains the BMI of the respondents from the initial stage to the sixth week and the twelveth week. The predictive margins plot, as presented in

Figure 17, shows the case of the average change in BMI within each group for the three measures taken.

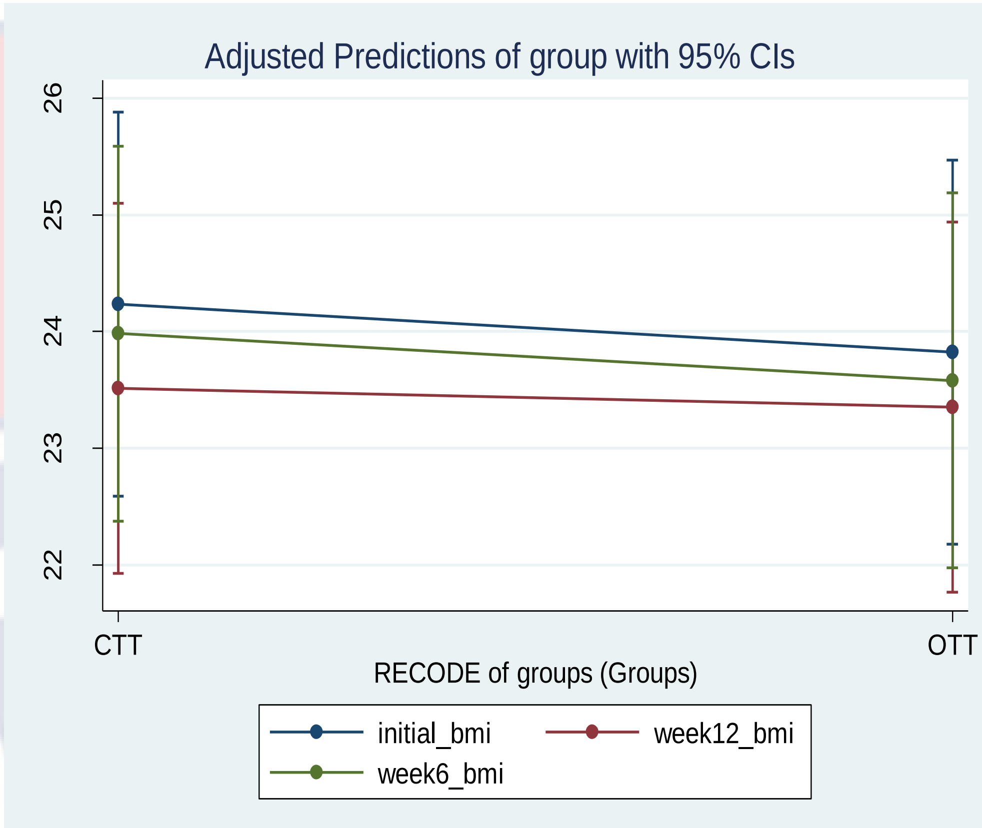


Figure 17: Margins-plot of BMI for each group for the sixth and twelveth weeks of exercise training

Source: Field data, 2021.

The plot depicts a significant BMI reduction among participants in the CTT group and those in the OTT group in the sixth and twelveth weeks. The plots suggest that the decrease after twelve weeks was significantly greater for participants in the CTT group than those in the OTT group. The significance of the differences between the reductions in the respective measures is summarised in Table 17.

Table 17: Margins Comparison between the CTT and OTT on BMI

		Delta-method	Unadjusted
Interaction	**Margin**	**Std. Err.**	**Groups**
_predict#group			
Initial#CTT	24.23636	.8158001	C
Intial#OTT	23.82273	.8158001	E
Week6#CTT	23.98182	.7955269	B
Week6#OTT	23.58182	.7955269	D
Week12#CTT	23.51364	.7861221	A DE
Week12#OTT	23.35	.7861221	ABC

Note: Margins sharing a letter in the group label are not significantly different at the 5% level.

Source: Field data, 2021

The results in Table 17 indicate that the initial margin BMI means of the two groups were significantly different at the initial stages of the analysis (no repetition of a letter). It could further be observed that the differences persisted after the first six weeks, but the difference vanished after 12 weeks of training in both schedules. Because the BMI was higher among the participants in the CTT group (mean = 24.24) than those in the OTT group (23.82), the identical performance in the 12th week indicated that the participants in the CTT group reduced their BMI more within the period. Hence, it could be concluded that the CTT schedule reduces the BMI of the respondents more than the OTT training schedule.

The primary conclusion from the analysis is that training, in general, is effective at reducing the BMI of the participating individuals irrespective of the training schedule option, but the longer the duration of the training schedule in terms of the number of weeks, the higher the reduction in BMI of the participants especially for the CTT schedule. The reason exercise could be effective at reducing BMI could be traced from the direct relationship between BMI and body fat as the individual exercises. As the body fat of the trainer reduces, given the height, the BMI automatically falls since the numerator, (weight), in estimating the BMI, falls (Kelley et al., 2015).

The result that all forms of exercise significantly reduce the BMI of the participants is in support of the earlier study by Alizadeh et al. (2013). Alizadeh et al. indicated that multiple short exercises for 150 minutes or more per week (CTT) are more effective at reducing weight among participants than single prolonged exercises. Furthermore, Clark (2015) indicated that a higher exercise intensity and energy expenditure could significantly reduce the BMI and body fat of the participants.

When the results from the two exercise protocols were compared, it was observed that the CTT exercise protocol significantly reduced BMI more than the OTT exercise protocol. The comparison indicated that the ability of training to influence the BMI of the participants depends on the nature of the training. The observation is consistent with the findings of Clark (2015), who concluded that multiple-time exercise intervention could significantly reduce individuals' body weight and body fat than other types of training. Alizadeh et al. (2016) also observed that multiple-time training exercises have very high effects on BMI, as observed in this current study. On the other hand, Themistocleous, Agathangelou, and Stefanakis (2021) observed that exercise training, irrespective of training, significantly improves the BMI of the participants.

Hypothesis 3: There will be no gender differences on the effect of long duration and thrice per week aerobic exercise programmes on selected physiological and anthropometric health markers of a keep fit club members in Accra after 12 weeks of exercising.

This hypothesis tested the statistical significance of the moderating role of gender of the participants on the effectiveness of the exercise protocols on the selected anthropometric and physiological measures. The analysis was done on each of the selected variables and discussed accordingly. The analyses used the one-sample t-test of the mean and paired sample t-test comparison of means. Figure 18 presents the mean plot of the respondents' average SBP across gender and training schedules.

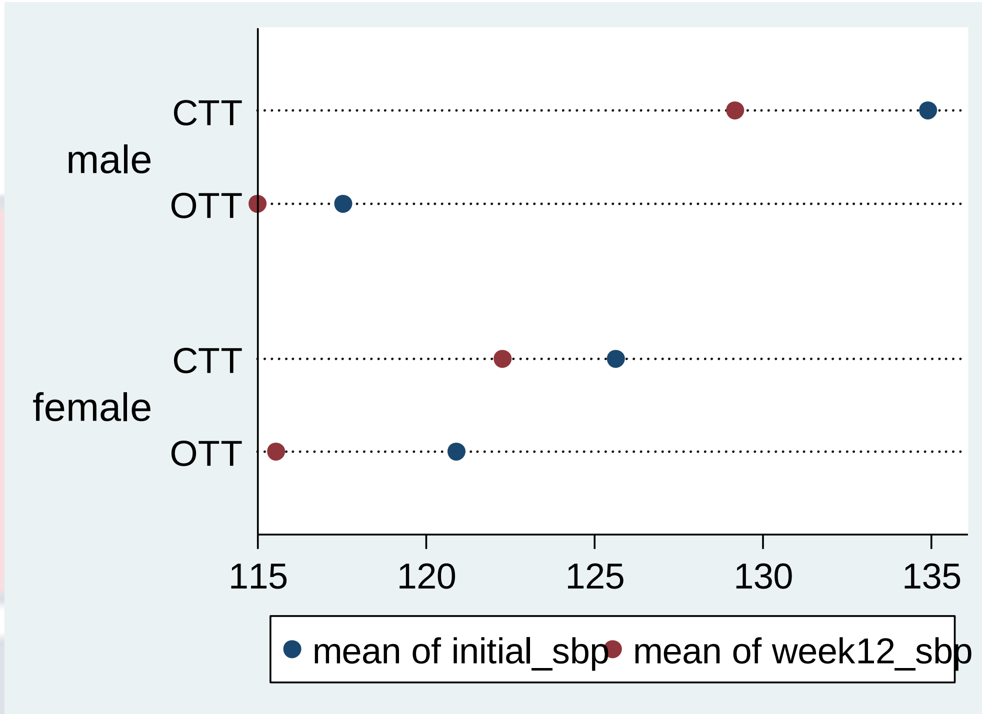


Figure 18: Mean plot of SBP over Gender and Exercise protocol

Source: Field data, 2021

The results revealed that the mean SBP of males in the CTT group was about 134.91 at the onset of the training, which reduced to 129.18 after 12 weeks. The paired sample t-test results suggests that the SBP of the male participants in the CTT group significantly reduced by about 5.73 at the 5% significance level (t = 6.79, df = 15, Ha: mean (diff) > 0, p-value = 0.00).

Also, the males in the OTT group began the training with an average SBP of about 117.55 and ended with an average SBP of about 115.00. The paired sample t-test indicated that the SBP of the males in the OTT group significantly reduced by about 2.55 at the 5% significance level (t = 2.23, df = 15, p = 0.02). The average reduction in SBP of males in the CTT group was about twice that of the males in the OTT group, which confirms the observation that CTT training could be more beneficial to males than OTT training when it comes to reducing SBP.

The results in Figure 18 further suggest that the females in the CTT group began with an average SBP of about 125.64 and ended with 122.27 after 12 weeks of training. The paired sample t-test results indicate that females in the CTT group reduced SBP by about 3.36, and the difference was statistically significant at the 5% significance level ($t = 5.68$, $df = 15$, $p = 0.00$). Also, the females in the OTT group began the training with an average SBP of 120.91 and ended with an average SBP of about 115.54. The mean comparison test suggested an average reduction of about 5.36 ($t = 10.74$, $df = 15$, p-value = 0.00) for males participating in the OTT. The percentage plots of the means, as presented in Figure 19, summarises the results discussed above.

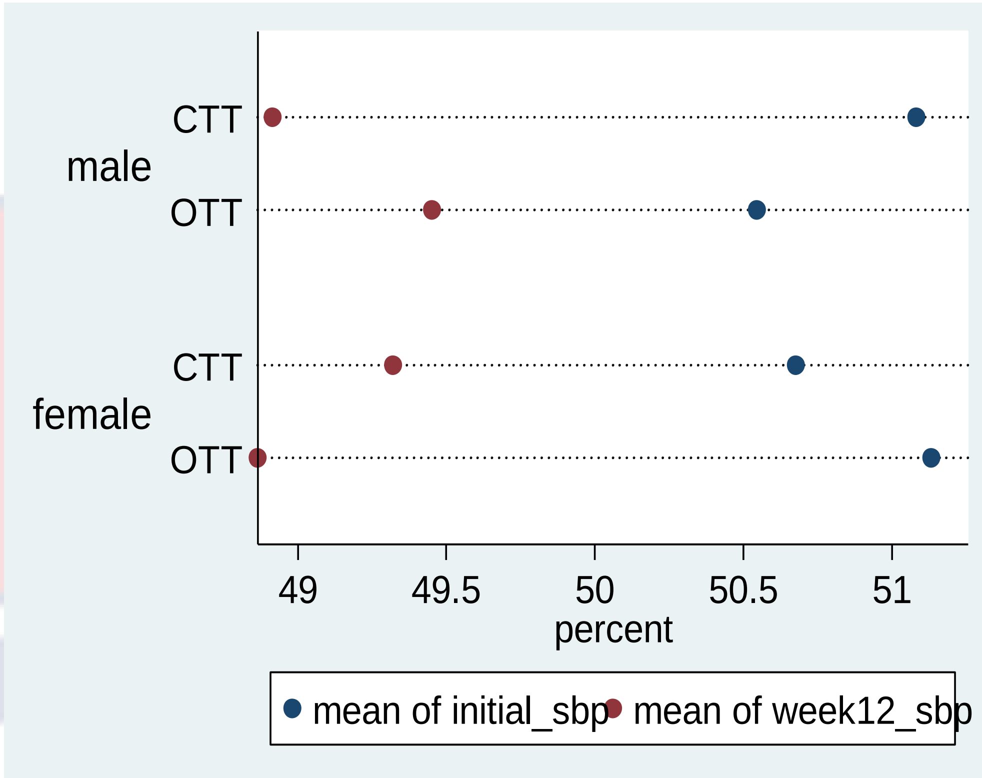


Figure 19: Mean plot of SBP (percent) over Gender and Training

Source: Field data, 2021

The moderating role of the gender of the participants on the effectiveness of the exercise protocols on DBP reduction was examined in this session. Figure 20 presents the mean plot of the respondents' average DBP across gender and training schedules.

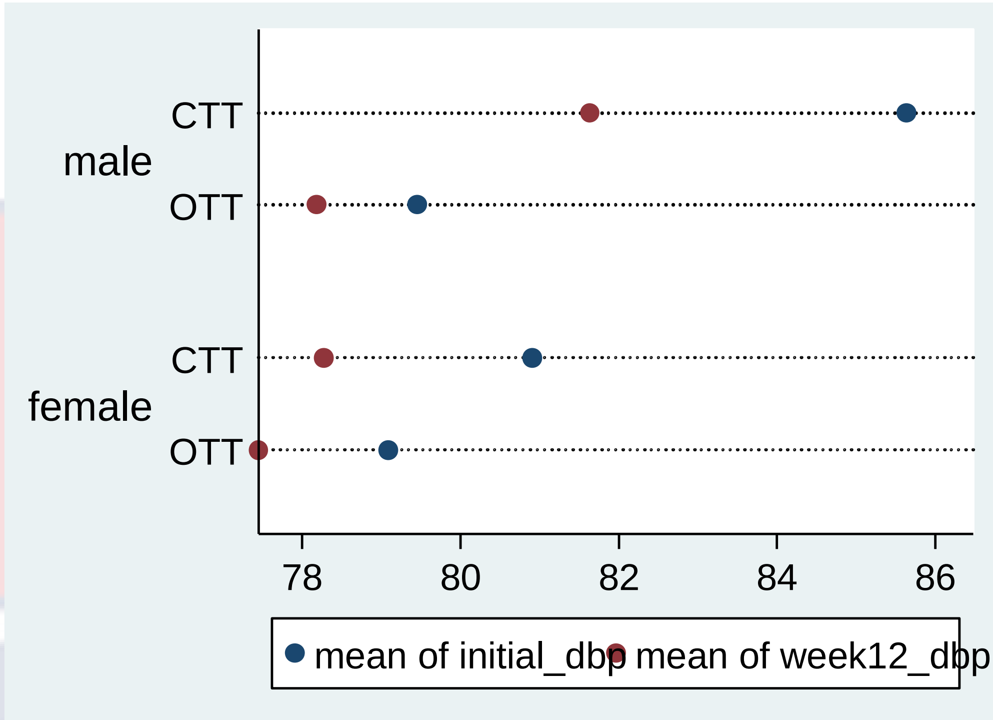


Figure 20: Mean plot of DBP over Gender and Exercise protocol

Source: Field data, 2021

The results indicated that the mean DBP of males in the CTT group was about 85.6364 at the onset of training, which reduced to 81.616 after 12 weeks. The paired sample t-test results suggest that the SBP of the male participants in the CTT group significantly reduced by about 5.727 at the 5% significance level (t = 4.000, df = 15, Ha: mean(diff) > 0, p-value = 0.000). Also, males in the OTT group began the training with an average DBP of about 80.9091 and ended with an average DBP of about 78.272. The paired sample t-test indicates that the DBP of the males in the OTT group significantly dropped by about 2.636 (t = 5.823, df = 15, p = 0.000). The average drop in DBP of males in the CTT group was about 1.5 times that of the males in the OTT group, which confirms the observation that CTT training could be more beneficial to males than OTT training when it comes to reducing DBP.

The results in Figure 20 further revealed that the females in the CTT group began with an average DBP of about 79.454 and ended with 78.181 after 12 weeks of training. The paired sample t-test results indicate that females in the CTT group dropped in DBP by about 1.272, and the difference was statistically significant at the 5% significance level (t = 2.353, df = 15, p = 0.020). Also, the females in the OTT group began the training with an average DBP of about 79.0909 and ended with an average DBP of about 77.454 after the 12 weeks of training. The mean comparison test suggests an average significant drop of about 1.636 (t = 3.008, df = 15, p-value = 0.006) for males participating in the OTT. The percentage plots of the means, as presented in Figure 21, summarise the results discussed above.

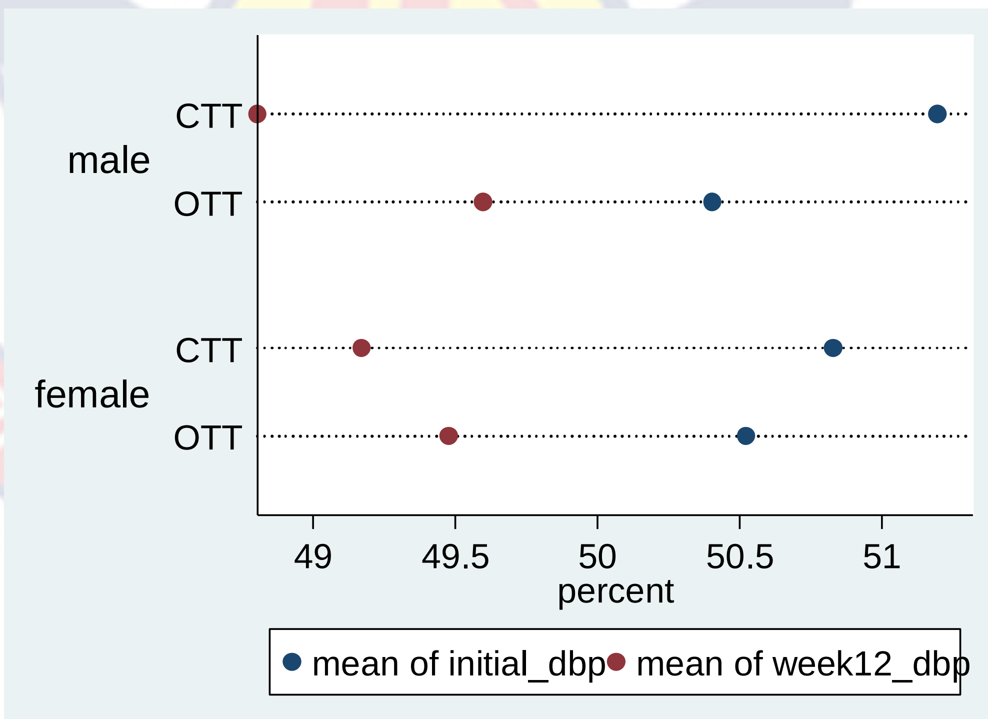


Figure 21: Mean plot of DBP (percent) over Gender and Training

Source: Field data, 2021

The results indicate that the CTT training leads to a significantly broader drop in DBP for females and males when all other factors are constant. The results support the findings of Imamura, et al., (2004) who concluded that gender moderates the effects of training on DBP but matters only to females regarding SBP. A similar explanation could be that the endurance of males for the multiple training exercises could be considered to be higher than that of the females; hence, females may find the OTT an easy option than the multiple exercise plan (Paoli et al., 2013; Lim et al., 2011).

The moderating role of the gender of the participants on the effectiveness of the exercise protocols on HR reduction was examined in this hypothesis. The analysis used the mean and paired sample t-test comparison of means. Figure 21 presents the mean plot of the respondents' average HR (HR) across gender and training schedules.

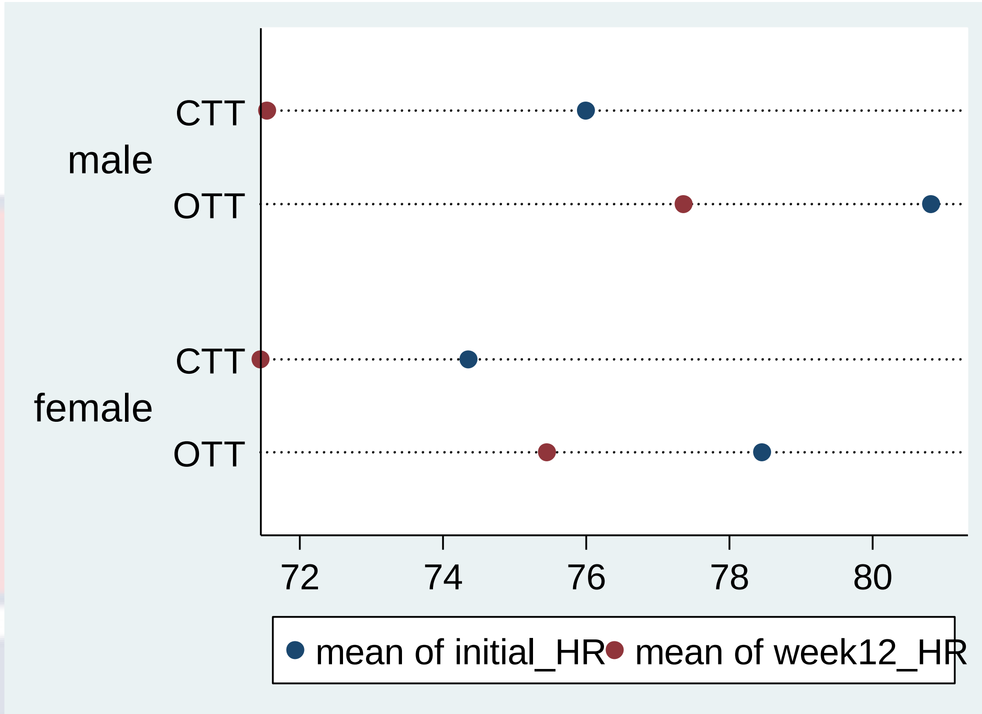


Figure 22: Mean plot of HR over Gender and Exercise protocols

Source: Field data, 2021

The results showed that the mean HR of males in the CTT group was about 76.00 at the beginning of the training, which reduced to 71.55 after 12 weeks. In addition, the paired sample t-test results revealed that the HR of the male participants in the CTT group significantly decreased by 4.45 at the 5% significance level (t = 6.69, df = 15, Ha: mean (diff) > 0, p-value = 0.000). Also, the males in the OTT group began the training with an average HR of 80.82 and ended with an average HR of 77.36. The paired sample t-test indicates that the HR of the males in the OTT group significantly reduced by 3.45 (t = 6.536, df = 15, p = 0.000). The results of the one-sample t-test suggest that the average reduction in HR of males in the CTT group was significantly higher than that of the males in the OTT group (t = -1.86, df = 15, p = 0.046), which suggests that CTT training is more beneficial to males than OTT training when it comes to reducing the HR.

The results in Figure 22 further revealed that the females in the CTT group began with an average HR of 74.36 and ended with 71.45 after 12 weeks of training. The paired sample t-test results indicate that females in the CTT group reduced HR by about 2.90, and the difference was statistically significant at the 5% significance level ($t = 11.61$, $df = 15$, $p = 0.000$). Also, the females in the OTT group began the training with an average HR of 78.45 and ended with an average HR of 75.45. The mean comparison test indicated an average significant reduction of 3.00 ($t = 1.744$, $df = 15$, p-value = 0.04) for females that participated in the OTT protocol. The percentage plots of the means (Figure 22), summarise the results.

The results indicate that the CTT training leads to a significantly greater percentage reduction in HR for males than females. In comparison, the OTT training schedule leads to a greater percentage reduction in HR for females than males when all other factors are constant. The results suggest that gender moderates the effects of the training type on HR, keeping all other factors constant.

This discovery that training has different effects on men and women agrees with those of several previous studies (Sydo et al., 2014; Marfell-Jones et al., 2006). According to Sydo et al., the HR responses to exercise differ between sexes. Using the standard formula (220-age), Sedo et al. found that men's HR responses were similar to those obtained, but women's peak HR had a lower intercept and fell more slowly with age (206-0.88age). Therefore, men and women of the same age can have differing HR response rates to the same type of exercise, even if all other parameters are constant. In contrast, Marfell-Jones et al., found that a well-designed 12-week endurance-training programme reduced resting and submaximal HR in both young and old persons.

Further, the moderating role of the gender of the participants on the effectiveness of the exercise protocols on percent body fat reduction was examined. Figure 23 presents the mean plot of the respondents' average percentage of body fat (%BF) across gender and training schedules.

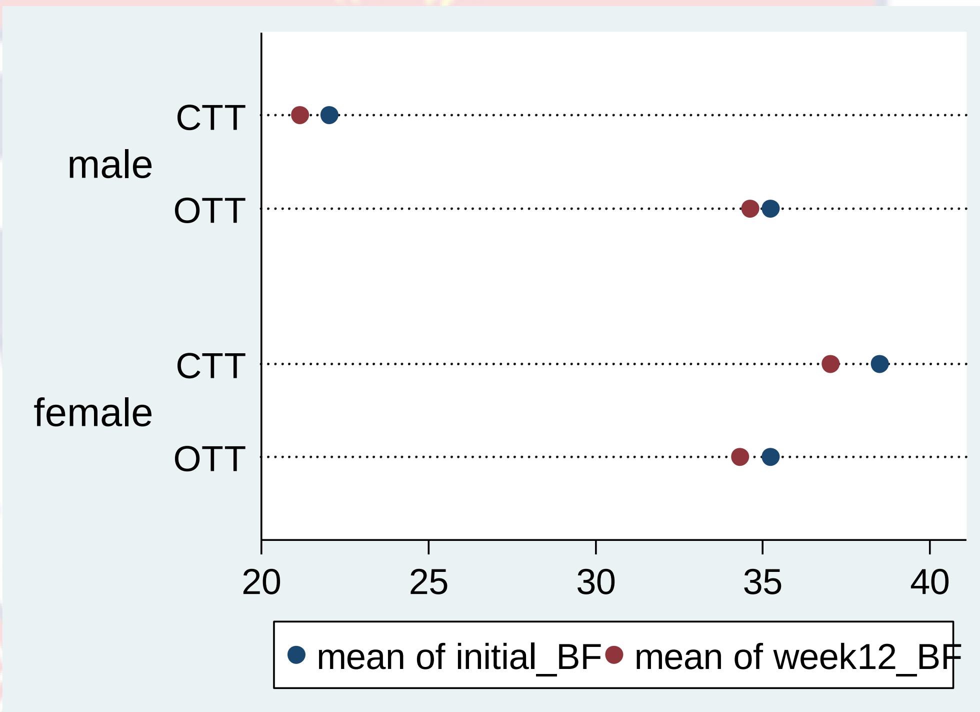


Figure 23: Mean plot of percentage BF over Gender and Exercise protocol

Source: Field data, 2021.

The results indicated that the mean %BF of males in the CTT group was about 22.04 at the beginning of the training, which reduced to 21.15 after 12 weeks. The paired sample t-test results suggest that the %BF of the male participants in the CTT group significantly reduced by about 0.88 at the 5%

significance level (t = 5.06, df = 15, Ha: mean(diff) > 0, p-value = 0.000). Also, the males in the OTT group began the training with an average %BF of about 35.25 and ended with an average %BF of about 34.64. The paired sample t-test indicated that the %BF of the males in the OTT group significantly dropped by about 0.61 (t = 9.091, df = 15, p = 0.000). The average drop in %BF of males in the CTT group was higher than that of the males in the OTT group, which implied that CTT training could be more beneficial to males than OTT training when it comes to reducing percent body fat.

The results in Figure 23 further revealed that the females in the CTT group began with an average %BF of about 38.51 and ended with 37.04 after 12 weeks of training. The paired sample t-test results indicated that females' %BF in the CTT group dropped by 1.47, and the difference was statistically significant at the 5% significance level (t = 10.050, df = 15, p = 0.000). Also, the females in the OTT group began the training with an average %BF of 35.24 and ended with an average %BF of about 34.34. The mean comparison test suggested an average significant reduction of about 0.90 (t = 1.744, df = 15, p-value = 0.000) for males participating in the OTT. The percentage plots of the means (Figure 24), present the summary of the results.

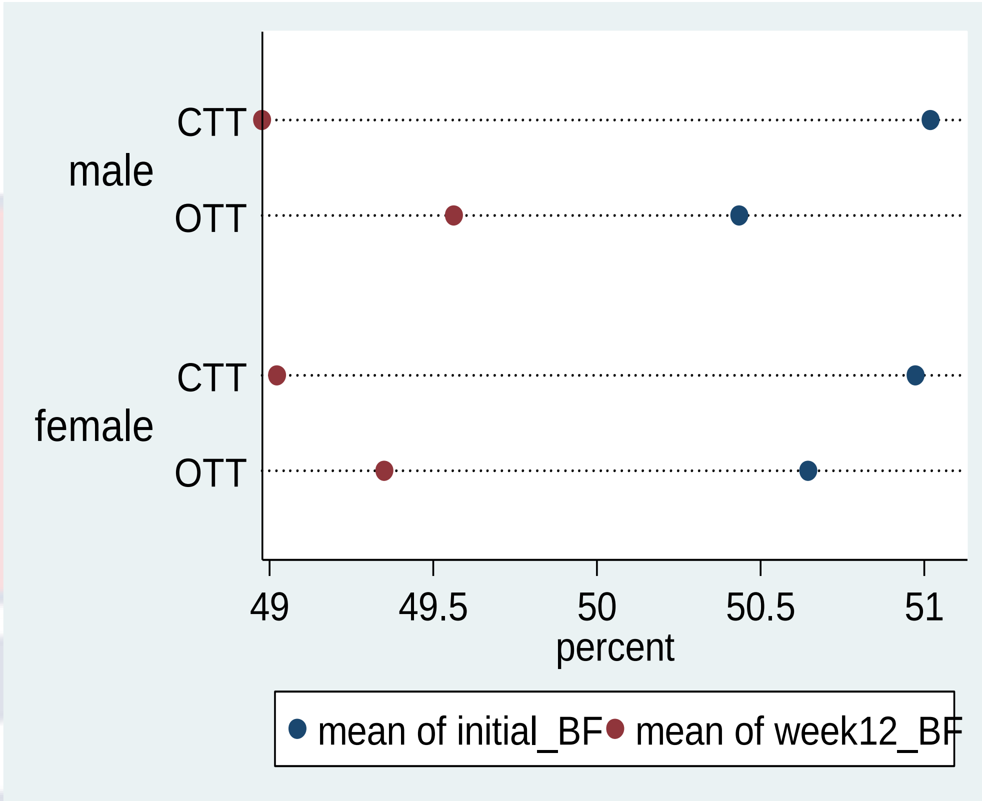


Figure 24: Mean plot of %BF over gender and training

Source: Field data, 2021

The results indicate that the CTT training leads to a greater percentage reduction in %BF for both males and females. In comparison, the OTT training schedule leads to a lower percentage reduction for females than males when all other factors are constant. The observation that both types of training were significantly effective for males was consistent with the studies of Kolahdouzi et al. (2019), who reached a similar conclusion after comparing single and multiple exercises. Females were found to benefit less from a single exercise per week compared to three times per week, which implies they have different responses to training types when it comes to reducing the percentage of body fat. Bradbury et al. (2017) observed the correlation between the BMI of males and females, which could explain the differences observed in the current study about the gender effects of training exercises. Bradbury et al. indicated that though strong positive correlations exist between the percentage of body fat and BMI among males and females, the strength is more muscular among females than among males. They concluded that among males and females of identical BMI, females are more likely to have a higher percentage of body fat than males, which explains why some training exercises that could work for males may not work for females.

A study by Min et al. (2019) empirically estimated the differences in the percentage of body fats for males and females after controlling for BMI. Earlier, Kim, Ko, Seo, and Kim (2018) concluded that for the same level of BMI, the percentage of body fat of females was 10.4% higher than that of males, which could make them respond differently to different durations and intensities of training when it comes to reducing body fat. When comparing genders, Donnelly, Hill, Jacobsen, Potteiger, and Sullivan (2003) discovered that women significantly reduced body fat. There was a significant weak to moderate negative linear link between the percent body fat and normalised strength in both sexes, as shown by Williams, Wood, Collins, and Callister (2015). Women, however, had more robust relationships. Nicklas et al. (2009) agreed with these findings and suggested that combination intervention would be most beneficial to women.

This session focused on the moderating role of the gender of the participants on the effectiveness of the exercise protocols on the reduction of BMI. The analysis used the mean and paired sample t-test comparison of means. Figure 25 presents the mean plot of the respondents' average BMI across gender and training schedule.

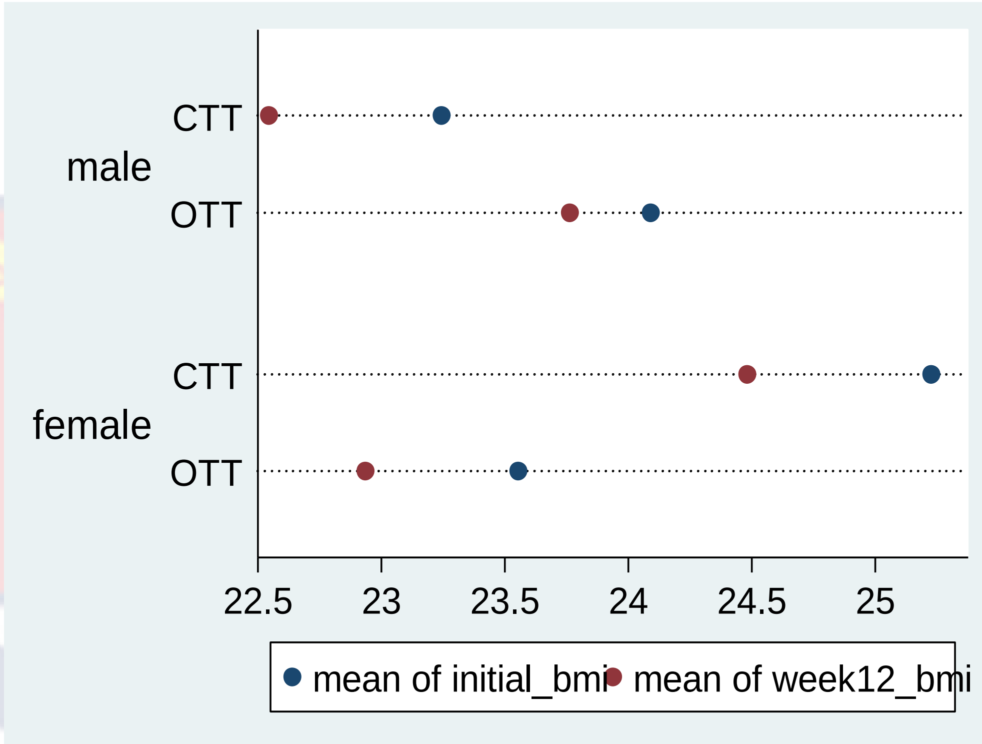


Figure 25: Mean plot of BMI over gender and exercise protocol

Source: Field data, 2021

The results indicated that the mean BMI of males in the CTT group was 23.25 at the beginning of the training, which reduced to 22.55 after 12 weeks. The paired sample t-test results revealed that the BMI of the male participants in the CTT group significantly reduced by about 0.70 at the 5% significance level (t = 8.21, df = 15, Ha: mean(diff) > 0, p-value = 0.00). Also, the males in the OTT group began the training with an average BMI of 24.09 and ended with an average BMI of about 23.76. The paired sample t-test indicated that the BMI of the males in the OTT group significantly reduced by 0.33 (t = 5.29, df = 15, p = 0.00). The average reduction in BMI of males in the CTT group was 0.37 higher than that of the males in the OTT group, which implied that CTT training could be more beneficial to males than OTT training when it comes to reducing the BMI.

The results in Figure 25 further implied that the females in the CTT group began with an average BMI of about 25.23 and ended with 24.48 after 12 weeks of training. The paired sample t-test results indicate that the females in the CTT group reduced BMI by about 0.75, and the difference was statistically significant at the 5% significance level ($t = 6.84$, $df = 15$, $p = 0.00$). Also, the females in the OTT group began the training with an average BMI of 23.56 and ended with an average BMI of 22.94. The paired sample mean comparison test suggested an average significant reduction of 0.62 ($t = 7.18$, $df = 15$, p-value = 0.00) for males participating in the OTT. The percentage plots of the means, as presented in Figure 26, summarise the results.

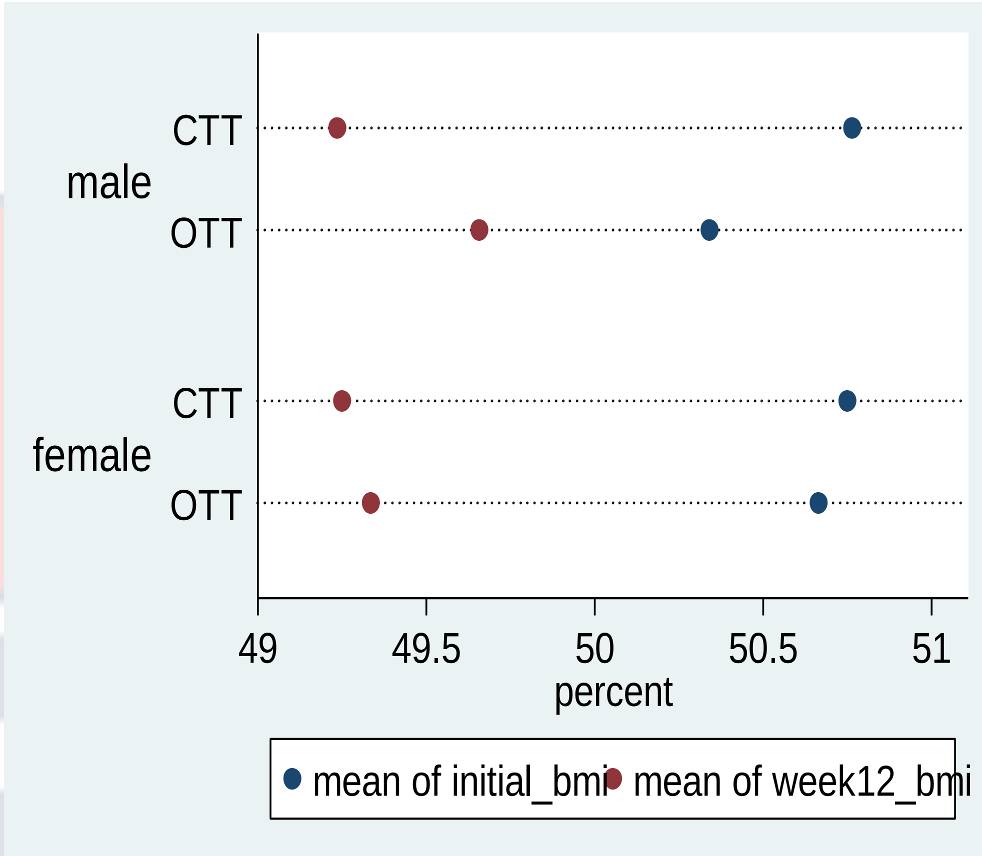


Figure 26: Mean plot of BMI (percent) over gender and exercise protocol

Source: Field data, 2021.

The results indicate that the CTT training leads to a significantly greater percentage reduction in BMI for both males and females. In contrast, the OTT training schedule leads to a smaller percentage drop for females than for males when all other factors are constant. The outcome implied that females can achieve relative success in reducing BMI whether training is organised thrice a week or done once a week but long enough. However, males can achieve more success at reducing BMI by participating in three-times-a-week training sessions as against doing a single prolonged training programme at the weekend. Studies of Min et al. (2019) and Atikovic et al. (2014) empirically found males and females to differ in their responses to exercises in terms of the level of motivation and responses to weight stigma. Xu et al. (2017) found that the BMI of males is influenced by several factors that do not significantly affect the BMI of females. Min et al. stated that males naturally tend to reverse their gains in BMI more from exercises, which may explain why single-time training was less effective for males than multiple-time training. That is, single-time training has longer rest time that allows the gains in BMI in males to be lost, but the loss is relatively slow in females (Min et al.,).

Hypotheses 4: There will be no age differences on the effect of long duration and thrice per week aerobic exercise programme on selected physiological and anthropometric health markers of a keep fit club members in Accra after 12 weeks of exercising.

This hypothesis sought to examine how the age of the respondents statistically influenced how the two training types affected the anthropometric and physiological measures of the respondents. The means were the main measure of central tendency used along with the one-sample t-test and the mean paired sample t-test. The mean difference was first visualised in the dot plot in terms of actual and percentages before formal tests of statistical differences were conducted.

Figure 27 presents the mean plot of the respondents' average SBP across age categories and training schedules.

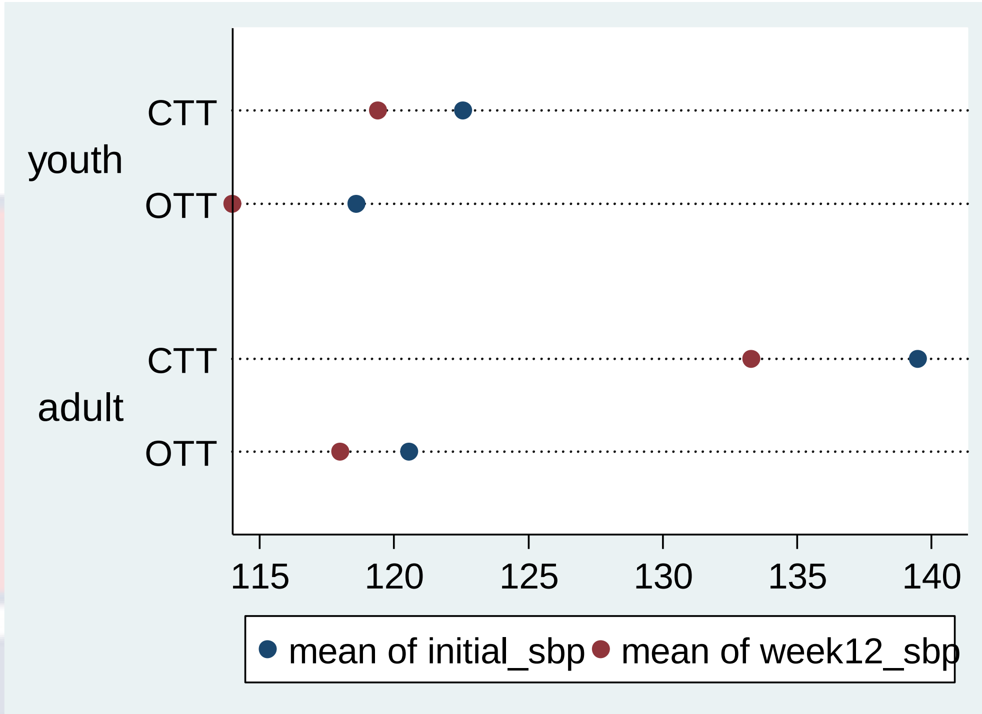


Figure 27: Mean plot of SBP over age category and exercise protocol

Source: Field data, 2021

The results indicated that the mean SBP of the youths in the CTT group was 134.91 at the beginning of the training, which reduced to 119.42 after 12 weeks. The paired sample t-test results suggest that the SBP of the adult participants in the CTT group significantly reduced by 3.17 at the 5% significance level ($t = 5.64$, $df = 15$, Ha: mean (diff) > 0, p-value = 0.00). Also, the youth in the OTT group began the training with an average SBP of 118.60 and ended with an average SBP of 114.00. The paired sample t-test indicated that the SBP of the adults in the OTT group significantly reduced by 4.60 at the 5% significance level ($t = 2.55$, $df = 15$, $p = 0.02$). The average reduction in the SBP of the youths in the OTT group was 1.43 more than the youths in the CTT group, which confirms the observation that OTT training could be more beneficial to youths than OT training when it comes to reducing SBP.

The results in Figure 27 further revealed that the adults in the CTT group began with an average SBP of about 139.50 and ended with about 133.30 after 12 weeks of training. The paired sample t-test results indicate that the SBP of the adults in the CTT group was reduced by 6.20, and the difference was statistically significant at the 5% significance level (t = 7.89, df = 15, p = 0.000). Also, the adults in the OTT group began the training with an average SBP of 120.57 and ended with an average SBP of about 118.00. The mean comparison test suggested an average reduction of 2.57, but the difference was insignificant (t = 1.39, df = 15, p-value = 0.11) for adults who participated in the OTT. The percentage plots of the means, as presented in Figure 28, summarise the results discussed.

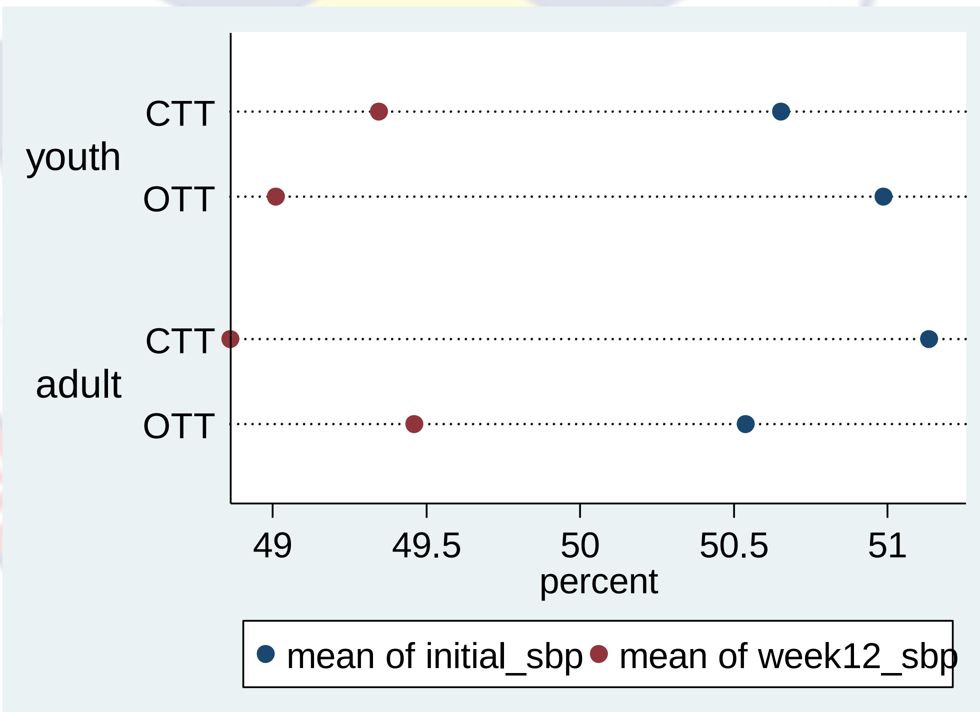


Figure 28: Mean plot of SBP (percent) over age category and exercise protocol

Source: Field data, 2021

Generally, the result was that training benefits youth and adults, but has different effects on the two groups. The observation that training typically helps reduce the SBP of youth and adults is consistent with the results of Schillaci and Pucci (2010) and Stevens, Katz, and Huxley (2010). The type of training and age group results indicated that the CTT training leads to a significantly greater percentage reduction in SBP for youths than adults. In comparison, the OTT training schedule leads to a greater percentage reduction for adults than youth when all other factors are constant. The result implies that, within 12 weeks or more, individuals must consider their age group before choosing a training plan that will give them the greatest success in reducing SBP. CTT training involves multiple training exercises within the week, with three different training exercises in a week but with a shorter duration. This implies that the participants must recover from a previous training and training within two days intervals continuously for 12 weeks. This obviously shall be easier for the youth than the adults, keeping other factors constant, hence, the observation that the youth benefits more from this training exercise than the adults. That is, the multiple or CTT arrangement on its own may constitute a stressful situation for the adults who may be tired from the previous training before the demand to attend the next exercise; even if they show up , they may not be fully involved as they did in the previous exercise. However, the adults may have fully recovered from the stress of previous training if training is organised weekly, and hence participate fully. Therefore, though the detraining period reduces the effectiveness of the OTT compared to the multiple CTT, the adults may find it an easy exercise and, hence, benefit more than the youth or other adults in the multiple exercises.

The result on the relationship between age group and training type or plan supports the outcome of earlier studies. For example, Schillaci and Pucci (2010) indicated that SBP dropped in the single-exercise group for female adults. The results, however, contradicted the finding of Cornelissen and Smart (2013) that both the mild and moderate intensity programmes were influential in blood pressure reduction for adults. Clark (2015) also suggested that short-interval training (multiple or CTT) instead of OTT (single training) was statistically significant in reducing blood pressure, lipid profile, and physical function during aging, but the current study reached the opposite conclusion.

Based on the results that CTT was effective for youth and males in reducing blood pressure, one would expect youth and males to endure more than females and adults. Woo, Derleth, Stratton, and Levy (2006) observed that young participants, irrespective of sex, benefit more from multiple training exercises three times a week by about 2–7%. The current study observed about a 5% reduction for young participants, which is within their hypothesised range. Schwingshakl et al., (2013) also concluded that though both multiple and OTT is beneficial to older participants' blood pressure, the former training had an additional positive impact of reduced arterial stiffness in treated hypertensive subjects.

Similarly, the moderating role of age categories (youth against adults) of the participants on the effectiveness of the exercise protocols on DBP reduction was examined. Figure 29 presents the mean plot of the respondents' average DBP across age categories and training schedules.

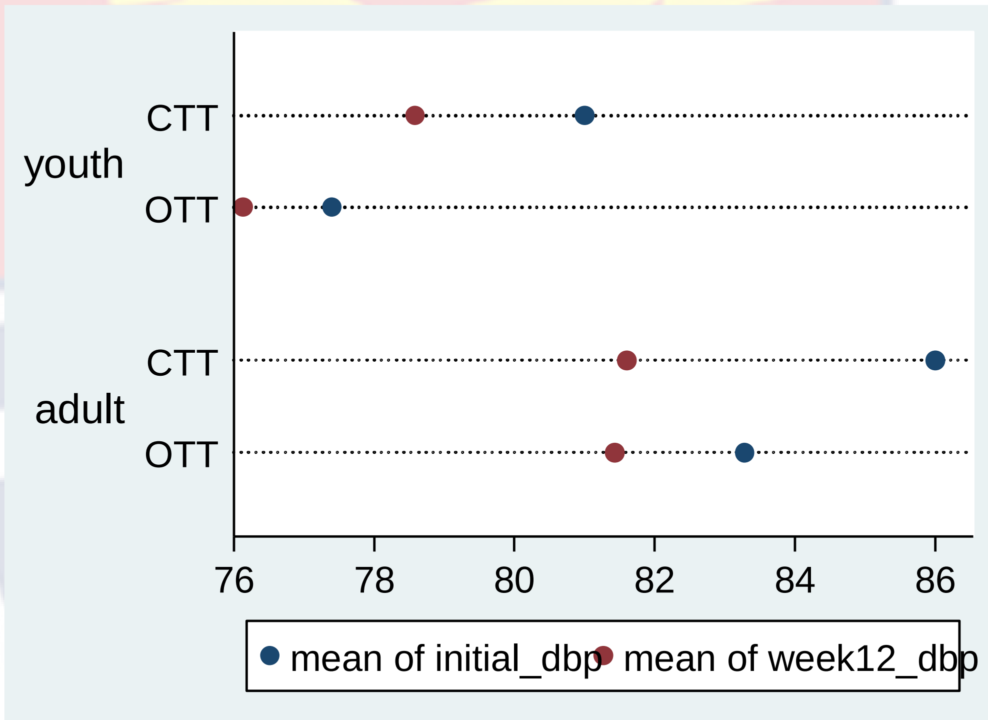


Figure 29: Mean plot of DBP over age category and exercise protocol
Source: Field data, 2021

The results showed that the mean DBP of the youth in the CTT group was 81.000 at the beginning of the training, which reduced to 78.5833 after 12 weeks. The paired sample t-test results suggest that the SBP of the youth participants in the CTT group was significantly reduced by 2.416 at the 5% significance level (t = 5.636, df = 31, Ha: mean(diff) > 0, p-value = 0.000). Also, the youth in the OTT group began the training with an average DBP of 77.400 and ended with an average DBP of 76.133 after 12 weeks of training. The paired sample t-test indicated that the DBP of the males in the OTT group significantly dropped by

1.2667 at the ten percent significance level (t = 2.522, df = 31, p = 0.012). The average drop in DBP of youth in the CTT group was twice that of the youths in the OTT group, which confirms the observation that CTT training could be more beneficial to youths than OTT training when it comes to reducing DBP.

The results in Figure 29 further suggest that the adults in the CTT group began with an average DBP of about 86.000 and ended with about 81.600 after 12 weeks of training. The paired sample t-test results indicate that adults in the CTT group dropped in DBP by about 4.4000, and the difference was statistically significant at the 5% significance level (t = 6.127, df = 31, p = 0.000). Also, the adults in the OTT group began the training with an average DBP of 83.285 and ended with an average DBP of 81.428 after 12 weeks of training. The mean comparison test suggested an average statistically significant drop of 1.857 for adults that participated in the OTT. The percentage plots of the means, as presented in Figure 30, summarise the results.

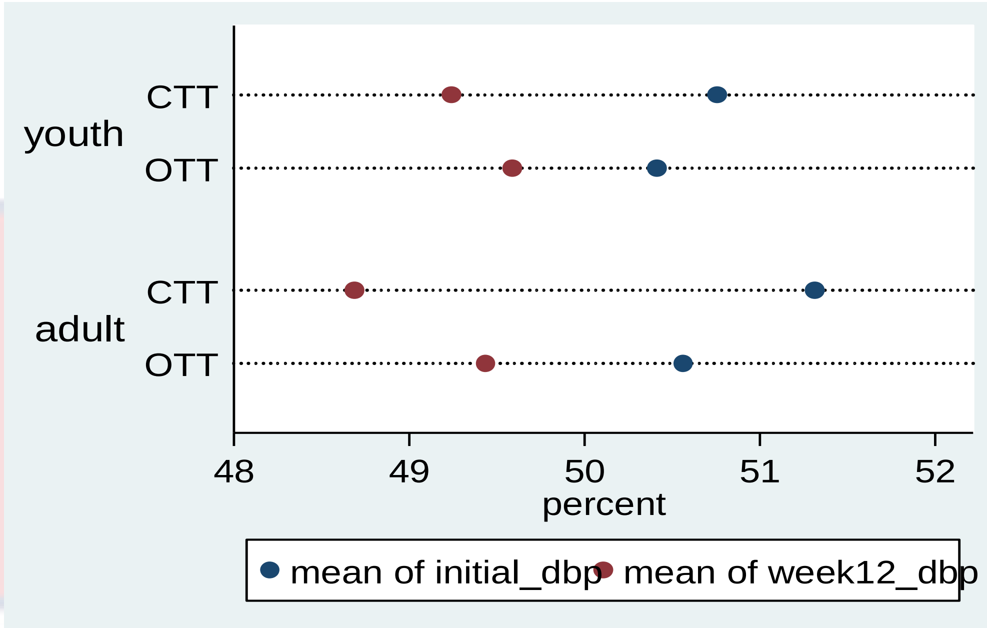


Figure 30: Mean plot of DBP (percent) over age category and exercise protocol
Source: Field data, 2021.

The results indicate that the CTT training leads to a significantly wider drop in DBP for youths and adults when all other factors are constant. The analysis of gender and age suggests that both variables significantly moderate the relationship between training type and its effects on DBP. The results on the age group are consistent with the studies of Paoli et al. (2013) on adults, which observed that age matters in the effectiveness of training on DBP.

The moderating role of age categories (youth against adults) of the participants on the effectiveness of the exercise protocols on HR reduction was examined. Figure 31 presents the mean plot of the respondents' average HR across age categories and training schedules.

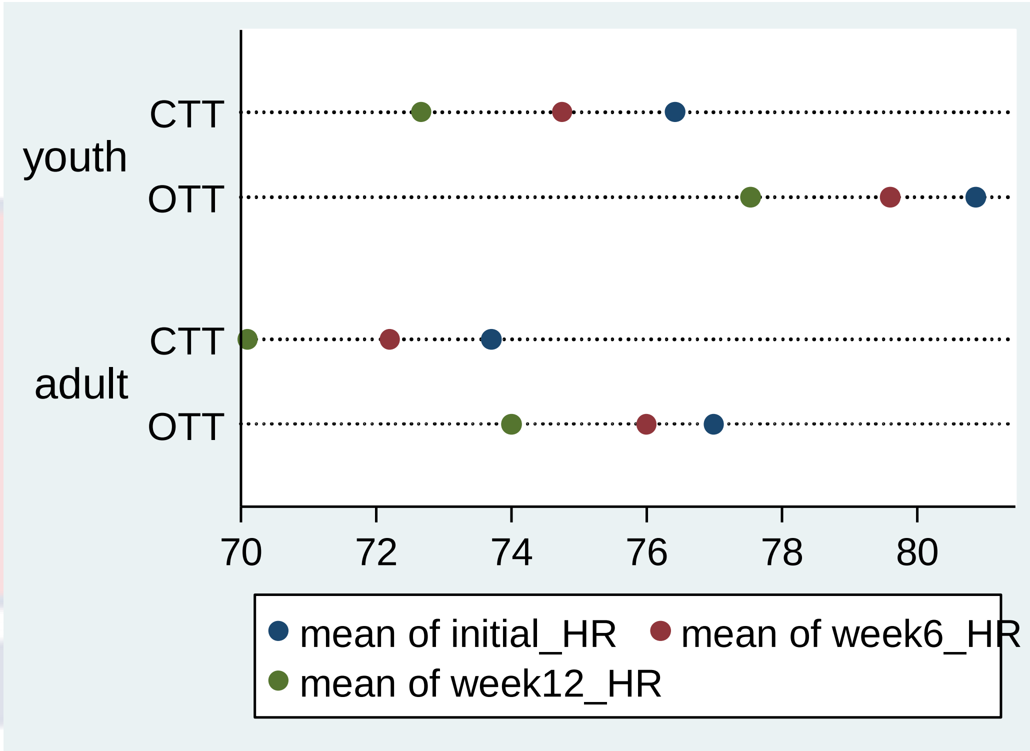


Figure 31: Mean plot of HR over age category and exercise protocol

Source: Field data, 2021.

The results revealed that the mean HR of youth in the CTT group was 76.42 at the beginning of the training, which reduced to 72.67 after 12 weeks. The paired sample t-test results suggest that the HR of the youth participants in the CTT group was significantly reduced by 3.75 at the 5% significance level (t = 5.46, df = 15, Ha: mean (diff) > 0, p-value = 0.000). Also, the youth in the OTT group began training with an average HR of 80.87 and ended with an average HR of 77.53. The paired sample t-test indicated that the HR of the males in the OTT group significantly reduced by 3.34 at the 5% significance level (t = 7.02, df = 9, p = 0.000). Therefore, the average reduction in HR of youth in the CTT group was 0.42 more than that of the youths in the OTT group, which makes both approaches relatively good for youth. That is, the one-sample t-test results indicated that the mean HR drop of 3.75 for youth in the CTT group was not statistically significantly different from that of the youth in the OTT group at the 5% significance level (t = -0.606, df = 14, p = 0.556).

The results in Figure 31 further indicated that the adults in the CTT group began with an average of 73.70 and ended with 70.10 after 12 weeks of exercise. The paired sample t-test results indicated that the adults in the CTT group reduced HR by 3.6, and the difference was statistically significant at the 5% significance level (t = 13.500, df = 9, p = 0.000). Also, the adults in the OTT group began the training with an average HR of 77.00 and ended with an average HR of 74. The mean comparison test suggested an average reduction of 3.00, and the difference was statistically significant (t = 7.94, df = 9, p = 0.001) for adults that participated in the OTT. That is, the one-sample t-test results indicated that the mean HR drop of 3.60 of youth in the CTT group was statistically significantly higher than that of the youth in the OTT group (3.00) at the 5% significance level (t = -0.606, df = 14, p = 0.025).

The percentage plots of the means, as presented in Figure 32, summarise the results.

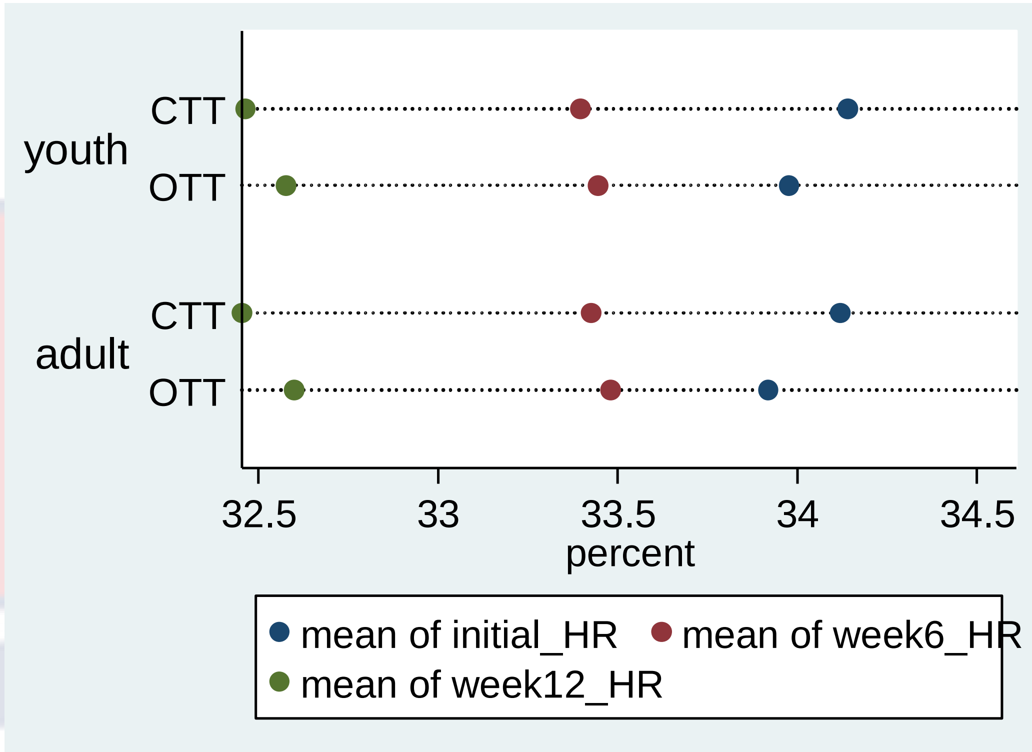


Figure 32: **Mean plot of HR (percent) over age category and exercise protocol**

Source: Field data, 2021

The results indicate that CTT training leads to a significantly greater percentage reduction in HR for youths than adults. In contrast, the OTT training schedule leads to a more significant percentage drop for adults than for the youth when all other factors are constant. This observation is consistent with the earlier results of Cornelissen and Smart (2013) and Clark (2015) who observed that young men and women that engage in multiple or CTT reduce HR on average of 8% and 6%, respectively

The general conclusion from the results is that the youth could achieve the desired HR reduction from either the CTT or OTT training exercise, but the CTT exercise was more effective at reducing the HR of adults than the OTT exercise. The result that the type of training schedule does not matter for the reduction of

HR for youth supports the findings of Cornelissen and Smart (2013)). Woo et al. (2006) explained why training type might matter for older people when it comes to reducing HR. Woo et al. found that older age is associated with decreased exercise efficiency and an increase in the oxygen cost of exercise, which contributes to a reduced exercise capacity. Hence, older people may require continuous or multiple exercises to reduce HR compared to younger people.

Theoretically, the fact that age explains the effects of exercise on HR was an a priori expectation based on the formulae for determining the maximum HR of an individual. The HR is a negative linear function of age estimated as “220-age” (Sydo, 2014), implying that the maximum HR decreases with time. Hence, more efforts might be needed at an older than younger age which explains the different effects of the different training exercises on the youth and the adults.

A similar analysis was done for the participants’ moderating role of age categories (youth against adults) on the effectiveness of the exercise protocols on %BF reduction. Figure 33 presents the mean plot of the respondents’ average %BF across age categories and training schedules.

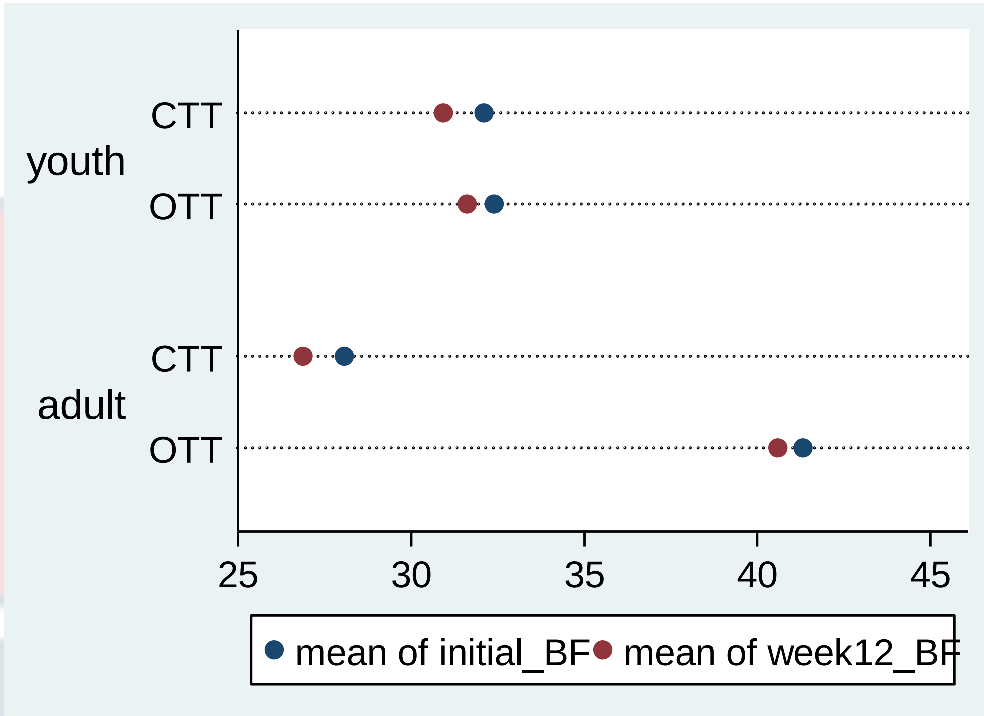


Figure 33: Mean plot of %BF over age category and exercise protocol

Source: Field data, 2021.

The results indicated that the mean %BF of youth in the CTT group was about 32.11 at the beginning of the training, which reduced to 30.94 after 12 weeks. The paired sample t-test results suggest that the %BF of the male participants in the CTT group significantly decreased by about 1.17 at the 5% significance level (t = 7.39, df = 15, Ha: mean (diff) > 0, p-value = 0.00). Also, the youth in the OTT group began training with an average %BF of 32.40 and ended with an average %BF of 31.63. The paired sample t-test indicated that the %BF of the males in the OTT group significantly dropped by 0.77 at the 5% significance level (t = 9.091, df = 14, p = 0.000). The average drop in %BF of youth in the CTT group was 0.40 more than that of the youths in the OTT group, which makes both approaches relatively good for youth.

The results in Figure 33 further revealed that the adults in the CTT group began with an average %BF of 28.07 and ended with 26.88 after 12 weeks of training. The paired sample t-test results indicated that adults in the CTT group dropped in %BF by 1.19, and the difference was statistically significant at the 5% significance level (t = 5.425, df = 14, p = 0.00). Also, the adults in the OTT group began training with an average %BF of 41.33 and ended with an average %BF of 4.60. The mean comparison test suggested an average drop of about 0.73, which was statistically significant at the 5% significance level (t = 6.46, df = 14, p-value = 0.00) for adults that participated in the OTT. The percentage plots of the means, as presented in Figure 34, summarise the results discussed.

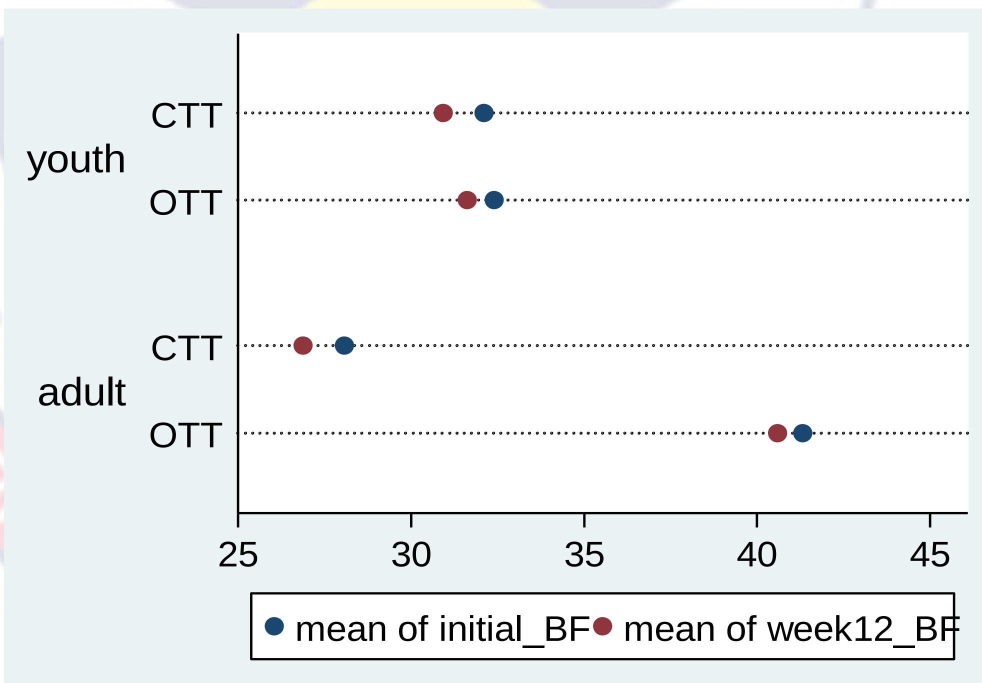


Figure 34: Mean plot of %BF over age category and exercise protocol

Source: Field data, 2021.

The results indicate that the CTT training leads to a greater percentage reduction in %BF for adults. In comparison, the OTT training schedule leads to a lower percentage reduction in %BF for the youth when all other factors are constant. The finding that single-time training was effective for younger trainers supports the earlier findings of Sykes, Choo, and Cotterrell (2004) and Kim, Ko, Seo, and Kim (2018). This session also examined the participants' moderating role of age categories (youth against adults) on the effectiveness of the exercise protocols on BMI reduction. Figure 35 presents the mean plot of the respondents' average BMI (BMI) across age categories and training schedules.

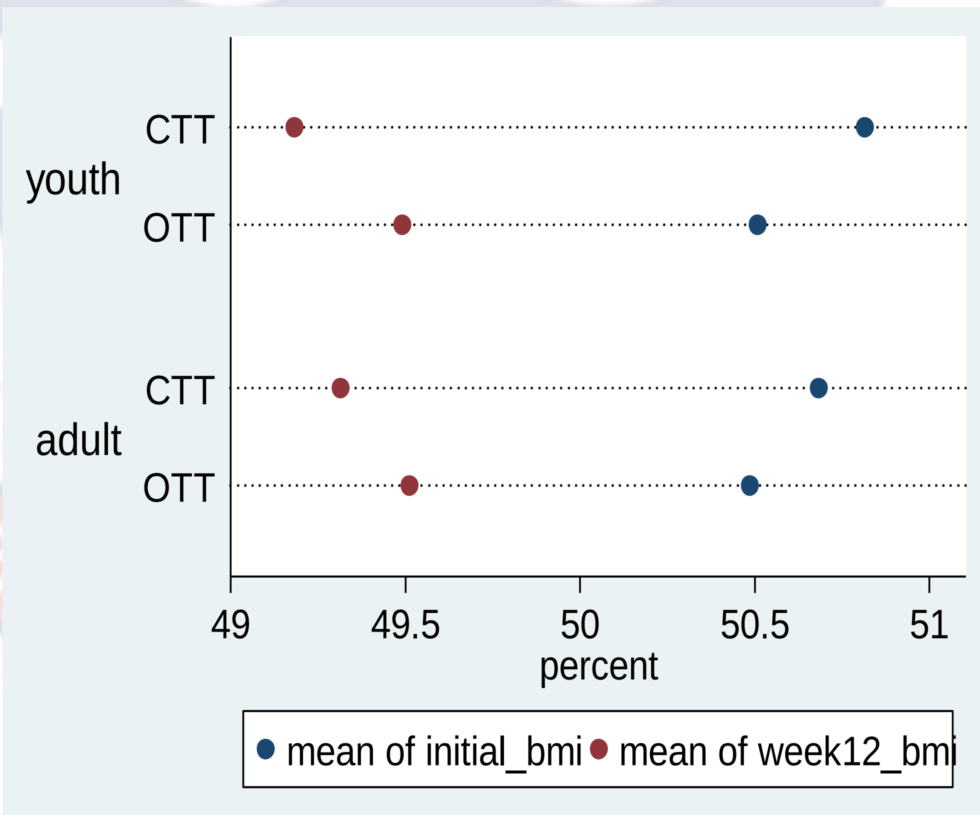


Figure 35: Mean plot of BMI over age category and exercise protocol

Source: Field data, 2021

The results indicated that the mean BMI of youth in the CTT group was 24.38 at the beginning of the training, which reduced to 23.60 after 12 weeks. The paired sample t-test results suggest that the BMI of the youth participants in the CTT group significantly reduced by 0.78 at the 5% significance level (t = 9.74, df = 16, Ha: mean(diff) > 0, p-value = 0.00). Also, the youth in the OTT group began the training with an average BMI of 22.50 and ended with an average BMI of 22.05. The paired sample t-test indicated that the BMI of the males in the OTT group significantly reduced by 0.45 at the 5% significance level (t = 5.95 df = 14, p = 0.00). The average reduction in BMI of youth in the CTT group was 0.33 more than that of the youths in the OTT group, but the one-sample t-test showed that this difference is not statistically significant at the 5% significance level. The result implies that both training types were relatively good for the youths.

The results in Figure 35 further revealed that the adults in the CTT group began with an average BMI of 24.06 and ended with 23.41 after 12 weeks of training. The paired sample t-test results indicated that adults in the CTT group reduced BMI by about 0.65, and the difference was statistically significant at the 5% significance level (t = 5.71, df = 14, p = 0.00). Additionally, the adults in the OTT group began the training with an average BMI of 26.66 and ended with an average BMI of 26.14. The mean comparison test suggested an average reduction of 0.51, which was statistically significant at the 5% significance level (t = 4.87, df = 14, p-value = 0.00) for adults that participated in the OTT. The percentage plots of the means, as presented in Figure 35, summarise the results discussed.

The results indicated that both CTT and OTT training were effective for youths, but only the CTT training was more effective than the OTT training exercise for adults in reducing the BMI of the respondent. The observation that age moderates the effects of training on BMI is consistent with the findings of Ranasinghe et al. (2013). Ranasinghe et al. concluded that until over 60 years, the relationship between the level of physical fitness and BMI depends on the age of the individuals, keeping other factors constant. They further found that the nature and type of exercise matter in the effects of training on individuals of different age groups and concluded that multiple training exercises (moderate intensity) could be more effective for older trainers. The fact that single-exercise training has limited effects on BMI, especially for adults, has a long history, as contained in (Ferreira et al. 2010; Ryan et al. 1995; Treuth et al. 1994). In situations where there is challenge of time, the once per week exercise protocol or schedule will provide the health benefits required.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of the study was to determine whether long-duration and thrice per week aerobic exercise will have any effect on physiological and anthropometric health markers of a Keep Fit Club Members in Accra. This chapter presents an overview of the entire work and a summary of the main findings. It also presents the summary, findings and conclusion based on the main findings and recommendations based on the conclusions drawn. Finally, directions for further studies were offered based on the limitations of the study.

Summary

Exercises or organised training have been proven effective at influencing physiological and anthropometric variables of individuals who engage in them for a considerable time. The debates, however, have been on how such exercises should be done and in which sequence they should be done to maximize the health benefits of training to the participants. The current study joined the debates by examining how two training schedules and exercise protocols impact selected anthropometric and physiological variables and how the participants' gender and age group moderates such effects. The physiological variables used include SBP, DBP, HR, percentage of body fat, and BMI.

The study was a quasi-experimental longitudinal study with two measurements at three different times. That is, the initial physiological variables of an intact group were taken, followed by another measurement after six weeks of training and a final measure taken 12 weeks after training. Two groups already formed for exercises in the same locality, that is, Gymike Keep Fit Club in Accra, were purposively selected, and a training schedule was assigned to the respective groups. One group had a schedule to exercise for 30 minutes each for three days a week (multiple or CTT), while the second group exercised for 90 minutes continuous hours once a week (single or OTT).

The data on the two groups were taken and compared for possible differences. The analysis was purely quantitative and used both descriptive and inferential statistics. The MANOVA, correlational analysis, paired sample t-test, and one-sample t-test were used for the inferential analysis. Since the groups were intact or in place before the study, the base variables were not statistically identical to allow for an independent sample t-test to compare the means across the training groups. Instead, the dependent sample t-test was used to first compare the extent of the difference within the six weeks and the twelve weeks interval for sex and age group, after which the difference in means was compared across the groups using a one-sample t-test.

The analysis was done in line with three objectives, each on five physiological and anthropometric variables. First, the correlations among the five physiological variables were examined in a pairwise manner for their level of association. Then the effect of each training schedule on each anthropometric measure within the sixth and twelfth weeks was assessed using the MANOVA and margins plots. Finally, the moderating role of sex and age group were examined for each measure using the dependent sample and one sample t-tests. The results were then discussed and integrated into the existing literature.

Main Findings

The following main findings were observed based on the research questions and hypotheses. First, statistically significant correlations were observed among the physiological and anthropometric variables. Specifically, a relatively strong positive association was observed between %BF and BMI, a moderate positive association was found between DBP and SBP, and a weak but significant negative association was observed between HR and DPB.

Regardless of the type of training plan, it was observed that training considerably reduced participants' SBP provided sufficient time is allowed. Multiple training activities were found to be more successful in lowering SBP than any single activity within six weeks. On the moderating role of gender, it was observed that multiple training was more beneficial to males than single training exercises. In contrast, a single training exercise was more beneficial to females than multiple training regarding reducing SBP. Finally, the results on the type of training and age group indicated that the multiple training was more beneficial to youths than adults, while the single training schedule was more beneficial to adults than youth regarding reducing SBP.

Training or exercise was also found to significantly reduce the HR of the participating individuals irrespective of the training schedule option, but the longer the duration in terms of the number of weeks of the training schedule, the higher the drop in HR of the participants, keeping other factors constant. Further, it was observed that multiple training schedules were more effective in reducing

HR than single training, irrespective of the duration of training (6 weeks or 12 weeks).

On gender, it was observed that the multiple training leads to a significantly greater percentage reduction in HR for males than females. In comparison, the single training schedule leads to a greater percentage reduction in HR for females than males when all other factors are constant. In the age group, it was found that the youth could achieve the desired HR reduction from either the multiple or single training exercises, but the multiple exercises were more effective at reducing HR for adults than the single exercise.

The exercise was again observed to be effective at reducing the percent body fat of the participants irrespective of the training schedule option, but the longer the duration in terms of the number of weeks of the training schedule, the higher the reduction in percent body fat of the participants in both training plans. It was further observed that multiple training is effective for both males and females. In contrast, the single training schedule leads to a lower percentage reduction for females than males when all other factors are constant. Multiple training exercises were found to be more effective for adults, while single training was more effective for youth, keeping other factors constant.

The exercise was generally observed to be effective at reducing the BMI of the participants, but the longer the duration of the training schedule in terms of the number of weeks, the higher the reduction in the BMI of the participants, especially for the multiple training schedules. When the results from the two exercise options were compared, it was observed that the multiple training exercises significantly reduced BMI more than the OTT training exercise.

On the moderating role of gender, it was observed that the multiple training exercises reduced BMI for both males and females, but the single training exercise was more effective for males than females when all other factors were constant. The results indicated that both multiple training and single training were effective for youths at reducing BMI. Still, the multiple training was more effective for adults than the single training exercise.

Conclusions

The analyses of the primary data collected led to several findings on the effects of the two training exercises on the five selected physiological variables. The findings formed the basis for which a number of conclusions were drawn. First, the study concluded that training is effective at improving blood pressure, HR, percentage of body fat, and the BMI of participants, but the effectiveness in all the cases is a direct function of time or duration of training. This conclusion lends credence to the observed effectiveness of training or exercise in general in improving the well-being of individuals that engages in it regularly. Further, all training exercises are effective at improving physiological variables, but some specific measures respond to particular training better than others. For example, SBP responds better to multiple training exercises than a single training exercise. In effect 90 minutes long duration exercise protocol once a week is effective to improve the health of individuals when they participate for at least 12weeks. This is important to those who are busy and have challenges in relation to time to participate in regular exercise.

In general, the multiple training exercises improved most of the physiological variables more than the single training exercise, although sex and age group significantly moderated such effects. Males primarily respond to multiple training more than females, while females respond better to single training than males. Younger trainers could improve their physiological variables with multiple or single training exercises, but older trainers benefit more from CTT. Hence gender and age group of participants significantly moderates the effectiveness of training on physiological variables.

It was also concluded that the effectiveness of training in improving physiological variables depends on the strength of the association among the physiological variables, which indirectly enforces the effects of the training. Physiological variables such as percent body fat and BMI record significantly greater improvement during exercise training due to their high correlation.

The length of the training programme was found to influence the effectiveness of the training type such that the multiple training exercises appeared to be more effective in the short run (6 weeks) than the single exercise, but the difference in effectiveness seemed to level off in the long run (12 weeks) of training. Hence it was concluded that short-duration programmes could achieve maximum benefit from multiple training exercises than a single training exercise, especially when the programme involves more elderly participants.

Recommendations

The study's key findings from the premises for the following recommendations are to be offered. First, individuals need to continue using either once-per-week or thrice-per-week exercise programmes as non-pharmacological means to improve physiological or anthropometric variables (%BF, BMI, SBP, DBP, and HR). Second, the prescription of a training exercise for clients needs to consider the client's sex and age for a more effective outcome on physiological and anthropometric variables improvements. To improve SBP and HR, males and youths should be encouraged to participate in the three times per week exercise programme, but females and adults should participate in once per week-long exercise.

Males, females, and adults should engage in a three times per week exercise programme to improve %body fat while the youth should exercise once per week to improve %body fat. When an exercise plan focuses on controlling the BMI, females and adults are required to follow three times per week exercise while males and the youth should participate in a once-per-week exercise programme. As indicated by the findings, the improvement in the physiological and anthropometric health indices can be said that exercise can be used as a preventive and curative measure for diseases. Everyone is therefore encouraged to participate in an exercise programme once per week or three times per week, but to get the full benefit, three times per week is much recommended.

Suggestions for Further Research

A major strength of the current study was the relatively large sample size compared to earlier studies on the topic, but the sample size was still small at the aggregated gender and age group level. Hence, future studies can expand the sample size by searching for large training clubs with relatively stable memberships. Also, other demographic characteristics such as occupation and income status and other factors like nutrition were not considered in the current study, which can be considered in future studies. Other physiological variables excluded from the study could be focused on to advance the argument on moderating factors to the effectiveness of training schedules on physiological variables. Another aspect of the training schedule and nature of the physical activity undertaken could also be considered. Finally, future studies can expand on the number of groups with more than two training exercises; and make provisions to include individuals younger than 18 years and older than 60 years.

REFERENCES

Abu, S. Irshad, A., Faizan, Z. K., & Shadabuddin, M. (2013). Effect of aerobic exercises on blood pressure in mild and moderate hypertensive middle-aged and older patients. *Journal of Health Sciences*, *1* (1) 56-67.

Adeagbo, D. I., & Bolarinwa, R. (2017). Effects of aerobic exercise training programme on percent body fat level as a cardiovascular disease risk factor in children. *Global Journal of Engineering Science and Research Management*, *4*(2), 1-7.

Ainsworth, B. E., Haskell, W. L., & Whit, M. C. (2000) Compendium of physical activities: An update of activity codes and MET intensities. *Medicine Science Sports Exercise*, *32*(9), 498-504

Ainsworth, B. E., Haskell, W.L., & Leon, A. S., (1993). Compendium of physical activities: Classification of energy costs of human physical activities. *Medicine and Science in Sports & Exercise*, *25*(1), 71–80.

Ajzen, I. (2012). Values, attitudes, and behavior. In *Methods, theories, and empirical applications in the social sciences* (pp. 33-38). Wiesbaden: VS Verlag für Sozialwissenschaften.

Akindele, M. O., Philips, J. S., & Igunmbor, E. U. (2016). The relationship between a body at percentage and BMI in overweight and obese individuals in an urban African setting. *Journal of Public Health in Africa*, *7*(1), 1 – 5.

Alizadeh, J., Kordi, P., Rostami, H. Y., Mansournia, G., Hosseinzadeh-Attar, H., & Fallah Y. (2013). Comparison between the effects of continuous and intermittent aerobic exercise on weight loss and body fat percentage in overweight and obese women: A randomized controlled trial. *International Journal of Preventive Medicine*, *4*, 881-888.

Alizadeh, Z., Kordi, R., Rostami, M., Mansournia, M. A., Hosseinzadeh-Attar, S., & Alvara, A. (2021). *Effect of single vs. accumulated bouts of exercise on body composition, fitness, and resting metabolic rate* (Doctoral dissertation, Stephen F. Austin State University).

American College of Sports Medicine, American Diabetes Association. (2010). Exercise and type 2 diabetes: American College of Sports Medicine and the American Diabetes Association: Joint position statement. Exercise and type 2 diabetes. *Medicine Science & Sports Exercise*, *42*(12), 2282–303.

American College of Sports Medicine. (1995). Osteoporosis and exercise. American College of Sports Medicine position stand. *Medical Science & Sports Exercise*, *27*(4), 1–7.

American College of Sports Medicine. (2000). *ACSM's guidelines for exercise testing and prescription* (6th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

American College of Sports Medicine. (2003). *Guidelines for exercise testing and prescription* (6th ed.). Philadelphia: Lippincott, Williams and Williams.

American College of Sports Medicine. (2009). Progression models in resistance training for healthy adults. American College of Sports Medicine position stand. *Medicine Science & Sports Exercise*, *41*(3), 687–708.

American Heart Association. (2015). *Heart Disease and Stroke Statistics – 2016 Update:* A Report from the American Heart Association, Circulation. Retrieved from http://circ.ahajournals. org/content/early/2015/CIR.0000000000000.citation. 21/3/2017.

Anderson, T. W. (2003). *An introduction to multivariate statistical analysis* (No. 519.9 A53).

Anne, W., & Allison, G, (2001). *Anatomy and Physiology in Health and wellness*. (9th Ed.). USA.: Campell Livingstone.

Armitage, C. J., & Sprigg, C. A. (2010). The roles of behavioural and implementation intentions in changing physical activity in young children with low socioeconomic status. *Journal of Sport & Exercise Psychology*, *32*(3), 359–76.

Armstrong, L. E, Brubaker, P. H., Whaley, M. H., & Otto, R. M. (2005). *ACSM's Guidelines for Exercise Testing and Prescription. American College of Sports Medicine* (7th ed.). Baltimore (MD): Lippincott Williams & Wilkin

Armstrong, N., & Welsman, J. (1997). *Young people and physical activity*. New York: Oxford University Press.

Ashutosh, K., Methotra, K., & Fragale-Jackson, J. (1997). Effects of sustained weight loss and exercise on aerobic fitness in obese women. *The Journal of Sports Medicine and Physical Fitness, 37* (4), 252-257.

Atienza, A. A. (2001). Home-based physical activity program for middle-aged and older adults: Summary of empirical research. *Journal of Aging and Physical Activity*, 9, 29–58.

Atikovic, S., Hodzic, J., Bilalic, J., Mehinovic, A., Nozinovic E., Mujanovic, A. & Kapidzic, C., (2014). Gender differences in BMI and PA of students in Tuzla Baltic. *Journal of Health and Physical Activity*, 6(3), 183-192.

Babbie, E. (2007). *The practice of social research* (11th ed.). Belmont: Wadworth Cengage Learning.

Bandura, A., & Hall, P. (2018). Albert bandura and social learning theory. *Learning theories for early year practice*, 63-65.

Bartholomew, J. B., & Miller, B. M. (2002). Affective responses to an aerobic dance class. The impact of perceived performance. *Research Quarterly for Exercise and Sports, 73* (3), 301-309.

Bassett, D. R. J., Wyatt, H. R., Thompson, H., Peters, J. C., & Hill, J. O. (2010). Pedometer-measured physical activity and health behaviours in U.S. adults. *Medicine Science & Sports Exercise, 42*(10), 1819–25.

Batacan, R. B., Duncan, M. J., Dalbo, V. J., Tucker, P. S., & Fenning, A. S. (2017). Effects of high-intensity interval training on cardiometabolic health: A systematic review and meta-analysis of intervention studies. *British Journal of Sports Medicine, 51*(6), 494-503.

Baungartner, T.A., & Jackson, A. S. (1999). *Measurement for evaluation in physical education and exercise science* (6th ed). New York: McGraw-Hill.

Berger, B., & Motl, R. (2001). Physical activity and quality of life. In R. Singer, H. Hausenblas, & C. Janelle (Eds.). *Handbook of sport psychology* (2nd Ed., 636 – 670). New York: Wiley.

Berlin, J. A., & Colditz, G. A. (2000). A meta-analysis of physical activity in the prevention of coronary heart disease. *American Journal of Epidemiology, 132*, 612-628.

Berry, J., Naylor, P. J., & Whart-Higgins, J. (2005). Stages of change in adolescents: An examination of self-efficacy, decisional balance, and reasons for relapse. *Journal of Adolescent Health, 37*, 452–459.

Berryman. J. W. (1995). *Out of many, one: A history of the American college of sports medicine. Champaign, IL: Human Kinetics.*

Bhattacharyya, S., Dasgupta, S., & Das, A. (2015). Signature of a continuous quantum phase transition in non-equilibrium energy absorption: Footprints of criticality on higher excited states. *Scientific reports, 5*(1), 16490.

Bhui, K. (2002). *Physical activity and stress as cited in stress and heart: Psychosocial pathways to coronary heart disease.* (Ed.). Stansfeld, S. A. and Marmot, M. G Williston, VT: BMJ Books.

Bijnen, F. C., Feskens, E. J., Caspersen, C. J., Nagelkerke, N., Mosterd, W. L., & Kromhout, D. (1999). Baseline and previous physical activity in relation to mortality in elderly men, the Zutphen Elderly Study. *American Journal of Epidemiology*, *150*, 1289-1296.

Bishop, J. G. (2002). *Fitness through Aerobics.* San Francisco: Benjamin Cummings.

Blue, C. L. (1995). The predictive capacity of the theory of reasoned action and the theory of planned behavior in exercise research: An integrated literature review. Res Nurs Health, *18*(2), 105–21.

Blumberg, F. C., Deater-Deckard, K., Calvert, S. L., Flynn, R. M., Green, C. S., Arnold, D., & Brooks, P. J. (2019). Digital Games as a Context for Children's Cognitive Development: Research Recommendations and Policy Considerations. Social Policy Report. *Society for Research in Child Development*, 32, 1

Bonfante, P., & Desirò, A. (2017). Who lives in a fungus? The diversity, origins and functions of fungal endobacteria living in Mucoromycota. *The ISME journal*, *11*(8), 1727-1735.

Booth, F. W., Roberts, C. K., & Laye, M. J. (2012). Lack of exercise is a major cause of chronic diseases. *Comprehensive Physiology*, *2*(2), 1143.

Borg, P., Kukkonen-Harjula, K., Fogelholm, M., & Pasanen, M. (2002). Effects of walking or resistance training on weight loss maintenance in obese, middle-aged men: A randomized trial. *International Journal of Obesity*, *26*(5), 676-683.

Bradbury, K. E., Guo, W., Cairns, B. J., Armstrong, M. E., & Key, T. J. (2017). Association between physical activity and body fat percentage, with adjustment for BMI: A large cross-sectional analysis of UK Biobank. *BMJ Open*, *7*(3), e011843.

Braith, R. W., Pollock, M. L., & Lowenthal, D. T. (1994). Moderate- and high-intensity exercise lowers blood pressure in normotensive subjects 60 to 79 years of age. *American Journal Cardiology*, *73*(15), 1124-1128

Branders, M., Klauschen, F., Kuchen, S., & Gemain, R. N. A. (2013). *A system analysis identifies a feed-forward inflammatory circuit leading to lethal influenza infection.* National Institute of Allergy and Infectious Diseases.

Bray, G. A., Frühbeck, G., & Ryan, D. H. (2016). Management of obesity. *Lancet*. 16, 00271-3.

Brito, L. C., Queiroz, A. C. C., & Forjaz, C. L. M. (2014). Influence of population and exercise protocol characteristics on hemodynamic determinants of post-aerobic exercise hypotension. *Brazilian Journal of Medical Biology Res.*, *47*, 626–636.

Bryner, R. W., Ulrich, I. H., Sauers, J., Donley, D., Hornsby, G., Kolas, M., & Yearter, R. (1999). Effects of resistance vs. aerobic training combined with an 800 calories liquid diet on lean body mass and resting metabolic rate. *Journal of the American College of Nutrition*, *18*, 115-121.

Bull, F., Geonka, S., Lambert, V., & Pratt, M. (2017) *Physical activity for the prevention of cardiometabolic disease.* In Prabhakaran D., Anand. S., Gaziano, T.A., Mbanya, J., Wu Y, & Nugent, R. (EDS) *cardiovascular respiratory and related disorder* (3rd ed.). Washington D.C: World Bank; 79-99.

Byrne, H. K., & Wilmore, J. H. (2001a). *The effects of exercise training on resting metabolic rate and resting blood pressure in women.* Austin, TX: University Texas at Austin.

Canadian Fitness and Lifestyle Research Institute. (2005). *Local opportunities for physical activity: Trends from 1999 –2004.* Ottawa, ON: Canadian Fitness and Lifestyle Research Institute.

Canadian Society for Exercise Physiology. (2002). *Physical Activity Readiness - Questionnaire (PAR-Q)*: Canadian Fitness and Lifestyle Research Institute. 202-185 Somerset Street West Ottawa, ON K2P OJ2.

Cardinal, B. J. (2016). Toward a greater understanding of the syndetic nature of hypokinetic diseases. *Journal of Exercise Science and Fitness*, *14*, 54-59.

Cardinal, B. J., Park, E. A., Kim, M.T., & Cardinal M. K. (2015). If exercise is medicine, where is exercise in medicine? Review of U.S medical education curricula for physical activity-related content. *Journal of Physical Activity Health, 12*, 1336-1343.

Carpio-Rivera, E., Moncada-Jiménez, J., Salazar-Rojas, W., & Solera-Herrera, A. Casonatto, J., Goessler, K. F…., & Polito, M. D. (2016). The blood pressure-lowering effect of a single bout of resistance exercise: A systematic review and meta-analysis of randomized controlled trials. *European Journal of Preventive Cardiology*, *23*, 1700–1714.

Castro, E. A., Peinado, A. B., Benito, P. J., Galindo, M., González-Gross, M., Cupeiro, R., & PRONAF Study Group. (2017). What is the most effective exercise protocol to improve cardiovascular fitness in overweight and obese subjects? *Journal of Sport and Health Science*, *6*(4), 454-461.

Catenacci, V. A., & Wyatt, H. R. (2007). The role of physical activity in production and maintaining weight loss; Nature, clinical practice, *Endocrinology and Metabolism*, *3*, 518-529.

Centres for Disease Control and Prevention. (2008). *Physical activity guidelines for Americans*. Atlanta, CA: Centres for Disease Control and Prevention.

Child Development Institute. (1999). *Stages of intellectual development in children and teenagers.* Retrieved on 09/29/2012 from http://childdevelopmentinfor.com/child-development/piaget.shtml.

Chodzko-Zajko, W. J, Proctor, D. N., Fiatarone-Singh, M. A., Minson, C. T, Nigg, C. R., Salem, G. J., & Skinner, J. S. (2009). Exercise and physical activity for older adults. American College of Sports Medicine position stand. *Medicine & Science in Sports Exercise*, *41*(7), 1510-1530.

Chua, T. P., Anker, S. D., Harrington, D., & Coats, A. J. (1995). Inspiratory muscle strength is a determinant of maximum oxygen consumption in chronic heart failure. *British Heart Journal*, *74*, 381-385.

Chung, J., Kim, K., Hong, J., & Kong, H. J. (2017). Effects of prolonged exercise versus multiple short exercise sessions on risk for metabolic syndrome and the atherogenic index in middle-aged obese women: A randomised controlled trial. *BMC Women's Health*, *17*(1), 1-9.

Clark, J. E. (2015). Diet, exercise or diet with exercise: Comparing the effectiveness of treatment options for weight-loss and changes in fitness for adults (18–65 years old) who are overfat or obese; systematic review and meta-analysis. *Journal of Diabetes & Metabolic Disorders*, *14*(1), 1-28.

Clark, J. E. (2021). The impact of duration on the effectiveness of exercise, the implication for periodization of training and goal setting for individuals who are overfat, A meta-analysis. *Obesity Reviews, 22*(2) doi: 10.1111/obr.13137

Clark, J. E., & Goon, D. T. (2015). The role of resistance training for treatment of obesity-related health issues and for changing health status of the individual who is overfat or obese: A review. *Journal of Sports Medicine & Physical Fitness*, *55*(3), 205-22.

Colditz, G. A., Willett, W. C., Rotnitzky, A., & Manson, J. E. (1995). Weight gain as a risk factor for clinical diabetes mellitus in women. *Annual International Medicine*, *122*(7), 481-486.

Consumers Union. (2000). Secrets of successful losers. *Consumer Reports on Health*, *12*(1), 1 – 4.

Cooke, R., & Sheeran, P. (2004). Moderation of cognition-intention and cognition-behaviour relations: A meta-analysis of properties of variables from the theory of planned behaviour. *British Journal of Social Psychology*, *43* (2), 159–86.

Cooper Institute. (2007). *History of aerobics.* Retrieved from http/.www.cooperint.org on 13th December, 2017.

Cooper, A. R., Moore, L. A., McKenna, J., & Riddoch, C. J. (2000). What is the magnitude of blood pressure response to a programme of moderator intensity exercise? Randomized controlled trial among sedentary adults with unmedicated hypertension. *British Journal of General Practice*, *50*, 958-962.

Corbin, C. B., Welk, G. J., Corbin, W. R., Welk, K. A. & Sidman, C. L. (2008). *Concept of Fitness and Wellness: A Comprehensive Lifestyle Approach* Seventh Edition. Published by McGraw-Hill Company.

Cornelissen, V. A., & Smart, N. A. (2013). Exercise training for blood pressure: A systematic review and meta-analysis. *Journal of the American Heart Association*, *2*(1), 44-73.

Costa, E. C., Dantas, T. C. B., & de Farias J. L. F. (2016). Inter- and intra-individual analysis of post-exercise hypotension following a single bout of high-intensity interval exercise and continuous exercise: A pilot study. *International Journal of Sports Medicine*, *37*, 1038–1043.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative and mixed methods approach, (3rd ed).* California: Sage publications Inc.

Crump, M., Neelapu, S. S., Farooq, U., Van Den Neste, E., Kuruvilla, J., Westin, J., ... & Gisselbrecht, C. (2017). Outcomes in refractory diffuse large B-cell lymphoma: results from the international SCHOLAR-1 study. *Blood, The Journal of the American Society of Hematology*, *130*(16), 1800-1808.

da Nobrega, A. C. (2005). The subacute effects of exercise: Concept, characteristics, and clinical implications. *Medicine & Science in Sports & Exercise*, *33*, 84–87.

Damuesh, A. A. (2015). *Effects of different intensity levels of circuit resistance training on physiological variables of young female adults in plateau state. Nigeria.* Unpublished master's thesis, Department of Physical and Health Education. Ahmadu Bello University, Zaria, Nigeria.

Dantas, T. C. B., de Farias, J. L. F., & Frazao, D. T. (2017). A single session of low-volume high-intensity interval exercise reduces ambulatory blood pressure in normotensive men. *Journal of Strength Condition Reserve*. *31*, 2263–2269.

Das, P., & Horton, R. (2012). Rethinking our approach to physical activity. *The Lancet*, *380* (9838), 189-190.

Davidson, L. E., Hudson, R., Kilpatrick, K., Kuk, J. L., McMillan, K., Janiszewski, P. M.… & Ross, R. (2009). Effects of exercise modality on insulin resistance and functional limitation in older adults: A randomized controlled trial. *Archives of International Medicine*, *169*, 122–131.

Davis, C., Tomprowski, P., Boyle, C., Waller, J., Miller, P., & Naglieri, J. (2007). Effects of aerobic exercise on overweight children's cognitive functioning: A randomized controlled trial. *Research Quarterly for Exercise and Sport*, *78*, 510–519.

de Koning, L., Merchant, A. T., Pogue, J., & Anand, S. S. (2007). Waist circumference and waist-to-hip ratio as predictors of cardiovascular events: meta-regression analysis of prospective studies. *European heart journal, 28*(7), 850-856.

De Souza, E., Silva, M. J., de Souza Rabelo, A., Vale, R. G, Ferrão, M. L., Gonçalves, L. C., & de Sá Rego Fortes, M. (2009). Effects of two kinds of aerobic training on body fat content and serum lipid profile in cadets. *Biomed Human Kinetics, 1*, 72–75.

De Vito, G., Hernandez, R, Gonzalez, V., Felici, F, & Figura, F. (2010). Low-intensity physical training in older subjects. *The Journal of Sports Medicine and Physical Fitness, 37*, 72-77.

Diabetes Prevention Program Research Group. (2002). Reduction in the incidence of type 2 diabetes with lifestyle intervention or met for min. *New England Journal Medicine, 346*, 393–403.

Dinas, P. C., Markati, A. S., & Carrillo, A. E. (2014). Exercise-induced biological and psychological changes in overweight and obese individuals: A review of recent evidence. *International Scholarly Research Notices, 15*, 120-130.

Ding D., Lawson, K. D., Kolbe-Alexander, T. L., Finkelstein, E. A., Katzmarzyk, P. T., & Mechelen, W. (2016). The economic burden of physical inactivity. A global analysis of major non-communicable diseases. *The Lancet, 388*(10051), 1311-24

Dishman R. K., Heath, G.W., & Lee, L. M. (2013). *Physical activity epidemiology*, (2nd ed.). *Champaign, IL: Human Kinetics.*

Dishman, R. K., Washburn, R. A., & Heath, G. W. (2004). *Physical activity epidemiology Champaign.* IL: Human Kinetics.

Domaradzki, J., Cichy, I., Rokita, A., & Popowczak, M. (2020). Effects of tabata training during physical education classes on body composition, aerobic capacity, and anaerobic performance of under-, normal-and overweight adolescents. *International Journal of Environmental Research and Public Health*, *17*(3), 876.

Domfeh, C., & Atikumi, N. (2016). The level of participation in physical exercise by university of Cape Coast Graduate Students and factors associated with it. *Journal of Counseling, Education and Psychology, 4*(2), 144-166

Dominic. O. L., Abolarin, J., Seidina, I. Y., Atikumi, N., & Ahmed, M. A. (2019). Influence of body composition on health status of civil servants in Efon local government of Ekiti State, Nigeria. *The Russian Journal of Physical Education and Sport*, *14*(2), 98-106.

Donelly, J., Blair, S., Jakicic, J., Manore, M., Rankin, J., & Smith, B. (2009). Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. *Medicine & Science in Sports & Exercise*. *41*(2), 459–471.

Donges, J. F., Donner, R. V., & Kurths, J. (2013). Testing time series irreversibility using complex network methods. *Europhysics Letters*, *102*(1), 10004.

Downs, D., & Hausenblas, H. (2005). Elicitation studies and the theory of planned behaviour. A systematic review of exercise beliefs. *Psychology of Sport and Exercise, 6,* 1–31.

Eakin, E. (2001). Promoting physical activity among middle-aged and older adults in health care settings. *Journal of Aging and Physical Activity, 9*, 29–37.

Edington, D. W., & Edgerton, V. R. (1996). *The biology of physical activity*. Boston: Houghton Mifflin Company.

Ehrman, J. K. (2009). *American College of Sports Medicine. ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription* (6th ed.). Baltimore (MD): Lippincott Williams & Wilkins.

Engeda, E. H., Dachew, B. A., Woreta, H. K., Kelkay, M. M., & Ashenafie, T. D. (2016). Health Seeking Behaviour and Associated Factors among Pulmonary Tuberculosis Suspects in Lary Armachiho District, North-west Ethiopia. A Country-Based Study. *Tuberculosis Research and Treatment, 4*, 1–7.

Engels, H. J., Currie, J. S., Luek, C. C., & Wirth, J. C. (2002). Bench Step training with and without extremity loading. *Journal of Sports Medicine and Physical Fitness, 42* (1), 71-78.

Estabrooks, P. A., Lee, R. E., & Gyursik, N. C. (2011). Resources of physical activity participation. Does availability and accessibility differ by neighbourhood socio-economic status? *Annals of Behavioural Medicine*, *25*(2), 100–104.

Ferreira, F. C., Medeieros, A. I., Nicioli, C., Nunes, J. E. D., Shiguemo G. E., Prestes, J., Verzola, R. M., Baldissera,V., & Perez, S. E. A. (2010). Circuit resistance training in sedentary women: body composition and serum cytokine level. *Applied Physiology Nutrition and Metabolism, 35, 163-171.*

Figley, C. R., Asem, J. S., Levenbaum, E. L., & Courtney, S. M. (2016). Effect of BMI and body fat percentage on default mode, exercise control and Salience network structure and functions. *Frontiers in Neuroscience, 10*(234), 1–23.

Figuero, A., Baynard, T., Fernhall, B., Carhart, R., & Kanaley, J. A. (2007). Endurance training improves post-exercise cardiac autonomic modulation in obese women with and without type 2 diabetes. *European Journal of Applied Physiology*, *100,* 437–444.

Forcht, B. C., & Hausenblas, H. (2001). Influence of quiet rest and acute aerobic exercise performed in a naturalistic environment on selected psychological responses. *Journal of Sport and Exercise Psychology*, *23*, 108–121.

Fox, S. M., Naughton, J. P., & Haskell, W. L. (1971). Physical activity and the prevention of coronary heart disease. *Annual Clinical Review*, *3*(6), 404–432.

Fraenkel, J. R., & Wallen, N. E. (2000). *How to design and evaluate research in education* (2nd ed.). *Boston: McGraw Hill Inc.*

Franz, M. J., Van Wormer, J., Crain, A. L., Boucher, J. L., Histon, T., Caplan, W., & Bowman, J. D. (2007). Weight-loss outcomes: A systematic review and meta-analysis of weight-loss clinical trials with a minimum 1-year follow-up. *Journal of America Diet Association 107*, 1755–1767.

Gang, H., Noël, C., Barengo, J. T., Timo, A. Lakka, A. N., & Pekka J. (2004). Relationship of Physical Activity and BMI to the Risk of Hypertension: A prospective study in Finland. *Journal of American Society of Hypertension, 43,* 25 - 30.

Garber, C. E., Blissmer, B. & Deschenes, M. R. (2011). American College of Sports Medicine Position Stand. The quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *Medical Science & Sports Exercise*, 43(7), 1334–1359.

Gavish, B., Ben-Dov, I. Z., & Bursztyn, M. (2008). Linear relationship between systolic and DBP monitored over 24 h: Assessment and correlates. *Journal of Hypertension*, *26*(2), 199-209.

Gebel, E. (2010). The science of sweat. Is exercise the best medicine? *Diabetes Forecast*, *63*, 47–51.

Gellish, R. L., Goslin, B. R., Olson, R. E., McDonald, A., Russi, G. D., & Moudgil, V. K., (2007). Longitudinal modeling of the relationship between age and maximal HR. *Medicine & Science in Sports & Exercise*, *39*(5), 822–829.

Ghana Health Service. (2015). *Ghana national health policy public health unit.* Accra: Author.

Gibbs, W. (2006). Gaining on fat. *Scientific American, 275,* 88–94.

Gilson, N. D., Cooke, C. B., & Mahoney, C. A. (2005). Adolescent physical self-perceptions, sports/exercise and lifestyle physical activity. *Health Education, 105*(6), 437–450.

Glass, T. A., de Leon C. M., Marottoli, R. A., & Berkman, L. F. (1999). Population-based study of social and productive activities as predictors of survival among elderly Americans. *British Medical Journal, 319*, 478-483.

Gleichmann, N. (2020). Paired vs unpaired t-test: Differences, assumptions and hypotheses. *Technology Networks*.

Gleichmann, N. (2023). Paired vs unpaired t-test: Differences, assumptions and hypotheses. *Technology Networks*.

Gökyürek, B., Sökmen T., & Usta, A. (2016). The Effects of Aerobics Exercise Programmes on Body Composition and Some Physical Parameters for the Pre-obese Class 1 Obese Student at High School Aged 15-17. *International Journal of Human Movement and Sports Sciences, 4*(3), 39-44,

Gordon, N. F., Scott, C. B., Wilkinson, W. J., Duncan, J. J., & Blair, S. N. (2000). Exercise and mild essential hypertension: Recommendations for adults. *Sports Medicine, 10*, 390-404.

Gulati, M., Shaw, L. J., Thisted, R., A., Black, H. R, Merz, C.N., & Arnsdorf, M. F. (2010). HR response to exercise stress testing in asymptomatic women. The St. James Women Take Heart Project. *Circulation, 122*(2), 130–137.

Gunen, E. A. (2010). Effects of CTT programme of moderate intensity on resting HR, percent body fat and vo_2 max. of pre-adolescent children. *Journal of Health Education and Sport Science*, 801, 6-11.

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2018). Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1· 9 million participants. *The Lancet Global Health*, *6*(10), e1077-e1086.

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2020). Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1· 6 million participants. *The Lancet Child & Adolescent Health*, *4*(1), 23-35.

Guyton, A. C., & Hall, J. E. (2000). *Textbook of medical physiology*. (10th ed.). Philadelphia, W. B. Saunders.

Gwani, J. A. (2009). *Test and measurement in physical and health education.* A lecture presentation for postgraduate students. Ahmadu Bello Univesity, Zaria (unpublished).

Gymike Fintness Centre. (2019). *Registration Records*. Accra: Authour.

Hansen, D., Dendale, P., Berger, J., van Loon, L. J. C., & Meeusen, R. (2007). The effects of exercise training on fat-mass loss in obese patients during energy intake restriction. *Sports Medicine 37*, 31–46.

Hardman, A. E. (2001). Physical activity and health: Current issues and research needs. *International Journal of Epidemiology*, *30*, 1193-1197.

Harmsen, W. J., Ribbers, G. M., Slaman, J., Heijenbrok-Kal, M. H., Khajeh, L., van Kooten, F., & van den Berg-Emons, R. J. (2017). The six-minute walk test predicts cardiorespiratory fitness in individuals with aneurysmal subarachnoid hemorrhage. *Topics in Stroke Rehabilitation, 24*(4), 250-255.

Haskell, W. L, Lee, I. M, Pate, R. R., Powell, K. E., Blair, S. N., Franklin, B.A…., & Thompson, P. D. (2007). Physical activity and public health: updated recommendation for adults from the college of sports medicine. *Journal of the American Medical Association 273, 402-407.*

Hawkins, S., & Wiswell, R., (2003). Rate and mechanism of maximal oxygen consumption decline with aging: Implications for exercise training. *Sports Medicine, 33*(12), 877–88.

Hecksteden, A., Grutters, T., & Meyer, T., (2013). Association between post-exercise hypotension and long-term training-induced blood pressure reduction: A pilot study. *Clinical Journal of Sports Medicine. 23*, 58–63.

Heyward, V. H. (1998). Advanced Fitness Assessment and Exercise Prescription (3rd Ed.). Champaign, IL: *Published by Human Kinetics.* P. 126-132, 145-158.

Hivert, M. F., Laglois, M. F., Berard, P., Cuerrier, J. P., & Carpentier, A. C. (2007). Prevention of weight gain in young adults through a seminar-based intervention programme. *International Journal of Obesity 20*(3), 1262-1269.

Hoeger, W. W. K. (1988). *Principles and Labs for Physical Fitness and Wellness*. Colorado: Morton Publishing Companies.

Hoeger, W. W. K., & Hoeger S. A. (2009). *Lifetime physical fitness and wellness.* Australia: Wadsworth Cengage Learning.

Hosseinpanah, F., Barzin, M., Mirmiran, P., & Azizi, F. (2010). Effect of changes in waist circumference on metabolic syndrome over a 6.6-year follow-up in Tehran. *European Journal of Clinical Nutrition*, *64*(8), 879-886.

Howley, E. T. (2001). Type of activity: resistance, aerobic and leisure versus occupational, physical activity. *Medicine & Science in Sports & Exercise*, *33*(6 Suppl), 364-419.

Hunter, G. R., McCarthy, J. P., & Bamman, M. M. (2004). Effects of resistance training on older adults. *Sports Medicine, 34*, 329–348.

Idris, M. A., & Dollard, M. F. (2011). Psychosocial safety in climate, work conditions, and emotions in the workplace: A Malaysian population-based work stress study. *International Journal of Stress Management*, *18*(4), 324-347.

Idris, M. A., Dollard, M. F., Coward, J., & Dormann, C. (2015). Psychosocial safety climate: Conceptual distinctiveness and effect on job demands and worker psychological health, *Safety Science*, *50*(1), 19-28.

Imamura, H., Shibuya, S., Uchida, K., & Teshima, K. (2004). Effect of moderate exercise on excess post-exercise oxygen consumption and catecholamines in young women. *Journal of Sports Medicine and Physical Fitness*, *44*(1), 23-29.

Indianetzone (2008b). *Low Impact aerobics*. Retrieved from http://www.aerobic.indianetzone.com on 26 September, 2017.

Irwin, M. L. (2003). Effects of exercise on total and intra-abdominal body fat in post-menopausal women. A randomized controlled trial; *Journal of American Medical Association, 289*, 323–330.

Ismail, I., Keating, S. E., Baker, M. K., & Johnson, N. A. (2012). A systematic review and meta-analysis of the effect of aerobic vs. resistance exercise training on visceral fat. *Obesity Review, 13*, 68–91.

Jackson, E (2013). Choosing a methodology: Philosophical underpinning. *Practitioner Research in Higher Education Journal, 7*(1), 49-62.

James, P. A., Oparil, S., & Carter, B. L. (2014). Evidence-based guideline for the management of high blood pressure in adults: Report from the panel members appointed to the Eighth Joint National Committee (JNC 8). *Journal of America Medical Association*, *311*, 507–520.

Jones, N. L., & Killian, K. J. (2000). Exercise limitations in health and disease. *The New England Journal of Medicine*, *343*, 632-641.

Joyner, M. (2003). Obesity update. *Exercise and Sport Sciences Reviews*, *31*, 1–2.

Juarez–Garcia, A., Vera-Calzaretta, A, Blanco-Gomez, G., Gomez-Ortiz,V., Hernandez-Mendoza, E., Jacinto-Ubillus, J., & Choi, B. (2015*)*. Validity of the effort/reward imbalance questionnaire in health professionals from Six Latin-American countries. *American Journal of Industrial Medicine, 58*(6), 636-649.

Juraschek, S., Blaha, M. J., & Whelton, & S. P. (2014). Physical Fitness and Hypertension in a Population at Risk for Cardiovascular Disease. Project. *Journal of the American Heart Association*. *3*(6), 1–11.

Katch, V. L., Mcardle, W. D., & Katch, F. I. (2011). *Essentials of exercise physiology* (4th ed.). Baltimore, MD: Lippincott Williams & Wilkins

Katyal, S., Freeman, M., Miller, J.A., & Thomas, S.G. (2011). Short–term aerobic training and circulatory function in women: Age and hormone-replacement therapy. *Clinical Science 104*, 267-273

Kavanaugh, K. (1995). Dance and drama therapies stimulate creativity and enhance patient well-being. *Brown University Long-Term Care Letter, 7* (14), 5-9.

Kay, S. J., & Fiatarone, S. M. A. (2006). The influence of physical activity on abdominal fat: A systematic review of the literature. *Obesity Review*, 7, 183–200.

Kelley, G. A., Kelley, K. S., & Pate, R. R. (2015). Exercise and BMI in overweight and obese children and adolescents: A systematic review and sequential trial meta-analysis. *BioMed Research International, 2(4), 246-260.*

Kesäniemi, Y. A., Danforth, E. Jr., Jensen, M. D., Kopelman, P. G., Lefebvre, P., & Reeder, B. A. (2001). Dose-response issues concerning physical activity and health: An evidence-based symposium, *Medicine and Science in Sports and Exercise, 33*, 351-358.

Kiens, B., & Lithell, H. (2009). Lipoprotein metabolism is influenced by training-induced changes in human skeletal muscle. *The Journal of Clinical Investigation*, *83*(2), 558-564.

Kim, J. W., Ko, Y. C., Seo, T. B., & Kim, Y. P. (2018). Effect of circuit training on body composition, physical fitness, and metabolic syndrome risk factors in obese female college students. *Journal of Exercise Rehabilitation*, *14*(3), 460.

Kim, S., Chen, J., Cheng, T., Gindulyte, A., He, J., He, S., ... & Bolton, E. E. (2019). PubChem 2019 update: improved access to chemical data. *Nucleic acids research*, *47*(D1), D1102-D1109.

King, J., (2007). *Rock your Body: The ultimate Hip-Hop Inspired workout to slim shape and strengthen your Body*. New York: Rodale.

Kiviniemi, A. M., Hautala, A. J., & Karjalainen, J. J. (2014). Acute post-exercise change in blood pressure and exercise training response in patients with coronary artery disease. *Front Physiology*, *5*, 526.

Kohrt, W. M. (1996). Exercise training improves fat distribution patterns in 60-70-year-old men and women; *Journal of Gerontology*, *47*, 99 – 105.

Kolahdouzi, S., Baghadam, M., Kani-Golzar, F. A., Saeidi, A., Jabbour, G., Ayadi, A., & Zouhal, H. (2019). Progressive circuit resistance training improves inflammatory biomarkers and insulin resistance in obese men. *Physiology & Behavior*, *205*, 15-21.

Kraemer, W. J., & Fleck, S. J. (2007). *Optimizing strength training*. Champaign: Human Kinetics.

Kravitiz, L., & Vella, M. S., (2002). Energy expenditure in different modes of exercise. Current comment, *American College of Medicine, 1-4*

Kravitz, L., & Heyward, V. H. (2017). *Getting a grip on body composition. Retrieved on 17th March 2018 from* *https://www.unm.edu/kravitz/article%0folder/underbodycomp.html*.

Kriemler, S., Radtke, T., Burgi, F., Lambrecht, J., Zehnder, M. & Brunner-La Rocca, H. P. (2014). Short-term cardiorespiratory adaptation to high altitude in children compared with adults, *Scandinavian Journal of Medicine & Science in Sports,* 37, 1-9

Kuhn, C. M. (1999). Adrenocortical and gonadal steroids in behavioral cardiovascular medicine. In: (pp: 185-204), *Handbook of research methods in cardiovascular behavioral medicine.* Eds: Schneiderman, N., Weiss, S. M. and Kaufmann P. New York: Plenum Press.

La Torre, A., Impellizzzeri, F. M., Rampinini, E., Casanova., F., Albert., G., & Marcora, S. M. (2005). Cardiovascular responses to aerobic step dance sessions with or without perpendicular overload. *Journal of Sports Medicine and Physical Fitness, 45*(3), 264-269.

Lankenau, B., Solari, A., & Pratt, M. (2004). International physical activity policy development: A commentary. *Public Health Reports, 19*, 352–355.

Leslie, E., Fotheringham, M. J, Owen, N., & Bauman, A., (2009). Age-related differences in the physical activity level of young adults. *Medicine and Science in Sports and Exercise, 37*, 255-258.

Li, Z, Wang, W, Yang, C., & Ding, H. (2017). Bicucle mode share in China: a city-level analysis of long-term trends. *Transportation*, *44*, *773-788.*

Lim, S., Shin, H., Song, J. H., Kwak, S. H., Kang, S. M., Yoon, J. W. Choi, S.H. Cho, S. Park, K. S., Lee, H., K., Jang, H. C. Koh, K. K., (2011). Increasing Prevalence of Metabolic Syndrome in Korea: The Korean National Health and Nutrition Examination Survey for 1998–2007. *Diabetes Care* 34(6):1323–1328.

Lindsay, D. C., Lovegrove, C. A., Dunn, M. J., Bennett, J. G., Pepper, J. R., Yacoub, M. H., & Poole- Wilson, P. A. (1996). Histological abnormalities of muscle from limb, thorax, and diaphragm in chronic heart failure. *European Heart Journal*, *17*, 1239-1250.

Linnan, L. A., & Marcus, B. (2001). Worksite– Based physical activity programmes and older adults: Current status and priorities for the future. *Journal of Aging and Physical Activity*, *9*, 59–70.

Locke, E. A., & Latham, G. P. (2019). The development of goal setting theory: A half century retrospective. *Motivation Science*, *5*(2), 93.

MacDonald, H. V., Johnson, B. T., & Huedo-Medina, T. B. (2016). Dynamic resistance training as stand-alone antihypertensive lifestyle therapy: A meta-analysis. *Journal of America Heart Association*, *5*, 32-35.

Mainous, A. G., Koopman, R. J., Diaz, V. A., Everett, C. J., Wison, P. W. F., & Tilley, B. C. (2007). A coronary heart disease risk score based on patient-reported information. *American Journal of Cardiology*, *99*(9), 1236-1241.

Marfell- Jones, M., Olds, T., Stewart, A., & Carter, J. E. L. (2006). *International standards for Anthropometric assessment.* Adelaide: ISAK.

Martins, B. B. (2012). *Types of aerobic exercise and different types of physical exercise; Improving health and energy*. Health Basics in Plain English. McGraw Hill Companies, USA.

Maruf, F. A., Akinpelu, A. O., Salako, B. L., & Akinyemi, J. O. (2016). Effects of aerobic dance training on blood pressure in individuals with uncontrolled hypertension on two antihypertensive drugs: A randomized clinical trial. *Journal of American Society of Hypertension*, *10*, 336–345.

McArdle, W. D., Katch, F. I. & Katch, V. L. (2000). *Essentials of exercise physiology* (2nd Ed.). Philadelphia: Lippincott Williams & Wilkins.

McAuley, E., & Blissmer, B. (2000). Self-efficacy determinants and consequences of physical activity. *Exercise and Sport Science Review*, *28*(2), 85–88.

McCarley, P. B., & Salai, P. B. (2007). Chronic kidney disease: A case presentation. *Nephrology Nursing Journal*, *34*(2), 187-199.

McHugh, M. P., & Cosgrave, C. H. (2010). To stretch or not to stretch: The role of stretching in injury prevention and performance. *Scandinavian Journal of Medicine Science Sports*, *20*(2), 169–181.

McMillan, S. (2001). *Fit over forty*. (1st Ed.). Delhi: J. J. Offset Printers.

McMillian, D. J., Moore, J. H., Hatler, B. S. & Taylor, D. C. (2006). Dynamic vs. static-stretching warm-up: The effect on power and agility performance. *Journal of Strength & Conditioning Reserve*, *20*(3), 492–499.

McMorris, T. E., Tomporowski, P. E., & Audiffren, M. E. (2009). *Exercise and cognitive function*. Wiley-Blackwell.

Meeuwsen, E. J., Melis, R. J. F., Adang, E. M., Golüke-Willemse, G. A., Krabbe, P. F., De Leest, B. J., & Olde Rikkert, M. G. M. (2009). Cost-effectiveness of post-diagnosis treatment in dementia coordinated by multidisciplinary memory clinics in comparison to treatment coordinated by general practitioners: an example of a pragmatic trial. *The Journal of Nutrition, Health and Aging*, *13*(3), 242-248.

Meikle, J., Al-Sarraf, A., Li, M. Grierson, K., & Frohlich, J. (2013). Healthy Heart program: A cohort study. *Cardiology*, 7, 145–151

Mercer, L. (2011). *Wellness.* Brigham: Author.

Merrick, J. Bachar, A., Carmeli, E., & Kodesh, E. (2013). Effects of Aerobic Exercise on Body Composition and Muscle Strength in Over-Weight to Obese Old Women with Intellectual Disability: A Pilot Study. *The Open Rehabilitation Journal*, *6*, 43-48

Meyer, F. J., Borst, M. M., Zugck, C., Kirschke, A., Schellberg, D., Kubler, W., & Haass, M. (2001). Respiratory muscle dysfunction in congestive heart failure. Clinical correlation and prognostic significance. *Circulation*, *103*, 2153-2158.

Mills, G. (2007). Cities as agents of global change. *International Journal of Climatology: A Journal of the Royal Meteorological Society*, *27*(14), 1849-1857.

Millstein, R. A. (2014). Measuring outcomes in adult weight loss studies that include diet and physical activity: A systematic review. *Journal of Nutrition and Metabolism*, *8,* 23-30

Min, H. J., Jung, W. J., & Kim, Y. H. (2019). Change in obesity and physical activity according to gender in south Korean adults, 2002–2013. *Journal of Men's Health*, *15*(4), 28-36.

Mittleman, M. A., Maclure, M., Tofler, G. H., Sherwood, J. B., Goldberg, R. J., & Muller, J. E. (1999). Triggering of acute myocardial infarction by heavy physical exertion. Protection against triggering by regular exertion. *The New England Journal of Medicine*, *329*, 1677-1683.

Monroe, M. (2007). Changing lives one move at a time. *International Dance and Exercise Association Fitness Journal*, *19*(5), 361-370

Morgan, O. (2005). Approaches to increase physical activity: Reviewing the evidence for exercise referral schemes. *Public Health*, *119*(5), 361-370.

Morgan, W. P., & Dishman, R. K. (2001). Prescription of physical activity: A paradigm shift. The academy Papers. *Adherence to Exercise and Physical Activity*, *53*, 367–382.

Morris, J. N., Clayton, D. G., Everitt, M. G., Semmence, A. M., & Burgess, E. H. (2000). Exercise in leisure time: Coronary attack and death rates. *British Heart Journal*, *63*, 325-334.

Mwangi, F. M., & Rintaugu, E. G. (2017). Physical activity and health-related physical fitness attributes of staff members in a Kenyan Public University. *International Journal of Sports Science 7*(2), *181-186*

Naci, H. H., & Loannidis, J. P. A. (2015). Comparatives effectiveness of exercise and drug interventions on mortality outcomes: Metaepidemiological study. *Biomedical Journal*, *49*, 1414-1422

Nelson, M. E., Rejeski, W. J., & Blair, S. N. (2007). Physical activity and public health in older adults: Recommendation from the American College of Sports Medicine and the American Heart Association. *Medicine & Science in Sports & Exercise*, *39*(8), 1435–1445.

Netfit, F. (2016a). *Fitness tests. Retrieved from www.netfit.co.uk/.on 25/03/2017*

Netz, Y., Zeev, A., Arnon, M., & Tenenbaum, G. (2008). Reasons attributed to omitting exercising: A population-based study. *International Journal of Sport and Exercise Psychology*, *6*, 9–23.

Ngongang, O. C., Imele, M. H. E., Menanga, A. P., Hamadou,O., Ouankou, M. D., Ama, M. V. J.…, & Kingne, S. (2017). Cardiovascular evaluation of adults aged 40 years and above involved in leisure physical activity: Experience of Yaonde- Cameroon. *International Journal of Sports Science*, *7*(2), 73-80.

Nicklas, B. J., Wang, X., You, T., Lyles, M. F., Demons, J., & Easter, L. (2009). Effect of exercise intensity on abdominal fat loss during calorie restriction in overweight and obese postmenopausal women: A randomized, controlled trial. *American Journal of Clinical Nutrition*, *89*, 1043–1052.

O'Donoghue, G., Blake, C., Cunningham, C., Lennon, O., & Perrotta, C. (2021). What exercise prescription is optimal to improve body composition and cardiorespiratory fitness in adults living with obesity? A network meta-analysis. *Obesity Reviews*, *22*(2), 131-137.

Odo, I., Ezeanyika U., & Uchendu, N. (2015). The Relationship among Body Composition and BMI in Population of Adolescents in Enugu State, Nigeria. *International Journal of Current Microbiology and Applied Sciences*, *4*(1), 884 – 897.

Office of Disease Prevention and Health Promotion. (2014). *Health-related quality of life and well-being.* Available at https:// www.healthypeople.gov/2020/about/foundationhealth-measures/Health-Related-Quality-of-Lifeand-Well-Being.

Ofori, R., & Dampson, D.G. (2011). *Research methods and statistics using SPSS.* Amakom –Kumasi: Payless Publication Limited.

Ogah, J. K. (2013). *Decision Making in the Research process.* Legon-Accra: Adwinsa publications (Gh) LTD.

Oke, K., & Agwubike, E. O. (2015). Body composition and pulmonary functional correlates in Nigerian male Amateur boxer. *Journal of Romanian Sports Medicine Society*, *42*, 884 – 897.

Osei-Tutu, K. B., & Campagna, P. D. (2005). The effects of short-vs. long-bout exercise on mood, VO_2max., and percent body fat. *Preventive Medicine*, *40*(1), 92-98.

Owen, N., Healy, G. N., Matthews, C. E., & Dunstan, D. W. (2010). Too much sitting: The population health science of sedentary behavior. *Exercise Sport Science Reviews, 38*(3), 105–113.

Pantelic, S., Kostic, R., Mikalckki, M., Duraskovic, R., Cokorilo, N., & Mladenovi, I. (2007). The effects of a recreational aerobic exercise model on the functional abilities of women. *Series Physical Education & Sport*, *5*(1), 19-35.

Paoli, A., Pacelli, Q. F., Moro, T., Marcolin, G., Neri, M., Battaglia, G...., & Bianco, A. (2013). Effects of high-intensity circuit training, low-intensity circuit training and endurance training on blood pressure and lipoproteins in middle-aged, overweight men. *Lipids in Health and Disease*, *12*(1), 1-8.

Pate, R. R., Pratt, M., & Blair, S. N. (1995). Physical activity and public health. A recommendation from the Centres for Disease Control and Prevention and the American College of Sports Medicine. *Journal of American Medical Association*, *273*(5), 402–407.

Pedersen, B. K., & Saltin, B. (2015). Exercise as medicine - Evidence for prescribing exercise as therapy in 26 different chronic diseases. *Scandinavian Journal of Medical Science and Sports*, *25* (Suppl. 3), 1-72, doi:10.1111/sms.12581

Pescatello, L. S., Arena, R. Riebe, D., & Thompson, P. D. (2014). *American College of Sports Medicine (ACSM)'s Guidelines for Exercise Testing and Prescription* (9th ed.). USA: Philadelphia.

Pestell, R. G., Hurley, D. M., & Vandongen, R. (1999). Biochemical and hormonal changes during a 1000 km ultramarathon. *Clinical and Experimental Pharmacology & Physiology*, *16*, 353-361.

Peterson, M. D., Rhea, M. R., & Alvar, B. A. (2005). Applications of the dose-response for muscular strength development: A review of meta-analytic efficacy and reliability for designing training prescription. *Journal of Strength and Conditioning Research*, *19*(4), 950–958.

Physical Activity Guidelines Advisory Committee Report (2018). *Washington, D.C: U.S Department of Health and Human Services; 2018. 78p. (cited) 2019. Retrieved from http://www.health.gov/paguidelines/report/pdf committee report.pdf* on 2/ 8/2018.

Pi-Sunyer, F. X. (1999). *Obesity. In modern nutrition in health and disease*. Baltimore: Williams and Wilkins.

Poehleman, E. J., & Melby, C. (1998). Resistance training and energy balance. *International Journal of Sports Nutrition*, *8*, 14–59.

Pontzer, H., Durazo-Arvizu, R., & Dugas, L. R., (2016). Constrained total energy expenditure and metabolic adaptation to physical activity in adult humans. *Curr Biol.*, *26*, 410-417.

Powers, W. J., Rabinstein, A. A., Ackerson, T., Adeoye, O. M., Bambakidis, N.C., Becker, K.…, & Jauch, E. C. (2018). 2018 guidelines for the early management of patients with acute ischemic stroke: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*, *49*(3), 46-99.

Pratt, M, Epping, J. N., & Dietz, W. H., (2009). Putting physical activity into public health: A historical perspective from the CDC. *Prevention Medicine*, 49, 301-302.

President Council on Physical Fitness and Sports (2005). *Fitness fundamentals.* Retrieved, on November 10, 2016. from http://www.cyberparent.com/fitness/healthfitness/defines /healthy/.htm

President's Council on Physical Fitness, and Sports. (2000). Definitions of health fitness and physical activity. Washington D.C. Retrieved from http://www.nia.nih.gov/health information/publications/exercise guide

Ranasinghe, C., Gamage, P., Katulanda, P., Andraweera, N., Thilakarathne, S., & Tharanga, P. (2013). Relationship between BMI (BMI) and body fat percentage, estimated by bioelectrical impedance, in a group of Sri Lankan adults: A cross-sectional study. *BMC Public Health*, *13*(1), 1-8.

Reckelhoff, J. F., (2001). Gender differences in the regulation of blood pressure. *Journal of American Society of Hypertension, 37*(5), 1199–1208.

Rees, S. S., Murphy, A. J., Watsford, M. L., McLachlan, K. A., & Coutts, A. J. (2007). Effects of proprioceptive neuromuscular facilitation stretching on stiffness and force-producing characteristics of the ankle in active women. *Journal of Strength Conditioning Reserve, 21*(2), 572–577.

Rhea, M. R., Alvar, B. A., Burkett, L. N., & Ball, S. D. (2003). A meta-analysis to determine the dose-response for strength development. *Medicine Science & Sports Exercise, 35*(3), 465–464.

Ries, M. D., Philbin, E. F., & Groff, G. D. (1995). Relationship between severity of gonarthrosis and cardiovascular fitness. *Clinical Orthopedics and Related Research, 313*, 169-176.

Rivellese, A. A., Riccardi, G., & Vaccaro, O. (2010). Cardiovascular risk in women with diabetes. *Nutrition Metabolism Cardiovascular Disease, 20*, 474-480, doi: 10.1016/j.numecd.2010.01.008.

Robergs, R. A., & Roberts, S. O. (2000). *Fundamental principles of exercise physiology for fitness, performance and health.* Boston: McGraw-Hill Company.

Robertson, R. J., Goss, F. L., & Dube, J., (2004). Validation of the adult OMNI scale of perceived exertion for cycle ergometer exercise. *Medicine & Science in Sports & Exercise*, *36*(1), 102–108.

Rodriguez-Hernandez, M. G., & Wadsworth, D. W. (2019). The effect of 2 walking programs on aerobic fitness, body composition, and physical activity in sedentary office employees. *PloS One*, *14*(1), e0210447.

Ross, R., & Rissanen, J., (1994). Mobilization of visceral and subcutaneous adipose tissue in response to energy restriction and exercise. *American Journal of Clinical Nutrition, 60,* 695–703.

Ross, R., Freeman, J. A., & Jansseen, I. (2000). Exercise alone is an effective strategy for reducing obesity and related comorbidities. *Exercise and Sports Science Reviews, 28*, 165-170.

Rothman, A. (2014). "Is there nothing more practical than a good theory?": Why innovations and advances in health behavior change will arise if interventions are used to test and refine theory. *International Journal of Behaviour Nutrition & Physical Activity, 1*(1), 11.

Ryan, R. M., Deci, E. L., & Grolnick, W. S. (1995). Autonomy, relatedness, and the self: Their relation to development and psychopathology.

Salis, J. F., & Owen, N. (2002). Ecological models of health behaviour. In Glanz, K., Rimer, B. K., Lewis, F. M. *Health Behaviour and Health Education: Theory, Research and Practice* (3rd Ed.). San Francisco: Jossey-Bass, 462-484.

Sallies, J., Cerin, E., Conway. T., Adams, M., Frank, L., Pratt, M…, & De Bourdeaudhuij, I. (2016). Physical activity in relation to urban environments in 14 cities worldwide: A cross-sectional study. *The Lancet 287*, 2207-2217.

Sallis, J. F., & Owen, N. (2002). Ecological models of health behavior. In: Glanz, Rimer, Lewis, editors. *Health Behavior and Health Education: Theory, Research, and Practice,* Third Edition. San Francisco: Jossey-Bass.

Sallis, J. F., Prochoska, J. J., & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. *Journal of Medical Science and Sports Exercise*, *32*(5), 965–975.

Samaras, K., Kelly, P. J., Chiano, M. N., Specrov. J. D., & Campbell, L. V. (1999). Genetic and environmental influences on total-body and central abdominal fat: The effects of physical activity in female twins. *Journal of Medical Science and Sports Exercise, 15*(2), 65–75.

Sampson – Akpan, P. E., Eyo, M. B. & Joshua, A. M. (2013). Physical activity for quality living among academic staff in Nigeria universities. *Harmdad Medicus, 56*(3) 78-90.

Sattler, T., Maddern, W., Toft, C., Torii, A., Hammarstrand, L., Stenborg, E., ... & Pajdla, T. (2018). Benchmarking 6dof outdoor visual localization in changing conditions. In *Proceedings of the IEEE conference on computer vision and pattern recognition* (pp. 8601-8610).

Schillaci, G., & Pucci, G. (2010). The dynamic relationship between systolic and DBP: Yet another marker of vascular aging? *Hypertension Research*, *33*(7), 659-661.

Schwartz, L., & Kindermann, W. (2000). Beta-endorphin, adrenocorticotropic hormone, cortisol and catecholamines during aerobic and anaerobic exercise. *European Journal of Applied Physiology, 61*, 165-171.

Schwartz, R. S., & Hirth, V. A. (1995). The effects of endurance and resistance training on blood pressure. *International Journal of Obesity Related Metabolism Disorder, 19*(suppl 4), 52-57.

Schwingshackl, L., Dias, S., Strasser, B., & Hoffmann, G. (2013). Impact of different training modalities on anthropometric and metabolic characteristics in overweight/obese subjects: A systematic review and network meta-analysis. *PloS One*, *8*(12), e82853.

Seamus, W., Ashley, C., Xue, X., & Jiang, H. (2002). Effect of Aerobic Exercise on Blood Pressure: A Meta-Analysis of Randomized, Controlled Trials. *Annals of Internal Medicine*, *36*, 493-503.

Senbanjo, I. O. & Oshikoya, K. A. (2010). Physical activity and BMI of school children and adolescents in Abeokuta, Southwest Nigeria; World. *Journal of Pediatrics*, *6*(3), 217–222.

Seo, Y. G., Noh, H. M., & Kim, S. Y. (2019). Weight loss effects of circuit training interventions: A systematic review and meta-analysis. *Obesity Reviews*, *20*(11), 1642-1650.

Sharman, M. J., Cresswell, A. G., & Riek, S., (2006). Proprioceptive neuromuscular facilitation stretching: Mechanisms and clinical implications. *Sports Medicine*, *36*(11), 929–939.

Sharples, M., de Roock, R., Ferguson, R., Gaved, M., Herodotou, C., Koh, E., ... & Wong, L. H. (2016). *Innovating pedagogy 2016: Open University innovation report 5*. Institute of Educational Technology, The Open University.

Shaw, K., Gennat, H., O'Rourke, P., & Del Mar, C., (2007). Exercise for overweight or obesity (review). *Cochrane*, 3, 1–85.

Siedentop, D. (2004). *Introduction to physical education, fitness and sport.* California: Mayfield Publishing Company.

Silva, V. R., Belozo, F. L., Pereira, R. M., Katashima, C. K., Cordeiro, A. V., Alves, J. F…, & De Moura, L. P. (2020). The effects of ninety minutes per week of moderate-intensity aerobic exercise on metabolic health in individuals with Type 2 Diabetes: A pilot study. *Journal of Rehabilitation Therapy*, *2*(2), 211-219

Sinclair, K. M., Hamlin, M. J., & Steel, G. D. (2005). Physical activity levels of first – year. New Zealand University students: Pilot study. *Youth Studies Australia, 24*(1), 38–42.

Sjodin, A. M., Forslund, A. H., Westerterp, K. R., Anderson, A. B., Forslund, J. M., & Hambraeus, L. M. (2006). The influence of physical activity on BMR. *Medicine and Science in Sports and Exercise, 28,* 85–91.

Sohler, N., Lubetkin, E., Levy, J., Soghomonian, C., & Rimmerman, A. (2009). Factors associated with obesity and coronary heart disease in people with intellectual disabilities. *Social Work Health Care, 48*(1), 76-89.

Sosner, P., Guiraud, T., Gremeaux, V., Arvisais, D., Herpin, D., & Bosquet, L., (2017). The ambulatory hypotensive effect of aerobic training: A reappraisal through a meta-analysis of selected moderators. *Scandinavia Journal of Medicine Science and Sports*, *27*, 327–341.

Stasiulis, A., Mockiene, A., Vizbaraite, D., & Mockus, P. (2010). Aerobic exercise-induced changes in body composition and blood lipids in young women. *Medicine (Kaunas) 46*, 129–134.

Stephens, J., Cai, J., Evenson, K. R., & Thomas, R. (2002). Fitness and fatness predictors of mortality from all causes and from cardiovascular disease in men and women in the Lipid Research Clinics Study. *American Journal of Epidemiology, 156*, 832–841.

Stevens, J., Katz, E. G., & Huxley, R. R. (2010). Associations between gender, age and waist circumference. *European Journal of Clinical Nutrition, 64*(1), 6-15.

Stewart, A. L. (2001). Community-based physical activity programmes for adults age 50 and older. *Journal of Aging and Physical Activity, 9*, 71–91.

Strasser, B., & Schobersberger, W. (2011). Evidence for resistance training as a treatment therapy in obesity. *Journal of Obesity*,7, 1-9.

Suman, C. (2016). Aerobic exercise programme and reduction in body weight and BMI (BMI). *Galore International Journal of Health Sciences & Research, 1*(1), 41-44.

Sutherland, R, Wilson, J., Aitchison, T., & Grants, S. (1999). Physiological responses and perceptions of exertion in a step aerobics session. *Journal of Sports Science, 17*, 495-503.

Swain, D. P. (2000). Energy cost calculations for exercise prescription: An update. *Sports Med*., *30*(1), 17–22.

Swain, D. P. (2014). *American College of Sports Medicine. ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription*. (7th ed.). Baltimore (MD): Lippincott Williams & Wilkins.

Swain, D. P., & Franklin, B. A. (2002). VO_2 reserve and the minimal intensity for improving cardiorespiratory fitness. *Medicine & Science in Sports & Exercise, 34*(1), 152–157.

Swain, D. P., & Leutholtz, B. C. (1997). HR reserve is equivalent to $\%VO_2$ reserve, not to $\%VO_2$max. *Medicine & Science in Sports & Exercise, 29*(3), 410–414.

Sydó, N., Abdelmoneim, S. S., Mulvagh, S. L., Merkely, B., Gulati, M., & Allison, T. G. (2014). Relationship between exercise HR and age in men vs women. In *Mayo Clinic Proceedings*, 89(12), 1664-1672.

Sykes, K., Choo, L. L., & Cotterrell, M. (2004). Accumulating aerobic exercise for effective weight control. *Journal of the Royal Society for the Promotion of Health, 124*(1), 24–28.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics (4th edi.).* Boston: Allyn and Bacon.

Talabi, A. E. (2016). *Heaven is Far - Only the Fit Can Make It*. Available at http://www.unilorin. Ng.

Talanian, J. L., Galloway, S. D., Heigenhauser, G. J., Bonen, A., & Spriet, L. L. (2007). Two weeks of high-intensity aerobic interval training increases the capacity for fat oxidation during exercise in women. *Journal of Applied Physiology, 102*, 1439–47.

Tanaka, H., Cléroux, J., de Champlain, J., Ducharme J. R., & Collu, R. (1999). Persistent effects of a marathon run on the pituitary-testicular axis. *Journal of Endocrinological Investigation, 9,* 97-101.

Tanaka, H., Monahan, K. D., & Seals, D. R. (2001). Age-predicted maximal HR revisited. *Journal of the American College of Cardiology*, *37*(1), 153–156.

Themistocleous, I. C., Agathangelou, P., & Stefanakis, M. (2021). Effects of Moderate-Intensity Intermittent Circuit Training in Obese and Overweight Individuals. *International Journal for Sports & Exercise Medicine*, *7,* 194.

Thompson, P. D., Arena, R., Riebe, D., & Pescatello, L. S. (2013). ACSM's new preparticipation health screening recommendations from ACSM's guidelines for exercise testing and prescription. *Current Sports Medicine Reports*, *12*(4), 215-217.

Thompson, R. (2007). Worldwide survey reveals fitness trends for 2008. *ACSM's Health & Fitness Journal, 23, 56-61.*

Tipton, C. M. (2014). The history of "Exercise Is Medicine" in ancient civilizations. *Advance Physiological Education, 38,* 109-117.

Trayhurn, P., & Beattie, J. (2001). Physiological role of adipose tissue: White Adipose Tissue as Endocrine and Secretary Organ. *Proceedings of the Nutrition Society, 60,* 329–339.

Tremblay, M. S., Chu, S. Y., & Muneika, R. (2003). Methodological and statistical considerations for exercise-related hormone evaluations. *Sports Medicine, 20,* 90–108.

Treuth, M. S., Myan, A. S., Pratley, R. E., Rubin, M. A., Miller, J. P., Nicklas, B. J…., & Hurley, B. F. (1994). Effects of Strength training on total and regional body composition in older men. *Journal of Applied Physiology*, *77*, 614-620.

Troiano, R. P., Stamatakis, E., & Bull, F. C. (2020). How can global physical activity surveillance adapt to evolving physical activity guidelines? Needs, challenges and future directions. *British Journal of Sports Medicine*, *54*(24), 1468-1473.

Ucan, Y. (2013). Effects of different types of exercises on body composition in young men and women. *Life Science Journal, 10(3),* 1799-1806.

Ukegbu, P., & Nwaegbute, A. (2012). Body Composition Changes among Lactating Mothers in Abia State, Nigeria. *American Journal of Food and Nutrition*. *2*(1), 21–25.

United Nations Conference on Housing and Sustainable Urban Development. (2016). *New urban agenda,* Quito, Ecuador, Held on 17th-20th October, 2016.

United Nations Development Plan. (2015). *Sustainable development goals.* Retrieve from *http://www.Undp/SDGs-booklet-web-en on 7/4/2018*

United State Department of Health and Human Services. (1996). *Physical activity and health: a report of the surgeon general.* Washington, D.C, U.S

United State Department of Health and Human Services. (2008). *Physical activity guidance for Americans. Rockville (MD): Office of disease prevention and health promotion.* U.S. Department of Health and Human Services.

United State Department of Health and Human Services. (2008). *Physical activity guidelines advisory committee report 2008. Retrieved from http://www.health.gov/paguidelines/committeereport.aspx on 2018/16*

United States department of health and human services. (2010). *Healthy people* 2015 (2nd ed.). Washington D.C, U.S Government Printing Office.

United States Department of Health and Human Services. (2012). *The truth about your immune system.* A special health report from Harvard Health Publication, National Institute of Health. USA., Harvard Publication.

Utter, A. C., Robertson, R. J., Green, J. M., Suminski, R. R., McAnulty, S. R., & Nieman, D. C. (2004). Validation of the Adult OMNI Scale of perceived exertion for walking/running exercise. *Medicine & Science in Sports & Exercise, 36*(10), 1776–80.

Vella, C. A., Taylor, K., & Drummer, D. (2017). High-intensity interval and moderate-intensity continuous training elicit similar enjoyment and adherence levels in overweight and obese adults. *European Journal of Sport Science, 17*(9), 1203-1211.

Venkateswalu, K. (2011). *Exercise for disease prevention and health promotion:* Somaru, Zaria: Ahmadu Bello University Press.

Vincent, K. R., Braith, R. W., Feldman, R. A., Magyari, P. M., Cutler, R. B., Persin, S. A.…, & Lowenthal, D. T. (2002). Resistance exercise and physical performance in adults aged 60 to 83. *Journal of the American Geriatrics Society, 50*, 1100–1107.

Virgin Active. (2004). *Class descriptors: Group training*. Virgin Active Gymnasiums, Western Cape.

Viru, A. (2000). Plasma hormones and physical exercise. *International Journal of Sports Medicine*, *13,* 201-209.

Wallace, L. S., Buckworth, J., Kirby, T.W., & Sherman, W. M. (2010). Characteristics of exercise behavior among college students: Application of social cognitive theory to predicting stage of change. *Preventive Medicine,* 31, 449-505.

Werner, W. K. H. & Sharon, A. H. (2007). *Lifetime Physical Fitness and Wellness, A Personalized Programme*, (9th Ed.). Published by Thomas Wadsworth. 196-217.

White, E. P., Ernest, S. M., Adler, P. B., Hurlbert, A. H., & Lyons, S. K. (2010). Integrating spatial and temporal approaches to understanding species richness. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *365*(1558), 3633-3643.

White, L. J., Gill, J. M., & Cathcart, A. J. (2010). Effect of 2 weeks of sprint interval training on health-related outcomes in sedentary overweight/obese men. *Metabolism*, *59*(10), 1421-1428.

Williams, D. M., Anderson, E. S., & Winett, R. A. (2005). A review of the outcome expectancy construct in physical activity research. *Annual Behaviour Medicine, 29*(1), 70–79.

Williams, R. L., Wood, L. G., Collins, C. E., & Callister, R. (2015). Effectiveness of weight loss interventions–is there a difference between men and women: a systematic review. *Obesity Reviews*, *16*(2), 171-186.

Willich, S. N., Lewis, M., Löwel, H., Arntz, H. R., Schubert, F., & Schröder, R. (1999). Physical exertion as a trigger of acute myocardial infarction. *The New England Journal of Medicine*, *329*, 1684-1690.

Wilmore, J.H., & Costil, D. L. (2004). *Physiology of Sport and Exercise* (3rd Ed.) Champaign, IL: Human Kinetics. 674-685.

Wilson, J. R., McCully, K. K., Mancini, D. M., Boden, B., & Chance, B. (2000). Relationship of muscular fatigue to pH and diprotonated Pi in humans: A 31P-NMR study. *Journal of Applied Physiology*, *64*, 2333-2339.

Winett, R. A., Williams, D. M., & Davy, B. M. (2009). Initiating and maintaining resistance training in older adults: A social cognitive theory-based approach. *British Journal of Sports Medicine*, *43*(2), 114-119.

Winters, M. V., Blake, C. G., & Trost, J. S. (2004). Passive versus active stretching of hip flexor muscles in subjects with limited hip extension: a randomized clinical trial. *Physical Therapy*, *84*(9), 800–807.

Wojcicki, T. R., White, S. M., & McAuley, E., (2009). Assessing outcome expectations in older adults: The multidimensional outcome expectations for exercise scale. *Journal of Gerontology & Psychological Social Science*, *64*(1), 33–40.

Wokoma, F. S. (2011). Hypertension in non-insulin-dependent diabetic, Kano Nigerians. A comparative study of normotensive and hypertensive subgroups. *Diabetes Kano Nigeria International*, 3, 57-58.

Woo, J. S., Derleth, C., Stratton, J. R., & Levy, W. C. (2006). The influence of age, gender, and training on exercise efficiency. *Journal of the American College of Cardiology*, *47*(5), 1049-1057.

Woodward, A., & Lindsay, G. (2010). Changing modes of travel in New Zealand cities. In: Howden, Stuart, Chapman, editors. *Sizing up the City-Urban form and Transport in New Zealand.* Wellington, New Zealand: University of Olago.

Woolstenhulme, M. T., Griffiths, C. M., Woolstenhulme, E. M., & Parcell, A. C. (2006). Ballistic stretching increases flexibility and acute vertical jump height when combined with basketball activity. *Journal of Strength and Conditioning Research, 20*(4), 799–803.

World Health Organization, T. (2010). *Global recommendations on physical activity for health*. World Health Organization.

World Health Organization. (2004). *Global strategy on diet, physical activity and health.* 57th World Health Assembly. Resolutions and decisions, annexes, Geneva.

World Health Organization. (2011). *New physical activity recommendations for reducing disease and preventing deaths.* Retrieved on 20/05/2017 from http://www.who.int/chp/media/news/releases/20112-physicalac

World Health Organization. (2013). Implementation tools: package of essential non-communicable (PEN) disease interventions for primary health care in low-resource settings.

World Health Organization. (2016). *Prevalence of insufficient physical activity among adults.* Retrieved from http://www.who.int on 30/3/2018

World Health Organization. (2018). *Country comparable estimates on physical activity 2016.*

World Health Organization. (2018a). *The draft global action plan. Retrieved 0n 23/2/2018 from http://www.who.int/neds/governance/physical-activity-plan/en/*.

World Health Organization. (2019). *Global action plan on physical activity 2018-2030: more active people for a healthier world*. World Health Organization.

World Health Organization. (2021). *Fair play: building a strong physical activity system for more active people* (No. WHO/HEP/HPR/RUN/2021.1). World Health Organization.

World Health Organization. (2021). Standards for healthy eating, physical activity, sedentary behaviour and sleep in early childhood education and care settings: a toolkit.

World Health Organization. (2022). *Global plan for the decade of action for road safety 2021-2030* (No. WPR/2022/VNM/001). WHO Regional Office for the Western Pacific.

Xu, L., Wang, Z., Wang, J., Xiao, Z., Huang, X., Liu, Z., & Wang, S. (2017). N-doped nanoporous Co3O4 nanosheets with oxygen vacancies as oxygen evolving electrocatalysts. *Nanotechnology*, *28*(16), 165402.

Young, D. R. & Steinhard, M. A. (1995). The importance of Physical Fitness for the reduction of Coronary artery disease risk factors. *Journal of Sports Medicine*, *19*, 303-310.

Zhu, N., Suarez-Lopez, J. R., & Sidney, S. (2010). Longitudinal examination of age-predicted symptom-limited exercise maximum HR. *Medicine & Science in Sports & Exercise*, *42*(8), 1519–1527.

APPENDICES

APPENDIX A

"ADULTS PRE-EXERCISE SCREENING TOOL (COMPULSORY)

This physical activity readiness questionnaire (PAR-Q) is to identify those individuals with a known disease, or signs or symptoms of disease, who may be at a higher risk of an adverse event during physical activity/exercise.

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to go.

Please read the questions carefully and answer each one honestly. Tick your response either Yes or No in the box provided".

"No.	Questions	Yes	No
1	Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?		
2	Do you feel pain in your chest when you do physical activity?		
3	In the past month, have you had chest pain when you were not doing physical activity?		
4	Do you lose your balance because of dizziness or do you ever lose consciousness?"		

5	"Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?		
6	Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?		
7	Do you know of any other medical reason why you should not do physical activity?"		

"I have read, understood and completed this questionnaire. I believe that to the best of my knowledge, all of the information I have supplied within this tool is correct.

Signature____

Date____

Adopted from:

Canadian Society for Exercise Physiology (2002)".

APPENDIX B

Form for Monitoring Clients and for collecting data for Research.

<u>Informed Consent</u>

I agree to participate in this study. Yes ( ) No ( ) Signature: …………….

Date: ……………

SECTION A

Biodata

<u>Instruction</u>: Please tick (√) where applicable and write where applicable

Sex: Male ( ) Female ( )

Age: …………………years

SECTION B

Physiological Data

	Week 1	**Week 6**	**Week 12**
Blood pressure (BP): $\frac{S}{D}$	……… mmHg	………mmHg	………mmHg
HR (HR):	…………. bpm	…………bpm	………bpm
% Body fat (%BF):	…………	………..	………….

Anthropometric Data

Height:	………… (cm)	…………..(cm)	…………..(cm)
Weight:	……….. (Kg)	…………...(Kg)	…………(Kg)
Hip circumference:	………….(cm)	…………….(cm)	……………(cm)
Waist Circumference:	………… (cm)	………….(cm)	…………….(cm)

APPENDIX C

ETHICAL CLEARANCE

UNIVERSITY OF CAPE COAST

INSTITUTIONAL REVIEW BOARD SECRETARIAT

TEL: 0558093143 / 0508878309/ 0244207814
E-MAIL: irb@ucc.edu.gh
C/O Directorate of Research, Innovation and Consultancy

OUR REF: UCC/IRB/A/2016/740
YOUR REF:
OMB NO: 0990-0279
IORG #: IORG0009096

3RD JULY, 2020

Mr. Nathaniel Atikumi
Department of Health, Physical Education and Recreation
University of Cape Coast

Dear Mr. Atikumi,

ETHICAL CLEARANCE – ID (UCCIRB/CES/2020/23)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted **Provisional Approval** for the implementation of your research protocol **Effects of Long Duration Aerobic Exercise on Physiological Variables among Gymike Keep Fit Club Members in Accra.** This approval is valid from 3rd July, 2020 to 2nd July, 2021. You may apply for a renewal subject to submission of all the required documents that will be prescribed by the UCCIRB.

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

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

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

Yours faithfully,

Samuel Asiedu Owusu, PhD
UCCIRB Administrator

ADMINISTRATOR
INSTITUTIONAL REVIEW BOARD
UNIVERSITY OF CAPE COAST

APPENDIX D

INTRODUCTORY LETTER

UNIVERSITY OF CAPE COAST
CAPE COAST, GHANA
COLLEGE OF EDUCATION STUDIES
FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION
Department of Health, Physical Education & Recreation

TELEPHONE: +233 -0206610931/0543021384/0268392819
TELEX 2552, UCC, GH.

Email:hper@edu.gh

Cables & Telegrams:
UNIVERSITY, CAPE COAST

Ref. No. **ET/PED/16/0001/**

12th February, 2020.

The Chairman
Institutional Review Board
University of Cape Coast
Cape Coast

INTRODUCTORY LETTER: NATHANIAL ATIKUMI (ED/PED/16/0001)

The bearer of this letter is an PhD (Physical Education) student of the above department. In partial fulfilment of the requirements for the programme, he is conducting a study on the topic **"Effects of Long Duration Aerobic Exercise on Physiological Variables Among Gymike Keep Fit Club Members in Accra."** and would need ethical clearance from your outfit.

We would therefore be most grateful if assistance could be offered to him to carry out the research.

We count on your co-operation.

Thank you.

Dr. Daniel Apaak
HEAD

UNIVERSITY OF CAPE COAST
CAPE COAST, GHANA
COLLEGE OF EDUCATION STUDIES
FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION
Department of Health, Physical Education & Recreation

TELEPHONE: +0206610931/0543021384/0268392819
TELEX: 2552, UCC, GH
Email: hper@edu.gh
Cable & Telegrams:
UNIVERSITY, CAPE COAST

Ref. No. **ED/PED/16/0001/**

12[th] February, 2020.

The Chairman
Institutional Review Board
University of Cape Coast
Cape Coast

INTRODUCTORY LETTER: NATHANIAL ATIKUMI (ED/PED/16/0001)

The above-named person is a student of the Department of Health, Physical Education and Recreation of the University of Cape Coast. He is pursuing a Doctor of Philosophy degree in Physical Education. In partial fulfilment of the requirements for the programme, he is conducting a research for his thesis titled" **Effects of Long Duration Aerobic Exercise on Physiological Variables Among Gymike Keep Fit Club Members in Accra."**

He has satisfied the conditions for data collection and we kindly request that he is granted ethical clearance to enable him conduct the research.

We count on your usual co-operation.

Thank you.

Dr. Daniel Apaak
(Principal Supervisor)

APPENDIX E

APPLICATION LETTER FOR ETHICAL CLEARANCE

UNIVERSITY OF CAPE COAST, INSTITUTIONAL REVIEW BOARD (UCC-IRB)

APPLICATION FORM FOR ETHICAL CLEARANCE OF NEW PROPOSAL

Dept. of Health, Physical Education & Recreation
University of Cape Coast
Cape Coast
17th February, 2020.

The Director
Institutional Review Board
University of Cape Coast
Cape Coast

Dear Director,

APPLICATION FOR ETHICAL CLEARANCE

I would be very grateful if I could be given ethical clearance to aid me collect data for my thesis. My particulars are:

Name: Nathaniel Atikumi

Programme: Ph.D. Physical Education

Registration number: ED/PED/16/0001

Email: atikumin@yahoo.com

Researching topic: Effects of long duration aerobic exercise on physiological variables of Gymike keep fit club members, Accra".

Principal Supervisor: Dr. Daniel Apaak (0266176876)

Thanks

Yours faithfully,

Mr. Nathaniel Atikumi
0243251905

i

UCC-IRB
VERSION: 2020