EFFECTS OF A TWELVE-WEEK ARM ERGOMETRY TRAINING ON SELECTED HEALTH INDICES OF LOWER LIMB PARALYTIC POLIOMYELITIS SURVIVORS

BY

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CERTIFICATION

We certify that this research work was carried out by Mrs. Abiola Abioye Atowoju, in the Department of Physiotherapy, College of Medicine, University of Ibadan, Ibadan, Nigeria under our supervision.

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DEDICATION

This work is dedicated to the Almighty God who consistently saw me through this research work, and my beloved family, whose support I maximally enjoyed throughout the research period. I will be eternally grateful.

ABSTRACT

Reduced mobility consequent to motor paralysis is associated with Secondary Health Conditions (SHC) among Lower Limb Paralytic Poliomyelitis Survivors (LLPPS). Arm ergometry, an effective aerobic exercise, can be used to improve the overall health of LLPPS with SHC, but no clinical trial has comprehensively and concurrently assessed its potential benefits in this population using a Randomised Clinical Trial (RCT) design. The study investigated the effects of a twelve-week arm ergometry training on selected health indices of LLPPS with SHC.

The RCT involved 60 LLPPS from eleven local government centres in Ibadan, Oyo State. They were randomly selected from the 252 who had SHC as determined using Tate SHC Questionnaire in a Cross-Sectional Survey. Participants were randomly assigned into Exercise Group (EG) and Control Group (CG). The EG received thrice-weekly arm ergometry training for twelve consecutive weeks in addition to flexibility exercises which was received by the CG. Participants' Resting Heart Rate (RHR), Resting Systolic Blood Pressure (RSBP), Resting Diastolic Blood Pressure (RDBP), Percent Body Fat (PBF), and Body Mass Index (BMI) were assessed using standard methods, while Cardio-Respiratory Fitness was assessed using Six-Minute Walk Test (6-MWT). The General Health Status (GHS), Quality of Life (QoL) and Depressive Symptoms (DS) were assessed using Dartmouth COOP Health Chart (higher scores indicate reduced activity), Ferrans and Powers QoL measure and Beck Depression Inventory respectively. Assessments were carried out at baseline and end of 4th, 8th and 12th weeks. Data were analysed using ANOVA, independent t- test and Mann Whitney-U at $p = 0.05$.

Twenty eight participants in EG (15 males, 13 females) and 26 in CG (11 males, 15 females) completed the study. Twenty six participants had bilateral, while 28 had unilateral lower limb affectation. Twelve were independently ambulant while 42 used assistive devices. Most participants were unmarried and had only secondary school education. They were predominantly traders and artisans with average monthly income of 4,556 naira. The mean ages of EG (38.43±6.97) and CG (38.08 ±5.75 years) were not significantly different. The common SHC observed were hypertension, depression,

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obesity, back pain and spinal deformities. At baseline, the health indices of EG and CG were not significantly different. At twelfth week, CG had significantly higher R SBP (126.69 ±7.18 vs 121.50 ± 6.29) and PBF (30.52±6.01 vs 23.43±11.24) than the EG respectively. The CG had significantly higher scores than EG in daily activities (at $4^{th}/8^{th}$, $0/8^{th}$, $4^{th}/12^{th}$ and $0/12^{th}$ weeks) and social activities (at week $8^{th}/12$th) domains of GHS. Groups were not significantly different in QoL and DS. Within-group comparison showed significant decreases in EG's RHR (F=16.33), RSBP (F= 8.99), RDBP (F=11.37), PBF (F=20.78), DS (χr^2 = 19.61) and increases in 6-MWT (F=33.45) and QoL (χr^2=23.53). CG had significant increase in PBF (F= 20.78) and decrease in pain (χr^2=13.67) and feelings (χr^2=8.01) domains of GHS. No gender variation was observed in all the variables.

Twelve-week arm ergometry training improved the health indices of lower limb paralytic poliomyelitis survivors with secondary health conditions. Arm ergometry should be incorporated into the rehabilitation programme of these individuals.

Keywords: Paralytic poliomyelitis, Arm ergometry, Secondary health conditions.

Word count: 500

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Finally, to all participants in this study, I appreciate your consent and cooperation. Remain blessed in the Lord.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

Polio survivors constitute one of the largest groups of people with disabilities in the world (Tsai et al, 2009). There is however, a dearth of published work on their current statistics in Nigeria. Laforce et al (1980) estimated the number of polio survivors in Nigeria at 200,000 -300, 000, while Parakoyi and Babaniyi (1990) estimated that a minimum of 33,300 paralytic poliomyelitis cases could have occurred annually in Nigeria between 1979 and 1983. While the disease has become almost preventable with its practical eradication in industrialized countries, Nigeria remains the most polio-endemic country and accounts for the highest prevalence of circulating wild polio virus in the world (WHO Factsheet, 2012; Aina and Ejembi, 2013).

Poliomyelitis has consistently proven to be a challenge to eradication programmes in Nigeria. While there is 99% reduction in its prevalence worldwide, control measures in Nigeria through the National Programme on Immunization (NPI) have not been fully successful (Aina and Ejembi, 2013). Cultural, religious, sociopolitical and other contextual factors severely constrain intervention options in northern Nigeria, which majorly accounts for the on-going transmission of the polio virus in Nigeria (Prata et al 2012). Although there has been geographical restriction of polio transmission in the country, the National Primary Health Care Development Agency (2013) recently submitted that the population immunity is frail, with a real risk of re-infection of states that have not reported any cases previously. Re-infection of these states would be a great setback to the progress being made and the country may fail to achieve interruption of polio transmission in the year 2014 and beyond (National Primary Health Care Development Agency, 2013).

In the United States of America where the last dramatic epidemic of polio occurred over 40 years ago, poliomyelitis still remains the second leading cause of paralysis after stroke (Bartels and Omura, 2005). Survivors of the past polio epidemics now face multiple health challenges associated with age and lifestyle (Bartels and Omura, 2005). The prevention of the new health risks of aging with polio and other long-term disabilities has thus become a major public health objective of the 21st century in the United States of America (Healthy People, 2010). With the ongoing polio endemicity in Nigeria, it appears that poliomyelitis will remain a subject of concern in the health sector for many years to come, even long after its successful eradication. It is imperative therefore; to consider strategies to promote the health of polio survivors in Nigeria and update available treatment options for their optimal care.

Many victims of past polio epidemics live with severe consequences of a lifelong paralysis and studies have documented various health challenges faced by them (Campbell, 1998; Stuiflbergen, 2005; Rimmer et al, 2007; Tersteeg, 2011; Ramachandran et al, 2013). Between 25% and 80% of them are at risk for the occurrence of certain physiological changes in their nervous system, which result in a characteristic set of symptoms, known as Post Polio Syndrome. This occurs after many years of neurologic and functional stability (Halstead, 1991; Halstead and Gawne, 1993; Birk, 2003; Howard, 2005; King, 2008). Polio survivors are also predisposed to chronic and non-communicable diseases associated with age and lifestyle. The significance of post-polio syndrome, lifestyle, and age-related chronic diseases lies in their potential to accelerate the aging process and produce secondary disabilities (Lollar, 1994; Ringaret and Watters, 2005; Forman et al, 2009). Consequently, a high prevalence of cardiovascular, pulmonary, endocrine and metabolic diseases as well as diseases of the locomotive apparatus have been documented among polio survivors (Gawne et al, 2003; Nielsen et al, 2004; Mohammad et al, 2009; Chang et al, 2011; Kang and Lin, 2011). Bicnik and Kennedy (2002) also identified a range of depressive symptoms among them.

Recently, polio was identified as a significant risk factor for stroke, independent of hypertension, diabetes mellitus, hyperlipidemia and cardiac diseases (Wu, 2012), and the length of years of polio disability is reportedly much of a risk factor as chronological age (Postpolio Health, 2002). Conditions that have been noted to occur at frequencies greater than 50% among polio survivors are hypertension, depression, scoliosis, and related back conditions (Field and Jette, 2007). Thus, the prevention and management of secondary health conditions is a critical health maintenance goal for this population (Rimmer, 2005; Stuifbergen, 2005).

Despite the growth in health promotion programmes for apparently healthy individuals, very little effort has been devoted to developing programmes for people with physical and cognitive disabilities (Rimmer and Braddock, 2002, Smeltzer, 2013). The public health community has traditionally paid little attention to the health needs of people with physical disabilities, though recent activities mark a shift toward engaging the health concerns of this large and growing population (Lollar, 2002). Anyaele (2012) submitted that lack of access to quality health care, poor nutrition, insurgency in the North, road traffic accidents and polio account for a growing number of people with disabilities in Nigeria. However, health promotion programmes for this growing population have not gained ground, or become adequately integrated in Nigeria. Specifically, COMPASS (2008), submitted that polio survivors in Nigeria have been shunned and marginalized for generations. Health promotion programmes for this population may however, help prevent or ameliorate secondary health conditions or co-morbidities and help improve their overall quality of life (Rimmer, 1999; Stuifbergen, 2005). Silver and Gawne (2004), opined that effective control of co-morbidities and optimization of lifestyle related to health and wellness must be included in the principles of care for polio survivors. While the underlying mobility disability may not be reversible, their general mental, physical and cognitive health can be improved (Rosenberg, 2011).

Exercise has been identified as a single intervention with great promise of reducing the risk of virtually all chronic diseases simultaneously (Booth et al, 2000). Its therapeutic and

preventive roles in maintaining good health and treating or preventing diseases is well established (Agarwal, 2012). Exercise beneficially affects the human body in a multifactorial manner (Booth et al, 2000) and aerobic exercise in particular has been associated with various health benefits including lower mortality rates from cardiac risk factors, improved cardio-respiratory fitness, optimal weight management and enhanced psychological well-being (O'Toole, 2002). The primary technique for improving cardiopulmonary endurance has been aerobic exercise (Birk and Nieshoff, 2003); hence, aerobic exercise training is widely employed for health promotion purposes.

Indications for exercise and cardiopulmonary training extend to polio survivors (Hamzat, 2000); but their use poses particular challenges, given their associated skeletal muscle impairment. With the motor loss of the lower limbs following injury or disease, upper extremity exercise is a logical choice for improving cardiovascular fitness and health. Consequently, for individuals with lower limb paralysis, aerobic training can be achieved by participating in modified wheel-chair aerobics; arm or upper body ergometry (i.e., bicycle pedalling with the upper extremity (or arm cranking); or wheelchair ergometry (pushing a wheel-chair on a treadmill or stationary rollers) (Lockette and Keyes, 1994, Rimmer, 2005). It is however established, that there are differences in physiological responses to upper and lower body submaximal and maximal aerobic exercise (Mayo et al, 2001).

Upper-limb exercise induces a greater cardiovascular stress for a given level of submaximal work than lower-limb exercise (Astrand and Rodhal, 1986; Mayo et al, 2001). Several possible explanations for the greater cardiovascular stress include smaller muscle mass involvement, decreased venous return to the heart, greater neural stimulation and an increased static component imposed during upper body exercise (Boileau et al, 1984; Eston and Brodie, 1986; Pivarnik et al, 1988; Toner et al, 1990; Miller, 1994). Research has demonstrated that for a given submaximal power output, arm exercise produces increased systolic and diastolic blood pressure, heart rate, total peripheral resistance, decreased stroke volume, and either a similar or decreased cardiac output (Astrand and

Rodahl, 1986; Miles et al., 1989). Stroke volume is usually less during upper-body exercise because of the absence of the skeletal muscle pump augmenting venous return from the lower limbs, while a greater sympathetic stimulation associated with upper-body exercise accounts for the elevated heart rate seen. Greater sympathetic stimulation also partly accounts for the increased blood pressure and total peripheral resistance associated with upper limb exercise (Mayo et al, 2001). The practical implication of this is that a lower training workload is usually appropriate to induce physiological responses with upper limb aerobic exercises and regular monitoring of untoward reactions is highly essential (Miller, 1994).

Arm or upper limb ergometry has been shown to be an effective mode of aerobic training for both apparently healthy and physically-challenged individuals; however, relatively few studies are available (DiCarlo et al, 1983; LeMura and Von-Duvillard, 2004) and polio survivors are rarely involved in such studies. There is therefore a dearth of literature on the impact of arm ergometry training on the health indices of polio survivors. The infrequence or rarity of formal aerobic conditioning programmes for individuals with lower limb paralysis in Nigeria, and limited research on the effectiveness of arm ergometry for aerobic conditioning purposes, may account for its poor utilization and conspicuous absence of arm ergometers in many clinics and fitness centers in Nigeria. With the present challenge of on-going polio virus transmission in Nigeria, measures to reduce attendant health complications and optimize the health of past and prospective polio survivors merit particular attention. This study was therefore designed to determine the effect of a twelve-week sub-maximal arm ergometry (a form of aerobic exercise) on selected health indices of lower limb paralytic poliomyelitis survivors in Ibadan, Oyo state, Nigeria.

1.2 Statement of Problem:

Aerobic exercise has proven useful for health-promotion and reduction of secondary health conditions because of its associated health benefits. However, in Nigeria, health promotion programmes are almost restricted to individuals without disabilities.

Consequently, there is a dearth of literature on the impact of aerobic training on the health of Nigerian polio survivors. Considering the on-going polio endemicity in Nigeria vis-à-vis the health burden associated with polio, the use of aerobic exercise to promote the health of this underserved population is imperative. However, arm ergometry, one of the suitable forms of aerobic exercise for this population is grossly under-utilized in clinical research. As a result, its effects on the health of polio survivors have not been adequately explored. Specifically, randomized clinical trials investigating the effect of sub-maximal arm ergometry on the health indices (general health, depressive symptoms, blood pressure, resting heart rate, percent body fat, cardio-respiratory fitness, and health-related quality of life) of Nigerian polio survivors are not available for referencing. Bearing in mind that some of these selected health indices are predictive factors of cardiovascular health, it is crucial therefore to explore the effects of various clinical interventions on these important health variables. This study therefore specifically sought answer to the question: What would be the effects of a 12-week, sub-maximal arm ergometry on selected health indices of lower limb paralytic poliomyelitis survivors with secondary health conditions in Ibadan, Oyo State, Nigeria?

1.3 Aim of Study:

This study was aimed at investigating the effects of a twelve-week, sub-maximal arm ergometry on selected health indices (general health, depressive symptoms, systolic blood pressure, diastolic blood pressure, resting heart rate, cardio- respiratory fitness, percent body fat, and health-related quality of life) of lower limb paralytic poliomyelitis survivors in Ibadan, Oyo State, Nigeria.

1.4. Hypotheses:

1.4.1. Major hypotheses:

1. There would be no significant difference in the general health, depressive symptoms, blood pressure, resting heart rate, selected indices of health-related fitness (cardio-pulmonary fitness and percent fat) and health-related quality of life scores of polio survivors in Ibadan, before and after a twelve-week arm ergometry training.

2. There would be no significant difference between the general health, depressive symptoms, blood pressure, resting heart rate, selected indices of health-related fitness, and health-related quality of life scores of experimental and control groups at weeks 0 (baseline), 4, 8 and 12 of the exercise training programme.

1.4.2. Sub Hypotheses:

1. There would be no significant difference in the experimental group's daily activities domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
2. There would be no significant difference in the control group's daily activities domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
3. There would be no significant difference in the experimental group's feelings domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
4. There would be no significant difference in the control group's feelings domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
5. There would be no significant difference in the experimental group's social activities domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
6. There would be no significant difference in the control group's social activities domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
7. There would be no significant difference in the experimental group's pain domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
8. There would be no significant difference in the control group's pain domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
9. There would be no significant difference in the experimental group's change-in-

health domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.

10. There would be no significant difference in the control group's change-in-health domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
11. There would be no significant difference in the experimental group's overall health domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
12. There would be no significant difference in the control group's overall health domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
13. There would be no significant difference in the experimental group's social support domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
14. There would be no significant difference in the control group's social support domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
15. There would be no significant difference in the experimental group's quality of life domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
16. There would be no significant difference in the control group's quality of life domain score of general health, on the Dartmouth COOP Chart across week 0 (baseline), 4, 8 and 12 of the study.
17. There would be no significant difference in the Beck Depression Inventory scores of the experimental group across week 0 (baseline), 4, 8 and 12 of the study.
18. There would be no significant difference in the Beck Depression Inventory scores of the control group across week 0 (baseline), 4, 8 and 12 of the study.
19. There would be no significant difference in the diastolic blood pressure of the experimental group across week 0 (baseline), 4, 8 and 12 of the study.
20. There would be no significant difference in the diastolic blood pressure of the

control group across week 0 (baseline), 4, 8 and 12 of the study.

21. There would be no significant difference in the systolic blood pressure of the experimental group across week 0 (baseline), 4, 8 and 12 of the study.
22. There would be no significant difference in the systolic blood pressure of the control group across week 0, 4, 8 and 12 of the study.
23. There would be no significant difference in the resting heart rate of the experimental group across week 0, 4, 8 and 12 of the study.
24. There would be no significant difference in the resting heart rate of the control group across week 0, 4, 8 and 12 of the study.
25. There would be no significant difference in the cardio-respiratory fitness scores of the experimental group across week 0, 4, 8 and 12 of the study.
26. There would be no significant difference in the cardio-respiratory fitness scores of the control group across week 0, 4, 8 and 12 of the study.
27. There would be no significant difference in the percent body fat of the experimental group across week 0, 4, 8 and 12 of the study.
28. There would be no significant difference in the percent body fat of the control group across week 0, 4, 8 and 12 of the study.
29. There would be no significant difference in the experimental group's health/functioning domain score of the Quality of life -- Multiple Sclerosis Version (QOL-MS), across week 0, 4, 8 and 12 of the study.
30. There would be no significant difference in the control group's health/functioning domain score of the Quality of life -- Multiple Sclerosis Version (QOL-MS), across week 0, 4, 8 and 12 of the study.
31. There would be no significant difference in the experimental group's social and economic domain score of the QOL-MS, across week 0, 4, 8 and 12 of the study.
32. There would be no significant difference in the control group's social and economic domain score of the QOL-MS, across week 0, 4, 8 and 12 of the study.
33. There would be no significant difference in the experimental group's psychological/spiritual domain score of the QOL-MS, across week 0, 4, 8 and 12 of the study.

34. There would be no significant difference in the control group's psychological/spiritual domain score of the QOL-MS, across week 0, 4, 8 and 12 of the study.
35. There would be no significant difference in the experimental group's family domain score of the QOL-MS, across week 0, 4, 8 and 12 of the study.
36. There would be no significant difference in the control group's family domain score of the QOL-MS, across week 0, 4, 8 and 12 of the study.
37. There would be no significant difference in the experimental group's overall health-related quality of life scores of the QOL-MS, across week 0, 4, 8 and 12 of the study.
38. There would be no significant difference in the control group's overall health-related quality of life scores of the QOL-MS, across week 0, 4, 8 and 12 of the study.
39. There would be no significant difference between the general health scores of the experimental and control groups at the time frames of week 0/week4, week4/week8, week0/week8, week4/week12, week8/week12 and week0/week12 in each of the eight Dartmouth COOP Chart domains.
40. There would be no significant difference between the Beck Depression Inventory scores of the experimental and control groups at the time frames of week 0/week4, week4/week8, week8/week12, week0/week8, week0/week12, week4/week12 of the study.
41. There would be no significant difference between the diastolic blood pressure of the experimental and control groups at the time frames of week 0/week4, week4/week8, week8/week12, week0/week8, week0/week12, week4/week12 of the study.
42. There would be no significant difference between the systolic blood pressure of the experimental and control groups at the time frames of week 0/week4, week4/week8, week8/week12, week0/week8, week0/week12, week4/week12 of the study.
43. There would be no significant difference between the resting heart rate of the

experimental and control groups at the time frames of week 0/week4, week4/week8, week8/week12, week0/week8, week0/week12, week4/week12 of the study.

44. There would be no significant difference between the cardio-respiratory fitness scores of the experimental and control groups at the time frames of week 0/week4, week4/week8, week8/week12, week0/week8, week0/week12, week4/week12 of the study.
45. There would be no significant difference between the percent body fat of the experimental and control groups at the time frames of week 0/week4, week4/week8, week8/week12, week0/week8, week0/week12, week4/week12 of the study.
46. There would be no significant difference between the health-related quality of life scores of the experimental and control groups at the time frames of week 0/week4, week4/week8, week8/week12, week0/week8, week0/week12, week4/week12 in each of the four domains on Quality of life-Multiple Sclerosis Version

1.5. Delimitation:

This study was delimited as follows:

i. Participants: Participants were adult paralytic poliomyelitis survivors with lower limb affectation alone, who were randomly selected from a larger pool of polio survivors who earlier participated in a cross-sectional survey to assess their secondary health conditions and co-morbidities.

ii. Participants were recruited from:

1. Four institutions for the physically-challenged individuals which were:
   a. Cheshire Home-School, Ijokodo, Ibadan.
   b. Moniya Disability Rehabilitation Centre, Ibadan,
   c. Sekinat Adekola Home-School for the Handicapped, Challenge, Ibadan
   d. W.O. Lawal School for the Handicapped, Ring Road, Ibadan, and,
2. Eleven local government centres in Ibadan, where weekly meetings of the Association of Persons with Physical Challenge are held. They were:

(a) Egbeda LG

(b) Lagelu LG

(c) Ibadan North-east LG

(d) Ibadan South-east LG

(e) Ido LG

(f) Ibadan North LG

(g) Ona Ara LG

(h) Ibadan North-west LG

(i) Ibadan South LG

(j) Oluyole LG and

(k) Akinyele LG.

iii. Variables: The measured variables in this study were delimited to:

a) General health

b) Depressive symptoms

c) Indices of Health-related fitness which included cardio-respiratory fitness and body composition [percent body fat and body mass index (BMI)]

d) Health-related Quality of life

e) Blood pressure

f) Heart rate

g) Secondary conditions and co-morbidities which polio survivors are readily susceptible to e.g overweight/obesity, depression, etc.

iv. Instruments: The instruments used included:

a) Dartmouth COOP Chart System (1989) (APPENDIX E) to assess general health.

b) Beck Depression Inventory (Beck et al., 1961) (APPENDIX F) to assess depressive symptoms.

c) Omron fat monitor (Omron BF 302, Europe) to assess percent body fat.

d) Tilt table to assist participants who could not independently stand, to assume the standing posture while assessing their percent body fat.

e) Quality of Life Index-Multiple Sclerosis (QLI-MS) Version (Ferrans andPowers, 1985) (APPENDIX G) to assess health-related quality of life.

f) Secondary Conditions Questionnaire (Tate, 1996) (APPENDIX H) to assess secondary conditions and co-morbidities which polio survivors are readily susceptible to e.g overweight/obesity, depression, etc.

g) Borg's Rate of Perceived Exertion Scale (Borg, 1982) (APPENDIX I) to assess rate of perceived exertion.

h) Weighing scale (Camry, China) to measure weight.

i) Non-elastic tape measure to measure participants' supine length (proxy for standing height) (Rimmer et al, 2010).

j) Sphygmomanometer (Omron MX2 Basic Digital Automatic Blood Pressure and heart rate Monitor, Japan) to measure diastolic and systolic blood pressure and heart rate.

k) Arm Ergometer (Physio trainer, Taiwan) for upper extremity aerobic training exercises.

l) Wooden table of variable height for mounting the arm ergometer.

v. Assessment of cardio-respiratory fitness: The Six-Minute Walk Test (6MWT) (Lipkin, 1986) was used to assess cardio-respiratory fitness.

1.6. Inclusion criteria:

Polio survivors must:

a) Have lower limb affectation only,

b) Be able to communicate in either English or Yoruba language,

c) Have no visual or hearing impairment,

d) Be either independently ambulant or ambulant with assistive devices,

e) Have no past or present medical history suggestive of upper extremity entrapment neuropathies and able to effectively use their upper limbs.

f) Agree not to participate in any other exercise programme during the twelve-week exercise training programme.

1.7. Exclusion criteria

The following categories of polio survivors were excluded from the study:

1. Polio survivors who had persistent, severe pains and could not participate effectively in an exercise training programme.
2. Polio survivors who had clinical evidence of respiratory insufficiencies
3. Polio survivors who had bilateral hamstring contractures which limited full extension of their knee joints and whose height could hence not be accurately ascertained for proper body mass index (BMI) calculation.

1.8. Limitations:

1. Diagnosis of polio for recruitment of survivors into the study: In the absence of clinical reports or laboratory-conducted viral studies confirming polio in the acute phase of the infection, the past medical history and objective assessment of participants' muscles were relied upon to infer polio before recruitment into the study. LaForce et al (1980) earlier opined that a diagnosis of polio can be made with a high degree of confidence, in the presence of flaccid paralysis with atrophy, where there is no decrease in sensation and a history of acute onset without progression
2. Non-availability of polio-specific scales for measuring health status, depression and quality of life: There are no polio-specific outcome measures to assess the general health, symptoms of depression and quality of life of polio survivors; hence, generic outcome measures were used in this study. However, the instrument used to assess the quality of life (QoL Multiple Sclerosis Version, Fermans and Powels, 1985) has been reviewed in a previous study by a panel of experts which included a polio survivor and all items were found to be relevant to QoL in persons with poliomyelitis (Stuifbergen, 2005). It has been found to be valid in previous studies conducted on polio survivors (Harrison and Stuifbergen, 2006).

3. Non-uniformity of exercise training venue: Participants' work places or homes were used as venue for the arm ergometry training programme, as participants were unwilling to leave work for twelve consecutive weeks. This could have had dissimilar effects on individual exercise responses.
4. Differences in the distance employed for the six-minute walk test (6MWT): The available space in each environment where the 6MWT took place determined the length of the distance used to carry out the test. The researcher however ensured that the distance used for each participant was the same all through the assessment period.

1.9. Significance of Study:

1. This study has provided scientific information on the beneficial effects of aerobic exercise on the health of Nigerian polio survivors. This may inform the need to establish specialized gymnasia for individuals with physical challenges in Oyo State and Nigeria at large. The scientific information provided in this study include the following:

   i) Lower limb paralytic poliomyelitis survivors with secondary health conditions could improve their cardio-respiratory fitness, blood pressure, resting heart rate and percent body fat through a carefully monitored, individualized and well-planned arm ergometry training programme.

   ii) Arm ergometry could be adopted as an integral part of an overall rehabilitation programme of lower limb paralytic poliomyelitis survivors in Nigeria for health-promotion purposes.
2. The findings of this study could form a baseline for related researches in Nigeria as studies on the polio population in Nigeria (and other parts of the world) are still very few.

1.10. Definition of operational terms:

a) Polio Survivors: These are individuals who have residual flaccid paresis or paralysis of muscles due to previous infection by the polio virus. They have however, recovered from the acute infection, having attained their peak recovery and are relatively stable in the community.

b) Adult: This is an individual who is 25years of age and above, and is culturally ripe to earn a livelihood and consent to marriage.

CHAPTER TWO

LITERATURE REVIEW

2.1. POLIOMYELITIS

2.1.1. Definition

The term 'poliomyelitis' is derived from three Greek words, namely: *polios* (gray matter), *myelos* (spinal cord), and *itis* (inflammation), meaning inflammation of the gray matter; the tissue most commonly affected in the spinal cord by the disease, which leads to its classic manifestations of paralysis (Neumann, 2004; King, 2008). The shortened term *polio* is commonly used and the disease was originally referred to as *infantile paralysis*, based on its propensity to infect the paediatric population. A name, which, although appropriate in the early days of the epidemic, inaccurately reflected the true demographics of the disease, as adults were also infected (Neumann, 2004). It is an acute viral disease that infects the anterior horn cells of the spinal cord and the motor neurons of the lower brain stem resulting in flaccid paresis or paralysis of one or more muscles (Pallansch and Jafari, 2006; Koopman et al, 2010). Usually, there is partial and sometimes complete recovery from the self-terminating disease (Koopman et al, 2010).

Although records from antiquity mention crippling diseases compatible with poliomyelitis, its first clinical description was provided by a physician, Michael Underwood from Britain in 1789, where he referred to polio as a debility of the lower extremities. It was however first recognized as a distinct condition by Jakob Heine in 1840, while its causative agent, poliovirus, was identified in 1908 by Karl Landsteiner (Paul, 1971). The first polio epidemic occurred in Sweden in 1887. The epidemic peaked in 1952, and during the middle decades of the twentieth century, polio became the most-feared disease of childhood and adolescence because of the crippling paralysis that was typically characteristic of the disease (Wilson, 2005; Weiler et al, 2009).

It has a worldwide distribution with the peak season being from July to September and the concentration being in the tropical areas of the Northern Hemisphere. It has no racial predilection, and its male-to-female ratio is 1:1(Weiler et al. 2009). Between 1840 and the 1950s, it was a worldwide epidemic. During the latter part of the twentieth century, it was practically eliminated from the Western hemisphere and since the development of polio vaccines, its incidence has greatly reduced. Nigeria, Pakistan and Afghanistan are the only remaining polio-endemic countries as at February, 2014, though Angola, Chad, and the Democratic Republic of the Congo recently experienced reestablished transmission of the poliovirus (WHO Factsheet, 2014).

2.1.2 Causative organism

Poliomyelitis is caused by small RNA viruses of the enterovirus group of the Picornavirus family (Vidyadhara, 2012). Three antigenically distinct strains of the virus are known, which are defined by the configuration of their capsid proteins which include: Type 1 (also known as Brunhilde), Type 2 (Lansing), and Type 3 (Leon) (King, 2008; Vidyadhara, 2012). All three are extremely virulent and produce the same disease symptoms (Ryan and Ray, 2004). Immunity from exposure to one poliovirus strain does not confer immunity against the other strains (Kew et al, 2005), thus, theoretically, a person could be infected more than once (Gawne and Halstead, 1995); though, immunity to each of the 3 strains is lifelong (Vidyadhara, 2012). Nearly all epidemics are due to type 1, whereas types 2 and 3 are more often isolated in vaccine-associated poliomyelitis. Chimpanzees, Rhesus monkeys and cynomolgus monkeys (syn. *Macacafascicularis*) can be infected orally and suffer paralysis as a result, but in practice, man is the only reservoir of the polio virus (Neumann, 2004). The virus is rapidly inactivated by heat, formaldehyde, chlorine, and ultraviolet light. It is neurotropic.

2.1.3 Pathophysiology

Poliovirus enters the body by oral ingestion, then replicates in the lymphoid tissue of the pharynx and ileum and spreads regionally to lymphoid tissue (Gawne and Halstead, 1995; Howard, 2005). On the cell membrane, it attaches itself to a specific protein; human poliovirus receptor (CD155). This protein belongs to the immunoglobulin superfamily and occurs in several tissues (brain, spinal cord,

kidneys, heart). However, some cells that express the receptor appear not to suffer any adverse effect, probably because one of the subsequent stages in the intracellular replication of the poliovirus is blocked (Wood, 2004). The response to poliovirus infection is highly variable, ranging from asymptomatic to symptomatic infective stages, and the disease is categorized based on the severity of its clinical presentations (Neumann, 2004).

2.1.4. Forms of Polio Disease

a) Sub-clinical Polio:

Up to 95% of all polio infections are inapparent or subclinical. In this form, the victim is unaware of the infection because no physical signs or symptoms of the disease is produced (Birk and Nieshoff, 2003). Infected persons without symptoms however shed the poliovirus in their stool and are able to transmit the virus to others (Neumann, 2004).

b) Abortive poliomyelitis: Approximately 4%–8% of polio infections consists of a minor, nonspecific illness without clinical or laboratory evidence of central nervous system invasion. It is usually a mild form of the disease characterized by complete recovery in less than a week (lasts only from hours to a few days). Three syndromes observed with this form of poliovirus infection are upper respiratory tract infection (sore throat and fever), gastrointestinal disturbances (nausea, vomiting, abdominal pain, constipation or, rarely, diarrhea), and influenza-like illness. The syndromes are indistinguishable from other viral illnesses (Birk and Nieshoff, 2003). In more than 95% of cases, the disease does not progress. No physical or skeletal muscle problems other than the short-lived symptoms are reported. Sometimes however, the virus may invade the nervous system and cause more severe forms of the disease (Aisen and Selzer, 1998; Birk and Nieshoff, 2003; King, 2008).

c) Non-paralytic poliomyelitis: This form occurs in about 1%–2% of polio infections. It typically produces aseptic meningitis (symptoms of stiffness of the neck, back, and/or legs) usually following several days after a prodrome similar to that of minor illness. Muscle paralysis and weakness occur early in the course of the disease and may also recur many years after acute infection (Birk and Nieshoff, 2003). As with abortive poliomyelitis, symptoms from non-paralytic polio usually subside within a

few days (lasting from 2 to 10 days), followed by complete recovery. No permanent damage is caused (Aisen and Selzer, 1998; King, 2008).

d) Paralytic poliomyelitis: In about 1 - 2% of cases, a more disabling form of the disease occurs. In this form, the virus invades the CNS, causing temporary damage or permanent destruction of the cells. Neurological and functional loss occurs as anterior horn cells are lost, and thus, the muscle fibres innervated by them are "orphaned." Paralytic symptoms generally begin 1 to 10 days after prodromal symptoms and progress for 2 to 3 days (Atkinson et al, 2007). The prodromal signs and symptoms include fever, a loss of superficial reflexes, initially increased deep tendon reflexes and severe muscle aches and spasms in the limbs or back. The illness progresses to flaccid paralysis with diminished deep tendon reflexes and reaches a plateau without change for days to weeks. It is usually asymmetrical (Birk and Nicshoff, 2003). Recovery begins in weeks and reaches a plateau in 6 to 8 months (Gawne and Halstead, 1995). Further modest return in muscle strength is possible up to 12 to 18 months after infection (Neumann, 2004). The extent of neurological and functional recovery is determined by: (1) the number of motor neurons that recover and resume their normal function, (2) the number of motor neurons that develop terminal axon sprouts to reinnervate muscle fibers left orphaned by the death of their original motor neurons, and (3) muscle hypertrophy (Gawne and Halstead, 1995; Atkinson et al, 2007).

The phenomenon of terminal axon sprouting makes it possible for an uninvolved or recovered motor neuron to "adopt" orphaned muscle fibers. Normally, a single healthy motor unit may innervate 500 to 1000 muscle fibres. Following axonal sprouting, this same motor unit may compensate by innervating 5000 to 10000 muscle fibres (Neumann, 2004). As a result, the survivors of acute poliomyelitis may be left with a few, significantly enlarged motor units doing the work previously performed by many units (Atkinson et al, 2007). In addition to this reinnervation, the remaining muscle fibers hypertrophy to increase the strength of the muscle group. Because this mechanism of neuro-physiological compensation is so effective, a muscle can retain normal strength even after 50% of the original motor neurons have been lost. Therefore, in some patients, Manual Muscle Testing (MMT) may be normal even when more than half the original anterior horn cells are destroyed (Grimby et al, 1989).

However, these "giant" motor neurons may fail over time due to their increased metabolic demand (Neumann, 2004).

Any limb or combination of limbs may be affected, but in children below 5 years of age, paralysis of one lower limb is most common (Aisen and Selzer, 1998; King, 2008). In adults, quadriplegia is more commonly seen, while in some cases, respiratory muscles are affected, thus necessitating the use of an artificial respirator. Depending on the site of paralysis, paralytic poliomyelitis is classified as spinal, bulbar, or bulbospinal (Wood et al. 2005).

i) Spinal polio: This results from viral invasion of the motor neurons of the anterior horn cells or the ventral gray matter in the spinal column. It causes inflammation of the nerve cells and consequent damage or destruction of the motor neuron ganglia. Wallerian degeneration of the affected spinal neurons ensues, leading to paralysis or paresis of muscles supplied by them (Cono and Alexander, 2002). It is the most common form, and during 1969–1979 epidemics, it accounted for 79% of paralytic cases, characterized by asymmetric paralysis that most often involves the lower limbs.

ii) **Bulbar polio:** This occurs when poliovirus invades and destroys nerves within the bulbar region of the brain stem (Atkinson et al, 2007) leading to weakness of muscles innervated by cranial nerves. Critical nerves affected are the glossopharyngeal nerve, the vagus nerve, the accessory nerve, the trigeminal nerve and the facial nerve (Silverstein et al, 2001). It accounted for 2% of cases during the 1969-1979 polio epidemics. Sometimes, the virus affects the brain stem, with resultant death (Wood, 2004).

iii) **Bulbospinal polio**: This is a combination of bulbar and spinal paralysis, also called respiratory polio (Atkinson et al, 2007). It affects the upper part of the cervical spinal cord (C3 through C5). Paralysis of the diaphgram occurs due to affectation of the phrenic nerve. It can also lead to paralysis of the limbs and may affect swallowing and heart functions (Hoyt et al., 2005). It accounted for 19% of cases during 1969-1979 epidemics (Wood, 2004). The death-to-case ratio for paralytic polio is generally 2%–5% among children and up to 15%–30% for adults (depending on age). It increases to 25%–75% with bulbar involvement.

Factors that increase the risk of polio infection or affect the severity of the disease include: immune deficiency, malnutrition, intramuscular injections, pregnancy, old age, localized trauma, such as a recent tonsillectomy, tooth extraction, or inoculations, and unusual physical exertion during the minor illness (Howard, 2005; Springhouse, 2005).

2.1.5. Prevention of polio infection

There is no cure for polio; however, the infection is preventable (King, 2008). The attempt to eradicate the disease represents one of the great medical success stories of modern times, following the introduction of polio vaccines in the 1950s. The two types of polio vaccines in use are:

a) Injectable polio vaccine (IPV): This was the first successful vaccine against polio. It was developed in the United States of America in 1954 by Dr Jonas Salk (King, 2008). The viruses are grown in a type of monkey kidney tissue culture (Vero cell line) and inactivated with formaldehyde. It contains 2-phenoxyethanol as a preservative, and trace amounts of neomycin, streptomycin, and polymyxin B. It is an injectable vaccine, supplied in a single-dose prefilled syringe and administered by either subcutaneous or intramuscular injection, hence, requires the service of trained medical personnel.

IPV produces antibodies in the blood which halt the circulation of poliovirus to the nervous system, thereby conferring a high degree of immunity on individuals. The only significant side effect of IPV is very rare reaction occurring in persons who are allergic to the antibiotics used in the vaccine-production. Once separated from the formaldehyde, the treated virus can no longer produce serious infection, but retains enough of its molecular character to stimulate the immune system to recognize and neutralize the virus, thus building future immunity against the virus. Various forms of this inactivated polio vaccine, administered by injection, have been used since the mid-1950s (Aisen and Selzer, 1998; Wood, 2004; King, 2008).

b) Oral polio vaccine (OPV): Trivalent OPV contains live attenuated strains of all three serotypes of poliovirus in a 10:1:3 ratio. The vaccine viruses are grown in monkey kidney tissue culture (Vero cell line). The vaccine contains trace amounts of neomycin and streptomycin, but does not contain a preservative and it is usually supplied as a single 0.5-mL dose in a plastic dispenser. It has gained wider use, almost

entirely replacing the injected form because of the ease of administration, particularly in remote areas which may lack trained medical personnel. Using live poliovirus in the oral polio vaccine however, could pose a risk, since there is a chance that a dosage may contain improperly weakened virus which is capable of causing a paralytic infection (Wood, 2004).

The mechanism of Vaccine Associated Paralytic Polio (VAPP) is believed to be a mutation, or reversion, of the vaccine virus to a more neurotropic form. Reversion is believed to occur in almost all vaccine recipients, but it only rarely results in paralytic disease. The paralysis that results is identical to that caused by wild virus, and may be permanent. Inactivated poliovirus vaccine does not contain live virus, hence, cannot cause Vaccine Associated Paralytic Polio (CDC, 2005). Infection or vaccination with one serotype of poliovirus does not confer immunity against the other serotypes and full immunity requires exposure to each serotype (Kew et al, 2005).

2.1.6. Polio eradication strategy

Global polio eradication represents one of the largest and most significant public health efforts under way (Thompson, 2007). The international community founded the Global Polio Eradication Initiative (GPEI) in 1988. Several well known organizations, including Rotary International, collaborated to spend billions of dollars on the eradication effort and polio vaccination. The GPEI's Independent Monitoring Board considers Nigeria and Pakistan to be the greatest challenges for eradicating polio (WHO 2014 Factsheet).

The WHO recommends the following strategies for the eradication of polio:

a) Attaining high routine coverage (at least 80%) with at least 3 doses of Oral Polio Vaccine (OPV),

b) Providing Oral Polio Vaccine (OPV) to children 0 – 59 months during National Immunization Days (NIDS),

c) Implementing Acute Flaccid Paralysis (AFP) Surveillance,

d) Conducting mop-up immunization when polio is reduced to focal transmission

2.1.7 Polio diagnosis and treatment

Paralytic poliomyelitis may be clinically suspected in individuals experiencing acute onset of flaccid paralysis in one or more limbs with decreased or absent tendon reflexes in the affected limbs, which cannot be attributed to another apparent cause, and without sensory or cognitive loss (CDC, 1997, Atkinson et al, 2007). A laboratory diagnosis is usually made by isolating the virus from an infected person using throat cultures, stool or CSF samples. Blood tests which indicate the presence of antibodies specific for the virus will also confirm a poliovirus infection (Atkinson et al, 2007). Once an individual is infected by the poliovirus, no drug or other medical treatment can halt its destructive potentials in the body. However, several medical treatments can lessen the severity of the disease. Mild cases of polio do not require specific treatment. For the more serious cases of paralytic polio, rest, in some cases, minimize the severity of paralysis (Howard, 2005). Initial treatment will consist of immediate hospitalization and strict bed rest. Antispasmodic drugs are beneficial for patients who suffer involuntary muscle contractions resulting from neural damage (King. 2008). If respiratory difficulty occurs, a ventilator will be required (Neumann, 2004). Once the high fever and other symptoms of polio's most severe stage have passed, patients who are disabled by paralysis receive physiotherapy. Physiotherapy is aimed at preventing joint stiffness and contractures, minimizing atrophy, and building muscle strength. Patients may also learn the use of braces, crutches, and other assistive devices which provide additional support and aid mobility (Wood, 2004; Atkinson et al, 2007; King, 2008).

2.1.8. Prognosis

Patients with abortive polio infections recover completely. In those that develop only aseptic meningitis, the symptoms can persist for two to ten days, followed by complete recovery (Neumann, 2004). In cases of spinal polio, if the affected nerve cells are completely destroyed, paralysis will be permanent; cells that are not destroyed but lose function temporarily may recover within four to six weeks after onset (Neumann, 2004). Half the patients with spinal polio recover fully, one quarter are left with severe disability (Cucurrullo, 2004). The degree of both acute paralysis and residual paralysis is likely to be proportional to the degree of immunity (Mueller et al., 2005). Spinal polio is rarely fatal (Silverstein et al., 2001), but bulbar polio often causes death if

respiratory support is not provided (Hoyt et al., 2005), with support, its mortality rate ranges from 25 to 75%, depending on the age of the patient (Neumann, 2004; Atkinson et al., 2007).

2.2 SECONDARY COMPLICATIONS OF POLIO

Muscle paresis and paralysis associated with polio can result in skeletal deformities, joint stiffness, contractures, limb-length discrepancy and movement disability. Osteoporosis and increased likelihood of bone fractures may occur. Extended use of braces or wheelchairs may cause compression neuropathy, as well as a loss of proper function of the lower limb veins (vasoparesis) due to pooling of blood in the paralysed extremities (Hoyt et al., 2005). Complications from prolonged immobility involving the lungs, kidneys and heart include pulmonary oedema, aspiration pneumonia, urinary tract infections, kidney stones, paralytic ileus, myocarditis and cor pulmonale (Hoyt et al., 2005). Some years after acute polio infection, about 25 to 80% of polio survivors may experience Post Polio Syndrome after neurological and functional stability (Halstead and Gawne, 1993; King, 2008). In Western countries where the large epidemics date back to the 1940s and 1950s, many polio survivors are now experiencing progressive complaints related to Post Polio Syndrome (Koopman et al, 2010).

2.2.1. Post Polio Syndrome

Historically, polio has been divided into three fairly distinct stages: acute illness, period of recovery, and stable disability. By the mid-1980s, however, clinicians and researchers began to realize there was a distinct fourth stage characterized by the onset of new symptoms related to the original polio attack. This stage has been described by various terms, including the late effects of polio, post-polio sequelae, post-polio progressive muscular atrophy, post-polio muscle dysfunction, and, commonly, post-polio syndrome (Halstead, 2004). The development of post-polio syndrome questions the concept of polio as a static disease. It poses a challenge not only to health profession, but also to policy makers tasked with providing the necessary health care measures and appropriate resources (Bouza et al, 2005). The evaluation of post-polio individuals with new health problems presents a challenge because of the general nature of many of the symptoms and the absence of special diagnostic tests. This

challenge is further complicated by the continuing uncertainty of the underlying cause and the lack of any medication or treatment that might result in a cure (Halstead, 2004). The reported incidence is between 25% and 80% and it occurs thirty to forty years after the acute polio infection (Halstead and Gawne, 1993; King, 2008). Its origins are multi-factorial and can be associated with under-exertion, over-exertion, inactivity due to inter-current illness or injury, hypo-oxygenation, sleep apnea, deconditioning, and the failure of sprouted, compensatory large motor units (Owen, 1991; Birk, 2003; Lin and Lim, 2005). New weakness, unaccustomed fatigue (both generalized and muscular), poor endurance, pain, reduced mobility, increased breathing difficulty, intolerance to cold, and sleep disturbance in various degrees and expressions make up the syndrome (Owen, 1991; Halstead, 2004; Koopman et al, 2010). Pain from joint degeneration and increasing skeletal deformities such as scoliosis are also common (Atkinson, 2007).

2.2.1.1. Diagnosis of Post Polio Syndrome (PPS)

Post-polio syndrome is a diagnosis of exclusion that is based on a thorough history and physical examination (Halstead, 2004). It may be diagnosed in a patient if the following are found (Neumann, 2004; King, 2008):

i) Evidence of prior paralytic polio: via EMG, an appropriate history, or characteristic residual atrophy.

ii) Period of apparent stability before any new symptoms. New symptoms may often be seen after an illness or injury.

iii) Exclusion of other conditions (especially motor neuron diseases and overuse syndromes).

2.2.1.2. Clinical Symptoms of Post-polio Syndrome (PPS)

A statistical summary of the clinical characteristics of several series of PPS patients is as follows (King, 2008):

1). Fatigue, Pain, and Weakness: Fatigue (89%); pain in muscle or joint (86%); new weakness (83%) in previously symptomatic (69%) or asymptomatic (50%) muscles are almost always present. After the third decade, all healthy individuals lose both numbers of motor units and a degree of muscle strength as a part of the normal aging process. This will also occur for PPS patients, but they have a greater loss of both

strength and motor units (Grimby et al, 1989), and the clinical consequences may be greater than in healthy humans because more muscle fibers are denervated within one enlarged motor unit (Stalberg and Grimby, 1995, Bartels and Omura, 2005). The normal ageing process probably contributes to the loss of muscle strength, but does not explain all of the deterioration. In previously polio-affected muscles, Type I fibers dominate, and there is decreased capillary density and reduced oxidative capacity' (Borg and Henriksson, 1991; Grimby et al., 1989, Atkinson, 2007).

2). New Atrophy: About 28% have new atrophy. This equates to Post Polio Muscular Atrophy (PPMA).

3). Activities of daily living difficulties: About 78% of PPS patients have functional loss. Walking (64%); Climbing Stairs (61%); Dressing (17%) (King, 2008).

Additional presenting problems include:

1. Pulmonary dysfunction:

Adults normally experience a slow decline in breathing capacity, but for polio survivors, the decline occurs twice as fast (1.8% versus 1% per year) (Bach and Alba, 2001). Patients with PPS may suffer from weakness of the respiratory muscles which may occasionally cause symptoms of dyspnoea on exertion and even at rest, poor clearance of respiratory secretions which increase the risk of pneumonia, and elevations in the resting arterial carbon (IV) oxide (CO_2) level (King 2008). Nocturnal hypoxemia and hypercarbia may lead to worsening of daytime function of the respiratory muscles (King, 2008).

2. Sleep Disorders:

Patients with PPS have a high incidence of sleep disturbances with poor sleep quality and frequent awakenings which may be due to several factors such as nocturnal hypoxemia and hypercarbia (Halstead and Gawne, 1993; Harrison and Stuiffbergen, 2001; King, 2008).

3. Dysphagia:

Many PPS patients report difficulty with eating or swallowing, though this occurs more commonly in those with bulbar polio (Halstead and Gawne, 1993; King, 2008)

4. Cold intolerance:

Limbs may be cold and cold exposure produces weakness. This is thought to be due to intermediolateral column involvement resulting in vasoparesis, venous pooling, and excessive heat loss. 29% of PPS patients have this complaint (King, 2008).

5. Degenerative arthritis:

A joint that is biomechanically disadvantaged may develop degenerative arthritis (King, 2008).

6. Social and psychological problems:

Long term disability and denial may result in social and psychological problems (Halstead and Gawne, 1993; Bienik and Kennedy, 2002; King, 2008).

2.2.1.3. Management of post-polio syndrome

Measures to prevent or cure Post-Polio syndrome have not been found. However, studies indicate that standard healthy lifestyle practices, namely: a healthy dietary consumption, regular, well-controlled exercise regimen, and regular medical examination are beneficial to the health of polio survivors with PPS (HealthNewsFlash, 2002).

2.3. AGING AND ITS HEALTH IMPLICATIONS ON POLIO SURVIVORS

Aging with a permanent disability is a challenge for polio survivors (Harrison and Stuifbergen, 2006) and Campbell (1998) opined that nowhere are the changing demographics of disability more evident than for persons aging with the long-term effects of polio. The health needs of polio survivors increase as they age because they often have other disabilities due to natural aging and lifestyle (Bartels and Omura, 2005). While genetics, environment and behaviour contribute to significant variations in individual patterns of aging (Field and Jette, 2007); in polio, the patho-physiology of aging is consistent with neuronal loss and denervation lying at the heart of the developing disorder (Bartels and Omura, 2005). Aging and lifestyle-related health challenges create a problem of premature or accelerated aging for polio survivors (Ringaert and Watters, 2005) and as it is applicable to other persons who have acquired a disability early in life, age-related illnesses occur nt younger ages for them because they often have reduced reserve capacity in one or more organ systems (Kailes, 2008). Thus, as persons with disability begin to reach age 50, many show the kind of functional changes that would not be expected until age 70-75 in people without disabilities (Kailes, 2008).

The interaction between the natural aging process and disability creates a demanding physical environment for polio survivors as they age, and tasks that could be accomplished in younger adulthood become major barriers in middle and later adulthood (Rimmer, 2005). Participation in regular physical activity however, has been found to elicit a number of favourable responses that contribute to healthy aging, and also reduce a number of functional declines associated with aging (ACSM, 1998; Booth et al, 2000, WHO, 2014 factsheet). Field and Jette (2007) opined that public health and clinical interventions can help prevent the onset of illness or injury and associated physical or mental impairments, as well as minimize the development of atypical or premature aging among young adults with disabilities. Although no amount of physical activity can stop the aging process, a moderate amount of regular exercise can minimize the physiological effects of an otherwise sedentary lifestyle and increase active life expectancy by limiting the development and progression of chronic disease and disabling conditions (Chodzko-Zajko et al., 2009).

2.4. PHYSICAL INACTIVITY AND ITS HEALTH IMPLICATIONS ON POLIO SURVIVORS

The combination of the health risks associated with physical inactivity and obesity presents a serious health concern among people with disabilities (Rimmer and Rowland, 2008). Warms (2006) noted that people with disabilities report more inactivity than does the general population and participation in regular moderate and vigorous physical activity is also lower among them (Heath and Fentem, 1997; Rimmer et al, 2001; Rimmer and Rowland, 2008). Globally, people with disabilities are not meeting the basic recommendations for physical activity (Boslaugh and Andressen, 2006). This is particularly important because physical activity is beneficial for people with or without disability and it has been shown to improve quality of life and reduce functional impairment and secondary health conditions among people with disabilities (Hogan et al, 2000; Waldrop and Stern, 2000; Tudor-Locke and Myers, 2001). Polio survivors in particular are less able to lead an active lifestyle and are therefore more prone to certain types of comorbidity (Polio Australia, 2012). A higher level of comorbidity has been shown to be associated with a lower level of physical functioning and a faster decline in physical functioning in polio survivors. Compared with the non-polio-affected population, polio survivors have more disease of the heart

and blood vessels, such as heart attacks, hypertension and cardiac arrhythmias (Polio Australia, 2012).

Physical inactivity ranks fourth on the World Health Organization's list of causes of death (WHO, 2014 Factsheet). While quantitative estimates indicate that sedentary living is responsible for about one-third of deaths due to coronary heart disease, colon cancer, and Type 2 diabetes (three diseases for which physical inactivity is an established primary causal factor) (Booth et al, 2000), participation in a regular exercise programme has been reported to elicit a number of favourable responses that contribute to healthy aging and well being (ACSM, 1998; Booth et al, 2000). Efforts to promote physical activity among older adults with existing mobility disability could help prevent a large burden of secondary illness (Rosenberg et al, 2011).

2.5. SECONDARY HEALTH CONDITIONS AND COMORBIDITIES AMONG POLIO SURVIVORS

Despite the enormous reduction in the number of acute polio cases globally (Howard, 2005), polio is still a relevant problem chiefly because of the secondary health conditions and comorbidities which its survivors are readily susceptible to. Secondary conditions usually, are health concerns that are not a direct result of a primary disability or health condition, but are acquired at a later time due to lifestyle changes associated with the primary disability or health condition (e.g., weight gain, pressure sores, pain, fatigue, depression, etc.). Co-morbidities on the other hand, are health conditions that develop independently of a primary health condition (Field and Jette, 2007). People with disabilities generally, are reported to have 3 to 4 times the number of secondary health problems, compared to their age-matched peers without disabilities (Ringaret and Watters, 2005). This is attributed to their reduced mobility, their potentially narrower margin of health, and the barriers they face in maintaining their health (Rimmer, 2005; Tersteeg, 2011). Inaccessible exercise equipment and other disability-related barriers discourage persons with physical disabilities from engaging in health-promoting behaviours (Rimmer, 2005; Smeltzer, 2013), thereby, susceptibility to secondary health conditions is high among them (Kinne et al, 2004).

In an 'Aging with Disability' study, polio survivors reported a total of 9 secondary health conditions (hypertension, scoliosis, high cholesterol, obesity, depression, respiratory disorders, heart disease, osteoporosis and diabetes), approximately 50 years after the acute onset of polio (Campbell, 1998). Studies have reported a high prevalence of cardiovascular, pulmonary, endocrine and metabolic diseases and diseases of the locomotive apparatus among polio survivors [Gawne et al (2003); Nielsen et al (2004); Mohammad et al (2009); Kang and Lin (2011)]. A range of depressive symptoms have also been identified among them (Bicnik and Kennedy, 2002). Harrison and Stuiffbergen (2001) noted fatigue, sleep problems, temperature sensitivity and chronic pain as the most commonly reported secondary health conditions of polio survivors, whereas, in the study of Field and Jette (2007), conditions noted to occur at frequencies greater than 50% were hypertension, depression, scoliosis, and related back conditions. Secondary conditions and comorbidities are well above the national rate in persons living with the effects of polio (Harrison and Stuiffbergen, 2001).

2.5.1. Hypertension among polio survivors

Kang and Lin (2011) in their study reported a significantly higher prevalence of hypertension among patients with paralytic poliomyelitis. Hypertension is an increasingly important medical and public health issue. Undiagnosed, untreated, and uncontrolled hypertension clearly places a substantial strain on the health care delivery system (Chobanian, 2003). The World Health Organization reports that sub-optimal blood pressure (>115 mmHg SBP) is responsible for 62% of cerebrovascular disease and 49% of Ischemic Heart Disease (IHD), with little variation by sex. In addition, sub-optimal blood pressure is the number one attributable risk factor for death throughout the world. High blood pressure, tobacco use, high blood glucose, physical inactivity, and obesity (in that order) explain 38% of total global deaths (WHO, 2009). The relationship between blood pressure and risk of cardiovascular disease events is continuous, consistent, and independent of other risk factors (Chobanian, 2003). Lifestyle modifications are advocated for the prevention, treatment, and control of hypertension, with exercise being an integral component (Hagberg et al, 2000, Pescatello et al, 2004). Exercise programmes that primarily involve endurance

activities prevent the development of hypertension and lower blood pressure in adults with normal blood pressure and those with hypertension (Pescatello et al, 2004).

2.5.1.1. Classification of hypertension

Various medical societies and organizations have attempted to categorize hypertension based on the systolic and diastolic blood pressure values. The Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure classified blood pressure values as follows:

BLOOD PRESSURE CLASSIFICATION	SYSTOLIC BP (mmHg)	DIASTOLIC BP (mmHg)
Normal	<120	and <80
Pre-hypertension	120-139	or 80–89
Stage1Hypertension	140–159	or 90–99
Stage2 Hypertension	≥160	or ≥100

(Chobanian, 2003).

The British Hypertension Society Classification blood pressure values (BHS-IV) include:

CLASSIFICATION	SYSTOLIC BP (mmHg)	DIASTOLIC BP (mmHg)
Hypotension	<90	<60
Optimal BP	90-119	60-79
Normal BP	120-129	80-84
High-normal BP	130-139	85-89
Grade 1 hypertension (mild)	140-159	90-99
Grade 2 hypertension (moderate)	160-179	100-109
Grade 3 hypertension (severe)	>/=180	>/=110
Isolated systolic hypertension (Grade 1)	140=159	<90
Isolated systolic hypertension (Grade 2)	>/=160	<90

This classification equates that of the European Society of Hypertension (ESH) and of the World Health Organization (WHO).

2.5.2. Obesity and overweight among polio survivors

Obesity is becoming a serious problem in physically-challenged individuals (Liou et al, 2005, Rimmer et al., 2010). People with disabilities have generally reported more problems with weight control (Rimmer, 1999; Nosek, 2000; Putnam et al, 2003; Rimmer et al, 2011). Weil et al (2002) and Rimmer et al (2007) found that people with physical disabilities have a higher prevalence of obesity than the general population. Epidemiologic studies have shown that people with physical disabilities have a 1.2- to 3.9-fold increase in obesity prevalence (Liou et al., 2005). The mechanisms by which obesity occurs in people with physical disabilities is not clear, but patho-physiological changes of body composition and energy metabolism, physical inactivity, and muscle atrophy all favour the development of obesity (Liou et al., 2005). Chang et al (2011) in their study reported a higher prevalence of obesity and a significant increase in total and regional fat mass among polio survivors, while Tersteeg et al (2011) attributed excess weight and physical inactivity to a lower level of functioning in polio survivors. Some studies reported children and adults with mobility limitations and intellectual or learning disabilities to be at greatest risk for obesity (Bandini et al, 2005; Elis et al, 2006 and Chen et al, 2010).

The World Health Organization report rated overweight and obesity as the fifth leading cause of global mortality (WHO Factsheet, 2013) and obesity is considered a co-morbidity of some of the most prevalent diseases of modern society (Flegal et al, 2007; Guh et al, 2009; Babalola, 2011). The number of co-morbidities displayed by an individual is said to rise with increasing body weight (Must, 1999; Hirsch, 2001), thus, obese people have a higher prevalence of diseases such as hypertension, osteoarthritis, and gallbladder disease (Flegal et al, 2007). Although obesity affects individuals of all ages, gender, and racial/ethnic groups, people with disabilities appear to be at the highest end of the risk curve (Liou et al., 2005; Rimmer et al., 2010). The consequences of obesity may cause greater harm to people with disabilities because of a lower threshold of health associated with various secondary conditions and the difficulty in accessing health promotion programmes in their home or community

(Liou et al., 2005; Rimmer et al., 2010). According to Booth et al (2000), one of the best public health approaches would be to concentrate on measures that prevent obesity. While obesity and altered body composition are highly related to an increase in the prevalence of metabolic syndrome and cardiovascular diseases (Grundy, 2002; Flegal et al, 2007; Guh et al, 2009), weight loss of as little as 10 lbs (4.5 kg) reduces blood pressure and/or prevents hypertension in a large proportion of overweight persons (Report of The Trials of Hypertension Prevention Collaborative Research Group, 1997; He et al, 2000).

2.5.2.1. Classification of obesity

Obesity can be classified in several ways. These include the body mass index (BMI) intervals and related aggregate risk of mortality, the anatomic phenotypes, or by using the etiologic criteria (Aronne, 2002). Overweight and obesity are defined as a BMI greater than or equal to 25 and 30 kg/m^2 respectively (WHO Factsheet, 2013). In terms of body fat percentage, most researchers have used >25% in men, and >30% in women, as cut-points to define obesity (Okorodudu et al, 2010).

The World Health Organization BMI classification is as follows:

BMI	CLASSIFICATION
< 18.5	Underweight
18.5–24.9	Normal weight
25.0–29.9	Overweight
30.0–34.9	Class I obesity (moderate risk)
35.0–39.9	Class II obesity (high risk)
≥ 40.0	Class III obesity (very high risk)

The most common anatomical characterization of obesity refers to a prevalently visceral or a prevalently subcutaneous deposition of fat. The ratio of waist circumference to hip circumference (WHR) has served the purpose of defining the degree of central (i.e. visceral) versus peripheral (i.e. subcutaneous) obesity. In the United States, a waist circumference of >102 cm in men and >88 cm in women (Janssen et al, 2002), or the waist-hip ratio of >0.9 for men and >0.85 for women, are

used to define central obesity (Yusuf et al, 2004). In the European Union, waist circumference of ≥ 94 cm in men and ≥ 80 cm in non-pregnant women are used as cut offs for central obesity (Tsigosa et al, 2008). A lower cut off of 90 cm has been recommended for South Asian and Chinese men, while a cut off of 85 cm has been recommended for Japanese men (Tsigosa et al, 2008). From an etiologic standpoint, obesity can be fundamentally classified as primary or secondary obesity.

2.5.3. Depression among polio survivors

Depression is a feeling of dejection, lack of hope, and absence of cheerfulness. It is a common symptom of failure to cope with mental stress and a significant feature of chronic pain (Yeomanns, 2000). A diverse range of social, cultural, environmental, educational, biological and psychological factors can impact on an individual's mental health (Kitchener and Jorm, 2002). In turn, individuals can develop symptoms and behaviours that are either distressing to themselves or others, which can interfere with their social functioning and capacity to negotiate daily life (Harrison and Stuifbergen, 2006). Some theories about the causes of depression suggest that people who become depressed have had too many negative life experiences (like serious illness or the loss of a job) or too few positive, pleasurable experiences (like rewarding relationships with others) (Thompson, 2002).

Depression and anxiety are common among polio survivors, especially among individuals with new limitations (Parsons, 1989; Kemp et al, 1997; Bienik and Kennedy, 2002; Harrison and Stuifbergen, 2006). Anecdotal reports and case histories describe powerful and traumatic early polio experiences of many survivors, which may impact psychological well-being (Kalpakjian and Roller, 2004). The onset of new disability from their disease places them at risk, and close individual follow-up is needed for those who are distraught over new symptoms or the loss of independence and function (Bartels and Omura, 2005). Depression itself is a disabling condition and in conjunction with a physical disability, can cause excessive health, functional and family problems (Thompson, 2002). Contrary to popular belief though, depression is not a "natural" consequence of disability or age. Kemp et al. (1997) found that among persons aging with polio, depression scores were higher only if individuals had more post-polio changes and/or had poor family cohesion. Bartels and Omura (2005) found

the incidence of depression among polio survivors to range from 16% to 23% in several studies. using several different indices to study depression. Neuropsychologic evaluation of patients with Post Polio Syndrome indicates that there are some subtle changes in the cognitive and psychologic function after polio and that there may be some contributions from the symptoms of pain and fatigue and the physiology of the infection with the poliovirus (Bartels and Omura, 2005). Depression responds to some lifestyle therapies, such as exercise, and to an array of medications appropriate for prescription by the primary care physician (Aronne, 2002).

2.5.3.1. Measurement of depression

Many tools are available for measuring depression or depressive symptoms. Examples include:

1. Centre for Epidemiological Studies Depression Scale-10 Item Version (CES-D10): A 10-item screening questionnaire for depressive symptoms. It measures severity of depression but does not diagnose it. It is a shortened version of 20-item CES-D (Andersen et al, 1994).
2. Beck Depression Inventory (BDI): A 21-item scale which measures presence and severity of depression in psychiatric and normal populations (Beck et al., 1996).
3. Patient Health Questionnaire-9 (PHQ-9): A diagnostic measure of the presence and severity of depression.
4. Brief Symptom Inventory: Measures levels of psychopathology. A shortened version of the Symptom Checklist-90 (SCL-90-R) (Boulet and Boss, 1991).
5. Medical Outcomes Study 36-item Short form Healthy Survey (SF-36) Mental Health Index Subscale: Measures general mental health (psychological distress and well-being) (Ware and Sherbourne, 1992).
6. General Health Questionnaire (GHQ-28): Measures symptoms of anxiety and depression (Goldberg and Williams, 1988).
7. Mental Health Inventory (MHI): Measures psychological distress (Veit and Ware, 1983).
8. Self-control Questionnaire (SCQ): A40-item scale which assesses beliefs about self-control and cognitions related to depression (Fuchs and Rehm, 1977), etc.

2.5.3.1.1. Beck depression inventory

The Beck Depression Inventory has been utilized in many studies and has been found to be a reliable screening approach that can be tepeated at regular intervals (Ycomanns, 2000). It is a 21-item self report questionnaire. Subjects rate symptoms of depression experienced during the past two weeks on a 4-point scale from 0 to 3. Scores are summated, ranging from 0 to 63. A total score of 0 to 10 is regarded as normal, 11 to 16 as mild depression, 17 to 20 indicates borderline depression, 21 to 30 indicates moderate depression, 31 to 40 indicates severe depression, and a score of over 40 indicates extreme depression (Beck et al., 1961).

2.6. PREVENTIVE CARE AND HEALTH PROMOTION FOR POLIO SURVIVORS

Until lately, people with disabilities or chronic health conditions were not considered suitable candidates for health promotion efforts because the emphasis in public health was to prevent disability, disease, or infirmity. However, the focus of public health is shifting from disability prevention to promotion of health (Rimmer, 1999: Symposium Proceedings of the Baylor College of Medicine, 2003). Developing innovative strategies that promote health among people with disabilities has now emerged as an important public health priority (Rimmer and Braddock, 2002). Emphasizing health promotion and disease prevention has the potential of helping individuals and communities live healthier and put less strain on the health care system (National Primary Health Care Conference Steering Committee, 2004).

People with disabilities report fewer healthy days than the general population and lower rates of health-promoting behaviours (Rimmer, 2005; Smeltzer, 2013). Thus, one of the major priorities in health promotion for people with disabilities is to prevent secondary health conditions (Rimmer, 1999; Tersteeg et al., 2011). Health promotion programmes for this population may help prevent or ameliorate secondary health conditions or co-morbidities and help improve their overall quality of life (Rimmer, 1999; Stuifbergen, 2005). Hassouneh-Phillips (2002) submitted that the bulk of efforts in preventive health care have been targeted at persons without disabilities, and persons with disabilities have not received the preventive health care they need. Promoting physically active lifestyles to enhance mobility (even among those with

disability) as a preventive and control strategy is imperative (Rosenberg et al. 2011) Since people with disabilities, and particularly polio survivors, risk secondary disabling conditions, health promotion is especially important for them, and factors that impede their ability to live a healthy life merit particular attention (Becker and Stuifbergen, 2004).

2.6.1. Exercise and health promotion

A wealth of scientific researches supports the value of exercise for health promotion among populations with or without disabilities (O'Toole, 2002; Birk, 2003). Exercise may be viewed as a prudent and viable alternative or adjunct to drugs in solving certain health problems (Lemanski, 2004). Campbell (1998) identified exercise as part of the protective influences that may buffer the impact of aging on the health and well-being of polio survivors. Regular exercise has consistently been shown to lower cardiovascular risk factors, reduce body- weight, increase high density lipids (HDL), lower triglycerides, lower blood pressure, and in those with diabetes or metabolic syndrome, lower blood sugar (O'Toole, 2004). Multiple long-term prospective clinical studies as well as observational cohort studies have shown that aerobic exercise in particular, protects against heart disease and cardiac death (Lemanski, 2004, O'Toole, 2004). Even a moderate aerobic exercise has been associated with a significantly lower mortality rate than inactivity (Lemanski, 2004).

Besides the cardio-protective benefits of exercise, exercise also directly or indirectly helps cognitive performance (Dregan and Gulliford, 2013). Blumenthal (1999) noted that exercise has beneficial effects in specific areas of cognitive function that are rooted in the frontal and pre-frontal regions of the brain and can be used as a singular treatment for some anxiety disorders and for people suffering from body image problems. Depression and anxiety are the two most studied mental health conditions in which exercise science may play a role, and these two mental disorders are frequently amenable to exercise (Blumenthal et al., 2007; Carek et al, 2011). Cardiovascular training in particular provides an effective conditioning programme for the management of both depression and anxiety, and Babyak et al. (2000) opined that exercise is as effective as medications used to control depression and anxiety in a good number of cases. Clinical evidence indicates that many polio survivors can enhance

their optimal health, cardio-respiratory fitness, range of motion, efficiency of movement and their capacity for activity by embarking on an individualized, well-controlled, regular, sub-maximal exercise regimen (PostPolio Health, 2003; Birk and Nieshoff, 2003).

2.7. PHYSICAL FITNESS:

Physical fitness relates to the ability to perform physical activity. It is a physiologic state of well-being that allows an individual to meet the demands of daily living (health-related physical fitness) or that provides the basis for sport performance (performance-related physical fitness), or both. (Warburton et al, 2006).

2.7.1. Components of physical fitness

1) Health-related components of physical fitness: This involves the components of physical fitness related to health status. They include cardiovascular or aerobic fitness, musculoskeletal fitness, body composition and metabolism (Seton, 2008).

i) Cardiovascular Fitness: This is also referred to as cardiovascular endurance, aerobic fitness and cardio-respiratory fitness. It relates to the ability of the circulatory, respiratory, and muscular systems to supply oxygen during sustained physical activity (Warburton et al, 2006; Lee et al, 2010). It is usually expressed in metabolic equivalents (METs) or maximal oxygen uptake (VO_2 max), which are measured by exercise tests (Lee et al, 2010). VO_{2max} test in the laboratory setting is considered to be the best measure of cardio-respiratory fitness (Seton, 2008).

Cardio-respiratory fitness is a strong and independent predictor of all-cause and cardiovascular disease mortality, however, its importance is often overlooked from a clinical perspective compared with other risk factors such as hypertension, diabetes, smoking, or obesity (Chase et al, 2009; Kodama et al, 2009; Lee et al, 2010). Several biological mechanisms suggest that cardio-respiratory fitness improves insulin sensitivity, blood lipid profile, body composition, inflammation, and blood pressure. Thus, Lee et al (2010) advised that cardio-respiratory fitness of patients should be improved upon through regular physical activity.

ii) Musculoskeletal fitness: This includes muscular strength, muscular endurance, power and flexibility.

a) **Strength**: This is a health-related component of physical fitness that relates to the ability of the muscle to exert force. For accurate assessment, it is necessary to test each major muscle group of the body. Laboratory and field tests are similar and involve the assessment of one repetition maximum (the maximum amount of resistance one can overcome at once). One Repetitive Maximum tests are typically conducted on resistance machines. Strength can also be assessed using dynamometers. Strength can be measured isometrically (static contractions) or isotonically (dynamic contractions) (Seton, 2008).

b) **Muscular Endurance**: This is a component of physical fitness that relates to the muscle's ability to continue to work without fatigue. For accurate assessment of muscular endurance, it is necessary to test each major muscle group of the body. Laboratory and field tests of muscular endurance are similar and are based on the number of repetitions that can be performed by the specific muscle group being tested (example: repetitions of push-ups or abdominal curls). Muscular endurance can also be measured isometrically (static contractions) or isotonically (dynamic contractions) (Seton, 2008).

c) **Flexibility**: This is the health-related component of physical fitness that relates to the range of motion available at a joint. Flexibility is specific to each joint of the body, thus there is no general measurement of flexibility. Flexibility is typically measured in the laboratory using measurement devices such as a goniometer, flexometer, and in the field, with tests which include thesit- and- reach and the zipper (Seton, 2008).

iii) **Body Composition**: This is a health-related component of physical fitness that relates to the relative amounts of muscle, fat, bone and other vital parts of the body (Seton, 2008). It is an assessment of the ratio of fat in the body to the overall levels of lean body mass. When the body fat mass ratio is high, an individual is considered over-weight, or obese. This high fat content ratio is a sign of a higher propensity to develop coronary heart disease, diabetes, joint and back pains, arthritis, and higher risk of tendon-muscular accidents and injuries due to inactivity (Warburton et al, 2006; Guh et al, 2009).

The health- related physical skills each contributes to a healthy quality of life. Optimal fitness is reflected in a person's ability to cope well with daily life, as actively fit individuals will develop a resistance to hypo-kinetic diseases such as obesity, heart

failure and diabetes, which are physical conditions associated with inactivity and sedentary lifestyles (Payne and Hann, 1998; Booth et al, 2000).

2) Performance or Skill-related Physical Fitness: Skill-related physical fitness consists of those components of physical fitness that have a relationship with enhanced performance in sports and motor skills. They include: coordination, speed, power, agility, balance and reaction time (Seton, 2008).

2.7.2. Assessment of body composition

Given that an excess of body fat is the defining variable of obesity, a proper diagnosis of obesity would require the assessment of body fatness (Parigi, 2010). There are many methods used to determine the body fat. Hydrostatic weighing, one of the most accurate methods of body fat calculation, involves weighing a person under water. Other methods include the skinfold test, in which a pinch of skin is precisely measured to determine the thickness of the subcutaneous fat layer (Jebb and Wells, 2005) and the bioelectrical impedance analysis which uses electrical resistance (NICE, 2006). Other body fat percentage measurement techniques used mainly for research include computed tomography (CT scan), magnetic resonance imaging (MRI), and dual energy X-ray absorptiometry (DEXA). These techniques provide very accurate measurements, but their measurements can be difficult to obtain in the severely obese due to weight limits of most equipment and insufficient diameter of many CT or MRI scanners (Jebb and Wells, 2005).

For practical reasons, the measurement of body weight has been adopted as a valid proxy for body mass and it is used to calculate the body mass index (BMI), which is defined as weight/height^2 (kg/m^2) (Parigi, 2010). Aronne (2002) opined that the initial step in evaluation of obesity is calculation of BMI. BMI correlates significantly with body fat, morbidity, and mortality and it can be calculated quickly and easily. Furthermore, recommendations for treatment of obesity are based on BMI. A BMI of 25 kg/m^2 is the generally accepted threshold for identifying a patient at higher risk for obesity-related diseases, most notably type 2diabetes, hypertension, and cardiovascular disease (Lyznicki et al, 2001). BMI is a simple method for estimating body fat mass, and it is an accurate reflection of body fat percentage in the majority of the adult population. It is the most widely used body fat assessment method (Frenste, 2008).

though, in a recent study, Chang et al (2011) reported that current BMI formula underestimates the total body fat mass percent of polio survivors, therefore, a population-specific BMI was proposed to address the prevalence of obesity in post-polio survivors (Chang et al, 2011). No population-specific BMI formula has however developed for the polio population till date.

In scholarly circles, the preferred obesity metric is the body fat percentage (BF%) - the ratio of the total weight of person's fat to his or her body weight, and body mass index (BMI) is viewed merely as a way to approximate BF%. Levels in excess of 30% for women and 25% for men are generally considered to indicate obesity (Okorodudu et al, 2010). Accurate measurement of body fat percentage is however much more difficult than measurement of BMI. Waist circumference is another important measure of obesity risk. Waist circumference is measured at the level of the top of the right iliac crest. The measurement is made at normal respiration. A high-risk waist circumference is accepted to be 35 inches or greater for women, and 40 inches or greater for men (Okorodudu et al, 2010).

2.7.3. Assessment of cardio-respiratory fitness

Cardio-respiratory fitness can be measured directly from expired gas analysis or estimated through various maximal or submaximal exercise tests (Lee et al, 2010). Directly measured cardio-respiratory fitness is more precise than other methods and it is determined by an individual's maximum aerobic power (VO_{2max}) i.e. the maximum amount of oxygen that can be transported to and used by the working muscles. However, owing to the complexity of direct assessment of VO_{2max} and its cost, many health and fitness professionals prefer to estimate VO_{2max} without measuring oxygen consumption by estimating the heart rate or exercise time to exhaustion in various exercise tests (Warburton et al, 2006; Lee et al, 2010).

2.7.3.1. Maximal exercise tests to assess cardio-respiratory fitness

Maximal exercise testing has a role in the assessment of maximal aerobic capacity or functional work capacity. However, because individuals are frequently limited by cardiopulmonary, musculoskeletal, and neuromuscular impairments and symptoms such as exertion dyspnoea, fatigue, weakness, and pain during their activities of daily

living, maximal exercise testing is often contraindicated or of limited value (Noonan ad Dean, 2000).

2.7.3.2. Sub-maximal exercise tests to assess cardio-respiratory fitness: Sub-maximal exercise tests are less difficult and more convenient in terms of time, effort, and cost, yet they provide adequate estimates of cardio-respiratory fitness (Lee et al, 2010). They can be used to predict VO_2max, make diagnoses and assess functional limitations, assess the outcome of interventions such as exercise programmes and measure the effects of pharmacological agents (Questead and Alquist, 1994; Ward et al, 1995; Dean, 1996). The goal of testing is to produce a sufficient level of exercise stress without physiologic or biomechanical strain (Noonan and Dean, 2000). Measurements taken before, during (where applicable), and after sub-maximal exercise tests can yield valuable information regarding an individual's exercise response (Noonan and Dean, 2000). These values can be compared across subsequent tests. Comparison of the responses to pre-test and post-test measurements is particularly useful for assessing the effect of an intervention such as an exercise programme. In this case, a reduction in sub-maximal exercise responses such as the heart rate, respiratory rate, and blood pressure can be consistent with improved aerobic conditioning, movement economy, or both. Movement economy refers to the efficient use of energy during movement (i.e. not excessive VO_2 for a given activity or work rate) (Noonan and Dean, 2000).

The most popular clinical exercise tests in order of increasing complexity are stair climbing, a 6-Minute Walk Test, a shuttle-walk test, detection of exercise- induced asthma, a cardiac stress test (e.g., Bruce protocol), and a cardiopulmonary exercise test (ATS, 2002). In the early 1960s, Balke developed a simple test to evaluate the functional capacity by measuring the distance walked during a defined period of time (ATS, 2002). A 12- minute field performance test was then developed to evaluate the level of cardio-respiratory fitness of healthy individuals and was also adapted to assess disability in patients with chronic bronchitis. However, in an attempt to accommodate patients with respiratory disease for whom walking 12 minutes was too exhausting, a 6-minute walk was introduced and found to be as good as the 12-minute walk (Butland et al, 1982). A recent review of functional walking tests concluded that the 6-minute

walk test is easy to administer, better tolerated, and more reflective of activities of daily living than the other walk tests (Solway et.al. 2001).

2.7.3.2.1. The 6- minute walk test (6 MWT): The 6MWT is a practical simple test that requires a 100-ft (30.48m) hallway, but no exercise equipment or advanced training. It measures the distance that a patient can quickly walk on a flat, hard surface in a period of 6 minutes (Moffat, 2008). Thus, it evaluates the global and integrated responses of all the systems involved during exercise, including the pulmonary and cardiovascular systems, systemic circulation, peripheral circulation, blood, neuromuscular units, and muscle metabolism. It however, does not provide specific information on the function of each of the different organs and systems involved in exercise, or the mechanism of exercise limitation, as is possible with maximal cardiopulmonary exercise testing (Moffat, 2008).

Most patients do not achieve maximal exercise capacity during the 6MWT; instead, they choose their own intensity of exercise and are allowed to stop and rest during the test. Because most activities of daily living are performed at sub-maximal levels of exertion, the 6MWT has been reported to better reflect the functional exercise level for daily physical activities (ATS, 2002). Gylfadottir (2006) reported that the 6MWT distance was useful in elucidating the relationship between impairment and functional activity in survivors of poliomyelitis.

2.8. EXERCISE TRAINING

To improve the health-related components of physical fitness in order to reap the benefits of exercise, the body must undergo some training in the specific area of interest, either to build endurance, or to improve strength. (Davies et al, 2001). When the body engages in exercise training, each of its physiologic systems undergoes specific adaptations that increase the body's efficiency and capacity. The body's adaptation to the habitual demands placed on it is specific to the parts and systems of the body that are stimulated. Consequently, the physiologic adaptations to exercise depend on the activities (type of exercise) selected (Mc Ardle, 2000). A greater than normal stress or load on the body is required for training adaptation to occur (Mc Ardle, 2000). The magnitude of these changes depends largely on the intensity and

duration of the training sessions, the force or load used in training, and the body's initial level of fitness (Mc Ardle, 2000). Both strength and endurance training are achieved by applying the principle of overload. Overload can be increased through: increase in intensity, increase in duration and increase in frequency (Davies et al, 2001).

2.8.1. Types of exercise

There are basically 3 types of exercises. These include: aerobic or cardio-pulmonary training exercises, strength-training exercises and flexibility exercises (McArdle, 2000).

2.8.1.1. Aerobic exercise: The primary technique for improving cardiopulmonary endurance is aerobic exercise (Dalakas and Hallet, 1998; Birk and Nieshoff, 2003). Aerobic exercise involves using the large muscles in a sustained, rhythmic effort that elevates the heart rate and utilizes oxygen. Examples of aerobic exercise include walking, jogging, running, cycling, swimming, in-line skating, dancing and cross-country skiing (Lockette and Keyes, 1994; Rimmer, 2005).

2.8.1.1.2. Aerobic/ cardio-respiratory exercise training for polio survivors

For individuals with physical disabilities, aerobic exercise training will depend on the muscles that are available (Lockette and Keyes, 1994). Given the motor loss of the lower limbs following injury therefore, upper extremity exercise is a logical choice for improving cardiovascular fitness and health (Halstead, 1998). Thus, for individuals with lower limb paralysis, aerobic training can be achieved by participating in modified wheel-chair aerobics; arm or upper body ergometry (i.e., bicycle pedalling with the upper extremity (or arm cranking); or wheelchair ergometry (pushing a wheel-chair on a treadmill or stationary rollers) (Lockette and Keyes, 1994).

Benefits of exercise occur in polio survivors when muscular fatigue or joint or muscle pains are prevented. Thus, an ideal aerobic exercise programme should exercise the muscles least affected by polio in order to get maximum cardiovascular benefits, while avoiding overuse or secondary degenerative effects on the more affected extremities (HealthNewsflash, 2002). The American College of Sports Medicine recommends an exercise intensity of 40-70% of the maximal heart rate reserve (maxHR) for polio

survivors (including those with post-polio syndrome) (Birk, 2003), and an exercise frequency of 3 to 5 sessions per week. A day of rest between exercise periods permits the body to gradually adapt to stresses and strains (Fletcher et al. 2001).

2.8.1.1.3. Differences in exercise response to upper and lower limb aerobic exercise

There are differences in physiological responses to upper and lower body submaximal and maximal aerobic exercise (Mayo et al, 2001). Upper-limb exercise induces a greater cardiovascular stress for a given level of submaximal work than lower-limb exercise (Astrand and Rodhal, 1986; Mayo et al, 2001). Several possible explanations for the greater cardiovascular stress include smaller muscle mass involvement, decreased venous return to the heart, greater neural stimulation and an increased static component imposed during upper body exercise (Boileau et al, 1984; Eston and Brodie, 1986; Pivarnik et al, 1988; Toner et al, 1990; Miller, 1994). Research has demonstrated that for a given submaximal power output, arm exercise produces increased systolic and diastolic blood pressure, heart rate, total peripheral resistance, decreased stroke volume, and either a similar or decreased cardiac output (Astrand and Rodahl, 1986; Miles et al., 1989). Stroke volume is usually less during upper-body exercise because of the absence of the skeletal muscle pump augmenting venous return from the lower limbs, while a greater sympathetic stimulation associated with upper-body exercise accounts for the elevated heart rate seen. Greater sympathetic stimulation also partly accounts for the increased blood pressure and total peripheral resistance associated with upper limb exercise (Mayo et al. 2001). The practical implication of this is that a lower training workload is usually appropriate to induce physiological responses with upper limb aerobic exercises and regular monitoring of untoward reactions is highly essential (Miller, 1994).

2.8.1.1.4. Physiologic adaptations to aerobic exercise

Physiologic adaptations to regular aerobic exercise include: reduction in resting heart rate and blood pressure; morphologic changes in skeletal and cardiac muscles resulting in improved physical work capacity and an enhancement of cardiovascular efficiency in delivering oxygen and nutrients to the tissues (Agre, 1999; O'Toole, 2002). Others include: increased muscular endurance, increased myocardial vascularity, reduced

blood coagulability, reduction in adiposity and increased lean body mass, increased cellular sensitivity to insulin, and favourable changes in blood lipids and cholesterol (Agre, 1999; O'Toole, 2002). The psychological changes include: reduction in muscular tension; improved sleep and possible increased motivation for improving other health habits such as changes in diet (reduction in saturated fat consumption, for example) and cessation of cigarette smoking (Agre, 1999; O'Toole, (2002). Unlike strength-training, muscles adapt to aerobic training by increases in their oxidative and metabolic capacities, which allows better delivery and use of oxygen (McArdle, 2000). For many patients with impaired muscle performance, aerobic training has a more positive impact on improving function than strength training (Lockette and Keyes, 1994).

2.8.1.2. Strength-training exercise: Strengthening or strength-training exercise is a systematic procedure of a muscle or muscle group lifting, lowering, or controlling heavy loads (resistance) for a relatively low number of repetitions or over a short period of time (McArdle, 2000). The most common adaptation to heavy resistance exercise is an increase in the maximum force-producing capacity of muscle, that is, an increase in muscle strength, primarily as the result of neural adaptations and an increase in muscle fiber size (McArdle, 2000).

2.8.1.3. Flexibility exercise:

This aims at improving the range of motion at joints, which help to prevent musculoskeletal injuries (Lockette and Keyes, 1994; McArdle, 2000).

2.9. HEALTH-RELATED QUALITY OF LIFE

Quality of life is defined by the World Health Organization as individuals' perception of their position in life, in the context of the cultural and value system in which they live, and in relation to their goals, expectations, standards and concerns (Shaw, 2006). In its broadest definition, the quality of an individual's life is influenced by factors that health care does not affect. These include: financial status, housing, employment, and social support. Consequently, many researchers favour the more restrictive terms of health-related quality of life (HRQoL), or functional status to mean the quality of life as it is affected by the health status (Curtis et al, 1996). While functional status

connotes a stronger basis in ability to perform the tasks of daily life, HRQoL connotes the subjective experience of the impact of health on the quality of one's life (Shaw, 2006). The health-related physical fitness components contribute to a healthy quality of life, since optimal fitness is reflected in a person's ability to cope well with daily life (Seton, 2008).

2.9.1 Measurement of health-related quality of life (HRQoL)

In general, HRQoL measures the impact of an individual's health on his or her ability to perform and enjoy the activities of daily life. HRQoL instruments vary from disease-specific measures of a single symptom to a generic global assessment of many facets which may include emotional functioning (mood changes and other psychiatric symptoms), social role functioning (employment, home management and social or family relationships), activities of daily living (self-care skills and mobility), and the ability to enjoy activities, hobbies and recreation (Curtis et al, 1996; Shaw, 2006). Generic measures are useful in comparing the impact of a wide variety of diseases and treatments on HRQoL, but may lack precision in a particular condition for which disease-specific measures are better suited. Commonly used generic instruments include: The Medical Outcomes Study 36-Item Short Form (SF-36) health survey, The Quality of Life Index (QLI) and The EuroQol Instrument (EQ-5D). Other examples are: Quality of Well-Being (QWB) Scale, Nottingham Health Profile (NHP), Sickness Impact Profile (SIP), Health Utilities Index (HUI), WHO Quality of Life Instrument, etc.

With several hundred available instruments, mainly disease specific, careful consideration has to be given to the selection of an appropriate tool. Examples of disease specific measures include: Arthritis Impact Measurement Scale, Asthma Quality of Life Questionnaire, The Inflammatory Bowel Disease Questionnaire, The Quality of Life Index (QLI), with several disease-specific versions, etc.

2.9.1.1. The quality of life index (QLI)

This was developed by Ferrans and Powers to measure quality of life in terms of satisfaction with life (Ferrans and Powers, 1985). Quality of life is defined by Ferrans as "a person's sense of well-being that stems from satisfaction or dissatisfaction with

the areas of life that are important to him/her" (Ferrans, 1990). The QLI measures both satisfaction and importance of various aspects of life. Importance ratings are used to weigh the satisfaction responses, so that scores reflect the respondents' satisfaction with the aspects of life they value. Items that are rated as more important have a greater impact on scores than those of lesser importance. The instrument consists of two parts: the first measures satisfaction with various aspects of life, while the second measures importance of those same aspects. Scores are calculated for overall quality of life and in four domains: health and functioning, psychological/ spiritual, social and economic, and family (Ferrans, and Powers, 1985; Ferrans, 1990; Ferrans and Powers, 1992; Ferrans, 1996). A number of versions of the QLI have been developed for use with various disorders and the general population.

2.9.1.2 Quality of life-measurement for polio survivors:

A Quality of Life Index Version has not been developed for persons with poliomyelitis (Stuiflbergen. 2005), but a panel of experts that included a polio survivor reviewed the Multiple Sclerosis (MS) Version of QLI (Ferrans and Powers, 1985) and found all items relevant to quality of life in persons with poliomyelitis (Stuiflbergen, 2005), hence, the choice of the instrument. According to Ferrans and Powers (1985), the internal consistency reliability for the quality of life (QLI) (total scale) across 48 studies had acceptably high Cronbach's alphas, ranging from 0.73 to 0.99. Cronbach's alphas for the four subscales have been published in 24 studies, which have provided support for internal consistency of the subscales. Cronbach's alphas ranged from 0.70 to 0.94 for the health and functioning subscale, and from 0.78 to 0.96 for the psychological/spiritual subscale. For the social and economic subscale, Cronbach's alphas were acceptably high in 23 studies, ranging from 0.71 to 0.92. For the family subscale, Cronbach's alphas were acceptably high in 19 studies, ranging from 0.63 to 0.92. (Ferrans and Powers, 1985).

Levasseur et al (2008) reported that a reduced activity level is associated with decreased quality of life, and in a study, found that the quality of life of polio survivors was lower than that of their able-body counterparts mainly in the health and functioning domain. Adegoke et al. (2012) reported lower overall quality of life as well as lower quality of life (QoL) in health, productivity, community participation and

emotion domains of QoL of adolescent polio survivors. QoL has also been found to be negatively affected by age-related changes in function and health (Kailes, 2008).

2.10. JUSTIFICATION FOR THE STUDY

The population of individuals aging with mobility disability is increasing and current research on exercise to promote health and reduce secondary conditions among them is limited (Rosenberg et al., 2011). Literature is replete with studies assessing the outcome of aerobic training on various systems of the body in health and disease-states. However, only a few of these studies involve the polio population. Besides, arm ergometry, one of the alternative modes of aerobic training recommended for people with lower limb paralysis (Lockette and Keyes, 1994, Rimmer, 2005), has not been adequately explored among polio survivors. Warpeha (2011) submitted that arm ergometry is the most-underused mode of aerobic training. Though acute polio is no longer a constant threat to people as in the past, there are thousands of polio survivors who are at risk of developing secondary health conditions and late manifestations of the disease (Farbu, 2010). These secondary health conditions and late sequalae are now recognized as serious problems of polio survivors of previous epidemics. As a result, there is need to continually improve or update current treatment options for their optimal management. This was the primary objective of this study.

2.10.1. Justification for methodology and instrumentation

2.10.1.1. Methodology - Use of sub-maximal, arm or upper limb aerobic training.

To maximise the cardiovascular benefits of aerobic exercise for polio survivors, Quinlivan and Thompson (2004) advised that the muscles which are least affected by polio should be employed in the exercise programme, while exercise intensity should not produce fatigue in subjects (Yarnell, 1991, Halstead, 1998). Thus, for individuals with lower limb paralysis, Lockette and Keyes (1994) recommended participation in modified wheel-chair aerobics, bicycle pedalling with the upper extremity, or wheelchair ergometry for aerobic training. Upper limb ergometry in particular has been shown to be an effective mode of aerobic training for both able-bodied and physically-challenged individuals (DiCarlo et al, 1983; LeMura and Von-Duvillard, 2004) and has been previously used for polio survivors (Kriz et al., 1992). However, published work on its effectiveness for aerobic conditioning among the polio

population is still grossly limited. Hence, its choice as the aerobic training modality for this study.

2.10.1.1.1. Exercise parameters: The American College of Sports Medicine recommends an exercise intensity of 40-70% of the maximal heart rate reserve (maxHR) for polio survivors (including those with post-polio syndrome), and an exercise frequency of 3 to 5 sessions per week (Birk,2003). The researcher complied with these recommendations. However, since it is advised that the initial aerobic exercise duration for polio survivors should be within subject's tolerance level, which may be as low as 5 minutes or more (Lockette and Keyes, 1994), participants' initial exercise duration was within their subjective limits of tolerable fatigue, muscle weakness and pain. They were however encouraged to increase their exercise duration per session to about 20 to 30 minutes, as training progressed.

2.10.1.2. Instrumentation:

1. Beck Depression Inventory (BDI): The Beck Depression Inventory has been employed in various researches involving polio survivors for screening for the presence of depressive symptoms (Freidenberg et al, 1989; Tate et al, 1994; Creange and Bruno, 1997; Bruno et al., 1998; Strohschein, 2003) and its scoring allows for assessment of progress, which is needed in this study. It has been validated among Nigerian adults and adolescents (Adewuya et al., 2007), hence, the choice of the instrument.
2. The 6-Minute Walk Test (6-MWT) (Lipkin, 1986): The 6-MWT is a self-paced cardio-respiratory fitness test which was used by Bertelsen et al. (2009) to assess the functional capacity of some polio survivors. A recent review of functional walking tests concluded that the 6-minute walk test is easy to administer, better tolerated, and more reflective of activities of daily living than the other walk tests (Solway et.al. 2001), hence the choice of the test as a cardio-respiratory fitness measure in this study.
3. The Dartmouth COOP Chart System (1989): There is no disease-specific general health outcome measure for polio survivors, however, the Dartmouth COOP Chart System comprises 9 charts which represent a very simple, easily administered and scored, general health screen, which could be used together or individually to fulfill the needs of a certain patient-population. Hence, the

choice of the instrument.

4. Quality of Life Index-Multiple Sclerosis Version (QLI-MS) (Ferrans and Powers, 1985): To date, there is no condition-specific Quality of Life instrument for polio survivors, however, a panel of experts that included a polio survivor reviewed the Quality of Life Index-Multiple Sclerosis (MS) Version and found all items relevant to quality of life in persons with poliomyelitis (Stuiffbergen, 2005) , and has been used in some studies involving polio survivors (Harrison and Stuiffbergen, 2006), consequently, the choice of the instrument for this study.
5. Borg's Rate of Perceived Exertion (RPE) Scale (Borg, 1982): This was used by Koopman et al. (2010) to assess the rate of perceived exertion of some polio survivors during an aerobic training programme. It has been shown to be a reliable and valid measure of perception of work intensity in both lean and obese individuals, and in individuals ranging in activity level from sedentary to very active (Moffat, 2008).

CHAPTER THREE

MATERIALS AND METHODS

3.1. Participants

Sixty polio survivors (30 participants each for the experimental and control groups) were involved in this study. They were selected from a larger group of 252 polio survivors who were earlier found to have secondary health conditions and co-morbidities in a crosssectional survey.

3.1.1. Inclusion criteria:

Polio survivors must:

1. Have lower limb affectation only,
2. Be able to communicate in either English or Yoruba language,
3. Have no visual or hearing impairment,
4. Be either independently ambulant or ambulant with assistive devices,
5. Have no past or present medical history suggestive of upper extremity entrapment neuropathies and able to effectively use their upper limbs,
6. Agree not to participate in any other exercise programme during the twelve-week exercise training programme.

3.1.2. Exclusion criteria

The following categories of polio survivors were excluded from the study:

1. Polio survivors who had persistent, severe pains and could not participate effectively in an exercise training programme.
2. Polio survivors who had clinical evidence of respiratory insufficiencies.
3. Polio survivors who had bilateral hamstring contractures which limited full extension of their knee joints and whose height could hence not be accurately ascertained for proper body mass index (BMI) calculation.

3.2. Materials

3.2.1. Instruments

1. Weighing scale: A large scale with platform (Camry, China) was used to measure participants' weight to the nearest kilogramme. This afforded participants the possibility of sitting on the scale. It has a range of 0 to 200kg.

2. Non-elastic tape measure: This was used to measure participants' supine length (proxy for standing height) (Hamzat, 2000; Rimmer et al, 2010).

3. Linoleum (2.5 by 1 metre): Participants laid on this, in supine position, for the measurement of their length (proxy for standing height).

4. Marker: This was used to indicate the points to measure on the linoleum (from the vertex of the head to the sole of the foot of the longer leg of each participant).

5. Sphygmomanometer: A Sphygmomanometer (Omron MX2 Basic Digital Automatic Blood Pressure and heart rate Monitor, Japan) was used to measure participants' diastolic blood pressure, systolic blood pressure and heart rate.

6. Fat monitor (Omron BF 302, Omron Healthcare, Europe): This was used to estimate participants' percent body fat and fat mass.

7. Tilt-table: This was used to support participants in standing posture (whenever necessary), while assessing their percent body fat.

8. Wooden blocks of various heights: These were used to compensate for limb-length discrepancy (when necessary) for participants who had affectation of one lower limb, who could therefore independently assume the standing posture with the unaffected limb while assessing their percent body fat.

9. Polar FT1 heart rate monitor: This was used to monitor participants' exercise heart rate to ensure that they exercised within their target zones during the training session.

10. Stopwatch: A stopwatch (Heuer, tracomate, China) was used to time all procedures that required timing in the study.

11. The Dartmouth COOP Chart System (1989) (Appendix E): The instrument was used to assess participants' general health status. It comprises nine health charts which assess physical fitness, feelings, daily activities, social activities, pain, change in health, overall health, social support and quality of life. Since the charts could be used together or separately according to the needs of a patient population (Yeomans, 2000), only 8 out of the 9 charts were used in this study. The chart which assesses physical fitness was excluded as the activities included are not applicable to the polio

population. Each chart consists of a title and a question pertaining to the participant's health status over the past 2 to 4 weeks, rated on a 1- to 5-point ordinal scale, where 1=Normal and 5=The most abnormal. High scores of 4 or 5 represent unfavourable levels of health and a score of 1 represents no problem. The COOP charts have been validated with other instruments, including the RAND health measures (Ware et al, 1980), the Sickness Index Profile (Pollard et al, 1976; Bergner et al, 1981), and the Duke-UNC Health Profile (Parkerson et al, 1981). The results of the COOP were similar to those of these instruments (Nelson et al, 1996) and very similar to the scores on MOS or SF-36 (Yeomans, 2000). The instrument was translated to the Yoruba language, back-translated and its contents were validated before being used in this study. The Yoruba version was found to be significantly and highly correlated with the original version with the Spearmann correlation coefficient (p) ranging from 0.769 to 0.956 for the different charts ($p<0.001$).

12. Beck Depression Inventory (BDI) (Appendix F): This was used to measure participants' depressive symptoms. The BDI is a 21-item self report questionnaire used to measure the severity of depression. Participants rated symptoms of depression experienced during the past two weeks on a 4-point scale of 0 to 3. Scores were summated and ranged from 0 to 63. A total score of 0 to 10 is regarded as normal, 11 to 16 as mild depression, 17 to 20 indicates borderline depression, 21 to 30 indicates moderate depression, 31 to 40 indicates severe depression, and a score of over 40 indicates extreme depression (Beck et al., 1961). The BDI has been employed in researches involving polio survivors to screen for the presence of symptoms of depression (Freidenberg et al, 1989; Tate et al, 1994; Creange and Bruno, 1997; Bruno et al., 1998; Strohschein, 2003). The instrument has been validated among Nigerian adults and adolescents and found by Adewuya et al. (2007) to be a valid instrument for screening for major depressive disorders among Nigerian adults and adolescents. The instrument was translated to the Yoruba language, back-translated and its contents were validated before being used in this study. The Yoruba version was found to be significantly and highly correlated with the original version (Spearmann correlation coefficient (p) = 0.984, $p<0.001$).

13. The Quality of Life Index-Multiple Sclerosis (QLI-MS) Version (Ferrans and Powers, 1985) (Appendix G): This was used to assess participants' quality of life. A Quality of Life Index Version has not been developed for persons with poliomyelitis,

but a panel of experts that included a polio survivor reviewed the Multiple Sclerosis (MS) Version and found all items relevant to quality of life in persons with poliomyelitis (Stuifbergen, 2005). The instrument has two parts, each consisting of 35 items which are distributed into four subscales: Health/functioning, Social and economic, Psychological/spiritual, and Family sub-scales. Part one measures satisfaction with various domains of life, while part two measures the relative importance of the same domains. Each item of the first part of the instrument corresponds to the same in the second. Participants rated each item on a 6-point scale. For the first part, the scale ranges from 1 (very unsatisfied) to 6 (very satisfied), while it ranges from 1 (very unimportant) to 6 (very important) for the second part. This scoring scheme is based on the belief that people who are highly satisfied with areas of life they consider important have a better quality of life than those who are unsatisfied with areas they consider important. The instrument was translated to Yoruba language, back-translated and its contents were validated before being used in this study. The Yoruba version of the instrument was found to be significantly and highly correlated with the original version, having a Spearmann correlation coefficient (ρ) ranging from 0.935 to 0.994 ($p<0.001$) for the different sub-scales.

According to Ferrans and Powers (1985), the internal consistency reliability for the quality of life (QLI) (total scale) across 48 studies had acceptably high Cronbach's alphas, ranging from 0.73 to 0.99. Cronbach's alphas for the four subscales have been published in 24 studies, which have provided support for internal consistency of the subscales. Cronbach's alphas ranged from 0.70 to 0.94 for the health and functioning subscale, and from 0.78 to 0.96 for the psychological/spiritual subscale. For the social and economic subscale, Cronbach's alphas were acceptably high in 23 studies, ranging from 0.71 to 0.92. For the family subscale, Cronbach's alphas were acceptably high in 19 studies, ranging from 0.63 to 0.92. (Ferrans and Powers, 1985).

14. Secondary Conditions Questionnaire (Tate, 1996) (Appendix II): This was used to assess secondary conditions and co-morbidities in participants. The questionnaire comprises a 21-item list of secondary conditions (any physical condition that is the result of poliomyelitis), and co-morbid conditions (diagnosed disease processes that coincide with polio). Participants indicated whether they had ever *experienced* listed

conditions (yes, no, don't know), if they had been *diagnosed* with the condition (yes, no, don't know), and rated how extensive a problem each condition had been for them during prior three months using a 4-point scale (ranging from 0: Never a problem, to 3: Significant problem). Harrison and Stuifbergen (2001) administered the questionnaire to persons living with polio to assess prevalence of secondary health conditions and co-morbidities among polio survivors. The instrument was translated to Yoruba language, back-translated and its contents were validated before being used in this study. The Yoruba version of the instrument was found to be significantly and highly correlated with the original version, having a Spearmann correlation coefficient (p) ranging from 0.826 to 1.000 (perfect correlation) ($p<0.001$).

15. The Borg's Rate of Perceived Exertion (RPE) Scale (Borg, 1982) (Appendix I): This was used to assess participants' perception of the intensity of the six-minute walk test .The instrument is based on a 15- point ordinal scale with a numerical rating between 6 (for no exertion at all) and 20 (for maximal exertion).It has a high correlation with percentage aerobic capacity and has been shown to be a reliable and valid measure of perception of work intensity in both lean and obese individuals and in individuals ranging in activity level from sedentary to very active (Moffat, 2008). The instrument was translated to the Yoruba language, back-translated and its contents were validated before being used in this study.

16. Arm Ergometer (Physio trainer, Taiwan): This was used for upper extremity aerobic training. The ergometer essentially comprises of an in-built pulley, a crank with pedals, and a computerized display panel which automatically displays the workout time, speed during workout, and the distance covered. It is compatible with the polar heart rate monitor, hence, when this is connected to the machine with the aid of a chest belt transmitter, it is possible to programme the target heart rate for each participant. The participant's heart rate would consequently be displayed during the workout and a sound signal would be given whenever the participant is not exercising within the target heart rate. The machine was mounted on a tabletop and secured with clamps such that its pedal axis is at shoulder height for each participant.

17. Wooden table of variable height for mounting the arm ergometer (Plate 3.1): The table comprises two shelves, a sturdy, removable box (shaped like a drawer), and a seat for the participant. The removable box, whose surface serves as the tabletop, is positioned on any of the shelves to vary the height of the table. The height suitable for

PLATE 3.1: Wooden table of variable height

each participant was used at the exercise training session.

3.2.2. Research Venue:

The randomized clinical trial was conducted at participants' different places of work. This was to ensure compliance as majority of the participants were unwilling to leave work thrice weekly for twelve consecutive weeks of the exercise training programme. Four participants (three, who were unemployed, and one who traded at home) however, had their exercise training sessions at home. This is indicated in the raw data.

3.3. METHODS

3.3.1. Sample Size Determination:

The sample size was determined using Cohen's formula (Macfarlane, 2003):

$$N = \frac{n(Z_1 + Z_2)^2}{E\,S^2}$$

Where, N = Sample size,

n = number of groups.

Z_1 = Standard normal deviation value at $\alpha = 0.05 \simeq 1.96$

Z_2 = standard normal deviation value at $\beta = 0.20 \simeq 0.84$

ES (Effect size) = 0.8

$$\text{Thus, } N = \frac{2(1.96 + 0.84)^2}{0.8^2}$$

$$= \frac{2(2.8)^2}{0.8^2} = \frac{15.68}{0.64} = 24.5$$

This gave a minimum of 25 participants each for the experimental and control groups. The attrition rate, estimated as 20% of the total sample size was 10. Thus, the experimental and control groups had additional 5 participants, giving a total of 30 participants per group.

3.3.2. Sampling Technique:

STEP 1: A purposive sampling technique was used to recruit 252 polio survivors in a cross-sectional survey to evaluate their secondary health conditions and co-morbidities.

STEP 2: A computer-generated randomization was used to select 60 participants from those who met the inclusion criteria for the study among the cohort of 252 polio survivors. Figure 3.1 shows the flowchart of participant's recruitment.

To ensure uniform assignment into the exercise and control groups, participants were first stratified based on whether they had unilateral or bilateral lower limb affectation and whether they used assistive walking devices or not. Participants in the different groups were then matched for age and sex. Assignment into either control or an exercise group was done by participants picking coloured cards in the different age and sex groupings. The colour of the card indicated the participant's intervention group (blue indicating the exercise group and red for the control group).

3.3.3. Research Design:

The study was a Randomized Clinical Trial (RCT). This form of design is said to be truly experimental in nature as it is characterized by high levels of control. It is the recommended design for health care research (Domholdt, 2000).

3.3.4. Procedure for Data Collection:

Ethical approval was sought and obtained from the Ethics Committee of the University of Ibadan/ University College Hospital, Ibadan. Permission to recruit participants was also sought and obtained from the Director, Ministry of Women's Affairs and Disability Matters in Oyo State and the authorities of the institutions (homes or schools) where participants were recruited from. Informed consent was sought and obtained from each participant after a thorough explanation on the goals of the study and the procedures involved. Screening, based on the past medical history of participants and objective clinical assessment of their muscles was carried out to confirm the presence of polio before recruitment into the study. The researcher was specifically interested in the following criteria for recruitment:

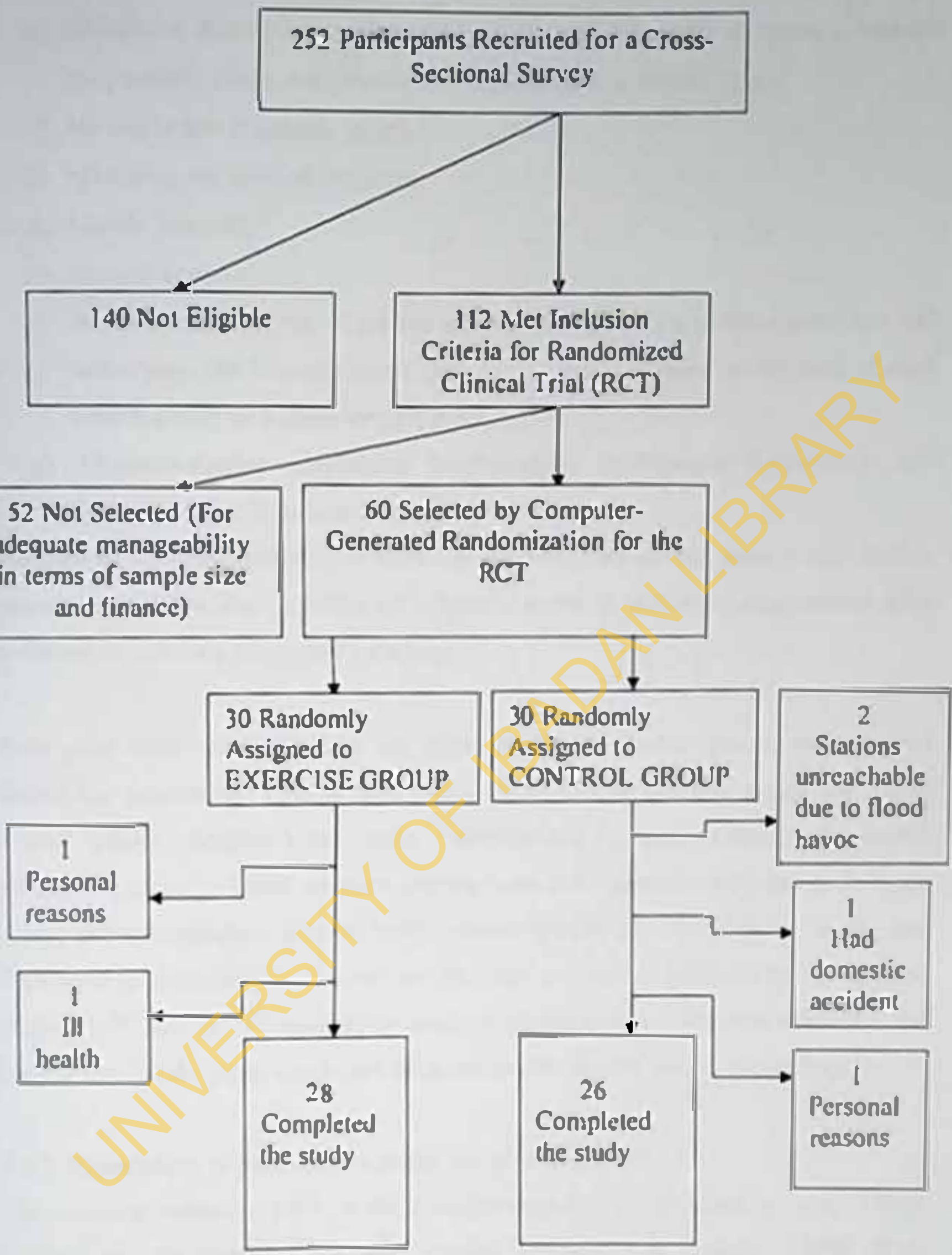

Figure 3.1: Flow Chart of Participants' Recruitment

a) Childhood history of acute onset of flaccid paralysis or paresis without progression, which was preceded by muscle pain or febrile illness,
b) No antecedent traumatic injury,
c) No loss or decrease of sensation,
d) Muscle flaccidity,
e) Marked atrophy,
f) Asymmetric paralysis or paresis of muscles (particularly the quadriceps and adductors). The Oxford muscle grading was used to assess the strength of each muscle group for paresis or paralysis.
g) Musculo-skeletal adaptations (contractures, limb-length discrepancy and deformities due to muscle imbalance).

Participants were recruited only if there was no ambiguity in their history and clinical presentations. Some also provided old hospital documents indicating diagnosis of polio to further corroborate researcher's findings.

Sixty polio survivors (30 each in the experimental and control groups respectively) started the randomized clinical trial, but only 54 (28 in exercise group and 26 in control group) completed the study. Measurement of each participant's health parameters, namely: blood pressure, resting heart rate, percent body fat, body mass index, cardio-respiratory fitness, health-related Quality of Life, general health and depressive symptoms were assessed and recorded at baseline (week 0) and at the ends of the 4th, 8th and the 12th week of the study. A physiotherapist, who was blinded to the participants' study group conducted the assessments, thereby ensuring blinding.

3.3.5. Translation of instruments to the Yoruba language:

The outcome measures used in the study[Dartmouth COOP Chart System (1989), Quality of Life-Multiple Sclerosis Version (Ferrans and Powers, 1985), Beck Depression Inventory(Beck et al.,1961), Tate secondary conditions/comorbidities questionnaire (Tate, 1996 format) and Borg's rate of perceived exertion scale (Borg, 1982)] were translated into the Yoruba language through a forward-backward translation process. The original versions of the instruments were given to two experts in Yoruba language for forward translation after which both compared their versions to identify discrepancies and ambiguous words and thereafter produced a version. An

expert in Yoruba language translated the new version of each instrument back into English language to ensure that it was acceptably comparable to the original instrument. Each of the translated versions were then pilot-tested on 20 bi-lingual polio survivors to ensure that the items were well understood by them before being put to use in the study. To assess the content validity of the Yoruba version of each instrument, both Yoruba and English versions were administered to participants, allowing an interval of one hour between the administration of each version. The Yoruba versions of all the instruments were found to be significantly ($p<0.001$ in all cases) and highly correlated with the original versions. The Spearmann correlation coefficient (ρ) for the Beck Depression Inventory was 0.984 while it ranged from 0.935 to 0.994 for the different sub-scales of Ferrans and Powers Quality of Life Index. For Tate secondary conditions/comorbidities questionnaire, the Spearmann correlation coefficient (ρ) ranged from 0.826 to 1.000 (perfect correlation), while it ranged from 0.769 to 0.956 for the different domains of Dartmouth COOP Chart System.

3.3.6. Measurements:

The following variables were assessed and computed in the study:

i. Body weight: This was measured with participants in light clothing with feet bare. Each participant sat on the platform of the weighing scale, looking straight, while the researcher read off the weight to the nearest kilogramme (Plate 3.2).

ii. Height: Each participant lied bare-footed in supine on a piece of linoleum with the head in the midline position. A ruler (30cm long) was brought into light contact with the vertex of the participant's head, ensuring that it extends to touch the linoleum at same vertical level. A marker was used to highlight this spot on the linoleum. The ruler was again brought in light contact with the heel of participant's longer leg and the spot where the ruler touched the linoleum was also highlighted. Height measurement was taken and recorded in metres as the distance between the two spots highlighted on the linoleum (Hamzat, 2000) (Plate 3.3).

iii. Body Mass Index (BMI):

The body mass index was calculated as the ratio of the weight in kilogrammes to the square of the height in metres.

$$\text{Body Mass Index} = \frac{\text{Weight}}{(\text{Height})^2}$$ (McArdle, 2000).

PLATE 3.2: Weight measurement of a participant

PLATE 3.3: Supine length measurement (proxy for standing height) of a participant

iv.Percent body fat:

This was assessed with the Omron F-302 body fat monitor which measures the percentage and total amount (or mass) of fat contained in the human body in kilogrammes, using the bioelectrical impedance analysis (BIA) method. The manufacturer's instruction manual was adhered to as follows: All metallic objects such as calipers, jewelleries and cell phones were removed, participants had no pacemakers or other implanted devices, and had their hands dry. The personal data of each participant viz: height, weight, age and sex were input through appropriate keys into the fat monitor. The participant stood with both feet slightly apart, leaning against the wall for support, with wooden block of appropriate height used to compensate for limb-length discrepancy where necessary. Participants who could not independently assume the standing posture were assisted to assume the position by strapping them to a tilt-table (Plate 3.4). Such participants were transported to the gymnasium of the Physiotherapy Department of the University College Hospital, Ibadan, Oyo State where the tilt table was used. Each participant was instructed to hold the grip electrodes of the fat monitor by wrapping the fingers around the groove of its handle with shoulders flexed to 90 degrees and both elbow joints in full extension. With the participant maintained in this posture, and movement restricted, the start button of the fat monitor was pressed, and in a few seconds, the percent body fat and total fat mass of the participant were displayed on the screen of the body fat monitor.

v. Resting heart rate and Blood Pressure: Each participant was allowed to rest in sitting for 10 minutes for the heart rate and blood pressure to stabilize. The inflatable cuff of the automated digital sphygmomanometer was then wrapped around the participant's exposed left upper arm, at the same vertical height as the participant's heart (Plate 3.5). On pressing the power knob, the cuff rapidly self-inflated and participant's systolic and diastolic blood pressure and heart rate were subsequently displayed on the screen of the sphygmomanometer after a few seconds. Following the American Heart Association (2005) recommendations, two blood pressure readings were taken, with one minute interval between them. The average of the measurements was recorded as the participant's blood pressure. Additional readings were taken if the

PLATE 3.4: Assessment of percent body fat, with a tilt-table supporting participant in standing posture.

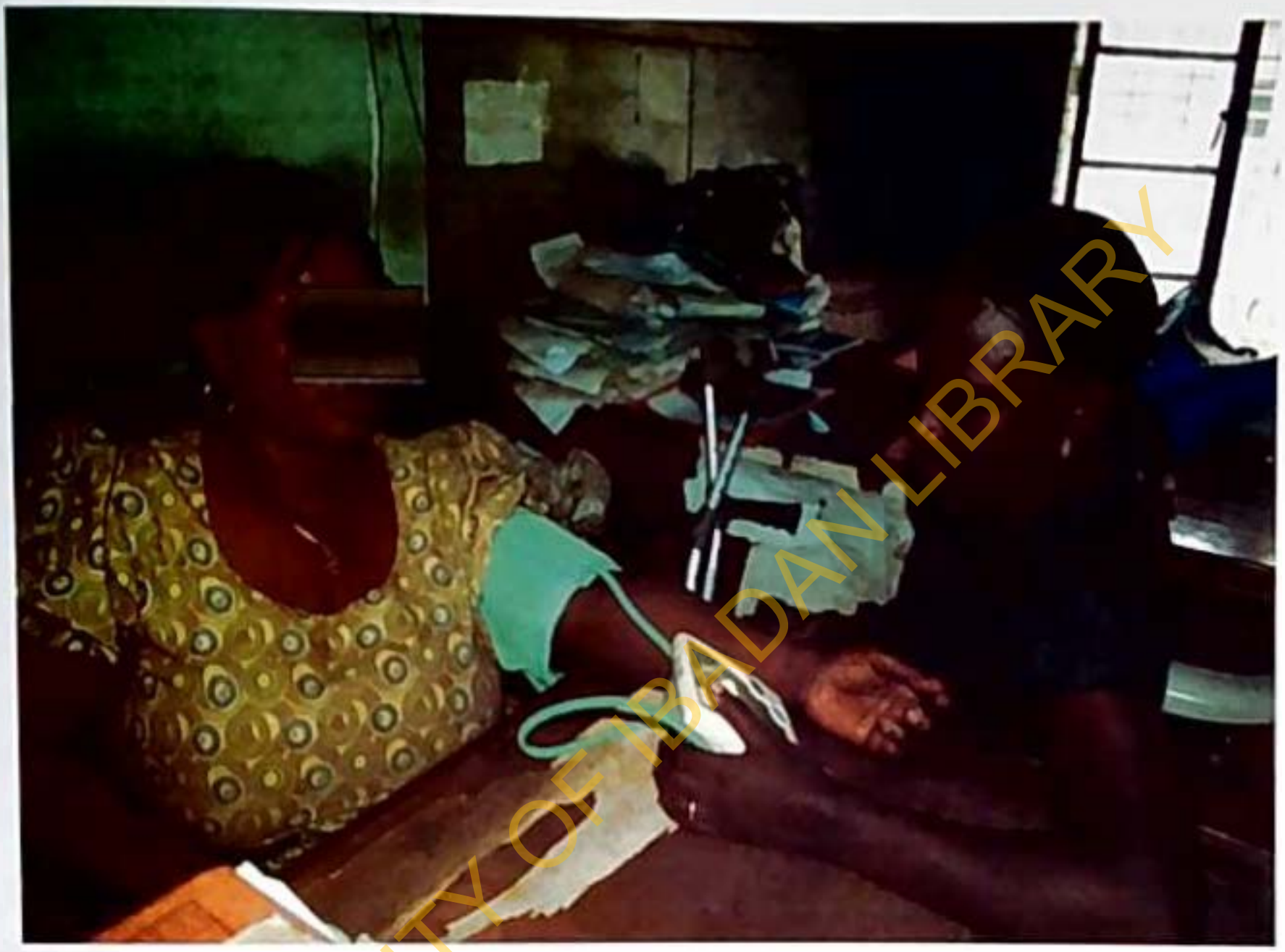

PLATE 3.5: Measurement of participant's blood pressure.

difference between the first two readings was greater than 5 mm Hg and the average found and recorded. The values were confirmed on two or three independent occasions at about same time of the day.

vi. General Health: The general health status of each participant was assessed using the English or Yoruba version of the Dartmouth COOP Chart System (1989). This was self-administered by the literate participants, while it was administered by interview for participants who were uneducated.

vii. Depressive symptoms: Participants' depressive symptoms were assessed using the English or Yoruba version of the Beck Depression Inventory (1961). This was self-administered by the literate participants, while it was administered by interview for participants who were uneducated.

viii. Health – Related Quality of Life: The Health-Related Quality of Life of participants was evaluated with the English or Yoruba version of the Quality of Life Index-Multiple Sclerosis (QLI-MS) Version (Ferrans and Power, 1985). This instrument was self-administered by the literate participants, while it was administered by interview for participants who were uneducated.

ix. Cardio-respiratory Fitness Index (CFRI): The Cardio-respiratory Fitness Index of the participants was assessed with the 6-minute walk-test on a measured, level ground. Each participant was instructed to walk the measured distance as far as possible in 6 minutes, taking as many laps as possible. The researcher walked along, giving standardized words of encouragement every minute (e.g., you are trying, 5 minutes to go, etc.) (Plate 3.6). Participants were allowed to stop and rest if tired, but were not allowed to sit until after the completion of the test, except if they desired to terminate the walk-test at the particular point in time (Moffat, 2008). The total number of laps taken was multiplied by the measured distance, to obtain the total distance covered from the laps, while a non-elastic tape measure was used to measure the remaining fraction. Both measurements were summed and recorded in metres as the distance covered during the 6MWT. The cardio-respiratory fitness index (VO_2 max) for each participant was estimated from the total distance covered, using the ACSM equation (ACSM, 1995).

$$VO_2 \text{ max} = \text{Speed} \times 0.1 \text{ ml } O_2/\text{kg/min}$$

$$\text{Where speed} = \frac{\text{distance covered(metres)}}{6(\text{mins})}$$

PLATE 3.6: Participant carrying out the 6-minute walk test.

3.4. ARM ERGOMETRY TRAINING PROGRAMME

3.4.1. EXERCISE GROUP:

The exercise protocol was in 3 phases:

a) Warm-up,

b) Arm ergometry workout (Main menu),

c) Cool down.

a) WARM-UP PHASE: The goal of this phase was to mildly stretch muscles and increase circulation to muscles and joints in preparation for the training session. It lasted 5 minutes and comprised flexibility exercises of the neck, upper limbs and trunk as follows:

NECK: Neck rotation to the left and right, neck flexion, and neck extension exercises.

UPPER LIMBS: Shoulder shrugs, arm raises (lateral, front and back), shoulder circles, elbow and wrist flexion and extension exercises.

TRUNK: Trunk rotation to the left and right, anterior and side flexion trunk exercises.

For convenience, the flexibility exercises were carried out in comfortable sitting. Participants were encouraged to carry out each flexibility exercise twice, to the limit of movement possible at each joint, while carrying out deep breathing exercises at intervals.

b) ARM ERGOMETRY WORK OUT (Main menu): The goal of this phase was to condition the cardio-respiratory system using the arm ergometer. The equipment was mounted on a tabletop and secured with clamps, while ensuring that the axis of its pedals was at shoulder height for each participant. Participants assumed a comfortable sitting posture close to the arm ergometer from where its pedals were grasped to carry out the cycling motions (Plate 3.7). The ACSM exercise recommendations for polio survivors (Birk, 2003) were adhered to as follows:

Exercise Intensity:

In compliance with the ACSM's recommendation, the exercise intensity for participants ranged from 40-70% of their calculated age-adjusted maximal heart rate (except if fatigue disallowed). The maximal heart rate was estimated as: max HR = 220-Age (Lockette and Keyes, 1994).

PLATE 3.7: A participant undergoing the arm ergometry training

Each participant commenced the arm ergometry training programme at the lower limit of the target exercise intensity (i.e. 40% of max HR). Progression was made every two weeks by ensuring 5% increment in participant's exercise heart rate, and additionally, by increasing the exercise duration by 5 minutes. Progression in the exercise intensity continued until the upper limit of the target exercise intensity (i.e 70% of max HR) was attained. The FT1 polar heart rate monitor was used to keep track of participants' heart rate at each point in time during the training session, as a visual and audible alarm was given whenever participants failed to exercise within their exercise target zones. The researcher controlled the exercise intensity by encouraging participants to modify the speed of pedalling, or by adjusting the resistance on the arm ergometer to produce the desired exercise target heart rate.

Exercise Duration: The initial aerobic exercise duration was within participants' tolerance level, but this was progressively increased by 5 minutes every two weeks until duration of 20 to 30 minutes per exercise session was attained.

Exercise Frequency: Thrice- weekly frequency rate with alternate days of rest was ensured throughout the twelve-week training programme. Table 3.1 shows the arm ergometry training protocol for the exercise group.

c) COOL DOWN PHASE: The goal of this phase was to allow the heart rate and blood pressure to gradually and safely return to their pre- exercise levels. The phase lasted five minutes and each participant was instructed to slowly decrease the rate of pedalling the arm ergometer. Flexibility exercises involving the neck, upper limbs and trunk were also carried out in this phase, interspersed with deep breathing exercises.

3.4.2. CONTROL GROUP: Participants in the control group did not take part in the arm ergometry training, but were also instructed to carry out the same flexibility exercises as for the exercise group as placebo. The flexibility exercises were interspersed with deep breathing exercises and carried out thrice weekly on alternate days for twelve consecutive weeks. No progression was made in their exercise programme. Table 3.2 shows the control group's placebo exercise design for the 12-week period.

TABLE 3.1: EXERCISE GROUP'S ARM ERGOMETRY TRAINING PROTOCOL.

ACTIVITY	TYPE OF EXERCISE	DURATION	INTENSITY	FREQUENCY
WARM UP	FLEXIBILITY EXERCISES NECK: -Neck rotation to the left and right -Neck flexion and extension UPPER LIMBS: -Shoulder shrugs and circles -Arm raises up, to the side, front and back -Elbow flexion and extension -Wrist flexion and extension TRUNK: -Trunk rotation to the right and left -Anterior and side flexion trunk exercise	5 minutes	2-5 repetitions for each exercise to the limit of movement possible, interspersed with deep breathing exercises	3 times weekly (on alternate days) for 12 consecutive weeks
MAIN MENU (AEROBIC EXERCISE WORKOUT)	ARM ERGOMETRY	**WEEK 1-2:** 5-10 minutes (determined by each participant's tolerance level) **WEEK 3-4:** 10-15 minutes **WEEK 5-6:** 15-20 minutes **WEEK 7-8:** 20-25 minutes **WEEK 9-10:** 25-30 minutes **WEEK 11-12:** 25-30 minutes	**WEEK 1-2:** 40-45% of each participant's calculated age-adjusted maximal heart rate (HRmax) **WEEK 3-4:** 45-50% of HRmax **WEEK 5-6:** 50-55% of HRmax **WEEK 7-8:** 55-60% of HRmax **WEEK 9-10:** 60-65% of HRmax **WEEK 11-12:** 65-70% of HRmax	3 times weekly on alternate days
COOL DOWN	Replica of warm up exercises	5 minutes as for warm up	As for warm up	As for warm up

TABLE 3.2: PLACEBO EXERCISE DESIGN FOR THE CONTROL GROUP

ACTIVITY	TYPE OF EXERCISE	DURATION	INTENSITY	FREQUENCY
PLACEBO	FLEXIBILITY EXERCISES NECK: -Neck rotation to the left and right -Neck flexion and extension UPPER LIMBS: -Shoulder shrugs and circles -Arm raises up, to the side, front and back -Elbow flexion and extension -Wrist flexion and extension TRUNK: -Trunk rotation to the right and left -Anterior and side flexion trunk exercise	10 minutes (No progression)	4-10 repetitions for each exercise to the limit of movement possible, interspersed with deep breathing exercises (No progression)	3 times weekly (on alternate days) for 12 consecutive weeks

3.4.3. Precautions for the exercise training programme

Participants were instructed to terminate the exercise sessions if they had shortness of breath, unbearable pain, fatigue, or dizziness. The researcher was present to monitor participants' exercise responses at each training session. A prior arrangement was made at the Emergency Unit of the University College Hospital for provision of immediate medical assistance in the event of untoward exercise reactions. However, none of the participants responded adversely to the exercise training programme.

3.5. DATA ANALYSIS:

1. Participants' socio-demographic characteristics, health variables, and secondary disablement profile were summarized using descriptive statistics of mean, standard deviation, percentages and frequency distribution.
2. The non-parametric Spearmann correlation coefficient was used to assess the content validity of the Yoruba versions of the Dartmouth COOP Chart System, Quality of Life-Multiple Sclerosis Version, Beck Depression Inventory and Tate secondary conditions/comorbidities questionnaire.
3. Repeated measures ANOVA was used for within-group comparison of the heart rate, blood pressure, cardio-respiratory fitness and percent body fat of the experimental and control groups across week 0, week 4, week 8 and week 12 of the study.
4. Friedman's ANOVA was used for within-group comparison of the general health mental health, and health-related quality of life scores of the experimental and control groups across week 0, week 4, week 8 and week 12 of the study.
5. Independent t- test was used to compare changes in heart rate, blood pressure, cardio-respiratory fitness and percent body fat of the experimental and control groups at the time frames of 0/4 week, 4/8 week, 0/8 week, 4/12 week, 8/12 week, and 0/12 week of the study.
6. Mann-Whitney U-test was used to compare changes in the general health, mental health and health-related quality of life scores of the experimental and control groups at the time frames of 0/4 week, 4/8 week, 0/8 week, 8/12 week and 0/12 week of the study.

The alpha-level for the t-test, ANOVA and Mann-Whitney U-test was set at 0.05.

Bonferroni post- hoc analysis with the alpha level set at 0.0125 was used to test for significant changes where repeated measures of ANOVA showed a significant difference.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. RESULTS

4.1.1. PARTICIPANTS

Sixty polio survivors (30 participants each for the experimental and control groups) started the randomized clinical trial, however, only 54 participants (90.0%) (28 experimental and 26 control) completed the study and had their data analyzed. Twenty-nine (53.70%) of the participants were females while 25 (46.30%) were males. Their ages ranged from 26 to 54 years while age of onset of polio was between 1 and 5 years with mean of 3.20±1.34 years. Participants had almost equal distribution between bilateral and unilateral lower limb affectation (n=26 or 48.1% versus n=28 or 59.1% respectively). Different forms of assistive devices were employed by participants for ambulation; however, axillary crutches were most commonly used. Twenty-six of the participants (48.1%) were unmarried. A good proportion had formal education (n=47 or 87.0%) though majority (n=43 or 79.6%) did not go beyond secondary school level. Spinal deformities (n=28 or 51.9%), contractures (n=22 or 40.7%), obesity (n=18 or 33.3%), back pain (n=17 or 31.5%), depression (n=14 or 25.9%) and hypertension (n=12 or 22.2%) were their commonest secondary health conditions/co-morbidities.

Tables 4.1 and 4.2 present the selected physical and socio-demographic characteristics of the participants respectively, while Table 4.3 presents their secondary health conditions/co-morbidities and general health complaints. Frequent telephone reminders and easy accessibility to the exercise training programme were probably responsible for good compliance, as participants were met at their different places of work/vocation for the exercise training sessions except for four participants who had their training sessions at home (three because they were unemployed, and one, because she was trading at home).

TABLE 4.1: PHYSICAL CHARACTERISTICS OF PARTICIPANTS

CHARACTERISTICS	FREQUENCY	PERCENT (%)	CUMULATIVE PERCENT (%)
GENDER			
M	25	46.3	46.3
F	29	53.7	100.0
PARTS AFFECTED			
One lower limb	28	51.9	51.9
Both lower limbs	26	48.1	100.0
MODE OF AMBULATION			
Hand-to knee gait	12	22.2	22.2
Walking stick	9	16.7	38.9
Elbow crutches	13	24.1	63.0
Axillary crutches	20	37.0	100.0
USE OF FULL LENGTH BRACE			
Not used	17	31.5	31.5
Used on one LL	24	44.4	75.9
Used on both LLs	13	24.1	100.0

LL= Lower limb.

TABLE 4.2: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS

VARIABLES	FREQUENCY	PERCENT (%)
MARITAL STATUS		
Single	26	48.1
Married	23	42.6
Divorced	4	7.4
Widowed	1	1.9
	54	100.0
EDUCATION		
Uneducated	7	13.0
Primary school	18	33.3
Secondary school	25	46.3
OND/NCE	2	3.7
HND/1st degree	2	3.7
	54	100.0
ACCOMMODATION		
1 room apartment	27	50.0
2-room apartment	6	11.1
1 room and parlour apartment	19	35.2
> 3 rooms	2	3.7
	54	100.0
MEANS OF TRANSPORTATION		
None	52	96.3
Saloon car	2	3.7
	54	100.0
RELIGION		
Christianity	23	42.6
Islam	31	57.4
	54	100.0
SOCIAL HABITS		
Not taking alcohol/smoking	47	87.0
Taking alcohol	6	11.1
Taking alcohol and smoking	1	1.9
	54	100.0
OCCUPATION		
Unemployed	3	5.6
Self employed(artisans/traders)	37	68.5
Paid employment (private/govt.)	14	25.9
	54	100.0
MONTHLY INCOME		
₦0-4,999.00k	43	79.6
₦5000-9,999.00k	9	16.6
₦10,000-14,999.00k	-	-
₦15,000-19,999.00k	-	-
₦20,000-24,999.00k	-	-
₦25,000-29,999.00k	1	1.9
₦30,000-34,999.00k	-	-
₦35,000-39,999.00k	-	-
₦40,000-44,999.00k	-	-
₦45,000-49,999.00k	1	1.9
₦50,000 and above	-	-
	54	100.0

TABLE 4.3: HEALTH COMPLAINTS AND SECONDARY HEALTH CONDITIONS/CO-MORBIDITIES AMONG PARTICIPANTS

HEALTH COMPLAINT OR CONDITION	FREQUENCY	PERCENT (%)	% DIAGNOSED	% REPORTING MODERATE OR SIGNIFICANT PROBLEM
Spinal deformities	28	51.9	0	25.0 (n=7 of 28)
Require more help for day-to-day tasks	8	14.8	Not applicable	0 (n=0 of 8)
Unwanted weight gain/obesity	18	33.3	0	44.4 (n=8 of 18)
Back pain	17	31.5	17.6 (n=3)	35.3 (n=6 of 17)
Contractures	22	40.7	22.7 (n=5)	40.9 (n=9 of 22)
Upper limb pain due to use of assistive devices	9	16.7	0	0 (n=0 of 9)
Periods of depression	14	25.9	0	0 (n=0 of 14)
Problem making or seeing friends	17	31.5	Not applicable	41.2 (n=7 of 17)
Chronic pain in muscles or joints	8	14.8	12.5 (n=1)	0 (n=0 of 8)
Reduced ability to carry out activities of daily living	6	11.1	Not applicable	16.7 (n=1 of 6)
Lack of romantic relationship	31	57.4	Not applicable	58.1 (n=18 of 31)
Serious episodes of anxiety	16	29.6	0	50.0 (n=8 of 16)
Episodes of fall or other injuries	6	11.1	Not applicable	0 (n=0 of 6)
Sensitivity to temperature in the extremities	2	3.7	0	0 (n=0 of 2)
New muscle weakness in previously weak muscles	4	7.4	0	25.0 (n=1 of 4)
Feelings of being isolated	21	38.9	Not applicable	52.4 (n=11 of 21)
New muscle weakness in previously strong muscles	2	3.7	0	0 (n= of 2)
Pins and needles sensation in the hands	0	0	0	0 (n=0 of 0)
Sleep problems	8	14.8	0	25.0 (n=2 of 8)
Increased thirst	1	1.9	Not applicable	0 (n=0 of 1)
Hypertension	12	22.2	100 (n=12)	66.7 (n=8 of 12)
Fractures	0	0	0	0 (n=0 of 0)
Diabetes	1	1.9	100 (n=1)	100.0 (n=1 of 1)

TABLE 4.3: HEALTH COMPLAINTS AND SECONDARY HEALTH CONDITIONS/CO-MORBIDITIES AMONG PARTICIPANTS

HEALTH COMPLAINT OR CONDITION	FREQUENCY	PERCENT (%)	% DIAGNOSED	% REPORTING MODERATE OR SIGNIFICANT PROBLEM
Spinal deformities	28	51.9	0	25.0 (n=7 of 28)
Require more help for day-to-day tasks	8	14.8	Not applicable	0 (n=0 of 8)
Unwanted weight gain/obesity	18	33.3	0	44.4 (n=8 of 18)
Backpain	17	31.5	17.6 (n=3)	35.3 (n=6 of 17)
Contractures	22	40.7	22.7 (n=5)	40.9 (n=9 of 22)
Upper limb pain due to use of assistive devices	9	16.7	0	0 (n=0 of 9)
Periods of depression	14	25.9	0	0 (n=0 of 14)
Problem making or seeing friends	17	31.5	Not applicable	41.2 (n=7 of 17)
Chronic pain in muscles or joints	8	14.8	12.5 (n=1)	0 (n=0 of 8)
Reduced ability to carry out activities of daily living	6	11.1	Not applicable	16.7 (n=1 of 6)
Lack of romantic relationship	31	57.4	Not applicable	58.1 (n=18 of 31)
Serious episodes of anxiety	16	29.6	0	50.0 (n=8 of 16)
Episodes of fall or other injuries	6	11.1	Not applicable	0 (n=0 of 6)
Sensitivity to temperature in the extremities	2	3.7	0	0 (n=0 of 2)
New muscle weakness in previously weak muscles	4	7.4	0	25.0 (n=1 of 4)
Feelings of being isolated	21	38.9	Not applicable	52.4 (n=11 of 21)
New muscle weakness in previously strong muscles	2	3.7	0	0 (n= of 2)
Pins and needles sensation in the hands	0	0	0	0 (n=0 of 0)
Sleep problems	8	14.8	0	25.0 (n=2 of 8)
Increased thirst	1	1.9	Not applicable	0 (n=0 of 1)
Hypertension	12	22.2	100 (n=12)	66.7 (n=8 of 12)
Fractures	0	0	0	0 (n=0 of 0)
Diabetes	1	1.9	100 (n=1)	100.0 (n=1 of 1)

4.1.2. CHARACTERISTICS OF PARTICIPANTS

The mean age, weight, height, body mass index, percent fat, resting systolic blood pressure, resting diastolic blood pressure, resting heart rate, Beck depression inventory scores, cardio- respiratory fitness scores and quality of life (QoL) scores of participants in the experimental group were 38.43±6.97 years, 52.09±13.43kg, 1.46±0.12m, 24.95±7.03kg/m^2, 28.51±11.89%, 127±7.78mmHg, 78.54±8.33mmHg, 80.50±7.06 beats/min, 7.49±7.21, 3.33±0.81 ml O$_2$/kg/min and 20.07±1.01 respectively, while the mean age, weight, height, body mass index, percent fat, resting systolic blood pressure, resting diastolic blood pressure, resting heart rate, Beck depression inventory scores, cardio-respiratory fitness scores and quality of life (QoL) scores for the control group were 38.08±5.75years, 51.63±10.53kg, 1.48±0.12m, 23.70±4.45kg/m^2, 28.17±5.62%, 127.85±7.78mmHg, 78.85±3.73mmHg, 79.12±8.04 beats/min, 9.00±6.39, 3.35±1.41ml O$_2$/kg/min and 21.05±0.81 respectively. Independent t-test at α =0.05 did not show any significant difference between the mean age (p=0.840), weight (p=0.890), height (p=0.604), BMI (p=0.436), percent fat (p=0.896), resting systolic blood pressure (p=0.951), resting diastolic blood pressure (0.862), resting heart rate (0.504), Beck depression inventory scores (p=0.213), cardio-respiratory fitness scores (0.956) and quality of life (QoL) scores (p=0.121) of participants in both groups (Table 4.4).

4.1.3. COMPARISON OF THE CARDIOVASCULAR PARAMETERS OF PARTICIPANTS IN THE EXPERIMENTAL AND CONTROL GROUPS AT BASELINE, WEEK 4, WEEK 8 AND WEEK 12 OF THE STUDY

Heart Rate. The mean heart rates of the experimental group were 80.50±7.06 beats/min, 78.79±7.73 beats/min, 76.11± beats/min and 73.54±1.99 beats/min at baseline, end of the 4th week, end of the 8th week and end of the 12th week of the study respectively, while that of the control group were 79.12±8.04 beats/min, 78.69±7.45 beats/min, 78.77±6.62 beats/min and 79.31±6.24 beats/min respectively at baseline, end of the 4th week, end of the 8th week and end of the 12th week of the study. Independent t-test at α =0.05 showed that the groups' heart rate were not significantly different at each of the time points of the study (Table 4.5). The trends of the heart rate of the experimental and control groups are presented in Figure 4.1. There was a short-

TABLE 4.4: CHARACTERISTICS OF PARTICIPANTS

Variables	Group		t-value	p-value
	Experimental n=28 Mean±SD	Control n=26 Mean±SD		
Age (years)	38.43±6.97	38.08±5.75	0.042	0.840
Height (m)	1.46±0.12	1.48±0.12	-0.034	0.604
Weight (Kg)	52.09±13.43	51.63±10.53	0.028	0.890
BMI (Kg/m^2)	24.95±7.03	23.70±4.45	0.022	0.436
Percent fat (%)	28.51±11.89	28.17±5.62	-0.132	0.896
RestiogSBP(mmHg)	127±7.78	127.85±7.78	0.062	0.951
RestingDBP(mmHg)	78.54±8.33	78.85±3.73	0.174	0.862
HR(beats/min)	80.50±7.06	79.12±8.04	-0.674	0.504
BDI scores	7.49±7.21	9.00±6.39	0.806	0.213
VO_2max (ml O_2/kg/min)	3.33±0.81	3.35±1.41	-0.054	0.956
QoL scores	20.07±1.01	21.05±0.81	0.785	0.121

BMI= Body mass index SBP=Systolic blood pressure DBP=Diastolic blood pressure

HR=Heart rate BDI =Beck depression inventory

VO_2 max = Index of cardio-respiratory fitness QoL=Quality of life

p = 0.05

TABLE 4.5: COMPARISON OF SELECTED HEALTH VARIABLES OF PARTICIPANTS AT WEEK 0, WEEK 4, WEEK 8 AND WEEK 12 OF THE STUDY.

Variables	Time frame	Group: Experimental (n = 28) Mean±SD	Group: Control (n = 26) Mean±SD	t-value	p-value
HR (beats/min)	Week 0	80.5±7.06	79.12±8.04	-0.674	0.504
	Week 4	78.79±7.73	78.69±7.45	-0.699	0.408
	Week 8	76.11±6.00	78.77±6.62	-1.282	0.207
	Week 12	73.54±4.99	79.31±6.24	-0.959	0.305
SBP (mmHg)	Week 0	127.71±7.78	127.85±7.78	0.062	0.951
	Week 4	126.21±6.33	126.96±7.43	0.045	0.806
	Week 8	124.07±6.68	126.62±7.35	1.703	0.062
	Week 12	121.50±6.29	126.69±7.18	3.764	0.004*
DBP (mmHg)	Week 0	78.54±8.33	78.85±3.73	0.174	0.862
	Week 4	77.25±7.30	78.15±3.12	0.282	0.511
	Week 8	73.18±6.10	77.69±3.15	0.929	0.480
	Week 12	71.36±4.98	77.54±3.39	1.465	0.100
PBF (%)	Week 0	28.51±11.89	28.17±5.62	-0.132	0.896
	Week 4	27.04±11.68	28.85±5.96	-0.771	0.420
	Week 8	25.46±11.46	29.45±5.99	-1.525	0.071
	Week 12	23.43±11.24	30.52±6.01	2.856	0.001*
VO_2max ($mlO_2/kg/min$)	Week 0	3.33±0.81	3.35±1.43	-0.055	0.956
	Week 4	3.47±0.84	3.38±1.40	0.287	0.776
	Week 8	3.72±0.92	3.30±1.41	1.305	0.198
	Week 12	4.04±0.93	3.19±1.39	2.657	0.010*

*Significant difference between experimental and control groups at α=0.05

HR=heart rate, SBP=systolic blood pressure, DBP=diastolic blood pressure,

PBF= percent body fat,

VO_2max= maximal oxygen consumption (index of cardio-respiratory fitness).

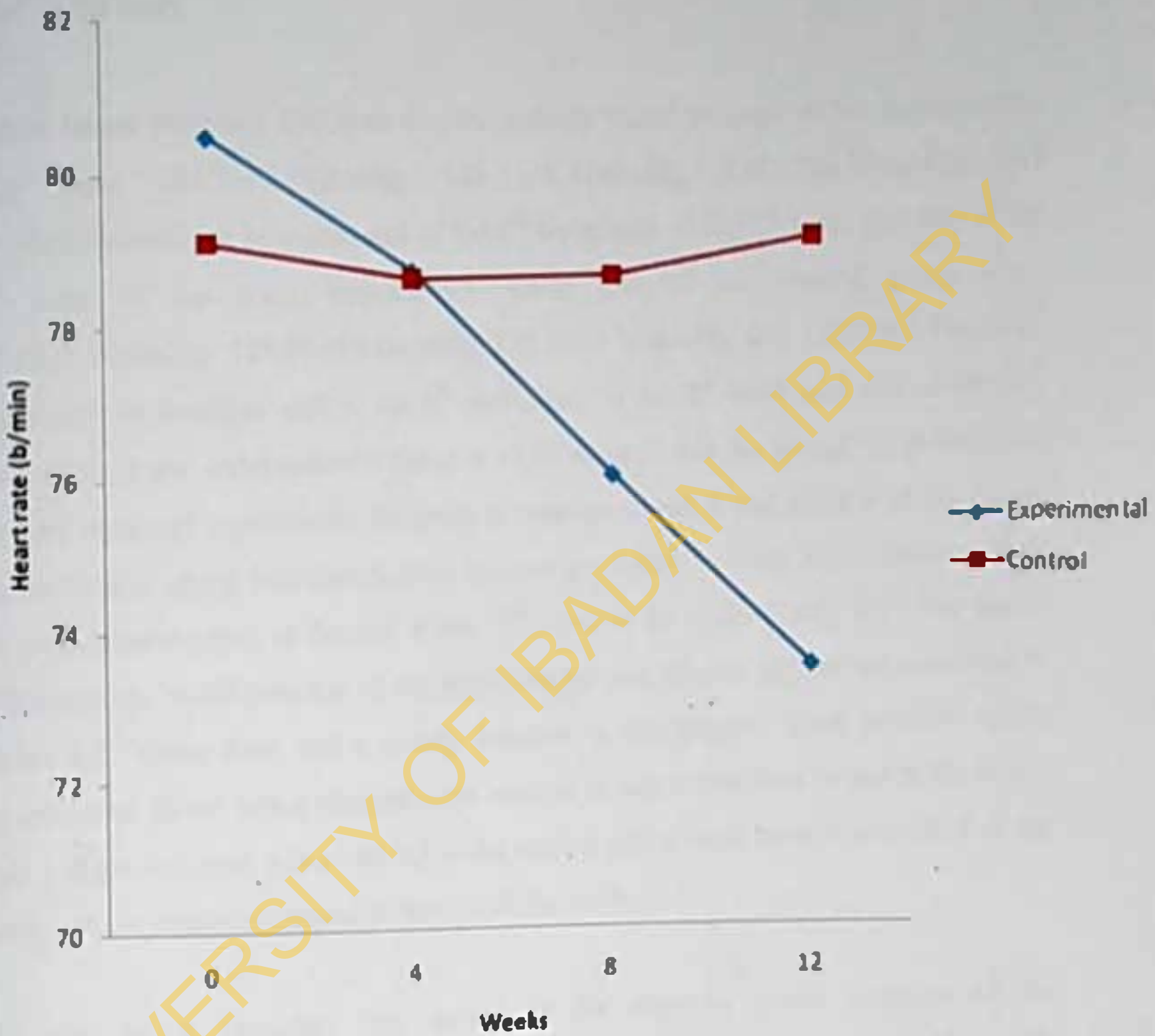

FIGURE 4.1: Heart rate of participants across the four time frames of the study

lived, slight decrease in the heart rate of the control group between week 0 and week 4, followed by a slight increase between week 8 and week 12, while there was a sustained, steady decrease in the heart rate of the experimental group throughout the period of the study.

Systolic Blood Pressure: The means of the systolic blood pressure of the experimental group were 127.71±7.78mmHg, 126.21±6.33mmHg, 124.07±6.68mmHg and 121.50±6.29mmHg at baseline, end of the 4th week, end of the 8th week and end of the 12th week of the study respectively, while that of the control group were 127.85±7.78mmHg, 126.96±7.43mmHg, 126.62±7.35mmHg and 126.69±7.18mmHg respectively at baseline, end of the 4th week, end of the 8th week and end of the 12th week of the study. Independent t-test at $\alpha = 0.05$ showed that the groups' systolic blood pressure were not significantly different at baseline, week 4 and week 8 of the study, but the control group had significantly greater ($p = 0.004$) systolic blood pressure than the experimental group at the end of the 12th week of the study (Table 4.5). The trends of the systolic blood pressure of the experimental and control groups are presented in Figure 4.2. While there was a steady decrease in the systolic blood pressure of the experimental group which became more marked in successive time points of the study, only a slight decrease was observed in the control group from week 0 to week 8 of the study, which almost plateaued at the end of the study.

Diastolic Blood Pressure: The means of the diastolic blood pressure of the experimental group were 78.54 ±8.33mmHg, 77.25±7.30mmHg, 73.18±6.10 mmHg and 71.36±4.98mmHg at baseline, end of the 4th week, end of the 8th week and end of the 12th week of the study respectively, while that of the control group were 78.85±3.73mmHg, 78.15±3.12mmHg, 77.69±3.15mmHg and 77.54±3.39mmHg respectively at baseline, end of the 4th week, end of the 8th week and end of the 12th week of the study respectively. Independent t-test at $\alpha = 0.05$ showed that the groups' diastolic blood pressure were not significantly different at each of the four time points in the study (Table 4.5). The trends of the diastolic blood pressure of the experimental and control groups are presented in Figure 4.3. While there was a substantial steady decrease in the diastolic blood pressure of the experimental group all through the four

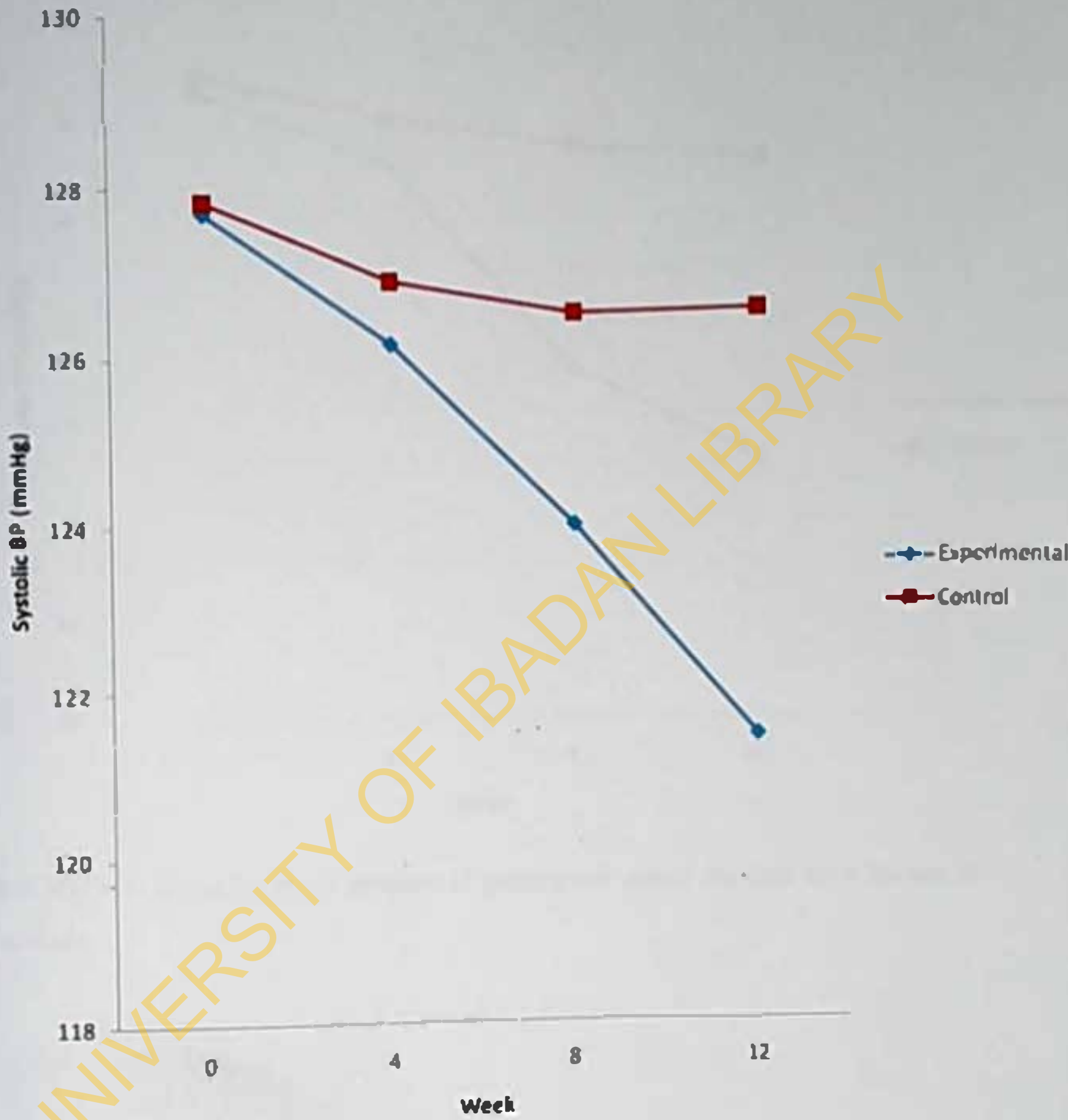

FIGURE 4.2: Systolic blood pressure of participants across the four time frames of the study

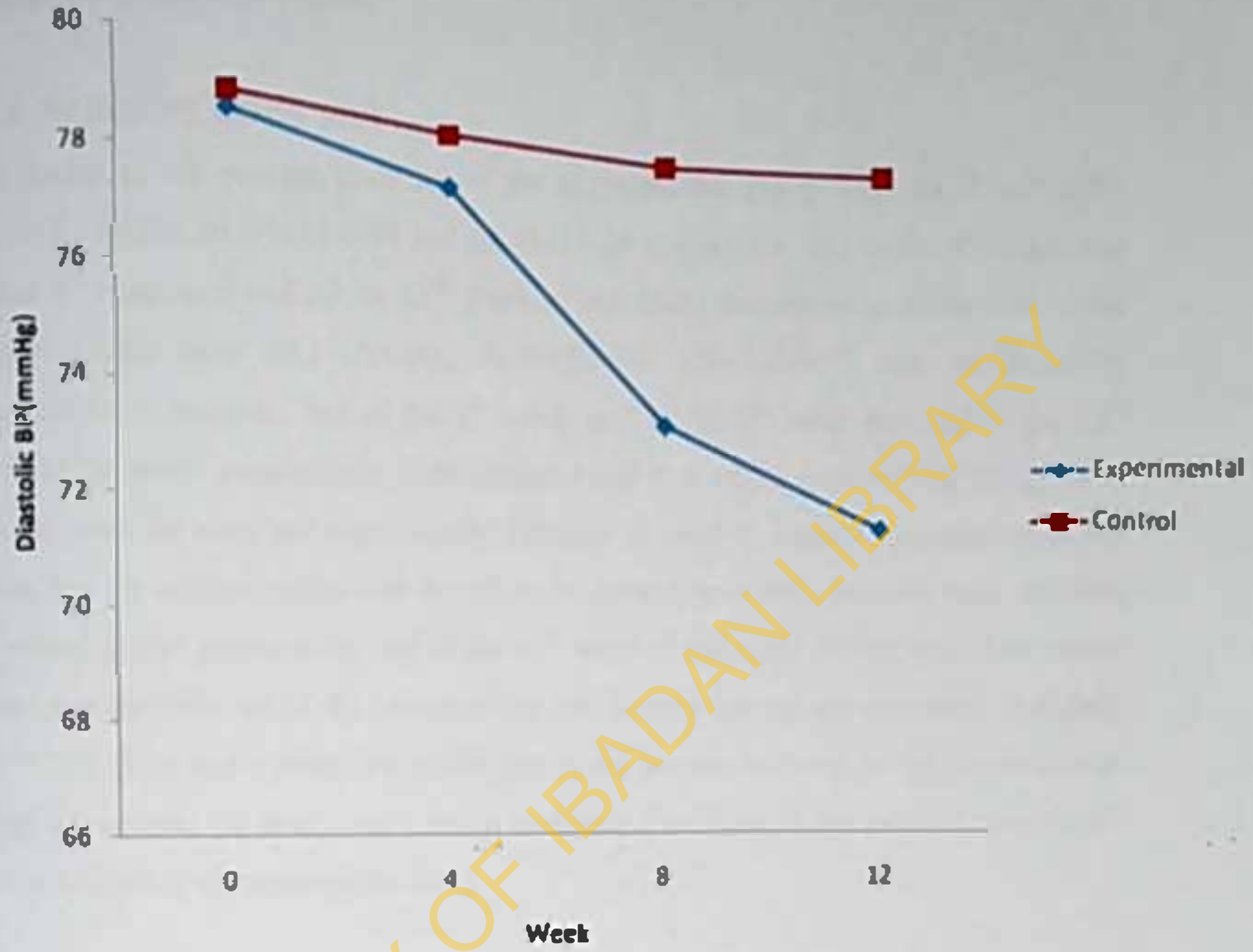

FIGURE 4.3: Diastolic blood pressure of participants across the four time frames of the study

time points of the study, there was only a slight decrease observed in the control group through the entire time period.

4.1.4. PERCENT BODY FAT

The means of the percent body fat of the experimental group were 28.51 ±11.89%, 27.04±7.11.68%, 25.46±11.46% and 23.43±11.24 at baseline, end of the 4th week, end of the 8th week and end of the 12th week of the study respectively, while that of the control group were 28.17±5.62%, 28.85±5.96%, 29.45±5.99% and 30.52±6.01% respectively at baseline, end of the 4th week, end of the 8th week and end of the 12th week of the study respectively. Independent t-test at α =0.05 showed that the groups' percent body fat were not significantly different at week 0, week 4 and week 8 of the study, but the control group had significantly greater (p=0.001) percent body fat than the experimental group at the end of the 12th week of the study (Table 4.5). The trends of the percent body fat of the experimental and control groups are presented in Figure 4.4. While there was a progressive decrease in the percent body fat of the experimental group throughout the study, there was a contrasting increase in the percent body fat of the control group throughout the study.

4.1.5. PARTICIPANTS' CARDIO-RESPIRATORY FITNESS

The mean maximal oxygen consumption (VO_2max) of the experimental group were 3.33±0.81mlO_2/kg/min, 3.47±0.84mlO_2/kg/min, 3.72±0.92mlO_2/kg/min, 4.04±0.93 mlO_2/kg/min at baseline, end of the 4th week, end of the 8th week and end of the 12th week of the study respectively, while that of the control group were 3.35±1.43 mlO_2/kg/min, 3.38±1.40mlO_2/kg/min, 3.30±1.41mlO_2/kg/min, 3.19±1.39 mlO_2/kg/min,at baseline, end of the 4th week, end of the 8th week and end of the 12th week of the study respectively. Independent t-test at α =0.05 showed that the groups' cardio-respiratory fitness scores were not significantly different at all the four time points of the study (Table 4.5). The trends of the cardio-respiratory fitness of the experimental and control groups are presented in Figure 4.5. While there was a steady increase in the cardio-respiratory fitness of the experimental group through the four time points of the study, decreases were conversely observed in the control group at the time points of the study.

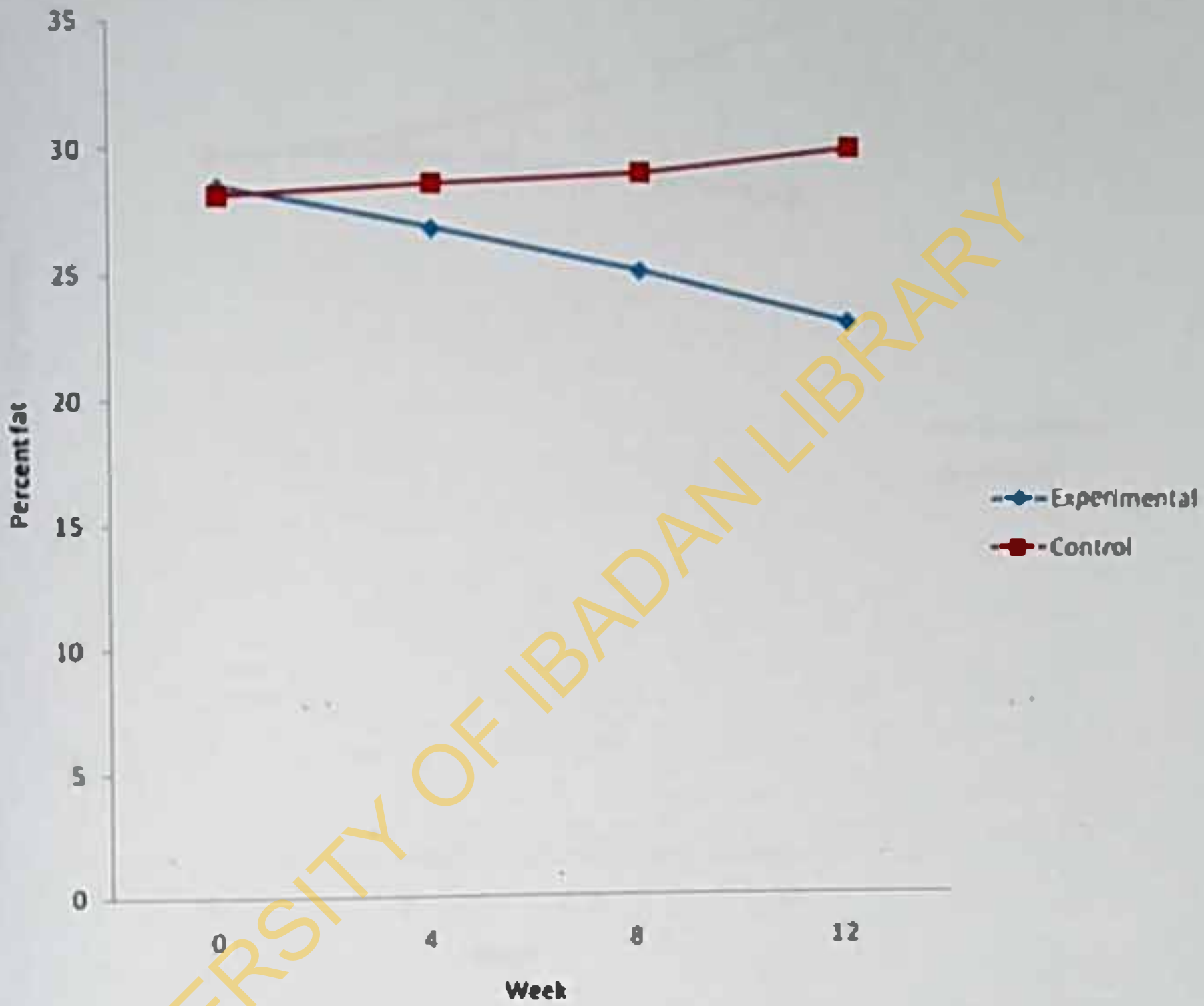

FIGURE 4.4: Percent body fat of participants across the four time frames of the study

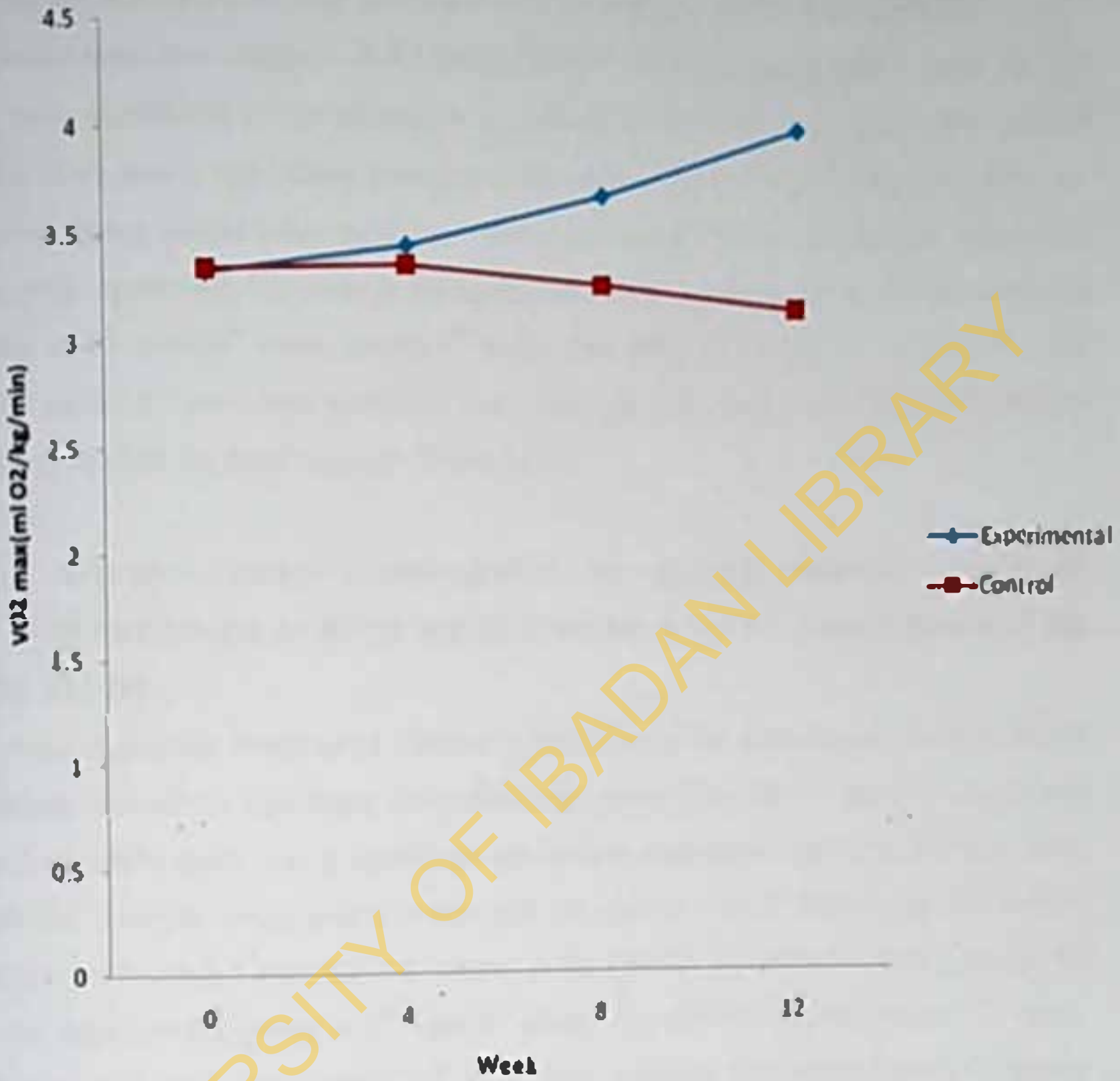

FIGURE 4.5: Cardio-respiratory fitness of participants across the four time frames of the study.

4.1.6. WITHIN-GROUP COMPARISON OF PARTICIPANTS' HEART RATE ACROSS WEEK 0, WEEK 4, WEEK 8 AND WEEK 12 OF THE STUDY

Repeated measures Analysis of Variance (ANOVA) of the participants' heart rate did not show significant group difference (p=0.410), but the test was significant for time while there was a significant group-time interaction (p<0.001) (Table 4.6). Post-hoc analysis using paired t-test with the α-level set at 0.0125 by Bonferroni adjustment indicated significant decreases in the heart rates of the participants in the experimental group at 4th week/8th week, 0week/8th week, 4th week/12th week, 8th week/12th week and 0 week/12th week time intervals. The control group however showed no significant difference at all the time intervals (Table 4.7).

4.1.7. WITHIN-GROUP COMPARISON OF PARTICIPANTS' SYSTOLIC BLOOD PRESSURE ACROSS WEEK 0, WEEK 4, WEEK 8 AND WEEK 12 OF THE STUDY

Repeated measures Analysis of Variance (ANOVA) of the participants' systolic blood pressure showed no significant group difference (p=0.504), but the test was significant for time while there was a significant group-time interaction (p<0.001) (Table 4.8). Post-hoc analysis using paired t-test with the α-level set at 0.0125 by Bonferroni adjustment indicated significant decreases in the systolic blood pressure of participants in the experimental group at 4th week/8th week, 0week/8th week, 4th week/12th week, 8th week/12th week and 0 week/12th week time intervals. The control group however did not differ significantly in their systolic blood pressure at any of the time intervals (Table 4.9).

4.1.8. WITHIN-GROUP COMPARISON OF PARTICIPANTS' DIASTOLIC BLOOD PRESSURE ACROSS WEEK 0, WEEK 4, WEEK 8 AND WEEK12 OF THE STUDY

Repeated measures Analysis of Variance (ANOVA) of the participants' diastolic blood pressure demonstrated no significant group difference (p=0.417), but the test was significant for time while there was a significant group-time interaction (p<0.001) (Table 4.10). Post-hoc analysis using paired t-test with the α-level set at 0.0125 by Bonferroni adjustment indicated significant decreases in the diastolic blood pressure of participants in the experimental group at 4th week/8th week, 0week/8th week, 4th

TABLE 4.6: REPEATED MEASURE ANALYSIS OF PARTICIPANTS' HEART RATE ACROSS THE FOUR TIME FRAMES

Source	Type 111 Sum of square	Mean square	Df	F	P
Between Subjects					
Group	116.712	116.712	1	0.691	0.410
Error	8783.163	168.907	52		
Within Subjects					
Time	464.969	464.969	1	16.332	<0.001*
Group x time	509.413	509.413	1	17.894	<0.001*
Error	1480.397	28.469	52		

*Significant difference at α=0.05

TABLE 4.7: POST-HOC ANALYSIS OF PARTICIPANTS' HEART RATE ACROSS THE FOUR TIME FRAMES OF THE STUDY

	Experimental			Control		
Week	Mean difference	t-value	P	Mean difference	t-value	P
0 vs 4	2.79	1.978	0.014	0.42	-0.633	0.437
4 vs 8	2.68	3.157	0.004*	-0.08	-0.228	0.821
0 vs 8	5.46	4.093	<0.001*	0.35	0.567	0.575
4 vs 12	5.25	4.864	<0.001*	-0.62	-1.424	0.178
8 vs 12	2.57	3.935	0.001*	-0.54	-1.549	0.134
0 vs 12	8.04	6.324	<0.001*	-0.19	-0.278	0.784

*Indicates significant difference between pair of weeks at α= 0.0125

TABLE 4.8: REPEATED MEASURE ANALYSIS OF PARTICIPANTS' SYSTOLIC BLOOD PRESSURE ACROSS THE FOUR TIME FRAMES

Source	Type III Sum of squares	Mean square	Df	F	P
Between Subjects					
Group	121.33	121.333	1	0.453	0.504
Error	13926.88	267.83	52		
Within Subjects					
Time	181.96	181.962	1	8.99	0.004*
Group x time	466.96	466.962	1	23.08	<0.001*
Error	1052.22	20.235	52		

*Significant difference at α=0.05

TABLE 4.9: POST-HOC ANALYSIS OF PARTICIPANTS' SYSTOLIC BLOOD PRESSURE ACROSS THE FOUR TIME FRAMES OF THE STUDY

	Experimental			Control		
Week	Mean difference	t-value	P	Mean difference	t-value	P
0 vs 4	1.50	2.583	0.016*	0.92	-0.792	0.241
4 vs 8	2.14	3.297	0.003*	-1.12	-1.598	0.142
0 vs 8	3.64	5.190	<0.001*	-0.19	-0.306	0.798
4 vs 12	4.71	6.003	<0.001*	-2.08	-3.768	0.036
8 vs 12	2.57	3.864	0.001*	-0.96	-2.682	0.063
0 vs 12	6.21	9.072	<0.001*	-1.15	-0.805	0.164

*Indicates significant difference between pair of weeks at α= 0.0125

TABLE 4. 10: REPEATED MEASURE ANALYSIS OF PARTICIPANTS' DIASTOLIC BLOOD PRESSURE ACROSS THE FOUR TIME FRAMES

Source	Type III Sum of squares	Mean square	df	F	P
Between Subjects					
Group	94.07	94.07	1	0.670	0.417
Error	7303.77	140.46	52		
Within Subjects					
Time	429.41	429.41	1	14.37	<0.001*
Group x time	497.46	497.46	1	16.65	<0.001*
Error	1553.48	29.88	52		

*Significant difference at α=0.05

week/12th week and 0 week/12th week time intervals. There was however no significant difference in the diastolic pressure of the control group across all the time intervals (Table 4.11).

4.1.9. WITHIN-GROUP COMPARISON OF PARTICIPANTS' PERCENT BODY FAT ACROSS WEEK 0, WEEK 4, WEEK 8 AND WEEK12 OF THE STUDY

Repeated measures Analysis of Variance (ANOVA) of the participants' percent body fat did not show significant group difference ($p=0.083$) but the test was significant for time while there was a significant group-time interaction ($p<0.001$) (Table 4.12). Post-hoc analysis using paired t-test with the α-level set at 0.0125 by Bonferroni adjustment revealed significant decreases in the percent body fat of participants in the experimental group across all the time frames of the study. Similarly, there were significant increases in the percent fat of the control group at the 4th week/8th week, 0week/8th week, 4th week/12th week, 8th week/12th week and 0 week/12th week time intervals (Table 4.13).

4.1.10. WITHIN-GROUP COMPARISON OF PARTICIPANTS' CARDIO-RESPIRATORY FITNESS SCORE ACROSS WEEK 0, WEEK 4, WEEK 8 AND WEEK 12 OF THE STUDY

Repeated measures Analysis of Variance (ANOVA) of the participants' cardio-respiratory fitness scores (VO_2max) showed no significant group difference ($p=0.822$) but the test was significant for time and there was significant group-time interaction ($p<0.001$) (Table 4.14). Post-hoc analysis using paired t-test with the α-level set at 0.0125 by Bonferroni adjustment showed significant increases in the cardio-respiratory fitness scores of participants in the experimental group across all the time frames of the study. There were however significant decreases in the cardio-respiratory fitness scores of participants in the control group at the 4th week/12th week, 8th week/12th week and 0 week/12th week time intervals (Table 4.15).

TABLE 4.11: POST-HOC ANALYSIS OF PARTICIPANTS' DIASTOLIC BLOOD PRESSURE ACROSS THE FOUR TIME FRAMES OF THE STUDY

Week	Experimental			Control		
	Mean difference	t-value	P	Mean difference	t-value	P
1 vs 4	1.29	1.581	0.125	-0.58	-1.248	0.522
1 vs 8	4.07	5.556	<0.001*	0.38	-1.401	0.395
0 vs 8	5.36	5.075	<0.001*	-0.19	-0.581	0.843
4 vs 12	5.89	4.998	<0.001*	0.00	-0.280	1.000
8 vs 12	1.82	2.421	0.067	-0.38	-1.505	0.376
0 vs 12	7.18	6.952	<0.001*	-0.58	-0.982	0.604

*Indicates significant difference between pair of weeks at α= 0.0125

TABLE 4.11: POST-HOC ANALYSIS OF PARTICIPANTS' DIASTOLIC BLOOD PRESSURE ACROSS THE FOUR TIME FRAMES OF THE STUDY

	Experimental			Control		
Week	Mean difference	t-value	P	Mean difference	t-value	P
0 vs 4	1.29	1.581	0.125	-0.58	-1.248	0.522
4 vs 8	4.07	5.556	<0.001*	0.38	-1.401	0.395
0 vs 8	5.36	5.075	<0.001*	-0.19	-0.581	0.843
4 vs 12	5.89	4.998	<0.001*	0.00	-0.280	1.000
8 vs 12	1.82	2.421	0.067	-0.38	-1.505	0.376
0 vs 12	7.18	6.952	<0.001*	-0.58	-0.982	0.604

*Indicates significant difference between pair of weeks at α= 0.0125

TABLE 4.12: REPEATED MEASURE ANALYSIS OF PARTICIPANTS' PERCENT BODY FAT ACROSS THE FOUR TIME FRAMES

Source	Type III Sum of squares	Mean square	Df	F	P
Between Subjects					
Group	1443.71	1443.71	1	3.12	0.083
Error	24032.86	462.17	52		
Within Subjects					
Time	69.55	69.55	1	20.78	<0.001*
Group x time	375.32	375.32	1	112.15	<0.001*
Error	174.02	3.35	52		

*Significant difference at α=0.05

TABLE 4.13: POST-HOC ANALYSIS OF PARTICIPANTS' PERCENT BODY FAT ACROSS THE FOUR TIME FRAMES OF THE STUDY

	Experimental			Control		
Week	Mean difference	t-value	P	Mean difference	t-value	P
0 vs 4	1.47	8.511	<0.001*	-0.65	-1.396	0.015
4 vs 8	1.58	4.582	<0.001*	-0.52	-3.450	0.003*
0 vs 8	3.05	8.213	<0.001*	-1.17	-5.907	<0.001*
4 vs 12	3.61	7.687	<0.001*	-1.40	-5.815	<0.001*
8 vs 12	2.04	11.884	<0.001*	-0.88	-8.396	<0.001*
0 vs 12	5.08	13.304	<0.001*	-2.06	-9.102	<0.001*

*Indicates significant difference between pair of weeks at α = 0.0125

TABLE 4.14: REPEATED MEASURE ANALYSIS OF CARDIO-RESPIRATORY FITNESS OF PARTICIPANTS ACROSS THE FOUR TIME FRAMES OF THE STUDY

Source	Type III Sum of squares	Mean square	Df	F	p
Between Subjects					
Group	2507.573	2507.573	1	778.726	<0.001*
Error	164.225	3.220	52		
Within Subjects					
Time	5.769	5.769	1	2.61	<0.001*
Group x time	4.402	4.402	1	95.67	<0.001*
Error	1.468	1.468	52		

*Significant difference at α=0.05

TABLE 4.15: POST-HOC ANALYSIS OF CARDIO-RESPIRATORY FITNESS OF PARTICIPANTS ACROSS THE FOUR TIME FRAMES OF THE STUDY

	Experimental			Control		
Week	Mean difference	t-value	p	Mean difference	t-value	p
0 vs 4	-0.14	-5.417	<0.001*	-0.03	-0.998	0.328
4 vs 8	-0.25	-5.429	<0.001*	0.08	2.537	0.018
0 vs 8	-0.39	-7.522	<0.001*	0.05	1.426	0.166
4 vs 12	-0.56	-10.663	<0.001*	0.20	5.112	<0.001*
8 vs 12	-0.32	-8.458	<0.001*	0.11	3.382	0.002*
0 vs 12	-0.70	-11.842	<0.001*	0.16	3.871	0.001*

*Indicates significant difference between pair of weeks at α= 0.0125

4.1.11. PARTICIPANTS' GENERAL HEALTH SCORES ACROSS WEEK 0, WEEK 4, WEEK 8 AND WEEK 12 OF THE STUDY

Within-group comparison of participants' general health using Friedmann's ANOVA showed significant decrease (implying improvement) in all the domains for the experimental group (p is <0.001, 0.002, 0.011, 0.001, <0.001, 0.044, 0.011 and 0.002 for the feelings, daily activities, social activities, pain, change in health, overall health, social support and quality of life (QoL) domains respectively). Significant decrease (implying improvement) was also seen in the feelings and pain domains (p= 0.044 and 0.003 respectively) for the control group (Table 4.16). Mann Whitney-U test however, showed that participants in the experimental group were significantly better in the daily activities domain at week 4th/8th (p= 0.020), week 0/8th (p=0.008), week 4th/12th (p= 0.029) and week 0/12th (p=0.028), and in the social activities domain at week 8th/12th (p=0.028) (Table 4.17). Further, the groups were not significantly different in their change-in-health, overall health, social support and quality of life domains of general health scores at any of the time frames (Table 4.18).

4.1.12. PARTICIPANTS' HEALTH-RELATED QUALITY OF LIFE SCORES ACROSS WEEK 0, WEEK 4, WEEK 8 AND WEEK 12 OF THE STUDY

Within-group comparison of participants' health-related quality of life using Friedmann's ANOVA showed significant increase in the overall quality of life (p<0.001), health and functioning sub-scale (p=0.001), social and economic sub-scale (p=0.027) and the psychological/spiritual sub-scale (p=0.027) for the experimental group across the different time points of the study. The control group only had significant increase in the overall quality of life (p= 0.002) (Table 4.16). Mann Whitney-U test however, showed no significant difference between the experimental and control groups at all the time frames in the overall QoL or the QoL sub-scales (Tables 4.19 and 4.20).

TABLE 4.16: FRIEDMAN'S ANOVA FOR GENERAL HEALTH SCORES, DEPRESSION AND HEALTH-RELATED QUALITY OF LIFE (HRQL) FOR THE EXPERIMENTAL AND CONTROL GROUPS ACROSS WEEKS 0, 4, 8 AND 12 OF THE STUDY.

	Experimental		Control	
Health variables	Chi-square	P	Chi-square	P
GENERAL HEALTH				
Feelings	23.132	<0.001*	8.007	0.044*
Daily activities	14.905	0.002*	4.714	0.194
Social activities	11.093	0.011*	2.538	0.468
Pain	15.808	0.001*	13.667	0.003*
Change in health	17.737	<0.001*	4.286	0.232
Overall health	8.122	0.044*	3.353	0.340
Social support	11.108	0.011*	10.101	0.061
QoL	15.0	0.002*	7.000	0.072
DEPRESSION	19.615	<0.001*	9.000	0.029*
HRQL				
QoL	23.526	<0.001*	14.755	0.002*
HFSUB	15.873	0.001*	4.600	0.204
SOCSUB	9.200	0.027*	4.600	0.204
PSPSUB	9.200	0.027*	7.250	0.064
FAMSUB	7.000	0.072	4.600	0.204

*Significant difference at α=0.05

QoL= Quality of life, HFSUB=Health and Functioning Subscale, SOCSUB=Social and Economic Subscale, PSPSUB=Psychological/spiritual Subscale, FAMSUB=Family Subscale.

TABLE 4.17: MANN WHITNEY-U TEST FOR COMPARISON OF EXPERIMENTAL AND CONTROL GROUPS' GENERAL HEALTH SCORES AT DIFFERENT TIME FRAMES IN THE STUDY

GENERAL HEALTH	EXPERIMENTAL	CONTROL		
Domains	**Mean Rank**	**Mean Rank**	**z-value**	**p-value**
Feelings				
Week 0 vs 4	26.52	28.41	-0.972	0.331
Week 4 vs 8	25.15	29.68	-1.813	0.070
Week 0 vs 8	24.63	28.16	-1.908	0.056
Week 4 vs 12	25.10	29.73	-1.542	0.123
Week 8 vs 12	26.08	28.82	-1.101	0.271
Week 0 vs 12	24.44	28.34	-1.792	0.073
Daily activities				
Week 0 vs 4	26.54	28.39	0.954	0.340
Week 4 vs 8	24.15	30.61	2.324	0.020*
Week 0 vs 8	24.08	30.68	2.641	0.008*
Week 4 vs 12	24.50	30.29	2.189	0.029*
Week 8 vs 12	27.58	27.43	0.076	0.939
Week 0 vs 12	24.48	30.30	2.202	0.028*
Social activities				
Week 0 vs 4	26.04	28.86	1.310	0.190
Week 4 vs 8	27.52	27.48	0.019	0.985
Week 0 vs 8	26.54	28.39	0.794	0.427
Week 4 vs 12	25.12	29.71	1.841	0.066
Week 8 vs 12	25.04	29.79	2.204	0.028*
Week 0 vs 12	25.08	29.75	1.681	0.093
Pain				
Week 0 vs 4	27.08	27.89	0.379	0.705
Week 4 vs 8	27.12	27.86	0.298	0.766
Week 0 vs 8	27.10	27.88	0.260	0.795
Week 4 vs 12	27.10	27.88	0.260	0.795
Week 8 vs 12	27.08	27.89	0.379	0.705
Week 0 vs 12	27.48	27.52	0.012	0.990

*Significant difference at α=0.05

TABLE 4.18: MANN WHITNEY-U TEST FOR COMPARISON OF EXPERIMENTAL AND CONTROL GROUPS' GENERAL HEALTH SCORES AT DIFFERENT TIME FRAMES IN THE STUDY

GENERAL HEALTH	EXPERIMENTAL	CONTROL		
Domains	Mean Rank	Mean Rank	z-value	p-value
Change in Health				
Week 0 vs 4	26.52	28.34	1.964	0.051
Week 4 vs 8	26.08	28.82	1.101	0.271
Week 0 vs 8	25.08	29.75	1.683	0.092
Week 4 vs 12	25.62	29.25	1.261	0.207
Week 8 vs 12	27.04	27.93	0.524	0.601
Week 0 vs 12	25.04	28.79	1.578	0.115
Overall Health				
Week 0 vs 4	27.08	27.89	0.379	0.705
Week 4 vs 8	27.06	27.91	0.341	0.733
Week 0 vs 8	27.06	27.91	0.342	0.733
Week 4 vs 12	26.08	28.82	0.988	0.323
Week 8 vs 12	26.04	28.86	1.309	0.191
Week 0 vs 12	26.46	28.46	0.857	0.391
Social Support				
Week 0 vs 4	27.58	27.43	0.076	0.939
Week 4 vs 8	27.58	27.43	0.076	0.939
Week 0 vs 8	27.65	27.36	0.113	0.910
Week 4 vs 12	27.65	27.36	0.113	0.910
Week 8 vs 12	27.58	27.43	0.76	0.939
Week 0 vs 12	27.69	27.32	0.128	0.898
QoL				
Week 0 vs 4	27.00	28.89	1.701	0.089
Week 4 vs 8	27.08	27.89	0.379	0.705
Week 0 vs 8	26.08	28.82	1.099	0.272
Week 4 vs 12	26.65	28.29	0.566	0.571
Week 8 vs 12	27.08	27.89	0.379	0.705
Week 0 vs 12	27.56	28.30	1.297	0.195

QoL= Quality of life

TABLE 4.19: MANN WHITNEY-U TEST FOR HEALTH-RELATED QUALITY OF LIFE SCORES OF PARTICIPANTS ACROSS DIFFERENT TIME FRAMES IN THE STUDY

HRQL	EXPERIMENTAL	CONTROL		
Domains	Mean Rank	Mean Rank	z-value	p-value
Total QoL				
Week 0 vs 4	27.21	27.81	0.213	0.831
Week 4 vs 8	26.75	28.31	0.537	0.591
Week 0 vs 8	26.82	28.23	0.486	0.627
Week 4 vs 12	25.79	29.35	1.053	0.293
Week 8 vs 12	25.18	28.68	1.599	0.110
Week 0 vs 12	26.00	28.00	0.921	0.357
HFSUB				
Week 0 vs 4	27.48	27.52	0.019	0.985
Week 4 vs 8	26.55	27.52	1.010	0.312
Week 0 vs 8	27.04	28.00	0.448	0.655
Week 4 vs 12	25.25	27.52	1.680	0.093
Week 8 vs 12	25.25	29.92	1.869	0.062
Week 0 vs 12	25.36	29.81	1.601	0.109
SOCSUB				
Week 0 vs 4	27.09	27.94	0.502	0.616
Week 4 vs 8	27.09	27.94	0.502	0.616
Week 0 vs 8	27.09	27.94	0.502	0.616
Week 4 vs 12	26.71	28.35	0.698	0.485
Week 8 vs 12	27.09	27.94	0.502	0.616
Week 0 vs 12	26.71	28.35	0.698	0.485

HRQL=Health-related quality of life, QoL=Quality of life, HFSUB= Health and functioning sub-scale, SOCSUB=Social and economic sub-scale.

TABLE 4.20: MANN WHITNEY-U TEST FOR HEALTH-RELATED QUALITY OF LIFE SCORES AND DEPRESSION ACROSS DIFFERENT TIME FRAMES IN THE STUDY

	EXPERIMENTAL	CONTROL		
	Mean Rank	Mean Rank	z-value	p-value
HRQL				
PSPSUB Domain				
Week 0 vs 4	27.64	27.35	0.153	0.879
Week 4 vs 8	27.57	27.42	0.076	0.939
Week 0 vs 8	27.61	27.38	0.114	0.909
Week 4 vs 12	27.04	28.00	0.386	0.700
Week 8 vs 12	27.04	28.00	0.567	0.571
Week 0 vs 12	27.14	27.88	0.297	0.767
HRQL				
FAMSUB Domain				
Week 0 vs 4	27.52	27.48	0.026	0.979
Week 4 vs 8	27.52	27.48	0.026	0.979
Week 0 vs 8	27.52	27.48	0.026	0.979
Week 4 vs 12	27.00	28.04	0.482	0.630
Week 8 vs 12	27.04	28.00	0.567	0.571
Week 0 vs 12	27.04	28.00	0.448	0.655
DEPRESSION				
Week 0 vs 4	28.36	26.58	0.763	0.445
Week 4 vs 8	28.82	26.08	1.101	0.271
Week 0 vs 8	27.23	25.63	1.242	0.214
Week 4 vs 12	28.27	25.63	1.242	0.214
Week 8 vs 12	28.26	26.26	0.763	0.445
Week 0 vs 12	27.29	26.22	1.193	0.233

HRQL=Health-related quality of life, PSPSUB= Psychological/Spiritual sub-scale

FAMSUB-Family sub-scale

4.1.13. BECK DEPRESSION INVENTORY SCORES OF PARTICIPANTS ACROSS WEEK 0, WEEK 4, WEEK 8 AND WEEK 12 OF THE STUDY

Within-group comparison of participants' depression score using Friedmann's ANOVA showed significant decrease (implying less depressive symptoms) for both the experimental and the control groups with p-values of <0.001 and 0.029 respectively (Table 4.16). Mann Whitney-U test however, showed no significant difference between the experimental and control groups across all the time frames (Table 4.20).

4.2. HYPOTHESIS TESTING

Sub-hypothesis 1

H_0 There would be no significant difference in the experimental group's daily activities domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.002

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 2

H_0 There would be no significant difference in the control group's daily activities domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.194

Since the observed p> 0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 3

H_0: There would be no significant difference in the experimental group's feelings domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: <0.001

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 4

Ho There would be no significant difference in the control group's feelings domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.044

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 5

H_0 There would be no significant difference in the experimental group's social activities domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.011

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 6

H_0 There would be no significant difference in the control group's social activities domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.468

Since the observed p> 0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 7

H_0 There would be no significant difference in the experimental group's pain domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.001

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 8

H_0 There would be no significant difference in the control group's pain domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.003

Since the observed p< 0.05, the hypothesis was therefore REJECTED

Sub-hypothesis 9

H_0 There would be no significant difference in the experimental group's change-in-health domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: <0.001

Since the observed p< 0.05, the hypothesis was therefore REJECTED

Sub-hypothesis 10

H_0 There would be no significant difference in the control group's change-in-health domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.232

Since the observed p> 0.05, the hypothesis was therefore ACCEPTED

Sub-hypothesis 11

H_0 There would be no significant difference in the experimental group's overall health domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.044

Since the observed p< 0.05, the hypothesis was therefore REJECTED

Sub-hypothesis 12

H_0 There would be no significant difference in the control group's overall health domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and

12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.340

Since the observed p> 0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 13

H_0 There would be no significant difference in the experimental group's social support domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.011

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 14

H_0 There would be no significant difference in the control group's social support domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.061

Since the observed p>0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 15

H_0 There would be no significant difference in the experimental group's quality of life domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.002

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 16

H_0 There would be no significant difference in the control group's quality of life domain score of general health, on the Dartmouth COOP Chart across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.072

Since the observed p> 0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 17

H_0 There would be no significant difference in the Beck Depression Inventory scores of the experimental group across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: <0.001

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 18

H_0 There would be no significant difference in the Beck Depression Inventory scores of the control group across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.029

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 19

H_0 There would be no significant difference in the diastolic blood pressure of the experimental group across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: One-way ANOVA

Observed p-value: 0.417

Since the observed p>0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 20

H_0 There would be no significant difference in the diastolic blood pressure of the control group across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: One-way ANOVA

Observed p-value: 0.417

Since the observed p>0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 21

H_0 There would be no significant difference in the systolic blood pressure of the experimental group across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: One-way ANOVA

Observed p-value: p=0.504

Since the observed p>0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 22

H_0 There would be no significant difference in the systolic blood pressure of the control group across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: One-way ANOVA

Observed p-value: p=0.504

Since the observed p>0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 23

H_0 There would be no significant difference in the resting heart rate of the experimental group across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: One-way ANOVA

Observed p-value: p=0.410

Since the observed p>0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 24

H_0 There would be no significant difference in the resting heart rate of the control group across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: One-way ANOVA

Observed p-value: p=0.410

Since the observed p>0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 25

H_0 There would be no significant difference in the cardio-respiratory fitness scores of the experimental group across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: One-way ANOVA

Observed p-value: p<0.001

Since the observed p<0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 26

H_0 There would be no significant difference in the cardio-respiratory fitness scores of the control group across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: One-way ANOVA

Observed p-value: p<0.001

Since the observed p<0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 27

H_0 There would be no significant difference in the percent body fat of the experimental group across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: One-way ANOVA

Observed p-value: p=0.083

Since the observed p>0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 28

Ho There would be no significant difference in the percent body fat of the control group across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: One-way ANOVA

Observed p-value: p=0.083

Since the observed p>0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 29

Ho There would be no significant difference in the experimental group's health/functioning domain score of the Quality of life – Multiple Sclerosis Version (QOL-MS), across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.001

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 30

Ho There would be no significant difference in the control group's health/functioning domain score of the Quality of life – Multiple Sclerosis Version (QOL-MS), across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.204

Since the observed p> 0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 31

Ho There would be no significant difference in the experimental group's social and economic domain score of the QOL-MS, across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.027

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 32

Ho There would be no significant difference in the control group's social and economic domain score of the QOL-MS, across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.204

Since the observed p> 0.05, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 33

H_0 There would be no significant difference in the experimental group's psychological/spiritual domain score of the QOL-MS, across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.027

Since the observed $p< 0.05$, the hypothesis was therefore REJECTED.

Sub-hypothesis 34

H_0 There would be no significant difference in the control group's psychological/spiritual domain score of the QOL-MS, across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.064

Since the observed $p> 0.05$, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 35

H_0 There would be no significant difference in the experimental group's family domain score of the QOL-MS, across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.072

Since the observed $p> 0.05$, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 36

Ho There would be no significant difference in the control group's family domain score of the QOL-MS, across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.204

Since the observed $p> 0.05$, the hypothesis was therefore ACCEPTED.

Sub-hypothesis 37

H_0 There would be no significant difference in the experimental group's overall health-related quality of life scores of the QOL-MS, across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: <0.001

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 38

H_0 There would be no significant difference in the control group's overall health-related quality of life scores of the QOL-MS, across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.002

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 39

H_0 There would be no significant difference between the general health scores of the experimental and control groups at the time frames of week 0/week4, week4/week8, week0/week8, week4/week12, week8/week12 and week0/week12 in each of the eight Dartmouth COOP Chart domains.

Alpha level= 0.05

Test statistic: Mann Whitney U

Observed p-value: The observed p- value was less than the alpha level (p< 0.05) only in two domains: the daily activities domain and the social activities domain at the following time frames:

Daily activities domain: At week4th/8^{th} (p= 0.020), week0/8^{th} (p=0.008), week4th/12^{th} (p= 0.029) and week0/12^{th} (p= 0.028).

Social activities domain: At week8th/12^{th} only (p=0.028).

Thus, the hypothesis was REJECTED for the daily activities domain at week4th/8^{th}, week0/8^{th}, week4th/12^{th} and week0/12^{th} and for social activities domain at week 8^{th}/12^{th}, but ACCEPTED for all the other time frames in these two domains as well as all the time frames in the remaining six domains (i.e. the feelings, pain, change in health, overall health, social support and quality of life (QOL) domains).

Sub-hypothesis 37

H_0 There would be no significant difference in the experimental group's overall health-related quality of life scores of the QOL-MS, across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: <0.001

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 38

H_0 There would be no significant difference in the control group's overall health-related quality of life scores of the QOL-MS, across week 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Friedmann's ANOVA

Observed p-value: 0.002

Since the observed p< 0.05, the hypothesis was therefore REJECTED.

Sub-hypothesis 39

H_0 There would be no significant difference between the general health scores of the experimental and control groups at the time frames of week 0/week4, week4/week8, week0/week8, week4/week12, week8/week12 and week0/week12 in each of the eight Dartmouth COOP Chart domains.

Alpha level= 0.05

Test statistic: Mann Whitney U

Observed p-value: The observed p- value was less than the alpha level (p< 0.05) only in two domains: the daily activities domain and the social activities domain at the following time frames:

Daily activities domain: At week4th/8^{th} (p= 0.020), week0/8^{th} (p=0.008), week4th/12^{th} (p= 0.029) and week0/12^{th} (p= 0.028).

Social activities domain: At week8th/12^{th} only (p=0.028).

Thus, the hypothesis was REJECTED for the daily activities domain at week4th/8^{th}, week0/8^{th}, week4th/12^{th} and week0/12^{th} and for social activities domain at week 8^{th}/12^{th}, but ACCEPTED for all the other time frames in these two domains as well as all the time frames in the remaining six domains (i.e. the feelings, pain, change in health, overall health, social support and quality of life (QOL) domains).

Sub-hypothesis 40

H_0 There would be no significant difference between the Beck Depression Inventory scores of the experimental and control groups at the time frames of week 0/week4, week4/week8, week0/week8, week4/week12, week8/week12 and week0/week12 of the study.

Alpha level= 0.05

Test statistic: Mann Whitney U

Observed p-values: 0.445, 0.271, 0.214, 0.214, 0.445 and 0.233 for week 0/week4, week4/week8, week0/week8, week4/week12, week8/week12 and week0/week12 respectively.

Since the observed p> 0.05 in all the time frames, the hypothesis was therefore ACCEPTED for each of the time frames.

Sub-hypothesis 41

H_0 There would be no significant difference between the diastolic blood pressure of the experimental and control groups at weeks 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Independent t-test

The p-values were 0.862, 0.511, 0.480 and 0.100 at weeks 0, 4, 8 and 12 of the study.

Since the observed p-value> 0.05 in each of the weeks, the hypothesis was therefore ACCEPTED for each of the weeks.

Sub-hypothesis 42

H_0 There would be no significant difference between the systolic blood pressure of the experimental and control groups at weeks 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Independent t-test

The p-values were 0.951, 0.806, 0.062 and 0.004 at weeks 0, 4, 8 and 12 of the study.

Since the observed p-value> 0.05 in weeks 0, 4 and 8 of the study and <0.05 in week 12 of the study, the hypothesis was therefore ACCEPTED for weeks 0, 4 and 8 of the study, but REJECTED for week 12 of the study.

Sub-hypothesis 43

H_0 There would be no significant difference between the resting heart rate of the experimental and control groups at weeks 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Independent t-test

The p-values were 0.504, 0.408, 0.207 and 0.305 at weeks 0, 4, 8 and 12 of the study. Since the observed p-value> 0.05 in each of the weeks of the study, the hypothesis was therefore ACCEPTED for all the weeks of the study.

Sub-hypothesis 44

H_0 There would be no significant difference between the cardio-respiratory fitness scores of the experimental and control groups at weeks 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Independent t-test

The p-values were 0.956, 0.778, 0.198 and 0.010 at weeks 0, 4, 8 and 12 of the study. Since the observed p-value> 0.05 in weeks 0, 4 and 8 of the study and <0.05 in week 12 of the study, the hypothesis was therefore ACCEPTED for weeks 0, 4 and 8 of the study, but REJECTED for week 12 of the study.

Sub-hypothesis 45

H_0 There would be no significant difference between the percent body fat of the experimental and control groups at weeks 0, 4, 8 and 12 of the study.

Alpha level= 0.05

Test statistic: Independent t-test

The p-values were 0.896, 0.420, 0.071 and 0.001 at weeks 0, 4, 8 and 12 of the study. Since the observed p-value> 0.05 in weeks 0, 4 and 8 of the study and <0.05 in week 12 of the study, the hypothesis was therefore ACCEPTED for weeks 0, 4 and 8 of the study, but REJECTED for week 12 of the study.

Sub-hypothesis 46

H_0 There would be no significant difference between the health-related quality of life scores of the experimental and control groups at the time frames of week 0/week4, week4/week8, week0/week8, week4/week12, week8/week12 and week0week12 in each of the four domains and in the overall scores of the Quality of life-Multiple Sclerosis Version.

Alpha level= 0.05

Test statistic: Mann Whitney U

Overall QOL: The p-values were: 0.831, 0.591, 0.627, 0.293, 0.110 and 0.357 for week 0/week4, week4/week8, week0/week8, week4/week12, week8/week12 and week0/week12 respectively.

Since the observed p> 0.05 in all the time frames, the hypothesis was therefore ACCEPTED for each of the time frames.

Health and functioning sub-scale: The p-values were: 0.985, 0.312, 0.655, 0.093, 0.062 and 0.109 for week 0/week4, week4/week8, week0/week8, week4/week12, week8/week12 and week0/week12 respectively.

Since the observed p> 0.05 in all the time frames, the hypothesis was therefore ACCEPTED for each of the time frames.

Social and economic sub-scale: The p-values were: 0.616, 0.616, 0.616, 0.485, 0.616 and 0.485 for week 0/week4, week4/week8, week0/week8, week4/week12, week8/week12 and week0/week12 respectively.

Since the observed p> 0.05 in all the time frames, the hypothesis was therefore ACCEPTED for each of the time frames.

Psychological/spiritual sub-scale: The p-values were: 0.879, 0.939, 0.909, 0.700, 0.571 and 0.767 for week 0/week4, week4/week8, week0/week8, week4/week12, week8/week12 and week0/week12 respectively.

Since the observed p> 0.05 in all the time frames, the hypothesis was therefore ACCEPTED for each of the time frames.

Family sub-scale: The p-values were: 0.979, 0.979, 0.979, 0.630, 0.571 and 0.655 for week 0/week4, week4/week8, week0/week8, week4/week12, week8/week12 and week0/week12 respectively.

Since the observed p> 0.05 in all the time frames, the hypothesis was therefore ACCEPTED for each of the time frames.

4.3. DISCUSSION

The aim of this study was to investigate the effect of a twelve-week, sub-maximal arm ergometry training on the systolic blood pressure, diastolic blood pressure, resting heart rate, cardio- respiratory fitness, percent body fat, depressive symptoms, health-related quality of life and overall general health of lower limb paralytic poliomyelitis survivors with secondary health conditions in Ibadan, Oyo State, Nigeria.

4.3.1. PHYSICAL CHARACTERISTICS OF PARTICIPANTS

The participants in the experimental and control groups in this study were not significantly different in age (p=0.84 0), height (p=0. 604), weight (p=0.89 0), body mass index (p=0.436), percent body fat (p= 0.89 6)diastolic blood pressure (p=0.862), systolic blood pressure (p=0.951), cardio-respiratory fitness (p=0.956), depressive symptoms (p=0.213) and quality of life (p=0.121) at baseline. Therefore, differences in the physical characteristics in the two groups might not have been a rival hypothesis for the differences observed in the groups' selected heath variables.

4.3.2. EFFECTS OF ARM ERGOMETRY TRAINING ON THE SELECTED HEALTH INDICES OF PARTICIPANTS

4.3.2.1. Cardiovascular Variables (Heart rate, systolic, and diastolic blood pressure)

The results of this study showed that there was no statistically significant difference in the heart rate and diastolic blood pressure of the experimental and control groups at the four selected time points of this study, while significant difference was observed in the systolic blood pressure at the end of the 12th week only. There was however significant improvement in all the cardiovascular variables (indicated by a significant reduction in the heart rate, systolic and diastolic blood pressure) of the experimental group across the different time frames in the study. Though there was no significant difference observed between the groups across the different time frames of this study, the main effects of group and time as well as their interaction effects were significant for heart rate, systolic blood pressure and diastolic blood pressure. This implies time-dependent changes in these health variables in the experimental group. A similar trend was however not observed in the control group.

Aerobic exercise training results in a number of anatomical and physiological adaptations that lead to enhanced cardiovascular function and improved aerobic capacity (Smith and Fernhall, 2011). Specifically, most of the beneficial effects of exercise on cardiovascular health have been linked to the modification of several modifiable coronary risk factors, such as blood pressure levels and body mass index (Wei et al, 1999; Pitsavos et al, 2011). Although there is a paucity of information about physiologic responses of persons with physical disabilities to exercise, existing literature supports that the capacity of these persons to adapt to increased levels of exercise is similar to that of persons without disabilities (Kilmer, 2002).

In the systematic review of exercise interventions for people with physical and cognitive disabilities, Rimmer et al. (2010a), observed that Multiple Sclerosis and Stroke were the most common conditions studied, while limited researches were carried out on polio survivors. Thus, closely related studies involving polio survivors (i.e., studies which employed arm ergometry as the form of aerobic exercise and assessed cardiovascular variables as research outcomes) are not readily available in literature. However, findings from this study compared favourably with findings from a previous study involving patients with lifestyle-limiting claudication. Treat-Jacobson et al (2009) reported no significant difference in the resting heart rate and diastolic blood pressure of their participants following 12 weeks of arm ergometry training, while there was significant decrease in the resting systolic blood pressure as similarly reported in this study.

Westhoff et al (2008) on the other hand, reported significant decreases in both systolic and diastolic blood pressure of patients with hypertension following a 12-week upper limb ergometry. As participants in this study in reference had high blood pressure; it is possible that their already-high blood pressure was readily amenable to the exercise-induced physiological change; or perhaps, the effect of the exercise programme was more readily detectable on their already-high blood pressure; hence, the significant difference reported also in their diastolic blood pressure. This is plausible in view of the submission of Cornelissen and Fagard (2005) that, reduction in blood pressure following cardiovascular exercise training is usually more pronounced in hypertensive patients. However, Jones et al (1989) reported no significant difference in the

cardiovascular variables of polio survivors following a 16-week aerobic exercise programme. It should be noted that unlike in the present study, Jones et al employed a bicycle ergometer, hence, participants performed their aerobic workout with their paretic lower limbs. Although the aerobic training programme lasted 4 weeks longer, participants' cardiovascular variables remained statistically unchanged. This could possibly be because of the difficulty in achieving their peak aerobic workout with paretic limbs and therefore, cardiovascular adaptations were not significantly induced (although reported increment in the participants' cardio-respiratory fitness index supported a training response). The researchers were also conscious of the need to avoid the risk of overuse and muscle fatigue in participants' polio-affected lower limbs. Thus, exercise training sessions were divided into bouts that were interspersed with rest periods. Additionally, participants exercised only once a week under supervision, while the remaining two sessions were carried out individually at home. Strict compliance with the exercise intensity all through the entire period was thus, doubtful. In the present study however, participants exercised under supervision all through the 12-week training period and the exercise intensity was adequately monitored for compliance. Since the upper limbs were not affected with polio, it was easy for participants to carry out the exercise programme within their target heart rate range effectively without quick fatigability.

Halstead (1998) had previously advised that upper limb aerobic exercise should alternatively be employed for polio survivors with lower limb paralysis in order to elicit all the desired effects of an aerobic workout. Findings from this study have further lent credence to this view that arm ergometry is an effective aerobic training programme and is capable of eliciting favourable training effect on the blood pressure. In addition, it provides evidence to support that polio survivors can achieve an aerobic exercise workload that is sufficient to elicit favourable responses in their cardiovascular systems despite their compromised neuromuscular status. An individualized, well-planned and closely monitored arm ergometry training of appropriate intensity will produce the expected training effects. Further studies involving polio survivors are however necessary to corroborate the present findings as studies investigating the effect of arm ergometry training on the cardiovascular variables of polio survivors are not available in literature for referencing.

4.3.2.2. Indices of Health-Related Fitness (Percent body fat and cardio-respiratory fitness)

The results of this study showed significant increases in the experimental group's cardio-respiratory fitness across all the time frames of the study, while significant between-group difference was only seen at the end of the 12th week of the study. This finding agrees with Kriz et al (1992) who reported both within and between-group increment in the cardio-respiratory fitness of polio survivors following a 16-week arm ergometry training programme. The results indicated that twelve weeks of appropriately-structured arm ergometry training programme was sufficient to significantly task the cardio-respiratory function of lower limb paralytic poliomyelitis survivors, with resultant improvement in cardio-respiratory fitness. Yamey and Greenwood (2005) had previously submitted that cardio-respiratory deconditioning; one of the factors responsible for reduced cardio-respiratory fitness in people with physical disabilities is readily amenable to exercise.

Though there is paucity of studies which employed arm ergometry training and examined cardio-respiratory fitness as a research outcome among polio survivors, increase in cardio-respiratory fitness following arm ergometry training have been documented among other populations with neurological sequelae. Briken et al (2013) reported within and between-group increases in the cardio-respiratory fitness of patients with Multiple Sclerosis following 8-10 weeks of arm ergometry training, while DiCarlo et al (1983) reported increase in the cardio-respiratory fitness of spinal cord-injured patients following 5-week arm ergometry training. These findings lend support to the fact that arm ergometry training is effective in promoting the cardiorespiratory health.

For percent body fat, significant reduction was observed in the experimental group across all the time frames of the study, while significant between-group difference was only seen at the end of the 12th week of the study. There is a dearth of literature on the effects of arm ergometry training (or other forms of aerobic training) on the percent body fat among polio survivors; hence, findings from this study cannot be compared with closely related studies. However, the observed findings differ from those of Marion et al (1986) who reported no change in the percent body fat after an 8-week

arm ergometry training in an adolescent with myelodysplasia. The training programme of Marion et al (1986) lasted only 8 weeks, while the duration of training in this study was four weeks longer, which probably have accounted for the significant reduction in participants' percent body fat. Moreover, Marion et al (1986) reported findings from a case study, and in view of the fact that case studies are often context-specific (Nwadinigwe, 2012) and in most cases, limited to the subject of study, conclusions from such studies are usually not subject to generalization.

Energy expenditure which accompanies regular aerobic exercise contributes positively to weight loss and reduction in percent body fat (Kravitz and Vella, 2002; Babalola, 2005). This is because, fat metabolism is an alternative energy source during prolonged exercise sessions, particularly when the muscle glycogen stores have become depleted with increased metabolic demand (Burton et al, 2004). Thus, a metabolic training effect of aerobic exercise is an enhanced ability to mobilize and breakdown triglycerides (the form in which fat is stored in the body) for energy use (Kravitz and Vella, 2002). This breakdown of fat results in weight loss.

Narayani and Sudhan-Paul-Raj (2010) and Song et al (2012) respectively reported significant reductions in percent body fat of obese women and obese men respectively, following an aerobic training programme, though modes of aerobic training other than arm ergometry were employed. Warpeha (2011) earlier noted that arm ergometry is the most under-used mode of aerobic training, hence, the apparent paucity of studies employing arm ergometry for referencing (particularly among polio survivors). However, Farbu et al (2010) opined that participation in aerobic training would, in most cases, lead to weight loss in polio survivors. This could have accounted for the reduction seen in the percent body fat of participants in the exercise group. Studies are however needed to corroborate the findings of this study among polio survivors, as none of the few available studies on aerobic exercise in this population has previously assessed percent body fat as an outcome variable.

The significant increase recorded in the measures of adiposity in the control group from the 4th week of the study was however an unexpected finding. There was weight gain among participants in the control group over the course of the 12-week study

which possibly accounted for the reduction in their fitness measures at the time frames of 4th/12th week, 8th/12th week and 0/12th week of the study. This weight gain probably occurred because the study took place in the rainy season with serious flood mishaps within Ibadan metropolis at the period, which might have caused the participants to restrain their outdoor activities and hence, their energy expenditure. When there is energy imbalance in the body, such that energy expenditure is less than intake, excessive fat accumulation, leading to weight-gain, is inevitable. Contrarily, this could have been compensated for in the experimental group who were on a regular exercise training programme all through the period. None of the groups was on calorie restrictions. Thus, it can be extrapolated that a well-structured, individualized, 12-week arm-ergometry training could adequately prevent unwanted weight-gain associated with physical inactivity among polio survivors, as inferred from findings in this study.

4.3.2.3. Quality Of Life and Depression

The findings of this study showed no significant between-group difference in the quality of life of participants in the experimental and control groups across all the time frames of the study. However, significant increases were observed in the overall quality of life (QoL) and all its sub-scales (except the family sub-scale) in the experimental group. This agrees with the findings of Oncu (2009), who reported significant increase in the QoL of polio survivors after an aerobic training programme. Seton et al (2008) earlier opined that the health-related components of physical fitness (such as cardio-respiratory fitness and body composition) contribute to a healthy QoL. This is because; optimal fitness is reflected in an individual's ability to cope well with daily life. Thus, the improved cardio-respiratory fitness and percent body fat of participants in the experimental group could have contributed to their improved QoL.

A significant decrease in depressive symptoms was also observed in the experimental group, though, no significant between-group difference was observed across all the time frames of the study. This is in consonance with the findings of Briken et al (2013) who reported significant reduction in depressive symptoms among Multiple Sclerosis patients following 8-10 weeks of arm ergometry training. The antidepressant action is one of the most commonly accepted psychological benefits of exercise (Knaus, 2007). Blumenthal et al (2007) opined that aerobic training provides an effective conditioning

programme for the management of depression and that in most cases; it is as effective as the medication used to control depression.

An unexpected finding from this study was the significant improvement in the overall QoL of the control group as well as reduction in their depressive symptoms. Since there is no scientific evidence to support that flexibility exercises which were carried out by the control group could improve QoL (Sigal et al, 2004) or reduce depression, it is probable that the improvement observed could merely be a result of improvement in their social environment (specifically, as regards their opportunity to freely interact with the researcher and the assistants during the period, which possibly reduced feelings of isolation or loneliness, as almost half of the participants were unmarried). Since participants in both experimental and control groups had opportunity to discuss issues that were pertinent to them, this could have contributed positively to their social aspect of QoL and lessened depressive symptoms. The WHO (2009a) identifies the social environment as one of the key factors in determining the QoL and health status of an individual and when this is favourable, the effect may be evident on the overall QoL.

4.3.2.4. General Health Measure

Findings from this study showed that there was significant positive trend towards improvement in all the domains of General Health measure in the experimental group, as significant decreases (implying improvement) were seen in all its domains (feelings, daily activities, social activities, pain, change-in-health, overall health, social support and QoL). Significant between-group difference (improvement) was however seen only in the daily activities' domain at week 4th/8th week 0/8th, week 4th/12th and week 0/12th time frames and in the social activities' domain at week 8th/12th time frame.

Exercise benefits the human body in a multi-factorial manner (Booth et al, 2000); hence, the 12-week arm ergometry training could have elicited some beneficial physiological changes that translated into improved health in all the domains of general health measure in the experimental group. Although there is a dearth of related studies among polio survivors, Briken et al (2013) and Treat-Jacobson (2009) reported reduced fatigue and improved walking ability following arm ergometry training in

non-polio survivors. Reduced fatigue and improved walking ability could both improve the sense of well-being and enhance the ability to carry out daily and social activities. Although, these were not primary outcomes in this study, it was observed that participants in the experimental group were able to progressively improve their performance of the six-minute walk-test (6-MWT) with less fatigability (an evidence of improved cardio-respiratory fitness). This could have improved their activities of daily living and accord them better opportunity to participate in social activities. Hence, the significant improvement observed in the daily and social activities domains of the experimental group when compared with their counterparts in the control group could have resulted from their improved level of cardio-respiratory fitness.

Participants in the control group also demonstrated significant decrease (implying improvement) in the feelings and pain domains of general health. Although this was unexpected, the 12-week flexibility exercises carried out by participants in this group could have cumulatively had a beneficial psychological effect on them, and resulted in a subtle improvement in their sense of feeling and general well-being. There is however, no published work to corroborate this submission, as flexibility exercise has been used in clinical trials primarily as a "placebo" exercise (Cuff et al. 2003; Yeung and Yeung, 2001). Further studies may be necessary to investigate other possible clinical benefits of flexibility exercises, particularly its long-term benefits, in case these might have been inadvertently overlooked.

4.4. CLINICAL IMPLICATION OF FINDINGS

The study's outcome indicated that the cardiovascular health, cardio-respiratory fitness, and general health of lower limb paralytic poliomyelitis survivors could be improved through a twelve-week individualized arm ergometry training programme. In view of the mobility limitation and consequent reduction in physical activity which make polio survivors readily susceptible to a myriad of secondary health conditions and comorbidities, the use of arm ergometry training to optimize their health is strongly encouraged. The routine use of arm ergometry training among this population may help reduce their health burden, thereby, enhance their quality of life and lessen the financial burden and physical stress of managing or coping with secondary health conditions and comorbidities. Consequently, there will be less strain on their families,

the community, as well as the health care system. Specifically, the study revealed that arm ergometry training could help in lowering blood pressure and reducing percent body fat; therefore, it can be used to prevent these 'intermediate' cardiovascular risk factors. Cardiovascular diseases are reportedly the number one cause of death globally (WHO factsheet, 2013a) and its prevention among this large population may have measurable impact on reducing the global mortality rate.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.0 SUMMARY

Poliomyelitis has become almost extinct, but its survivors remain one of the largest groups of people with disabilities in the world. Reduced mobility places polio survivors at risk of early onset of age and lifestyle- related secondary health conditions and co-morbidities and a number of health conditions have been documented among them. While exercise is now actively employed to promote health and prevent secondary health conditions, its use in Nigeria is almost exclusively limited to individuals without disabilities and people with disabilities are not getting needed preventive exercise. It is thus not clear if Nigerians with physical disabilities can benefit from structured exercise training programmes. The effects of a twelve-week arm ergometry training on selected health indices of lower limb paralytic poliomyelitis survivors were investigated in this study.

The literature review focused on definition, patho-physiology, forms, clinical symptoms, management, and complications of polio, the health implications of aging and physical inactivity on polio survivors, and secondary health conditions and co-morbidities associated with polio. Other areas covered by the literature review included: health-related physical fitness, assessment of body composition, assessment of cardio-respiratory fitness, blood pressure and health-related quality of life, exercise and its health promotion and preventive role, types of exercise, physiological adaptations to exercise training and aerobic/cardio-respiratory training for polio survivors.

Sixty polio survivors with secondary health conditions, who were randomly selected from a cohort of 252 polio survivors, participated in the study. Thirty participants each were randomly assigned into either a control or exercise group. However, 54

participants (exercise group=28, control group=26) completed the study. The exercise group had a twelve-week arm ergometry training which was individualized for each participant using the American College of Sport Medicine's exercise guideline for polio survivors. Flexibility exercises were employed for warm-up and cool-down phases, while the control group had only flexibility exercises (replica of the warm-up and cool-down activities carried out by the exercise group). The selected health indices, namely the general health (GH), depressive symptoms (DS), quality of life (QoL), resting diastolic blood pressure (RDBP), resting systolic blood pressure (RSBP), resting heart rate (RHR), cardio-respiratory fitness (CRF), percent body fat (PBF) and body mass index (BMI) were assessed at baseline and at every four-week of the exercise programme. Data were analyzed using descriptive statistics of mean and standard deviation and inferential statistics, ANOVA, independent-t and Mann Withney-U tests with alpha level set at 0.05.

The mean ages of exercise (38.43 ±6.97years) and control groups (38.08 ±5.75years) were not significantly different. At baseline, exercise and control groups were not significantly different in their RSBP (127.71±7.78 vs 127.85±7.78mmHg), RDBP (78.54±8.33 vs 78.85±3.73mmHg), RHR (80.50±7.06 vs 79.12±8.04beats/min), PBF (28.51±11.89 vs 28.17±5.62%), CRF (3.33±0.81 vs 3.35±1.43), QoL (20.07±1.01 vs 21.05 ±0.81), DS (7.2143 ±7.49 vs 6.3846±9.00) and in all the eight domains of GH. At the twelfth week, control group had significantly greater RSBP (p=0.004) and PBF (p=0.001) and significantly lower CRF (p=0.010) There were significant time and time-group interaction effects for RSBP (p=0.000), RDBP (p=0.000), RHR (p=0.000), PBF (p=0.000) and CRF (p=0.000). Significant between-group differences were found only in the daily activities (p=0.020, 0.008, 0.029 and 0.028 at $4^{th}/8^{th}$, $0/8^{th}$, $4^{th}/12^{th}$ and $0/12^{th}$ weeks respectively) and social activities (p=0.028 at week $8^{th}/12th$) domains of GH. There was no significant between-group difference in both QoL and DS (p>0.5).

5.1. CONCLUSION

A twelve-week, individualized, arm ergometry training reduced the resting heart rate, resting systolic blood pressure, percent body fat, and increased the cardio-respiratory fitness index, and social and daily activities domains of general health status of lower limb paralytic poliomyelitis survivors with secondary health conditions. Thus, arm

ergometry training is an effective mode of aerobic exercise that can be used to optimize the health of polio survivors with lower limb affectation, who may find it difficult to condition their cardio-pulmonary system, using conventional methods.

5.2. RECOMMENDATIONS

The following recommendations were made.

5.2.1. Recommendations for Physiotherapists

The outcome of this study should encourage physiotherapists to readily employ arm ergometry training as a mode of aerobic exercise for lower limb paralytic poliomyelitis survivors with the aim of optimizing their health. In effect, routine arm ergometry training should form part of the basic care of lower limb paralytic poliomyelitis survivors with secondary health conditions.

5.2.2. Recommendations for the government, health-policy makers and public health officials

The health-policy makers and public health officials should double their efforts at ensuring that polio survivors and people with disabilities generally, have access to disease prevention and public health promotion strategies. The government at state and federal levels should focus on assisting people with disabilities to meet their individual potentials for physical, social, emotional, and intellectual health by creating disability-friendly community fitness centres. Accessible exercise equipments (particularly arm ergometers) should be made available in various health centres for routine aerobic exercises for people with lower limb paralysis.

5.2.3. Recommendations for further studies

1. Future studies should include a follow-up phase to investigate possible carry-over effects of a 12-week arm ergometry training on selected health indices of polio survivors.

2. Future studies are needed to develop polio-specific outcome measures to assess depression, quality of life and other selected health indices of polio survivors. Generic outcome measures were basically employed in this study as polio-specific outcome measures were nonexistent.

3. Similar [illegible] training period should be considered.

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3. Similar studies employing n longer training period should be considered.

REFERENCES

Adegoke, B.O.A., Oni, A.A., Gbiri, C.A. and Akosile, C.O. 2012. Paralytic poliomyelitis: quality of life of adolescent survivors. *Hong Kong Physiotherapy Journal*. 30. 2. Dec: 93-98.

Adewuya, A.O., Ola, B.A., and Afolabi, O.O. 2007. Prevalence of major depressive disorders among Nigerian adolescents – *European Child and Adolescent Psychiatry* 16. 5. August edition. Abstract.

Agarwal, S.K. 2012. Cardiovascular benefits of exercise. *International Journal of General Medicine* 5: 541-545. Epub 2012, June 22.

Agre, J.C. 1999. The role of activity. *Polio Network News* 15. 2. Spring. International Networking Institute, 4207 Lindell Blvd, #110, St. Louis, MO 63108-2915.

Aina, O. and Ejembi, C.L.2013. Socioeconomic status of women and immunization status of under five children in northern Nigeria- a case study of poliomyelitis in Kaduna state. *1st Annual International Interdisciplinary Conference Proceedings*, 24-26 April, Azores, Portugal - Proceedings- 785-786.

Aisen, M.A.L. and Seizer, M.E. 1998. Diseases of the spinal cord. *Comprehensive neurology*. Rosenberg and Pleasure, Eds. 2nd ed. U.S.A. New York: John Wiley and Sons Inc: 670.

American College of Sports Medicine (ACSM). 1995. *Guidelines for graded exercise testing and exercise prescription*. Lea and Fabiyer, Philadelphia.

_____, 1998. American college of sports medicine position stand. Exercise and physical activity for older adults. *Journal of Medicine Science, Sports and Exercise* 30. 6. June. Abstract.

American Heart Association 2005. Stress and blood pressure: prevention and treatment (step 5). Retrieved Jan. 27, 2014 from http://www.heart.org/HEARTORG/Conditions/HighBloodPressure/PreventionTreatmentofHighBloodPressure/Stress-and-BloodPressure_UCM_301883_Article.jsp.

American Thoracic Society (ATS) 2002: Guidelines for the six-minute walk test. *American Journal of Respiratory and Critical Care Medicine* 166:111-117.

Andresen, E.M., Malmgren, J.A.. Carter, W.B. and Patrick, D.L. 1994. Screening for depression in well older adults: evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale). *American Journal of Preventive Medicine* 10. 2: 77–84.

Anyaele, D.O. in Baiyewu, L. 2012. 19 million Nigerians are physically challenged. *The Punch* May 6 2012.

Aronne, L.J. 2002. Treatment of obesity in the primary care setting. *Handbook of Obesity Treatment*. Wadden, T. and Stunkard, A.J. Eds.Guilford Press, New York.383–394.

Astrand, P.O. and Rodahl, K. 1986. *Textbook of work physiology: Physiological bases of exercise*. Singapore: Mc-Graw Hill.

Atkinson, W., Hamborsky, J., McIntyre, L., and Wolfe S. Eds. 2007. Poliomyelitis (pdf). *Epidemiology and prevention of vaccine-preventable diseases* 10th ed. Washington DC: Health foundation: 101-114.

Babalola, J.F. 2005. Physical exercise and dieting for weight control. *International Journal of African and African American Studies* 4.2. July:26.

_____, 2011. Health consequences of obesity. *Pakistan Journal of Social Sciences* 8.3: 118-124.

Babyak, M., Blumenthal, J.A., Herman, S., Khatri, P., Doraiswamy, M., Moore, K., Craighead, W.E., Baldewicz, T.T. and Krishnan. K.R. 2000. Exercise treatment for major depression: maintenance of therapeutic benefit at 10 months. *Psychosomatic Medicine* 62. 5. 633-638.

Bach, J. R. and Alba, A.S. 2001. *Aging with a disability: What the clinician needs to know*. Kemp, B. and Mosqueda, L.A. Eds. The John Hopkins University Press. U.S.A. Baltimore, Maryland. ISBN 0-8018-7816-0. 182.

Baidini, L.G., Curtin, C., Hamad, C. Tybot, D.J. and Must, A. 2005. Prevalence of overweight in children with developmental disorders in the continuous national health and nutrition examination survey (NHANES) 1999–2002. *Journal of Pediatrics* 146. 6. 738–743,

Bartels, M.N. and Omura, A. 2005. Aging in polio. *Journal of Physical Medicine and Rehobilitation* 16. 1: 197-218.

Beck, A.T., Ward C.H., Mendelson, M., Mock J. and Erbaugh J. 1961. An inventory for measuring depression. *Archives of General Psychiatry* 4: 561-571.

_____. Brown, G., and Steer, R. A. 1996. *Beck depression inventory II manual*. San Antonio, Texas: The Psychological Corporation.

Becker. H. and Stuifbergen, A. 2004. What makes it so hard? barriers to health promotion experienced by people with multiple sclerosis and polio. *Family and Community Health* 27. 1. Jan/Feb/March: 75-85.

Bergner, M., Bobbitt, R.A. Carter, W.B and Gilson, B.S. 1981. The sickness index profile: development and final revision of a health status measure. *Medical Care* 19: 787-809.

Bertelsen, M., Broberg, S. and Madsen, E. 2009. *Journal of Rehabilitation Medicine* 4. 1. Jan: Abstract.

Bienick, L., ond Kennedy, K. 2002. Improving quality of life: healing polio memories. *Polio Network News* 18. 1. 1-7.

Birk, T.J. 2003. ACSM'S exercise management for persons with chronic diseases and disabilities. *Polio and post-polio syndrome*. J.L. Durstine and G.E. Moore. Eds. Human Kinetics, Champaign, IL 618255076: U.S.A. 273-280.

_____ and Nieshoff, E.C. 2004. Polio. *Clinical exercise physiology: application and physiological principles*. L.M. LeMura and S.P. Von Duvillard. Eds. Lippincott Williams and Wilkins, 530 Walnut Street, Philadelphia, Pennsylvania 19106, U.S.A ISBN: 0-7817-2680-8. 269-284.

Blumenthal, J. A., Babyak, M. A., Moore, K. A., Craighead, W. E., Herman, S., Khatri, P., Waugh, R., Napolitano, M.A.,Forman, L.M., Appelbaum, M., Doraiswamy, P.M. and Krishnan, K.R. 1999. Effects of exercise training on older patients with major depression. *Archives of Internal Medicine* 159: 2349–2356.

_____, Babyak, M.A., Doraiswamy, P.M., Watkins, L., Hoffman, B.M., Barbour, K.A, Herman, S., Craighead, W.E., Brosse, A.L., Waugh, R., Hinderliter, A. and Sherwood. A. 2007. Exercise and pharmacotherapy in the treatment of major depressive disorder. *Psychosomatic medicine* 69. 7. 587-596.

Boileau, R., Mckeown, B. and Riner, W. 1984. Cardiovascular and metabolic contributions to the maximal aerobic power of the anns and legs. *Journal of Sports and Cardiology* 1:67-75.

Booth, F.W., Gordon, S.E., Carlson, C.J. and Hamilton, M.T. 2000. Waging war on modern chronic diseases: primary prevention through exercise biology. *Journal of Applied Physiology* 88:774-787.

Borg, G.A. 1982. Psychophysical bases of perceived exertion. *Medicine and Science in Sports and Exercise* 14:377-381.

Borg, K. and Henriksson, J. 1991. Prior poliomyelitis-reduced capillary supply and metabolic enzyme content in hypertrophic slow-twitch (type 1) muscle fibre. *Journal of Neurology and Neurosurgical Psychiatry* 54. 3: 236-240.

Boslaugh, S.E. and Andresen, E.M. 2006. Correlates of physical activity for adults with disability. *Preventing Chronic Disease* 3.3. July: A78.

Boulet, J. and Boss, Marvin, W. 1991. Reliability and validity of the brief symptom inventory. psychological assessment: *A Journal of Consulting and Clinical Psychology* 3.3. Sep: 433-437.

Bouza, C., Munoz, A. and Amate, J.M. 2005. Postpolio syndrome: a challenge to the health-care system. *Health Policy* 71. 1: 97-106.

Briken, S., Gold, S.M., Patra, S., Vettorazzi, E., Harbs D., Tallner, A., Ketels G., Schulz K.H. and Heesen C. 2013. Effects of exercise on fitness and cognition in progressive MS: a randomized, controlled pilot trial. *Multiple Sclerosis* Oct. 24. Retrieved Dec. 2013 from doi: 10.1177/1352458513507358.

Bruno, R.L., Creange, S.J. and Frick, N.M. 1998. Parallels between post-polio fatigue and chronic *American Journal of Medicine* 105. 3A: 66-73.

Burton, D.A., Stokes, K. and Hall, G.M. 2004. Physiological effects of exercise. *Continuing Education in Anoesthesia, Critical Care and Pain* 4. 6:186. Retrieved Jan. 5, 2014 from http://ceaccp.oxfordjournals.org/.

Butland, R.J., Pang, J., Gross, E.R., Woodcock, A. and Geddes, D.M. 1982. Two-, six- and 12-minute walking tests in respiratory disease. *British Medical Journal* 284:1607-1608.

Campbell, M.L. 1998. The changing dynamics of aging with polio. 1999. *Polio Network News*. 15. 2. Spring edition. International Networking Institute. 4207 Lindell Blud.MO 63 108-2915.

Carek, P.J., Laibstain, S.E. and Carek, S.M. 2011. Exercise for the treatment of depression and anxiety. *International Journal of Psychiatry in Medicine* 41. 1. 15-28.

Centers for Disease Control and Prevention (CDC). 2007. Physical activity among adults with a disability-United States, 2005. *Morbidity and Mortality Weekly Report* 56. 39. Oct. 5: 1021-1024.

Chang, K.H., Lai, C.H., Chen, S.C., Hsiao, W.T., Liou, T.H. and Lee C.M. 2011. Body composition assessmeot in Taiwanese individuals with poliomyelitis. *Archives of Physical Medicine and Rehabilitation* 92.7. July: 1092-1097.

Chase, N.L., Sui, X., Lee, D.C. and Blair, S.N. 2009. The association of cardiorespiratory fitness and physical activity with incidence of hypertension in men. *American Journal of Hypertension* 22. 4. April: 417.424.

Chen, A. Y., Kim, S. E., Houtrow, A. J. and Newacheck, P. W. 2010. Prevalence of obesity nmong children with chronic conditions. *Obesity* 18. 1: 210-213.

Chobanian, A.V., Bakris, G.L., Black, H.R., Cushman, W.C., Green, L.A., Izzo, J.L. Jr, Jones. D.W., Materson, B.J., Oparil, S., Wright, J.T. Jr and Roccella, E.J., 2003. JNC 7: Complete report. seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. National heart, lung, and blood institute; national high blood pressure education coordinating committee. *Hypertension* 42. 6: Dec. 1206-1252.

Chodzzko-Zajko, W., Schwingel, A. and Park, C.H. 2009. Successful aging: the role of physical activity. *American Journal of Lifestyle Medicine* 3.1. Jan. / Feb.: 20-28.

COMPASS (Community Participation for Action in the Social Sector, Nigeria). 2008. Non compliance in polio eradication: COMPASS takes on the cause. March 2008 Newsletter.

Cono, J. and Alexander, L.N. 2002. Poliomyelitis. *Vaccine preventable disease surveillance manual* (3rd ed.). Centers for Disease Control and Prevention. Chapter 10: 10-11.

Comclissen, V.A. and Fagard, R.H. 2005. Effects of endurance training on blood pressure, blood pressure regulating mechanisms, and cardiovascular risk factors. *Hypertension* 46:667-675.

Creange, S.J. and Bruno, R.L. 1997. Complinnce with treatment for post-polio sequelae: effect of Type A behavior, self-concept and loneliness. *American Journal of Physical Medicine and Rehabilitation* 76: 378-382.

Cuccurullo, S.J. 2004. *Physical Medicine and Rehabilitation Board Review.* Demos Medical Publishing, ISBN 1-888799.45-5.

Cuff, D.J., Meneilly, G.S., Martin, A., Ignaszewski, A., Tildesley, H.D. and Frohlich, J.J. 2003. Effective exercise modality to reduce insulin resistance in women with type 2 diabetes. *Diabetes Care* 26:2977–2982.

Curtis, J.R., Deyo, R.A. and Hudson, L.D. 1996. Health-related quality of life among patients with chronic obstructive pulmonary disease (COPD). *Pulmonary rehabilitation* Simonds et al. Eds. BMJ Publishing Group, BMA House, London WCIH 9.JR: 166-171.

Dalakas, M.C. and Hallett, M. 1998. The post-polio syndrome. *Advances in Contemporary Neurology*. Plum, F. Ed. Philadelphia: F.A. Davis: 51-94.

Davies, A., Blakeley, A.G. and Kidd, C. 2001. *Human Physiology*. London: Harcourt Publishers Limited. Harcourt Place, 32 Jamestown Road, London NW17BY. 123-130.

Dean, E. 1996. Mobilization and exercise. *Principles and Practice of Cardiopulmonary Physical Therapy*. Frownfelter, D. and Dean, E. Eds. 3rd ed. St Louis, Mo: Mosby: 265–298.

DeJong, G. (1995): Preventing and managing secondary conditions in an era of managed care. A presentation at the conference on secondary conditions and aging with a disability. Department of Physical Medicine and Rehabilitation, SUNY Health Science Center, Syracuse, New. York.

DiCarlo, S.E., Supp, M.D. and Taylor, H.C. 1983. Effect of arm ergometry on physical work capacity of individuals with spinal cord injuries. *Physical Therapy* 63. 7: 1104-1107.

Domholdt, E. 2000. *Physical therapy research: Principles and applications*. W.B. Saunders Company, U.S.A.ISBN 0-7216-6963-8: 69, 190.

Dregan, A. and Gulliford, M. C. 2013. Leisure-time physical activity over the life course and cognitive functioning in late mid-adult years: a cohort-based investigation. *Psychological Medicine* 43. 2447–2458.

Ells, L.J., Lang, R., Shield, J.P., Wilkinson J.R., Lidstone, J.S.,Coulton, S. and Summerbell, C.D. 2006. Obesity and disability-a short review. *Obesity Review* 7.4: 341–345.

Eston, R. and Brodie, D. 1986. Responses to arm and leg ergometry. *British Journal of Sports Medicine* 20:4-6.

Farbu, E. 2010. Update on current and emerging treatment options for post-polio syndrome. *Therapeutics and Clinical Risk Management* 6: 307-313.

Fenuns, C. E. 1990. Development of a quality of life index for patients with cancer. *Oncology Nursing Forum* 17. 3: 15-19.

_____ 1996. Development of a conceptual model of quality of life. *Scholarly Inquiry for Nursing Practice: An International Journal* 10. 3: 293-304.

_____and Powers. M. 1985. Quality of life index: development and psychometric properties. *Advances in Nursing Sciences* 8: 15-24.

_____and Powers, M.J. 1992. Psychometric assessment of the quality of life index. *Research in Nursing and Health* 15. 1. Feb: 29-38.

Field, M.N. and Jette, A.M. 2007. *The future of disability in America. A new look.* Institute of Medicine (U.S) Committee on Disability in America Washington (DC): National Aendemies Press (US). ISBN-13: 978-0-309-10472-2: 65 and 140-150. Retrieved March, 2011 from http://:www.nap.edu/

Flegal, K.M., Graubard, B.I., Willinmson D.F. and Gail, M.H. 2007. Cause-specific excess deaths nssociated with underweight, overweight, and obesity. *Journal of American Medical Association* 298. 17: 2028–2037.

Fletcher, G.F, Balady, G.J. and Amsterdam, E.A., Chaitman, B., Eckel, R., Fleg, J., Froelicher, V.F., Leon, A.S., Pina, I.L., Rodney, R., Simons-Morton, D.A., Williams, M.A. and Bazzarre, T. 2001. Exercise standards for testing and training: a statement for healthcare professionals from the American heart association. *Circulation* 104. 14. Oct 2:1694-1740.

Forman, L.S., Carruthers, D., and Londner, R.B. 2009. What is aging and how is it different with a disability? *Professional Case Management* 14. 5: 270-272.

Freidenberg, D.L., Freeman, D., Huber, S.J., Perry, J., Fischer, A. and Van Gorp, W.G. 1989. Postpoliomyelitis syndrome: assessment of behavioural features. *Neuropsychiatry, Neuropsychology, and Behavioural Neurology* 40: 272-281.

French, S.S. and Sloss, G.S. 1999. Health and demographic characteristics of polio survivors. *The Lincolnshire Post-Polio Network* 1999-2010. Retrieved Mar. 9, 2012from URL:http://www.zynet.co.uk/ott/polio/lincolnshire/library/usa/kentucky survey. html

Frenste, M. 2008. Classification of overweight and obesity by body mass index (BMI). Retrieved August, 28, 2012 from http://EzineArticles.com/?expert=Frenste_Michele.

Fuchs, C.Z. and Rehm, L.P. 1977. A self-control behavior therapy program for depression. *Journal of Consulting and Clinical Psychology* 45: 206-215.

Gawne, A.C. and Halstead, L.S. 1995. Post-polio syndrome: pathophysiology and clinical management. *Critical Reviews in Physical Medicine and Rehabilitation* 7. 2: 147-188.

_____, Wells, K.R. and Wilson, K.S. 2003. Cardiac risk factors in polio survivors. *Archives of Physical Medicine and Rehabilitation* 84. 5. May: 694-696.

Goldberg, D., and Williams, P. 1988. *A user's guide to the general health questionnaire*. Windsor, UK: NFER-Nelson.

Grimby, G., Einarsson, G., Hedberg, M. and Aniansson, A. 1989. Muscle adaptive changes in post-polio subjects. *Scandinavian Journal of Rehabilitation Medicine* 21. 1: 19-26.

Grundy, S.M. 2002. Obesity, metabolic syndrome, and coronary atherosclerosis. *Circulation* 105: 2696–2698.

Guh., D.P., Zhang, W., Bansback, N., Amarsi, Z., Birmingham C.L. and Aslam, H. 2009. The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis. *BioMedCentral Public Health* 9: 88.

Gylfadottir, S., Dallimore, M. and Dean, E. 2006. The relation between walking capacity and clinical correlates in survivors of chronic spinal poliomyelitis *Archives of Physical Medicine and Rehabilitation* 87: 944-952.

Hagberg, J.M., Park, J.J. and Brown M.D. 2000. The role of exercise training in the treatment of hypertension: an update. *Sports Medicine* 30:193-206.

Halstead, L. S. 1991. Assessment and differential diagnosis for post-polio syndrome. *Orthopedics* 14. 11: 1209-1217.

_____,1998. Ed. Managing post-polio: a guide to living well with post-polio syndrome. NRH Press, Washington D.C.

_____, 2004. Diagnosing post-polio syndrome: inclusion and exclusion criteria. *Post-polio syndrome*. J.K Silver and A.C. Gawne. Eds. U.S.A. Hanley and Belfus, The Curtis Center, Independence Square West, Philadelphia: 1-5.

_____ and Gawne, A.C. 1993. National rehabilitation hospital limb classification for exercise prescription in post-polio patients. *Proceedings from the 1993 Copenhagen Post-Polio Conference* :85.91.

Hamzat, T.K. 2000. Cardiovascular responses to exercise tests in subjects with poliomyelitis: a pilot study. *South African Journal of Physiotherapy* 56. 3: 39-41.

Harrison, T. and Stuiltbergen, A. 2001: Barriers that further disablement: a study of survivors of polio. *Journal of Neuroscience Nursing* 33: 160-166.

_____, 2006. Life purpose: effect on functional decline and quality of life in polio survivors. *Rehabilitation Nursing* 31: 149–154.

Hassouneh-Phillips, D. 2001. Conference on Rethinking Care. J.L Headley . Ed. *Post-Polio Health International* 18.1. Winter, 2002.

He, J., Whelton, P.K., Appel, L.J., Charleston, J. and Klag, M.J. 2000. Long-term effects of weight loss and dietary sodium reduction on incidence of hypertension. *Hypertension* 35:544-9.

HealthNews flash. 2002. Articles about exercise for polio survivors. *Polio Network News* 18. 3. Summer edition. Retrieved June. 2010 from http://www.healthnewsflash.com/conditions/post_polio_syndrome.php

Healthy People, 2010: *Draft for public comment. 1998 public health service*. Office of Disease Prevention and Health Promotion, Department of Health and Human Services (HHS). Washington, DC.

Heath, G.W. and Fentem, P.H. 1997. Physical activity among persons with disabilities-a public health perspective. *Exercise and Sport Sciences Reviews* 25: 195-234.

Hirsch, J., Salnns, L. B. and Aronne, L.J. 2001. Obesity. *Principles and practice of endocrinology and metabolism*. K.L. Becker. Ed. 3rd ed. Lippincott, Williams, and Wilkins Philadelphia. 1239–1246.

Hogan, A., McClellan, L. and Bauman, A. 2000. Health promotion needs of young people with disabilities: a population study. *Disability and Rehabilitation* 22. 8: 352-357.

Howard, R.S. 2005. Poliomyelitis and the post-polio syndrome. *British Medical Journal* 330. 7503 June 4:1314-1318.

Hoyt, W.G., Miller, N. and Walsh F. 2005. *Walsh and Hoyt's Clinical Neuro-ophtamology*. Hagerstown, M.D: Lippincott Williams and Wilkins. ISBN 0-7817-4814-3: 3264-3265.

Janssen, I., Katzmarzyk, P.T. and Ross, R. 2002. Body mass index, waist circumference, and health risk: evidence in support of current national institutes of health guidelines. *Archives of Internal Medicine* 162. 18. Oct: 2074–2079.

Jebb, S. and Wells, J. 2005. Measuring body composition in adults and children. *Clinical obesity in adults and children*. P.G. Kopelman. Ed. Blackwell Publishing. ISBN 1-4051-1672-2: 12-28.

Jones, D. R., Speier, J., Canine, K., Owen, R. and Stull, G. A. 1989. Cardiorespiratory responses to aerobic training by patients with postpoliomyelitis sequelae. *Journal of American Medical Association* 261. 22: 3255-3258.

Jung, R. T. 1997. Obesity as a disease. *British Medical Bulletin* 53: 307–321.

Kailes, J.I. 2008. 5 'gs' getting access to health care for people with physical disabilities, 2008 version 1. *Center for Disability Issues and the Health Professions*. Western university of health sciences, 309 e. second street, Pomona, CA 91766-1854. Retrieved Feb. 21, 2011 from http://www.jik.com/awdrtcawd.html.

Kalpakjian, C. and Roller, A. 2003. Psychological well-being of polio survivors. *State of the art reviews in physical medicine and rehabilitation: polio and post-polio syndrome*. Silver, J. Ed. Philadelphia (PA): Elsevier.

Kang, J.H. and Lin, H.C. 2011. Comorbidity profile of poliomyelitis survivors in a Chinese population: a population-based study. *Journal of Neurology* 258.6: 1026-1033.

Kemp, B.J., Adams, B.M. and Campbell M.L. 1997. Depression and life satisfaction in aging polio survivors versus age – matched controls: relation to post-polio syndrome, family functioning and attitude towards disability. *Archives of Physical Medicine and Rehabilitation* 78: 187-192.

Kew, O.M., Sutter, R.W., de Gourville E.M., Dowdle, W.R. and Pallansch M. A. 2005. Vaccine-derived polioviruses and the endgame strategy for global polio eradication. *Annual Review of Microbiology*. 59: 587-635.

Kilmer, D. 2002. Response to aerobic exercise training in humans with neuromuscular disease. *American Journal of Physical Medicine and Rehabilitation* 81. 11 suppl:S148-150.

King, C. 2008. *Poliomyelitis*. Microsoft (R) Student. (DVD). Redmond, WA: Microsoft Corporation.

Kinne, S., Patrick, D.L. and Doyle, D.L. 2004. Prevalence of secondary conditions among people with disabilities. *American Journal of Public Health* 94: 443-445.

Kitchener, B.A. and Jorm, A.F. 2002. Mental health first aid training for the public: Evaluation of effects on knowledge, attitudes and helping behaviour. *BMC Psychiatry* 2. October: 10.

Kodama, S., Saito, K. and Tanaka, S. Maki, M., Yachi, Y., Asumi, M.,Sugawara, A., Totsuka, K., Shimano, H., Ohashi, Y., Yamada, N. and Sone, H. 2009. Cardiorespiratory fitness as a quantitative predictor of all-cause mortality and cardiovascular events in healthy men and women: meta-analysis. *The Journal of American Medical Association* 301. 19. May 20: 2024-2035.

Koopman, F., Beelen, A., Gerrits, K., Bleijenberg, G., Abma, T., de Visser, M. and Nollet, F. 2010. Exercise therapy and cognitive behavioural therapy to improve fatigue, daily activity performance and quality of life in postpoliomyelitis syndrome: The Protocol of the FACTS-2-PPS trial. *BMC Neurology* 10. 8. (PMC Article).

Retrieved March 1, 2010 from http://www.biomedcentral.com/1471-2377/10/8.

Kravitz, L. 2007. The 25 most significant health benefits of physical activity and exercise. *IDEA Fitness Journal* 4. 9. Oct. Retrieved Sept. 2013 from http://www.ncbi.nlm.nih.gov/pubmed?

_____, and Vella C.A. 2002. Energy expenditure in different modes of exercise. *American College of Sports Medicine Current Comment* June. Retrieved October, 2013 from www.acsm.org.

Kriz, J.L., Jones, D.R., Speier, J.L., Canine, J.K., Owen, R.R. and Serfass, R.C. 1992. Cardiorespiratory responses to upper extremity aerobic training by postpolio subjects. *Archives of Physical Medicine and Rehabilitation* 73.1: 49-54.

Laforce, F.M, Lichnevski, M.S, Keja, J. and Henderson, R.H. 1980. Clinical survey techniques to estimate prevalence and annual incidence of poliomyelitis in developing countries. *Bulletin of World Health Organization* 58. 4: 610.

Lee, D.C., Artero, E.G., Sui, X. and Blair, S.N. 2010. Mortality trends in the general population: the importance of cardiorespiratory fitness. *Journal of Psychopharmacology* 24. supplement 4: 27–35.

Lemanski, P.E. 2004.The non-medicated life: the role of exercise. Centre for preventive medicine and cardiovascular health. Retrieved Feb, 2013 from http://www.centerforpreventivemedicine.com/article9.htm.

LeMura, L.M. and Von-Duvillard, S.P. 2004. *Clinical exercise physiology: application and physiological principle.* Baltimore M.D: Lippincott Williams and Wilkins. 219-235.

Levasseur, M., Desrosiers, J. and Tribble, D.S. 2008. Do quality of life, participation and environment of older adults differ according to level of activity? *Health and Quality of Life Outcomes* 6: Abstract.

Lin, K. and Lim, Y. 2005. Post-poliomyelitis syndrome: case report and review of the literature. *Annals of the Academy of Medicine, Singapore* 34.7: 447-449.

Liou, T.H., Pi-Sunyer, F.X. and Laferrere, B. 2005. Physical disability and obesity. *Nutrition Reviews* 63. 10. October: 321-331.

Lipkin, D.P., Scriven, A.J., Crake, T. and Poole-Wilson, P.A. 1986. Six-minute walking test for assessing exercise capacity in chronic heart failure. *British Medical Journal* 292: 653-655.

Lockette, K.F, and Keyes, A.M. 1994. Aerobic training. *Conditioning with physical disabilities.* Chicago: Human Kinetics. Champaign, IL 6182-5076, 1-800-747-4457:39-48.

Lollar, D.J. 2002. Public health and disability: emerging opportunities. *Public Health Reports* 117. March-April: 131-135.

Lyznicki, J. M., Young, D. C., Riggs, J. A. and Davis R.M. 2001. Obesity: assessment and management in primary care. *American Family Practitioner and Physician* 63: 2185–2187.

Macfarlane, T.V. 2003. Sample size determination for research projects. *British Orthodontic Society* 30. 2: 100.

Marge, M. 1988. Health promotion for persons with disabilities: moving beyond rehabilitation. *American Journal of Health Promotion* 2.4: 29-35.

Marion, C., Berg, K., Meyer, K. and Jacques, L. 1986. Effects of arm ergometry training in an ndolescent with myelodysplasia: a case report *Physical Therapy* 66:59-63.

Mayo, J.J., Kravitz, L. and Wongsathikun, J., 2001. Detecting the onset of cardiovascular strain during combined arm and leg exercise. *Journal of Exercise Physiology online* 4 (3) May: 53-60.

McArdle, D.M., Katch, F.I. and Katch, V.L. 2000. Essentials of exercise physiology. 2nd ed. Philadelphia PA: Lippincon Williams and Wilkins.

Miles, D.S., Cox, M.H. and Bomze, J.P. 1989. Cardiovascular responses to upper body exercise in nonnal and cardiac patients. *Medicine and Science in Sports and Exercise* 21(5):s126-s131.

Miller, P.D. (Ed.)1994. *Fitness programming and physical disability*. A publication for disabled sports, U.S.A. ISBN 13:978-0873224345.

Moffat, M. 2008. Physical therapists as exercise experts for aging adults: evidence – based examination and exercise prescription, *workshop manual. African region world confederation for Physical Therapy*, held in Abuja. Nigeria. 6-8.

Mohammad, A.F., Khan, K.A., Galvin, L., Galvin, L., Hardiman, O. and O'Connell, P.G. 2009. High incidence of osteoporosis and fractures in an aging post-polio population. *European Neurology* 62: 369-374.

Mueller, S., Wimmer, E. and Cello, J. 2005. Poliovirus and poliomyclitis: a tale of guts, brains, and an accidental event. *Virus Research* 111. 2: 175-193.

Must, A., Spadano, J., Coakley, E.H., Field, A.E., Colditz, G. and Dietz, W.H. 1999. The disease burden associated with overweight and obesity. The *Journal of American Medical Association* 282. 16. Oct. 27: 1523-1529.

Narayani, U. and Sudhan- Paul- Raj, R.L. 2010. Effect of aerobic training on percentage of body fat, total cholesterol and HDL-C among obese women. *World Journal of Sport Sciences* 3. 1: 33-36.

National Institute for Health and Clinical Excellence (NICE) 2006. Obesity: Guidance on the prevention, identification, assessment and management of overweight and obesity in adults and children (pdf). National health services (NHS): 36. Retrieved April 8, 2009 from http://www.nice.org.uk/nicemedia/pdf/CG43NICEGuideline.pdf.

National Primary Health Care Conference Steering Committee 2004. Primary health care fact sheet *Physiotherapy and primary health care: evolving opportunities*. Submitted by Fricke, M. 2005. Department of Physical Therapy, School of Medical Rehabilitation, University of Manitoba: 1-2.

National Primary Health Care Development Agency, 2013. *2014 Nigeria polio eradication emergency plan*. Dec.: 16.

Nelson, E.C, Wasson, J.H., Johnson, D.J. and Hays, R.D. 1996. Dartmouth coop functional health assessment charts: brief measures for clinical practice. *Quality of life and pharmaco-economics in clinical trial*. B. Spilker. Ed. 2nd ed. Philadelphia: Lippincott-Raven. 161-168.

Neumann, D. 2004. Polio: its impact on the people of the United States and the emerging profession of physical therapy. *The Journal of Orthopaedic and Sports Physical Therapy* 34. 8: 479-492.

Nielsen, N.M., Rostgaard, K., Askgaard, D., Skinhoj, P. andAaby. P. 2004. Life-long morbidity among danes with poliomyelitis. *Archives of Physical Medicine and Rehabilitation* 85. March: 385-391.

NINDS (National Institute of Neurological Disorders and Stroke) 2008. (n.d.). *Post-polio syndrome fact sheet*. Retrieved June 23, 2008, from http://www.ninds.nih.gov/disorders/post_polio/detail_post_polio.htm.

Noonan, V. and Dean, E. 2000. Review submaximal exercise testing: clinical application and interpretation. *Physical Therapy* 80.8. August: 782-807.

Nosek, M.A. 2000. Overcoming the odds: the health of women with physical disabilities in the united states. *Archives of Physical Medicine and Rehabilitation* 81: 135-138.

Nwadinigwe I.P. 2012. Fundamentals of research methods and statistics. 3rd ed. Vitamin educational books and publishers. Lagos. ISBN: 978-8012-28-0. 13.

Okorodudu, D.O., Jumean, M. F., Montori, V. M. , Romero-Corral, A., Somers, V.K., Erwin, P.J. and Lopez-Jimenez, F. 2010. Diagnostic performance of body mass index to identify obesity as defined by body adiposity: a systematic review and meta-analysis. *International Journal of Obesity* 34:791–799.

Oncu, J., Durmaz, B. and Karapolat, H. 2009. Short-term effects of aerobic exercise on functional capacity, fatigue, and quality of life in patients with post-polio syndrome. *Clinical Rehabilitation* 23. 2. Feb: 155-163.

O' Toole, M.L. 2002. Physical activity. *Health and disease in women*. Douglas. Ed. 2nd ed. Philadelphia, Pennsylvania 19106: W. B. Saunders Company. 178 -187.

Owen. R.R.. 1991. Postpolio syndrome and cardiopulmonary conditioning. *Western Journal of Medicine* 154. 5. May: 557–558.

Pallansch, M.A. and Jafari, H. 2006. Enterovirus infections, including poliomyelitis. *Tropical infectious diseases-principles, pathogens and practice*. R.L. Gleirant, D.H. Walker and P.F. Wellen Eds. 2nd ed. Vol. 1. Philadelphia, PA 1903-2899, U.S.A: Elsevier, Churchill Livingstone. 664.

Parakoyi, B. and Babaniyi, O.A. 1990. Prevalence of paralytic poliomyelitis in children of Kwara state, Nigeria: report on house-to-house survey. *East African Medical Journal* 67. 8. Aug: 545-549.

Parigi, A.D. 2010. Definitions and classification of obesity. *Endotext- the most accessed source on endocrinology for medical professionals*. Retrieved Dec, 2010 from http://ad.doubleclick.net/click;h:v8/3d1f/0/0/*/w;242851802;00;0;67965838;354728/90;42752716/42770503/1;;~aopt=2/1/3/0;~sscs=?http://www.endotext.org

Parkerson, G.R. Jr., Gehlbach, S.H., Wagner, E.H., James, S.A., Clapp, N.E. and Muhlbaier, L.H. 1981. The Duke-UNC health profile: an adult health status instrument for primary care. *Medical Care* 19: 806-828.

Parsons, R.E. 1989. Data on polio survivors from the national health intensive survey. US Government Printing Office, Washington DC.

Paul, J.R.1971. A history of poliomyelitis. *Yale studies in the history of scienceand medicine*. New Haven, Conn; Yale UniversityPress, ISBN 0-300-01324: 16-18.

Payne, W.A. and Hahn, D.B. Eds. 1998. *Staying physically fit*. 5th ed. U.S.A: WCB McGraw-Hill Companies Incorporation. 82-107.

Pescatello, L.S., Franklin, B.A., Fagard, R., Farquhar, W.B., Kelley, G.A and Ray, C.A. 2004. American college of sports medicine position stand. Exercise and hypertension. *Medicine and Science in Sports and Exercise* 36. 3. March: 533-553.

Pitsavos, C., Chrysohoou, C., Koutroumbi, M., Aggeli, C., Kourlaba, G., Panagiotakos, D., Michaelides, A. and Stefanadis C. 2011. The impact of moderate aerobic physical training on left ventricular mass, exercise capacity and blood pressure response during treadmill testing in borderline and mildly hypertensive males. *Hellenic Journal of Cardiology* 52: 6-14.

Pivarnik, J., Grafner, T. and Elkins, E. 1988. Metabolic, thermoregulatory, and psychophysiological responses during arm and leg exercise. *Medicine and Science in Sports and Exercise* 20:1-5.

Polio Australia. 2012. The late effects of polio: introduction to clinical practice. Polio Australia Incorporated. ISBN 978-0-9874392-0-8. Retrieved Sept, 2013 from http://www.polioaustralia.org.au/wp-content/uploads/2010/09/The-Late-Effects-of-Polio-Introduction-Module-Online-Version.pdf.

Pollard, W.E., Bobbitt, R.A., and Carter, W.B. 1976. The sickness impact profile: development and final revision of a health status measure. *Health Care* 19: 787.

Pope, A.M. and Tarlov, A.R. Eds. 1991. *Disability in America. Toward a national agenda for prevention.* Department of health promotion and disease prevention. Institute of medicine. R1-376. Retrieved Dec, 2013 from http://www.nap.edu/catalog.php?record_id=1579.

PostPolio Health. 2002. The late effectsof polio: an overview. *Postpolio Health* 30. 2. Post-Polio Health International (PHI) 4207 Lindell Blvd., #110, Saint Louis. MO 63108-2930 USA. Retrieved Feb, 2012 from http://www.post-polio.org/edu/lep.html.

_____ 2003. A statement about exercise for survivors of polio. *Quarterly Newsletter* 19. 2. Spring (ISSN 1066-5331). Retrieved Dec. 2013 from http://www.post-polio.org/edu/pplnews/pph19-2a.html.

Prata, N., Ejembi, C., Fraser, A., Shittu, O. and Minkler, M. 2012. Community mobilization to reduce postpartum haemorrhage in home births in Northern Nigeria. *Social Science and Medicine* 74: 1288-1296.

Putnam, M., Geenen, S., Powers, L., Saxton, M., Finney, S., and Dautel, P. 2003. Health and wellness: people with disabilities discuss barriers and facilitators to well-being. *Journal of Rehabilitation* 69. 1: 37.45.

Quesicad, K.A. and Alquist, A. 1994. Exercise assessment in clinical practice. *Physical Medicine and Rehabilitation Clinics of North America* 5: 243–253.

Quinlivan, R. and Thompson, N. 2004. Disorders of muscle and post-polio syndrome, *Physical management in neurological rehabilitation*. M Stokes. Ed. 2nd ed. China: Elsevier Mosby Limited. 278.

Ramachandran, T.S., Ramachandran, A. and Johnson, R.T. 2013. Post-polio syndrome. *Clinical summary preview*. Reineved Sept. 8, 2013 from http://www.medlink.com/medlinkcontent.asp

Report of The Trials of Hypertension Prevention Collaborative Research Group, 1997. Effects of weight loss and sodium reduction intervention on blood pressure and hypertension incidence in overweight people with high-normal blood pressure. The Trials of hypertension prevention, phase II. *Archives of Internal Medicine* 157:657-67.

Rimmer, J.H. 1999. Health promotion for persons with disabilities: the emerging paradigm shift from disability prevention to prevention of secondary conditions. *Physical Therapy* 79: 495-502.

_____ 2005. The conspicuous absence of people with disabilities in public fitness and recreation facilities: lack of interest or lack of access? *American Journal of Health Promotion* 19. 5. May/June: 327–329.

_____ and Braddock, D. 2002. Health promotion for people with physical. cognitive and sensory disabilities: an emerging national priority. *American Journal of Health Promotion* 16. 4: 220-224.

_____, and Rowland, J.L. 2008. Physical activity for youth with disabilities: a critical need in an underserved population. *Developmental Neurorehabilitation* 11. 2. Apr-June:141-148.

_____ , Rowland, J.L. and Yamaki, K. 2007. Obesity and secondary conditions in adolescents with disabilities: addressing the needs of an underserved population. *Journal of Adolescent Health* 41.3. Sept: 224-229.

_____, Wang, E., Yamaki, K. and Davis, B. 2010. Documenting disparities in obesity and disability. *FOCUS*. A publication of the national center for the dissemination of disability research (NCDDR). Technical Brief24. 7. 1-12.

_____, Chen, M.D., McCubbin, J.A., Drum, C. and Peterson, J. 2010a. Exercise intervention research on persons with disabilities: what we know and where we need to go. *American Journal of Physical Medicine and Rehabilitation /Association of Academic Physiatrists* 89. 3. 249-263.

_____, Yamaki, K., Davis, B.M., Wang, E. and Vogel, L.C. 2011. Obesity and overweight prevalence among adolescents with disabilities. *Preventing Chronic Disease* 8. 2. March: A41.

Ringaert, L. and Watters, C. 2005. Disability and aging. *Discussion paper on seniors with disabilities for the office of disability issues (ODI)*. Canadian centre on disability studies (CDDS), Winnipeg, Manitoba. July 19: 3-5.

Rosenberg, D.E., Bombardier, C.H., Hoffman, J.M. and Belza B. 2011. Physical activity among persons aging with mobility disabilities: shaping a research agenda. *Journal of Aging Research*. Doi:10.4061/2011/708510. PMCID : PMC 3124953. Retrieved March 14, 2013 from http://dx.crossref.org/10.4061/2011/708510.

Ryan, K.J. and Ray, C.G. Eds. 2004. Enteroviruses. *Sherris medical microbiology*. 4th ed. McGraw Hill. ISBN 0-8385-8529-9: 535-537.

Seton. 2008. Components of physical fitness. *Fitness calculators* Retrieved April, 2010 from https://www.goodhealth.com/articles/2008/03/28/fitness_calculators.

Shaw, E. 2006. Disability and quality of life. *Decision-making in pain management*. S. Ramamurthy, J.N. Rogers and F. Alanmanou Eds. 2nd ed. U.S.A. Philadelphia. Pennsylvania 19103: Mosby Elsevier. 18-19.

Sigal, R.J., Kenny, G.P., Wasserman, D.H. and Castaneda-Sceppa, C. 2004. Physical activity/exercise and type 2 diabetes. *Diabetes Care* 27. 10. Oct: 2518-2539.

Silver, J.K. and Gawne, A.C. 2004. *Postpolio syndrome*. Hanley and Belfus. University of Michigan. ISBN 1560536063, 9781560536062. 275-278.

Silverstein, A., Silverstein, V. and Nunn, L.S. 2001. *Polio, diseases and people*. Berkeley Heights, NJ: Enslow Publishers. ISBN 0-7660-1502-0: 12.

Smeltzer, S.C. 2013. Improving health and wellness of people with disabilities. *International Encyclopedia of Rehabilitation* J.H. Stone and M. Blouin. Eds. Retrieved March 20, 2013 from http://cirrie.buffalo.edu/encyclopedia/en/article/300/.

Smith, L. 2005. New American heart association (AHA) recommendations for blood pressure measurement. *American Family Physician* 72. 7. Oct. 1: 1391-1398.

Smith, D.L. and Fernhall, B.O. 2011. *Advanced cardiovasular exercise physiology*. Human kinetics series volume 2. ISBN-13:9780736073929. Chapter 1: Essentials of the cardiovascular system. Retrieved March, 2014 from http://www.humankinetics.com/products/all-products/the-advanced-cardiovascular-exercise-physiology.

Solway, S., Brooks, D., Lacasse, Y. and Thomas, S. A. 2001. A qualitative systematic overview of the measurement properties of functional walk tests used in the cardiorespiratory domain. *Chest* 119. 1. Jan: 256-270.

Song, J.K., Stebbins, C.L., Kim, T.K., Kim, H.B., Kang, H.J. and Chai, J.H. 2012. Effects of 12 weeks of aerobic exercise on body composition and vascular compliance in obese boys. *Journal of Sports Medicine and Physical Fitness* 52. 5: 522-529.

Springhouse, 2005. *Professional Guide to Disease*. 8th edition. Lippincott Williams and Wilkins. ISBN: 1-58255-370-x.

Stalberg, E. and Grimby, G. 1995. Dynamic electromyography and muscle biopsy changes in a four-year follow-up: study of patients with a history of polio. *Muscle Nerve* 18. 7: 699–707.

Strohschein, F. J., Kelly, C.C., Clark, A. C., Westbury, C.F., Shuaih, A.,Chan, K. and Ming, M.D. 2003. Applicability, validity, and reliability of the piper fatigue scale in postpolio patients. *American Journal of Physical Medicine and Rehabilitation* 82. 2. Feb: 122-129.

Stuilbergen, A.K. 2005. Secondary conditions and life satisfaction among polio survivors. *Rehabilitation Nursing* 30. 5. Sept/Oct: 173-179.

Symposium Proceedings of the Baylor College of Medicine 2003. Improving the health and wellness of women with disabilities. A project of the center for research onwomen with disabilities. Retrieved Jan. 8, 2009 from http://www.crowdbcm.net/index.htm.

Tate, D.G. 1996. Secondary conditions questionnaire. *Wellness for women with polio* programme. University of Michigan Medical Center. 1-10.

____, Kirsch, N., Maynard, F., Peterson, C., Forchheimer, M., Roller, A. and Hansen, N. 1994. Coping with the late effects: differences between depressed and non-depressed polio survivors. *American Journal of physical Medicine and Rehabilitation* 73. 1: 27–35.

Tersteeg, I., Stolwijk, J., Beelen, A. and Nollet, F. 2011. Impact of comorbidity and lifestyle related factors on functioning in aging polio survivors. Post-polio syndrome-a challenge of today. *Copenhagen presentation*. Aug 31-Sept. 2, 2011. Department of Rehabilitation. University of Amsterdam, Netherlands.

Thompson, K. 2002. *Depression and disability- a practical guide*. The North Carolina Office on Disability and Health. UNC-CH, Campus Box 8185, Chapel Hill, N.C.27599-8185. 5-27.

_____, 2007. Prevention: it just makes cents. *Harvard Public Health Review*. Spring/Summer. Harvard School of Public Health, U.S.A.

Toner M, Glickman E. and McArdle W. 1990. Cardiovascular adjustments to exercise distributed between the upper and lower body. *Medicine and Science in Sports and Exercise* 22:773-8.

Treat-Jacobson, D., Bronas, U.G., and Leon, A.S. 2009. Efficacy of arm-ergometry versus treadmill exercise training to improve walking distance in patients with claudication. *Vascular Medicine* 14: 203–213.

Tsai, H.C., Hung, T.H., Chen, C.C, Lieu, F.K., Cho, H., Tung, T.H. and Chen, S.F. 2009. Prevalence and risk factors for upper extremity entrapment neuropathies in polio survivors. *Journal of Rehabilitation Medicine* 41. 1. Jan: 26-31.

Tsigosa, C., Hainer, V., Basdevant, A., Finer, N., Fried, M., Mathus-Vliegen, E., Micic, D., Maislos, M., Roman, G., Schutz, Y., Toplak, H. and Zahorska-Markiewicz B. 2008. Management of obesity in adults: European clinical practice guidelines. *The European Journal of Obesity* 1. 2. April: 106–116.

Tudor-Locke, C.E. and Myers, A.M. 2001. Challenges and opportunities for measuring physical activity in sedentary adults. *Sports Medicine* ;3. 2. 91-100.

Veit, C.T. and Ware, J.E. Jr. 1983. The structure of psychological distress and well-being in general populations. *Journal of Consulting and Clinical Psychology* 51: 730-742.

Vidyadhara, S. 2012. Poliomyelitis. *WHO health topic page on poliomyelitis* Retrieved July 4, 2012 from http:// emedicine.medscape.com/article/1259213-treatment.

Waldrop, J., and Stern, S. Disability status, 2000. US Census Bureau, US Dept of Commerce. Retrieved June, 2005 from http://www.census.gov/hhes/www/disability.html.

Warburton, D.E.R., Nicol, C.W. and Bredin, S.S.D. 2006. Prescribing exercise as preventive therapy. *Clinical Trials and Meta-analyses* 174, 7.

Ward, A., Ebbeling, C.B. and Ahlquist, L.E. 1995. Indirect methods for estimation of aerobic power. *Physiological Assessment of Human Fitness*. Maud, P.J. and Foster, C. Eds. Champaign, Illinois. Human Kinetics. 37–56.

Ware, J.E. and Sherbourne, C.D. 1992. The MOS 36-item short-form survey (SF-36) Conceptual framework and item selection. Medical Care. 30:473–483.

_____, Brook, R.H. and Davies-Avery, A. 1980. *Conceptualization and measurement of health for adults in the health insurance study. Volume I. Model of health and methodology*. Santa Monica, RAND Corporation. California. Publication No. R-1987/1-HEW.

Warms, C. 2006. Physical activity measurement in persons with chronic conditions: methods, strategies, and issues. Promoting health in persons with chronic and disabling conditions. *Family and Community Health* 29, 1.Suppl. Mar: 78S-88S.

Warpcha, J.M. 2011. Upper body ergometry-the most underused aerobic activity. *NSCA's Performance Training Journal* 4, 6: 8. Retrieved Jan 15, 2014 from http://www.seatingdynamics.com.au/SiteFiles/seatingdynamicscomau/pdfs/140_Study-UBE_TheMostUnderUsedAerobicActivity.pdf.

Wei, M., Kampert, J.B., Barlow, C.E., Nichaman M.Z., Gibbons L.W., Paffenbarger R.S. Jr., and Blair, S.N. 1999. Relationship between low cardiorespiratory fitness and mortality in normal-weight, overweight, and obese men. *The Journal of American Medical Association* 282.16, Oct 27: 1547-1553.

Weil, E., Wachterman, M., McCarthy, E.P., Davis R.B., O'Day, B., Lezzoni, L.I. and Wee, C.C. 2002. Obesity among adults with disabling conditions. *The Journal of American Medical Association* 288:1265–1268.

Weiler, C., Xing, S.Y and Schwartz, H. 2009. Acute poliomyelitis. *Medscape's continually updated clinical reference*. Retrieved Oct. 10, 2010 from http://emedicine-medscape.com/article 306440-Overview.

Westhoff, T.H., Schmidt, S., Gross, V., Joppke, M., Zideka, W., Giet, M. V-D. and Dimeo, F. 2008. The cardiovascular effects of upper-limb aerobic exercise in hypertensive patients. *Journal of Hypertension* 26. 7: 1336-1342.

World Health Organization 2009. Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks Geneva: World Health Organization Press.

_____2009a. Milestones in health promotion. Statements from global conferences. Geneva: World Health Organization Press.

WHO Factsheet, 2013. Poliomyelitis. *Fact sheet N°114*, April, 2013. Retrieved Feb, 2014 from http://www.who.int/mediacentre/factsheets/fs114/en/.

_____, 2013a. Cardiovascular diseases (CVDs). *Fact sheet N°317*. Retrieved Feb, 2014 from http://www.who.int/mediacentre/factsheets/fs317/en/.

_____, 2014. Physical activity. *Fact sheet N°385*. Retrieved March, 2014 from http://www.who.int/mediacentre/factsheets/fs385/en/.

Wilson, D.J. 2005. *Living with polio: the epidemic and its survivors*. University of Chicago Press. ISBN 0226901033, 9780226901039.

Wood, M.J. 2004, Neurotropic virus disorders. *Infectious diseases vol 1*. Cohen and Powderly Eds. 2nd ed. Edinburgh: Mosby. Elsevier Limited: 321-323.

Wood, L.D.H., Hall, J.B. and Schmidt, G.D. 2005. *Principles of critical care*. 3rd ed. McGraw-Hill Professional: 870. ISBN 0-07-1416-10-4.

Wu, C.H., Liou, T.H., Chen, H.H., Sun, T.Y., Chen K.H., and Chang K.H. 2012. Stroke risk in poliomyelitis survivors: a nationwide population-based study. *Archives of Physical Medicine and Rehabilitation* 93. 12. Dec. 2184-2188.

Yarney, G. and Greenwood, R.J. 2005. Physical consequences of neurological disablement. *Handbook of neurological rehabilitation*. 2nd edition. Greenwood, R.J., McMillan, T.M., Barnes, M.P. and Ward, C.D. Eds. Taylor and Francis e-library. ISBN 0-86377-757-0. Chapter 15: 191-204.

Yarnell, S.K. 1991. Non-fatiguing general conditioning exercise programme (the 20% rule). *Post-Polio Health* 7. 3.

Yeomans, S.G. 2000. *The clinical application of outcomes assessment.* U.S.A: Appleton and Lange, Stamford, Connecticut. 51-54, 507-510.

Yeung, E.W. and Yeung, S.S. 2001. Interventions for preventing lower limb soft-tissue injuries in runners. *Cochrane Database of Systematic Reviews* 3:CD001256.

Yusuf, S., Hawken, S., Ounpuu, S., Baulista, L., Franzosi, M.G., Commerford, P., Lang, C.C., Rumboldt, Z., Onen, C.L., Lisheng, L., Tanomsup, S., Wangai, P., Razak, F., Sharma, A.M. and Anand, S.S. 2005. INTERHEART study investigators. Obesity and the risk of myocardial infarction in 27,000 participants from 52 countries: a case-control study. *Lancet* 366: 1640-1649.

APPENDIX A: ETHICAL APPROVAL

INSTITUTE FOR ADVANCED MEDICAL RESEARCH AND TRAINING (IAMRAT)
COLLEGE OF MEDICINE, UNIVERSITY OF IBADAN. IBADAN, NIGERIA.

Director: Prof. A. Ogunniyi, [illegible] MBChB, FMCP, FWACP, FRCP (Edin), FRCP (Lond)
Tel: 08023038583, 08038094173
E-mail: aogunniyi@comui.edu.ng

UI/UCH EC Registration Number: NHREC/05/01/2008a

NOTICE OF FULL APPROVAL AFTER FULL COMMITTEE REVIEW

Re: Survey of Health Profile of Polio Survivors in Oyo State and their Responses to Twelve-Week Arm Ergometry Training

UI/UCH Ethics Committee assigned number: UI/EC/12/0019

Name of Principal Investigator: **Adebola A. Atowoju**

Address of Principal Investigator: Department of Physiotherapy,
College of Medicine,
University of Ibadan, Ibadan

Date of receipt of valid application: 23/01/2012

Date of meeting when final determination on ethical approval was made: 21/06/2012

This is to inform you that the research described in the submitted protocol, the consent forms, and other participant information materials have been reviewed and given *full approval by the UI/UCH Ethics Committee*.

This approval dates from 21/06/2012 to 20/06/2013. If there is delay in starting the research, please inform the UI/UCH Ethics Committee so that the dates of approval can be adjusted accordingly. Note that no participant accrual or activity related to this research may be conducted outside of these dates. *All informed consent forms used in this study must carry the UI/UCH EC assigned number and duration of UI/UCH EC approval of the study.* It is expected that you submit your annual report as well as an annual request for the project renewal to the UI/UCH EC early in order to obtain renewal of your approval to avoid disruption of your research.

The National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the Code including ensuring that all adverse events are reported promptly to the UI/UCH EC. No changes are permitted in the research without prior approval by the UI/UCH EC except in circumstances outlined in the Code. The UI/UCH EC reserves the right to conduct compliance visit to your research site without previous notification.

UI/UCH EC
21 JUN 2012
APPROVED
COLLEGE OF MEDICINE, UI

Professor A. Ogunniyi
Director, IAMRAT
Chairman, UI/UCH Ethics Committee
E-mail: [illegible]

Research Units • Genetics & Bioethics • Malaria • Environmental Sciences • Epidemiology Research & Service • Behavioural & Social Sciences • Pharmaceutical Sciences • Cancer Research & Services • HIV/AIDS

APPENDIX B

LETTER OF INTRODUCTION

Dear Sir/Madam,

Mis. Atowoju, A.A. is a postgraduate student in the Department of Physiotherapy, College of Medicine, University of Ibadan (Matric No. 66258). She is carrying out a research titled "Survey of health profile of polio survivors in Oyo state and their responses to a twelve-week arm ergometry training", in partial fulfillment of the requirements for the award of the PhD. (Physiotherapy) degree of the University of Ibadan.

We therefore solicit your cooperation in completing the attached questionnaire honestly, and in allowing some measurements to be taken on you. We wish to assure you that all information will be kept strictly confidential and used for research purpose only.

Thank you.

Mrs. Abiola A. Atowoju — Researcher

Dr. B.O.A. Adegoke — Supervisor

APPENDIX C

INFORMED CONSENT FORM

IRB Research approval number:
This approval will elapse on:

Survey of Health Profile of Polio Survivors in Oyo State and Their Responses to a Twelve-week Arm Ergometry Training.

This study is being conducted by Mrs. Abiola A. Atowoju of the Department of Physiotherapy, University of Ibadan. It is self-sponsored.

The purpose of the research is to find out the present health profile of individuals who have survived the past polio epidemics in Oyo State, and secondly, to determine the effect a twelve-week exercise training programme will have on their health.

The research will be in two phases. Phase 1 will be a survey while Phase 2 will be an exercise training session. For the survey, some of your health parameters, for instance, your blood pressure, will be assessed using simple medical equipments. You will also be expected to complete some forms which will help to determine some aspects of your health. These will be o once-and –for-all assessment, obtained on a single day. No samples (e.g. blood) will be taken from you. As many participants as possible will be recruited for this phase. For the second phase, about 60 participants who take part in the survey, who reside in Ibadan will be selected. Lottery will be used to divide them into two groups, involving 30 participants each.
The two groups will be subjected to different forms of exercises. A group will be required to come thrice weekly, on alternate days, for twelve consecutive weeks, while the other will come on other three days of the week for same number of weeks. Your health variables (the ones assessed at the survey) will be re-assessed every four weeks to determine the effect your exercise programme has on you. You should not spend more than 1 hour at each visit. Your participation in the research will not cost you anything as the researcher will be totally responsible for your transportation to- and fro- the research venue. If at the end of the study the other group happens to benefit better than your group, you will be allowed to go through a similar exercise protocol if you so desire. You may have mild muscle aches or pains after the exercise training session because your body is not used to such activity. However, this is expected to reduce gradually as your body gets accustomed to the exercise programme. You will not need any treatment for this.

All information obtained in this study will be used for research purposes alone. Your names will be coded such that there will be no direct link of any information to your name. Your name will not reflect in any publication emanating from this study.

Your participation in this research is entirely voluntary. You may choose not to participate, and you may withdraw your participation at anytime. This will not place any negative consequence on you whatsoever. However, information obtained from you before you withdraw may have been modified or used in reports or publications.
You will not be paid any fees for participating in this research.

Statement of person obtaining informed consent:
I have fully explained this research

to_____

and have given sufficient information to make an informed decision.

DATE_____SIGNATURE_____

NAME_____

Statement of person giving consent:
I have read the description of the research (or have had it translated into a language I understand). I understand that my participation is voluotay. I know enough about the purpose, methods, benefits, and the reaction I may possibly have after carrying out the exercise session. if I am involved in the second phase. I understand that I may freely stop being part of this study at any time. I know enough about the study to judge that I want to participate in it. I have received a copy of this consent form.

DATE_____SIGNATURE_____

NAME_____

APPENDIX D
BACKGROUND INFORMATION SHEET

Name:.....
Date of Birth/Age:.....Sex:.....
Religion:.....Tribe/State:.....
Address:.....
Mobile phone No.....

FAMILY STATUS:

1. Married [ ] Divorced [ ] Spinster/Bachelor [ ] Widowed [ ]
2. Type of marriage: Monogamy [ ] Polygamy [ ] Polyandry [ ]
3. Do you live alone? Yes [ ] No [ ]
4. Do you have children? Yes [ ] No [ ]. If yes, how many?.....

EDUCATIONAL STATUS:

What is your highest educational qualification?

- No formal education [ ] Vocational training [ ] Pry. Sch. Leaving Cert. [ ]
- Sec. Schl leaving Cert/G.C.E/Teacher's Training Grade II Cert. [ ]
- OND/NCE[ ]
- HND/First Degree[ ]
- Post-graduate Diploma [ ]
- Masters [ ]
- Ph.D [ ]

ECONOMIC STATUS/INVOLVEMENT IN THE LABOUR MARKET

1. Do you work for a living? Yes [ ] No [ ]
2. If yes, pls tick the appropriate box below
   - I am self-employed
   - I work in a government establishment (civil servant)
   - I work in a private establishment
3. Profession/Occupation:
   .....
4. If unemployed, why? Retired [ ]
   Retired due to disability [ ] Unfit to work [ ] No job opportunity [ ]
5. Do you have means of transportation? Car [ ] Motor cycle [ ] None [ ]
   Others, specify-------
6. Type of Accommodation: Rented [ ] Self-owned [ ] Inherited [ ]

   Others, specify.....
7. Size of accommodation: Detached building/ Flat [ ] 2 bedrooms and parlour apartment[ ] A room and parlour apartment[ ] A room [ ] Others specify----
   .....

8. How much do you earn in a month? (Pls. give an estimate if not earning monthly salary and tick the appropriate box):

#0-4,999.00k [ ] #5000-9,999.00k [ ] #10,000-14,999.00k [ ] #15,000-19,999.00k [ ] #20,000-24,999.00k [ ]

#25,000-29,999.00k [ ] #30,000-34,999.00k [ ] #35,000-39,999.00k [ ] #40,000-44,999.00k [ ] #45,000-49,999.00k [ ] #50,000 and above [ ]

HISTORY OF POLIO

1. Age of contracting pollo.....
2. Parts of body affected:

Both arms and legs [ ]
One arm and both legs [ ]
One leg and both arms [ ]
Both legs [ ] Both arms [ ]
One leg: (Rt.) side [ ] (Lt.) Side [ ]

3. Do you use any form of walking aids/devices? Yes [ ] No [ ].
If yes, which type?

Axillary crutches [ ]
Elbow Crutches [ ]
Walking stick [ ]
Others, specify_____

4. Do you use calipers? No [ ]
Yes, one leg [ ]
Yes, both legs [ ]
5. Were you hospitalized at onset? Yes [ ] No [ ] Don't know [ ]

Ifyes, for how long?

.....

6. Did you use a respirator? Yes [ ] No [ ] Don't know [ ]
7. Have you had any surgery on account of condition? Yes [ ] No [ ]
Do not know [ ]

If yes, type of surgery:.....

PAST TREATMENT FOR POLIO

Where did you receive treatment in the past?

Private Hospital [ ]
General hospital [ ]
Specialist/teaching hospital [ ]
Non-Orthodox treatment (e.g. treatment provided by native doctors) [ ]
Do not know [ ]

PRESENT MANAGEMENT FOR POLIO/PRESENT HEALTH STATUS:

1. Present treatment/Rehabilitation:
   Attends Private clinic [ ]
   Attends General hospital [ ]
   Attends Specialist/ Teaching hospital [ ]
   Receiving non-orthodox treatment [ ]
   Receiving no treatment [ ]
2. a) If attending any health centre, what exactly are you being managed for?
   .....
   b) How regular do you attend?
   Only if there is complaint [ ]
   Regular, in keeping with clinic appointments [ ]
3. Have you noticed deterioration since initial recovery from polio? Yes [ ] No[ ]
4. Do you require more help now for day-to-day activities? Yes [ ] No [ ]
5. Have you had to change your assistive device in order to cope better with activities of daily living? Yes [ ] No [ ]
6. If yes, previous assistive device used:.....
7. Have you had to give up job as a result of pain or weakness? Yes [ ] No [ ]
8. If yes, when?.....
9. Have you had to change job as a result of pain or weakness? Yes [ ] No [ ]
10. If yes, when? .....
11. How can you rate your health now? Improving [ ] Worsening [ ] No change [

LIFESTYLE:

1. Do you smoke? Yes [ ], No [ ]
   If yes, how often? Scarcely [ ], Occasionally [ ], Regularly [ ]
2. Do you take alcoholic drinks? Yes [ ] No [ ]
   If yes, how often? Scarcely [ ], Occasionally [ ], Regularly [ ]

APPENDIX E

DARTMOUTH COOP CHARTS

INSTRUCTION: For each of the following, please choose the answer that best describes how you have been feeling during the past four weeks, including today. There are no right or wrong answers.

FEELINGS

During the past 4 weeks...
How much have you been bothered by emotional problems such as feeling anxious, depressed, irritable or downhearted and blue (sad)?

Not at all

Slightly

Moderately

Quite a bit

Extremely

DAILY ACTIVITIES

During the past 4 weeks...
How much difficulty have you had doing your usual activities or task, both inside and outside the house because of your physical and emotional health?

No difficulty at all — 1

A little bit of difficulty — 2

Some difficulty — 3

Much difficulty — 4

Could not do — 5

SOCIAL ACTIVITIES

During the past 4 weeks...
Has your physical and emotional health limited your social activities with family, friends, neighbors or groups?

Not at all

Slightly

Moderately

Quite a bit

Extremely

PAIN

During the past 4 weeks...
How much bodily pain have you generally had?

No pain	1
Very mild pain	2
Mild pain	3
Moderate pain	4
Severe pain	5

CHANGE IN HEALTH

How would you rate your overall health now compared to 4 weeks ago?

Much better	++ 1
A little better	+ 2
About the same	= 3
A little worse	- 4
Much worse	-- 5

OVERALL HEALTH

During the past 4 weeks...
How would you rate your health in general?

Excellent	1
Very good	2
Good	3
Fair	4
Poor	5

SOCIAL SUPPORT

During the past 4 weeks ...
Was someone available to help you if you needed and wanted help? For example if you

- Felt very nervous, lonely, or blue (sad)
- Got sick and had to stay in bed
- Needed someone to talk to
- Needed help with daily chores
- Needed help just taking care of yourself

Yes, as much as I wanted	
Yes, quite a bit	
Yes, some	
Yes, a little	
No, not at all	

QUALITY OF LIFE

How have things been going for you during the past 4 weeks?

1. Very well:
Could hardly be better

2. Pretty good
(considerably good)

3. Good & bad parts
about equal

4.Pretty bad
(considerably bad)

5.Very bad.
Could hardly be worse

APPENDIX F:
BECK DEPRESSION INVENTORY

Name: _____ Marital Status: _____

Age: _____ Sex: _____

Occupation: _____ Educational status: _____

Instructions: This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the one statement in each group that best describes the way you have been feeling during the past two weeks, including today. Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for any group. Including item 16 (Changes in Sleeping Pattern) or item 18 (Changes in Appetite).

1. **Sadness**
   - 0 I do not feel sad.
   - 1 I feel sad much of the time.
   - 2 I am sad all the time.
   - 3. I am so sad or unhappy that I can't stand it.

2. **Pessimism**
   - 0 I am not discouraged about my future.
   - 1 I feel more discouraged about my future than I used to be.
   - 2 I do not expect things to work out for me.
   - 3 I feel my future is hopeless and will only get worse.

3. **Past Failure**
   - 0 I do not feel like a failure
   - 1 I have failed more than I should have.
   - 2 As I look back, I see a lot of failures.
   - 3 I feel I am a total failure as a person.

4. **Loss of Pleasure**
   - 0 I get as much pleasure as I ever did from the things I enjoy.
   - 1 I don't enjoy things as much as I used to.
   - 2 I get very little pleasure from the things I used to enjoy.
   - 3 I can't get any pleasure from the things I used to enjoy.

5. **Guilty Feelings**
   - 0 I don't feel particularly guilty.
   - 1 I feel guilty over many things I have done or should have done.
   - 2 I feel quite guilty most of the time
   - 3 I feel guilty all of the time.

6. **Punishment Feelings**
   - 0 I don't feel I am being punished.
   - 1 I feel I may be punished.
   - 2 I expect to be punished.
   - 3 I feel I am being punished.

7. **Self-Dislike**
   - 0 I feel the same about myself as ever.
   - 1 I have lost confidence in myself.
   - 2 I am disappointed in myself.
   - 3 I dislike myself.

8. **Self-Criticalness**

0 I don't criticize or blame myself more than usual.
1 I am more critical of myself than I used to be.
2 I criticize myself for all of my faults.
3 I blame myself for everything bad that happens.

9. **Suicidal Thoughts or Wishes**

0 I don't have any thoughts of killing myself.
1 I have thoughts of killing myself, but I would not carry them out.
2 I would like to kill myself.
3 I would kill myself if I had the chance.

10. **Crying**

0 I don't cry anymore than I used to.
1 I cry more than I used to.
2 I cry over every little thing.
3 I feel like crying but I can't.

11. **Agitation**

0 I am no more restless or wound up than usual.
1 I feel more restless or wound up than usual.
2 I am so restless or agitated that it's hard to stay still
3 I am so restless or agitated that I have to keep moving or doing something.

12. **Loss of Interest**

0 I have not lost interest in other people or activities.
1 I am less interested in other people or things than before.
2 I have lost most of my interest in other people or things
3 It's hard to get interested in anything.

13. **Indecisiveness**

0 I make decisions about as well as ever.
1 I find it more difficult to make decisions than usual.
2 I have much greater difficulty in making decisions than I used to.
3 I have trouble making any decisions.

14. **Worthlessness**

0 I do not feel I am worthless.
1 I don't consider myself as worthwhile and useful as I used to.
2 I feel more worthless as compared to other people.
3 I feel utterly worthless.

15. **Loss of Energy**

0 I have as much energy as ever.
1 I have less energy than I used to have.
2 I don't have enough energy to do very much.
3 I don't have enough energy to do anything.

16. **Changes in Sleeping Pattern**

0 I have not experienced any change in my sleeping pattern.
1a I sleep somewhat more than usual.
1b I sleep somewhat less than usual.
2a I sleep a lot more than usual.
2b I sleep a lot less than usual.
3a I sleep most of the day.
3b I wakeup 1-2hours early and can't get back to sleep.

17. **Irritability**

0 I am no more irritable than usual
1 I am more irritable than usual.
2 I am much more irritable than usual.
3 I am irritable all the time.

18. **Changes in Appetite**

0 I have not experienced any change in my appetite.
1a My appetite is somewhat less than usual
1b My appetite is somewhat greater than usual.
2a My appetite is much less than before
2b My appetite is much greater than usual.
3a I have no appetite at all.
3b I crave food all the time.

19. **Concentration Difficulty**

0 I can concentrate as well as ever.
1 I can't concentrate as well as usual.
2 It's hard to keep my mind on anything for very long.
3 I find I can't concentrate on anything

20. **Tiredness or Fatigue**

0 I am no more tired or fatigued than usual
1 I get more tired or fatigued more easily than usual.
2 I am too tired or fatigued to do a lot of the things I used to do.
3 I am too tired or fatigued to do most of the things I used to do.

21. **Loss of Interest in Sex**

0 I have not noticed any recent change in my interest in sex.
1 I am less interested in sex than I used to be.
2 I am much less interested in sex now.
3 I have lost interest in sex completely.

APPENDIX G
FERRANS AND POWERS QUALITY OF LIFE INDEX
MULTIPLE SCLEROSIS VERSION III

PART 1: For each of the following, please choose the answer that best describes how satisfied you are with that area of your life. Please mark your answer by circling the number. There are no right or wrong answers.

Very Dissatisfied – 1
Moderately Dissatisfied – 2
Slightly Dissatisfied – 3
Slightly Satisfied – 4
Moderately Satisfied – 5
Very Satisfied – 6

HOW SATISFIED ARE YOU WITH:

1. Your health? 1 2 3 4 5 6
2. Your health care? 1 2 3 4 5 6
3. The amount of pain that you have? 1 2 3 4 5 6
4. The amount of energy you have for everyday activities? 1 2 3 4 5 6
5. Your ability to take care of yourself without help? 1 2 3 4 5 6
6. Your ability to get around, go places? 1 2 3 4 5 6
7. Your ability to speak? 1 2 3 4 5 6
8. The amount of control you have over your life? 1 2 3 4 5 6
9. Your chances of living as long as you would like? 1 2 3 4 5 6
10. Your family's health? 1 2 3 4 5 6
11. Your children? 1 2 3 4 5 6
12. Your family's happiness? 1 2 3 4 5 6
13. Your sex life? 1 2 3 4 5 6
14. Your spouse, lover, or partner? 1 2 3 4 5 6
15. Your friends? 1 2 3 4 5 6
16. The emotional support you get from your family? 1 2 3 4 5 6
17. The emotional support you get from people other than your family? 1 2 3 4 5 6
18. Your ability to take care of family responsibilities? 1 2 3 4 5 6
19. How useful you are to others? 1 2 3 4 5 6
20. The amount of worries in your life? 1 2 3 4 5 6
21. Your neighborhood? 1 2 3 4 5 6
22. Your home, apartment, or place where you live? 1 2 3 4 5 6
23. Your job (if employed)? 1 2 3 4 5 6
24. Not having a job (if unemployed, retired, or disabled)? 1 2 3 4 5 6
25. Your education? 1 2 3 4 5 6
26. How well you can take care of your financial needs? 1 2 3 4 5 6
27. The things you do for fun? 1 2 3 4 5 6
28. Your chances for a happy future? 1 2 3 4 5 6
29. Your peace of mind? 1 2 3 4 5 6
30. Your faith in God? 1 2 3 4 5 6
31. Your achievement of personal goals? 1 2 3 4 5 6
32. Your happiness in general? 1 2 3 4 5 6
33. Your life in general? 1 2 3 4 5 6
34. Your personal appearance? 1 2 3 4 5 6
35. Yourself in general? 1 2 3 4 5 6

(Please go to the next section)

PART 2: For each of the following, please choose the answer that best describes how important that area of your life is to you. Please mark your answer by circling the number. There are no right or wrong answers.

Very Unimportant – 1
Moderately Unimportant – 2
Slightly Unimportant – 3
Slightly Important – 4
Moderately Important – 5
Very Important – 6

HOW IMPORTANT TO YOU IS:

1. Your health? 1 2 3 4 5 6
2. Your health care? 1 2 3 4 5 6
3. Having no pain? 1 2 3 4 5 6
4. Having enough energy for everyday activities? 1 2 3 4 5 6
5. Taking care of yourself without help? 1 2 3 4 5 6
6. Your ability to get around, go places? 1 2 3 4 5 6
7. Your ability to speak? 1 2 3 4 5 6
8. The amount of control you have over your life? 1 2 3 4 5 6
9. Your chances of living as long as you would like? 1 2 3 4 5 6
10. Your family's health? 1 2 3 4 5 6
11. Your children? 1 2 3 4 5 6
12. Your family's happiness? 1 2 3 4 5 6
13. Your sex life? 1 2 3 4 5 6
14. Your spouse, lover, or partner? 1 2 3 4 5 6
15. Your friends? 1 2 3 4 5 6
16. The emotional support you get from your family? 1 2 3 4 5 6
17. The emotional support you get from people other than your family? 1 2 3 4 5 6
18. Taking care of family responsibilities? 1 2 3 4 5 6
19. Being useful to others? 1 2 3 4 5 6
20. Having no worries? 1 2 3 4 5 6
21. Your neighborhood? 1 2 3 4 5 6
22. Your home, apartment, or place where you live? 1 2 3 4 5 6
23. Your job (if employed)? 1 2 3 4 5 6
24. Not having a job (if unemployed, retired, or disabled)? 1 2 3 4 5 6
25. Your education? 1 2 3 4 5 6
26. Being able to take care of your financial needs? 1 2 3 4 5 6
27. Doing things for fun? 1 2 3 4 5 6
28. Having a happy future? 1 2 3 4 5 6
29. Peace of mind? 1 2 3 4 5 6
30. Your faith in God? 1 2 3 4 5 6
31. Achieving your personal goals? 1 2 3 4 5 6
32. Your happiness in general? 1 2 3 4 5 6
33. Being satisfied with life? 1 2 3 4 5 6
34. Your personal appearance? 1 2 3 4 5 6
35. Are you to yourself? 1 2 3 4 5 6

APPENDIX H: SECONDARY CONDITIONS/CO-MORBIDITIES DISABLEMENT SURVEY QUESTIONNAIRE

A. Have you ever EXPERIENCED any of these conditions?

	Secondary Health Conditions/Co-morbidities	Yes	No	Don't know
1	New muscle weakness in previously weak muscles			
2	New muscle weakness in previously strong muscles			
3	General weakness			
4	Sensitivity to temperature in the extremities/cold intolerance			
5	Low stamina/high fatigue			
6	Chronic pain in muscle, joints			
7	Sleep problems			
8	Spinal deformities			
	(Scoliosis [ ] Kyphosis [ ] Exaggerated lordosis [ ] Reduced lordosis [ ]			
9	Periods of Depression			
10	Fractures			
11	Contractures			
12	Obesity/unwanted weight gain			
13	Reduced ability to carry out normal activities			
14	Requires more help now for day-to-day tasks			
15	Bladder Dysfunction			
16	Bowel dysfunction			
17	Swallowing problems			
18	Feelings of being isolated			
19	Diabetes			
20	Hypertension/High blood pressure			
21	Memory problems			
22	Falls or other injuries			
23	Breathing difficulties/Respiratory problems (not cold)			
24	Arthritis			
25	Pressure sores			
26	Heart problems/Disease			
27	Arm/shoulder problems due to use of crutches			
28	Personality change			
29	Back pain			
30	Serious episodes of anxiety			
31	Problems making/seeing friends			
32	Lack of romantic relationship			
33	Osteoporosis (Brittle bones)			
34	Circulatory problems			
35	Pins and needles sensation in the hands			
36	Increased thirst			
37	Asthma			
38	Skin problems			

B. Have you ever been DIAGNOSED of any of these conditions?

	Secondary Health Conditions/Co-morbidities	Yes	No	Don't know
1	New muscle weakness in previously weak muscles			
2	New muscle weakness in previously strong muscles			
3	General weakness			
4	Sensitivity to temperature in the extremities/cold intolerance			
5	Low stamina/high fatigue			
6	Chronic pain in muscle, joints			
7	Sleep problems			
8	Spinal deformities			
	(Scoliosis [ ] Kyphosis [ ] Exaggerated lordosis [ ] Reduced lordosis [ ]			
9	Periods of Depression			
10	Fractures			
11	Contractures			
12	Obesity/unwanted weight gain			
13	Reduced ability to carry out normal activities			
14	Requires more help now for day-to-day tasks			
15	Bladder Dysfunction			
16	Bowel dysfunction			
17	Swallowing problems			
18	Feelings of being isolated			
19	Diabetes			
20	Hypertension/High blood pressure			
21	Memory problems			
22	Falls or other injuries			
23	Breathing difficulties/Respiratory problems (not cold)			
24	Arthritis			
25	Pressure sores			
26	Heart problems/Disease			
27	Arm/shoulder problems due to use of crutches			
28	Personality change			
29	Back pain			
30	Serious episodes of anxiety			
31	Problems making/seeing friends			
32	Lack of romantic relationship			
33	Osteoporosis (Brittle bones)			
34	Circulatory problems			
35	Pins and needles sensation in the hands			
36	Increased thirst			
37	Asthma			
38	Skin problems			

C. How often do you experience these problems?

	Secondary Health Conditions/Co-morbidities	1 (It's never a problem)	2 (It's occasionally a problem)	3 (It's a problem most of the time)	(it's a proble all the time)
1	New muscle weakness in previously weak muscles				
2	New muscle weakness in previously strong muscles				
3	General weakness				
4	Sensitivity to temperature in the extremities/cold intolerance				
5	Low stamina/high fatigue				
6	Chronic pain in muscle, joints				
7	Sleep problems				
8	Spinal deformities				
	(Scoliosis [ ] Kyphosis [ ] Exaggerated lordosis [ ] Reduced lordosis [ ]				
9	Periods of Depression				
10	Fractures				
11	Contractures				
12	Obesity/unwanted weight gain				
13	Reduced ability to carry out normal activities				
14	Requires more help now for day-to-day tasks				
15	Bladder Dysfunction				
16	Bowel dysfunction				
17	Swallowing problems				
18	Feelings of being isolated				
19	Diabetes				
20	Hypertension/High blood pressure				
21	Memory problems				
22	Falls or other injuries				
23	Breathing difficulties/Respiratory problems (not cold)				
24	Arthritis				
25	Pressure sores				
26	Heart problems/Disease				
27	Arm/shoulder problems due to use of crutches				
28	Personalisty change				
29	Back pain				
30	Serious episodes of anxiety				
31	Problems making/seeing friends				
32	Lack of romantic relationship				
33	Osteoporosis (Brittle bones)				
34	Circulatory problems				
35	Pins and needles sensation in the hands				
36	Increased thirst				
37	Asthma				
38	Skin problems				

APPENDIX I

BORG'S RATE OF PERCEIVED EXERTION SCALE (Borg, 1982)

EXERTION	RATE OF PERCEIVED EXERTION
No exertion at all	6
Extremely light	7
	8
Very light	9
	10
Light	11
	12
Somewhat hard	13
	14
Hard/heavy	15
	16
Very hard	17
	18
Extremely hard	19
Maximal exertion	20

APPENDIX J: ÀSOMỌ́ KÍNÍ

OJÚ EWÉ AFINIMỌ̀NÀ NÍPA OLÙDÁHÙN ÌBÉÈRÈ

Orúkọ: ....

Ọjọ́ ibi tàbí ọjọ́ ori.............................. Ọkùnrin tabi obìnrin? ....

Ẹ̀sin..................................... Ẹ̀yà tàbí ípínlẹ̀...

Àdírẹ́si..

Nọ́mbà Ẹ̀rọ alágbèéká...

ÈTÒ ẸLẸ́BÍ DÉ:

1. Ti ṣégbèyàwó [ ] Ti kọ́ sílẹ̀ [ ] Wùndía tabi Àpọn [ ] Opó [ ]
2. Irú igbéyàwó tí o ṣe: Olobìnrin kan [ ] Ìkóbìnrinjọ́ [ ] ọ̀lọ́kọ́púpọ̀ [ ]
3. Ṣe ò n dáàgbé ni? Bẹ́ẹ̀ni [ ] Bẹ́ẹ̀kọ́ [ ]
4. Ṣe o bi ọmọ? Bẹ́ẹ̀ni [ ] Bẹ́ẹ̀kọ́ [ ]

   Tí ó bá jẹ́ bẹ́ẹ̀nì ọmọ mélòó ni o bi? ....

ÈTÒ Ẹ̀KỌ́

Kíni iwé ẹ̀rí tí ó ga jùlọ tí o ní tàbí ipele tí o kàwé dé?

- Púrúntú [ ] Iṣẹ́ ọwọ́ [ ] Ìwé ẹ̀rí onípò kẹ́tà [ ]
- Iwé ẹ̀rí girama tàbí ilé ẹ̀kọ́ olùkọ́ onípò keji [ ]
- ipele àkọ́kọ́ ni póli tàbí ilé ẹ̀kọ́ olùkọ́ni [ ]
- Ipele keji ní póli tàbí oyè àkọ́kọ́ ni fásitì [ ]
- Dípúlọ́mà lẹ́yìn oyé àkọ́kọ́ [ ] Oyè ìjìnlẹ̀ [ ] Oyé ìjìnlẹ̀ gíga [ ]

ÈTÒ ỌRỌ̀ AJÉ TÀBÍ ÌLỌ́WỌ́SÍ ỌRỌ̀ AJÉ

1. Njẹ́ ò n ṣe Iṣẹ́ òòjọ́? Bẹ́ẹ̀nì [ ] Bẹ́ẹ̀kọ́ [ ]
2. Tí ó bá jẹ́ bẹ́ẹ̀nì, jọ̀wọ́ mú èyí tí ó bá iṣẹ́ rẹ mu nínú ìwọ̀nyí:

   Èmi ni mo ni iṣẹ́ ara mi tí mò n ṣe [ ]

   Òṣìṣẹ́ ìjọba ni mi [ ]

   Òṣìṣẹ́ ni mí ní ilé iṣẹ́ aládani [ ]
3. Iṣẹ́ tí ò n ṣe ....
4. Tí o kò bá níṣẹ́, kí ló fàá?

   Mo ti fẹ̀yìn tì [ ] kòsàgbára àti ṣiṣẹ́ [ ] Kò sí iṣẹ́ [ ]

   Mo fẹ̀yìntì nítorí àìlera [ ]

5. Njẹ o ni ohun irinṣẹ? Ọkọ ayọkẹlẹ [ ] Alùpùpù [ ] Ko si kankan [ ]
Oríṣi ohun ìrinṣẹ́ míràn tí o ní ....

6. Irú ilé wo ni o n gbé? Méhàyá [ ] Ilé tirẹ [ ] Àjogúnbá [ ]
Òmíràn tí ó yàtọ̀ sí ìwọ̀nyí....................................

7. Ibi ti ò n gbé ti tóbi to?: Ilé aládàáwà fúlàtì [ ] Yàrá méjì àti pálọ̀ [ ] Yàrá kan àti pálọ̀ [ ] Yàrá kan [ ]
Òmíràn tí ó yàtọ̀ sí ìwọ̀nyí....................................

8. Èló ni owó rẹ lóṣù? (Jọ̀wọ́ gbìyànjú láti ṣíro owó tí ó n wọlé fún ọ lóṣù tí o kò bá kí n gba owó oṣù, kí o sì mú àyí tí ó bamu nínu awọn ipele wonyí)

a) Kò tó ẹgbẹ̀ẹ̀dọ́gbọ̀n náírà (#0-4,999.00k) [ ]

b) Láàrín ẹgbẹ̀ẹ̀dọ́gbọ̀n sí ẹgbẹ̀rúnmẹ́wa ó dín oókan náírà [ ]
(#5000-9,999.00k)

d) Láàrín ẹgbẹ̀rúnmẹ́wa sí ẹgbẹ̀rúnmárùndínlógún ó dín oókan náírà [ ]
#10,000-14,999.00k

e))Láàrín ẹgbẹ̀rúnmárùndínlógún sí ẹgbẹ̀rún lọ́nà ogún ó dín oókan náírà [ ]
#15,000-19,999.00k

ẹ) Láàrín ẹgbẹ̀rún lọ́nà ogún sí ẹgbẹ̀rúnmárùndínlọ́gbọ̀n ó dín oókan náírà [ ]
#20,000-24,999.00k

f) Láàrín ẹgbẹ̀rúnmárùndínlọ́gbọ̀n sí ẹgbẹ̀rún lọ́nà ọgbọ̀n ó dín oókan náírà [ ]
#25,000-29,999.00k

g) Láàrín ẹgbẹ̀rún lọ́nà ọgbọ̀n sí ẹgbẹ̀rúnmárùndínlógójì ó dín oókan náírà [ ]
#30,000-34,999.00k

gb) Láàrín ẹgbẹ̀rún márùndínlógójì sí ẹgbẹ̀rún lọ́nà ogójì ó dín oókan náírà [ ]
#35,000-39,999.00k

h) Láàrín ẹgbẹ̀rún lọ́nà ogójì sí ẹgbẹ̀rún márùndínláàdọ́ta ó dín oókan náírà [
#40,000-44,999.00k

i) Láàrín ẹgbẹ̀rún márùndínláàdọ́ta sí ẹgbẹ̀rún lọ́nà àádọ́ta ó dín oókan náírà
#45,000-49,999.00k

j) Ó ju ẹgbẹ̀rún lọ́nà àádọ́ta náírà [ ] (#50,000 and above)

ÌTÀN ÀRÙN ỌMỌLÁPÁ-ỌMỌLẸ́SẸ̀

1. Ọjọ́ orí tí ó lùgbàdì àrùn ọmọlẹ́sẹ̀.....

2. Ẹ́yá ara tí ó lùgbàdì:

   Àtọwọ́-atẹsẹ̀ [ ]

   Ọwọ́ kan àti ẹsẹ̀ méjèèjì [ ]

   Ẹsẹ̀ kan, àtí ọwọ́ méjèèjì [ ]

   Ẹsẹ̀ méjèèjì [ ] Ọwọ́ méjèèjì [ ]

   Ẹsẹ̀ kan [ ] ọ̀tùn [ ] òsì [ ]

3. Njẹ́ o n lo ohun ìrànlọ́wọ́ kankan lati rìn? Bẹ́ẹ̀ni [ ] Bẹ́ẹ̀kọ̀ [ ]

   Tí ó bá jẹ́ bẹ́ẹ̀ni, irú èwo ni?

   Igi ìrìnsẹ̀ abiyà [ ]

   Igi ìrìnsẹ̀ igbọ́nwọ́ [ ]

   Ọpá ìtílẹ̀ [ ]

   Òmíràn tí ó yàtọ̀ sí ìwọ́nyí.....

4. Njẹ́ o n lo irin-afìrìn? Bẹ́ẹ̀kọ́ [ ]

   Bẹ́ẹ̀ni, ẹsẹ̀ kan [ ]

   Bẹ́ẹ̀ni, ẹsẹ̀ méjèèjì [ ]

5. Ṣé a dà ọ́ dúró sí ilé-ìwòsàn nígbàtí àìsàn yí bẹ̀rẹ̀? Bẹ́ẹ̀ni [ ] Bẹ́ẹ̀kọ̀ [ ]

   N kò mọ́ [ ]

   Tí ó bá jẹ́ bẹ́ẹ̀ni, fún ìgbà wo?.....

6. Ṣe o lo èrọ ti a fi n mí nígbànàà? Bẹ́ẹ̀ni [ ] Bẹ́ẹ̀kọ̀ [ ] N kò mọ́ [ ]

7. Njẹ́ o ti ṣe iṣẹ́ abẹ nítorí àrùn ọmọlàpà-ọmọlẹ́sẹ̀:

   Tí ó bá jẹ́ bẹ́ẹ̀ni, irú iṣẹ́-abẹ wo:.....

ÌTỌJÚ FÚN ÀRÙN ỌMỌLÁPÁ-ỌMỌLẸ́SẸ̀ NÍGBÀKAN RÍ:

Níbo ni o ti gba ìtọ́jú fún àrùn ọmọlàpà ọmọlẹ́sẹ̀ nígbàkan rí

Ilé-ìwòsàn alàdàáni [ ]

Ilé-ìwòsàn ìjọba [ ]

Ilé-ìwòsàn akọ́sẹ̀mọsẹ̀ tàbí tí a ti n kọ́ni [ ]

Ìtọ́jú tọ́dọ̀ àwọn onísẹ́gùn ibílẹ̀ [ ]

N kò mọ [ ]

ỌNÀ TÍ Ò N GBA TỌJÚ ÀRÙN ROMỌLÁPÁ-ROMỌLẸ́SẸ̀ TÀBÍ IPÒ TÍ ÀLÁÁFÍÀ RẸ WÀ BÁYÌÍ:

1. Bí o ṣe n tọ́jú ara à rẹ bàyìí:

Mọ́ n lọ sí ilé-ìwòsàn àdáni [ ]

Mò n lọ sí ilé-ìwòsàn ìjọba [ ]

Mọ́ n lọ sí ilé-ìwòsàn akọ́sẹ́mọsẹ́ [ ]

Mò n gba ìtọ́jú lọ́dọ́ àwọn onísẹ́gùn ìbílẹ̀ [ ]

N ko gba ìtọ́jú rárá bayìí [ ]

2a). Bí o bá n lọ sí ilé-ìwòsàn, kíni ohun tí ò n gba ìtọ́jú fún pàtó?

.....

2b). Njẹ́ ò n lọ déédé bí?

Àfi bí mo bá ni ìṣòro tàbí àìlera ìdí ṣe [ ]

Mò n lọ déédé, ní ìbámu pẹ̀lú ọjọ́ tí a bá dá fún mì ní ilé-ìwòsàn [ ]

3. Njẹ́ o ṣe àkíyèsí ìpadàsẹ́yìn kankan látì ìgbà àkọ́kọ́ tí o ti gbàdún ninú àrun romọlápá-romọlẹ́sẹ̀? Bẹ́ẹ̀ni [ ] Bẹ́ẹ̀kọ́ [ ]

4. Njẹ́ o níìò ìrànlọ́wọ́ ju atẹ́yìnwà ọ látì ṣe isẹ́ ojúmọ́ rẹ bàyìí?

Bẹ́ẹ̀ni [ ] Bẹ́ẹ̀kọ́ [ ]

5. Njẹ́ o ti níìò lati pàárọ́ ohun ìrànlọ́wọ́ ti ò n lò látì le ṣe isẹ́ ojúmọ́ rẹ déédé? Bẹ́ẹ̀ni [ ] Bẹ́ẹ̀kọ́ [ ]

6. Bí ó bá jẹ́ bẹ́ẹ̀ni, ohun ìrànlọ́wọ́ wo ni ò n lò tẹ́lẹ́ rí?

7. Njẹ́ o ti ní làìl fi isẹ́ sílẹ̀ nítorí ìrora tàbí àìlókun? Bẹ́ẹ̀ni [ ] Bẹ́ẹ̀kọ́ [ ]

8. Bí ó bá jẹ́ bẹ́ẹ̀ni, ìgbà wo? .....

9. Njẹ́ o ti ní làìl pàárọ́ isẹ́ nítorí ìrora tàbí àìlókun? Bẹ́ẹ̀ni [ ] Bẹ́ẹ̀kọ́ [ ]

10. Bí ó bá jẹ́ bẹ́ẹ̀ni, ìgbà wo?.....

11. Kíni o lé ṣọ nípa àláàìíà rẹ bàyìí?

Ó n dárá sìí [ ] Ó n burú sí [ ] kò sí ìyípadà [ ]

IGBÉ-AYÉ

1. Njẹ́ ò n mu sìgá? Bẹ́ẹ̀ni [ ] Bẹ́ẹ̀kọ́ [ ]

Bí ó bá jẹ́ bẹ́ẹ̀ ni, báwo ni ó ṣe ṣe déédé sí?

Ó ṣọ̀wọ́n [ ] Ẹ̀kọ̀ọ̀kan [ ] Léraléra [ ]

2. Njẹ́ ó n mu ọtí. Bẹ́ẹ̀ní [ ] Bẹ́ẹ̀kọ́ [ ]

Bí o ba jẹ́, bẹ́ẹ̀ní bawo ni? Ó ṣọ̀wọ́n [ ] Ẹ̀kọ̀ọ̀kan [ ] Léraléra[ ]

APPENDIX K

ÀSOMỌ́ KEJÌ

DARTMOUTH COOP CHARTS (YORUBA VERSION)

Fún ọkọ̀ọkan ákójọ Ibéèrè wọ̀nyí, jọ̀wọ́ mú ìdáhùn kan tí ó fi hàn bí ó ṣe ti rí fún ọ lati ọ̀sẹ̀ mẹ́rin séyìn lítí dí òní. Kò sí ìdáhùn tó dára tàbí ti kò dára.

ÈRÒ ỌKÀN

Laarin ọ̀sẹ̀ mẹ́rin tí o lo séyìn, bawo ni o ṣe ni Iporuru ọkan, idaamu, Irẹwẹsi, ibanujẹ, tabi Ikorò tó?

Kò sí rárá	1
Díẹ̀ ṣaa	2
Ó wá niwọnba	3
Ó pọ̀ díẹ̀	4
O pọ̀ pupọ̀	5

ỊṢẸ́ OJOOJUMO

Laarin ọ̀sẹ̀ mẹ́rin tí o lò séyìn, bawo ni o ṣe ni Iṣòro sí lati lè ṣe iṣẹ ojoojumọ rẹ ninú ile tabi Ibomiran nitor ipo ti alaafia ara ati ọkan rẹ wá?

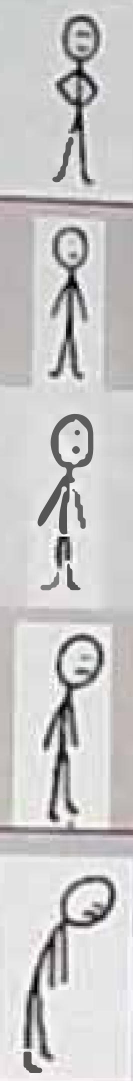
Kò si Iṣòro rara	1
Iṣòro wa, ko to nnkankan	2
Iṣòro wa níwọ̀nba	3
Iṣòro pupọ wa	4
Iṣòro wa lọ́pọ̀lọ́pọ̀ (n ko le ṣe nkankan rara)	5

ÀJÙMỌ̀ṢE TABI AJÙMỌ̀KẸ́GBẸ́

Laarin ọ̀sẹ̀ mẹ́rin tí o lo séyìn, njẹ́ Ipo ti alaafia ara ati ọkan rẹ wa jẹ okùnfà ìdíwọ́ lati darapọ mọ awọn elomiran (ojulumọ, ore, aladugbo, abbl). Lati ṣe ojuṣe rẹ tàbí tati jumọ kẹ́gbẹ́?

Kò jẹ́ ìdíwọ́ rara	1
Ó jẹ́ ìdíwọ́ díẹ̀, ko to nnkankan	2
Ó jẹ́ ìdíwọ́ níwọ̀nba	3
Ó jẹ́ ìdíwọ́ púpọ̀	4
Ó jẹ́ ìdíwọ́ lọ́pọ̀lọ́pọ̀ tí ko le ṣe nkankan!	5

Laarin ọ̀sẹ̀ mẹ́rin ti o lo sẹ́yìn, bawo ni irora rẹ lápapọ̀ ṣe pọ̀ to?



Ko si irora rara	1
Irora diẹ wà, o kere púpọ̀	2
Irora wà níwọ̀nba	3
Irora wà níwọ̀ntúnwọ̀nsì	4
Irora púpọ̀ wà	5

Ki ni o le sọ nipa àlááfia rẹ bayii ti o ba wòye ipo ti o wa ni ọsẹ mẹrin sẹyin?

Ó dára sii púpọ̀	↑↑	++
Ó dára díẹ̀ sii	↑	+
Kò sí iyàtọ̀	←→	=
Ó burú díẹ̀ sii	↓	-
Ó burú púpọ̀ sii	↓↓	--

ÀLÁÁFIA RẸ LÁPAPỌ̀

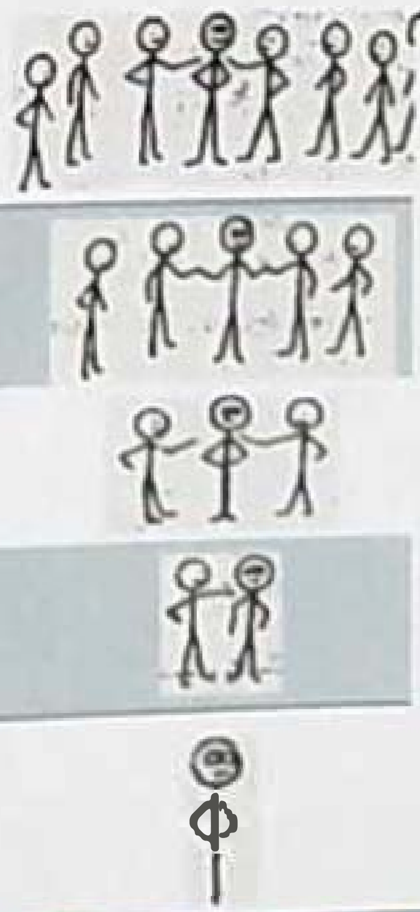
Laarin ọ̀sẹ̀ mẹ́rin ti o lo sẹ́yìn, kini o le sọ nípa àlááfia rẹ lápapọ̀?

Ó dára púpọ̀ púpọ̀	1
Ó dára púpọ̀	2
Ó dára	3
Ó dára díẹ̀	4
Kò dára rárá	5

ÈTÒ ÌMÁYÈRỌRÙN TÀBÍ ÌRANILỌ́WỌ́

Laarin ọ̀sẹ̀ mẹ́rin ti o lo sẹ́yìn, njẹ ẹnikẹni wa ti o ṣe ìrànlọ́wọ́ ti o fẹ́ fun ọ? Fun apẹẹrẹ:

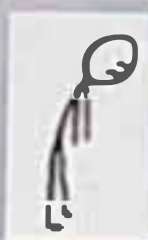
- Nígbàtí o wa ninu Ìdààmú, ìdánikanwà, tabi ipò ìbànújẹ́,
- Nígbàtí o wà ni ìdùbúlẹ̀ àìsàn.
- Nígbàtí o nílò lati bá yàn jírọ̀rọ̀
- Nígbàtí o nílò ìrànlọ́wọ́ lati lè ṣe iṣẹ́ ilé
- Nígbàtí o nílò ìtọ́jú fun ara rẹ,



Bẹ̀ẹ̀ni, ìrànlọ́wọ́ wà gẹ́gẹ́bí mo ṣe fẹ́	1
Bẹ̀ẹ̀ni, ìrànlọ́wọ́ to pẹ́ye wà	2
Bẹ̀ẹ̀ni, ìrànlọ́wọ́ díẹ̀ wà	3
Bẹ̀ẹ̀ni, ìrànlọ́wọ́ wà níwọ̀nba	4
Kò sí ìrànlọ́wọ́ rárá	5

ÌRORA

Laarin ọsẹ mẹrin ti o lo sẹyìn, bawo ni irora rẹ lápapọ̀ ṣe pọ̀ to?

Ko si irora rara		1
Irora diẹ wà, o kere púpọ̀		2
Irora wà níwọ̀nba		3
Irora wà níwọ̀ntúnwọ̀nsì		4
Irora púpọ̀ wà		5

ÀLÁÀFIA RẸ LÁPAPỌ̀

Laarin ọsẹ mẹrin ti o lo sẹyìn, kini o lè sọ nípa àlàáfíà rẹ lápapọ̀?

Ó dára púpọ̀ púpọ̀		1
Ó dára púpọ̀		2
Ó dára		3
Ó dára díẹ̀		4
Kò dára rárá		5

ÌYÍPADÀ ALAAFIA ARA

Ki ni o le sọ nipa àlàáfíà rẹ bayìí ti o ba wòy
ipo ti o wa ni ọsẹ mẹrin sẹyin?

Ó dára ju ti púpọ̀	↑↑	++
Ó dára díẹ̀ sìí	↑	+
Kò sí iyàtọ̀	← →	=
Ó burú díẹ̀ sìí	↓	-
Ó burú púpọ̀ sìí	↓↓	--

ÈTÒ ÌMÁYÉRORÚN TÀBÍ ÌRANILỌ́WỌ́

Laarin ọsẹ mẹrin ti o lo sẹyìn, njẹ enikẹni wa ti o ṣe ìránilọ́wọ́ tí o fẹ fun ọ? Fun apẹẹrẹ:

- Nígbàtí o wa ninu ìdáàmú, ìdánikanwà, tabi ipò ìbánújẹ́.
- Nígbàtí o wà ni ìdúbúlẹ̀ àìsàn.
- Nígbàtí o nílò ìati báyàn jìròrò
- Nígbàtí o nílò ìránilọ́wọ́ lati lè ṣe iṣẹ́ ilé
- Nígbàtí o nílò ìtójú fun ara rẹ.

Bẹẹ̀ni, ìránilọ́wọ́ wà gẹ̀gẹ̀bí mo ṣe fẹ́		1
Bẹẹ̀ni, ìránilọ́wọ́ to péye wà		2
Bẹẹ̀ni, ìránilọ́wọ́ díẹ̀ wà		3
Bẹẹ̀ni, ìránilọ́wọ́ wà níwọ̀nba		4
Kò sí ìránilọ́wọ́ rárá		5

ÓṢUWỌN ÌGBÉ AYÉ

Báwo ni nnkan ti ri lun ọ jati bi ọsẹ mẹnn sẹyin?

1. Ó dára púpọ, ó lè ma le dára ju bayi lọ
2. Ó dára
3. Kò burú, kò sì san (méjèèjì wa l'ọgbọgba)
4. Ó burú
5. Ó burú púpọ, ó lè ma le burú ju bayi lọ

APPENDIX L

ÀSOMỌ́ KẸTA: BECK DEPRESSION INVENTORY (YORUBA VERSION)

Orúkọ: _____ Étò ẹlẹ́bì dé:_____ Ọjọ́

Ori:_____ Okùnrín ni ọ́ tàbí obìnrin?_____ Isẹ́ ẹ rẹ́:_____

Ẹkọ́ tí o kà parí:_____

Àtòjọ ibéèrè yí ní àkójọ ọ̀rọ̀ mọ́kànlélógún. Jọ̀wọ́ ka ọ̀kọ̀ọ̀kan àwọn àkójọ ọ̀rọ̀ yìí pẹ́lú ìfarabàlẹ́, kí o sì mú ọ̀kan nínú àwọn àkójọ ọ̀rọ̀ tí o fi hàn kedere bí o se ni ìmọ́sílàra láti bi ọ̀sẹ̀ méjí seyin títí di òní. Yì odo sí númbà tí ó wà lẹ́gbẹ̀ẹ́ ọ̀rọ̀ tí o bá mú. Tí ọ̀pọ̀lọpọ̀ àwọn ọ̀rọ̀ yìí ba bá ọ mu yi odo si númbà tí ó tóbì jùlọ nínú àkójọ ọ̀rọ̀ nàà. Rí dájú pé o kò mú ju ẹyọ ọ̀rọ̀ kan nínú àkójọ kọ̀ọ̀kan pẹ̀lú ipele kẹ̀rìnlógún (ìyípadà bi o ṣe n sùn) tàbí ipele kejìdínlógùn (ìyípadà nipa ìfẹ́ láti jẹun)

1. Ìbànújẹ́

0. N k ì i banújẹ́

1. Mò n b anújẹ́ lọ́pọ̀ ìgbà

2. Mo má a n banújẹ́ ní gbogbo ìgbà

3. Mo máa n banújẹ́ gan-an tàbí ní àìnídùnnú débi pé mi ò lé gba mọ́ ra.

2. Àìnírétí

0. N kò ṣ e ojo nítorí ọjọ́-ọla mi

1. Mò n ṣe ojo nítorí ọjọ́ ọ̀la mi ju àtẹ́yìnwá lọ

2. N kò nir ètì kì nnkan ṣe deede fún mi

3. Mo mọ̀ p ọ́jọ́-ọ́la mi kó nírètì àtí pé yóó màa burú sìí ni.

3. Ìjákulẹ̀ Àtẹ́yìnwá

0. N kò rí ar a à mí gẹ̀gẹ̀ bí ẹni tí o ní ijàkulẹ̀

1. Mo ti ní í jákulẹ̀ ju bí ó ṣe yẹ lọ.

2. B i mo bojúwẹ̀yìn, mo rí ọ̀pọ̀lọpọ̀ ìjákulẹ̀.

3. Mo rí ara á mì gẹ̀gẹ̀ bí ẹni tí ó ti ní ìjákulẹ̀ pàtápàtà.

4. Fáàjì Pípádánù

0. Mo ṣì ní ọpọlọpọ ìáàjì gẹ́gẹ́ bí mo ṣe ma n ní nínú àwọn ohun ti mo gbádùn.

1. N kìí g bádún nnkan gẹ́gẹ́ bí mo ṣe máa n gbádùn wọn tẹ́lẹ́.

2. Ìwònb a ìáájì ni mò n rí nínú ohun tí mo máa n gbàdun tẹ́lẹ́.

3. N kò rí ì áájì kankan mọ́ nínú ohun tí mo tí máa n gbádun lẹ́lẹ́.

5. Àírò Ẹbi Ẹṣẹ́

0. Mi o lér ò pé mo jẹ́bi.

1. Mo lérò pé mo jẹ́bi lórí púpọ́ nínú ohun ti mo ti ṣe tábí ti ó yẹ ki n ṣe.

2. Mo lérò pe mo jẹ́bi lópọ́ ìgbá.

3. Mo lérò pé mo jẹ́bi ni gbogbo ìgbá

6.Ìronú Ìjìyá

0. Mi ò lér ò pé a n fi ìyá jẹ mi.

1. Mo lérò pé a le fi ìyá jẹ mi.

2. Mò n retí kí a fí ìyá jẹ mi.

3. Mo lérò pé a n fí ìyà jẹ mi.

7. Ìkórìíra Ara-Ẹni

0. Mo n ì ér ò kannáà nípa ara a mi bi ti àtẹyìnwà.

1. Mo ti p ádánù ìgbẹ́kẹ̀lé nínú ara à mi

2. Mo ni ìj ákulẹ́ nínú ara à mi

3. Mo kórìíra ara à mi

8. Ṣíṣe ìdájọ́ ara-ẹni/ Dídá ara ẹni lẹ́bi

0. N kì í dá ara à mí lẹ́jọ́ tàbí dalẹ́bi ju bí ó ti yẹ lọ.

1. Mo n dá ara à mi lẹjọ ju bi mo ṣe maa n ṣe lẹ́lẹ́ lọ.

2. Mo máa n da ara a mí lẹjọ lòrí gbogbo àìṣedéédé mi.

3. Mo máa n dá ara à mi lẹjọ lòrí ohun búburù gbogbo tí ó bá sẹlẹ́.

9. Èró Ìpara-ẹni

0. N kò ní èró láti pa ara à mi

1. Mo ní èr ò láti pa ara á mi, ṣùgbọn mi ò ní ṣe é

2. Máà fẹ́ láti pa ara à mi.

3. Máa p a ara à mi bí áyé rẹ bá yọ.

10. Ẹkún ẹ́sun

0. N ki i s unkún ju bi mo ṣe máá n sun un tẹ́lẹ́ lọ.

1. Mo n su nkún ju ti tẹ́lẹ́ lọ.

2. Mo máa n sunkún lórí ohun gbogbo bi o ti wù ú ki o kékeré to.

3. Mo fẹ́ l áti sunkún, ṣùgbọn n kò le sun.

11. Ìru-Sóké

0. N ko ṣ e wọ́nranwọ́nran tàbí sésé ju ti àtẹ́yìnwá lọ.

1. Mo n ṣe wọ́nranwọ́nran tàbí sésé ju ti àtẹ́yìnwá lọ.

2. Mo ní àì balẹ́-ọkàn tàbí ìru-sóké dédé pé o nira fún mi láí farabalẹ́.

3. Mo ni àìbalẹ́-ọkàn, tàbí ìru-sóké dédé pé mo ní láti máa rìn tàbí ṣe nnkan kan.

12. Pípàdánù Ìfẹ́ sí nnkan

0. N ko tii pàdánù ìfẹ́ sí ẹlòmíràn tàbí aápọn.

1. Ìfẹ́ ti mo ni sí ééyàn àti nnkan dínkù ju tátẹ́yínwá lọ.

2. Mo ti p adànù ọ́pọ́ ifẹ́ ti mo ní sí àwọn ééyàn tàbí nnkan.

3. Ó ṣòro l áti ni ìfẹ́ sí ohunkóhun

13. Àìnípinnu

0. Mo ṣi n ṣe ìpinnu bí tátẹ́yìn wá

1. Ó ṣòro fún mi ju tití ẹ́lẹ́ lọ lati ṣe ìpinnu

2. Ó ṣòro f ún mi púpọ́ púpọ́ ju tití ẹ́lẹ́ lọ láti ṣe ípinnu.

3. Mo ni ìṣ òro láti ṣe ìpinnu kípinnu.

14. Àljámọ́ nnkankan

0. N ò rò pé n ò jámọ́ nnkankan

ò. N kò rí ar a á mí gẹ́gẹ́ bí ẹni tí ó jámọ́ nnkan tàbí tí ó wúlò bi titẹ́lẹ́

ẹ́. Mo rí ara á mi gẹ́gẹ́ bí ẹni tí kò jámọ́ nnk ankan lẹ́gbẹ́ áwọn ẹlomìrán.

ẹ́. Mo rí ara á mi bí ẹni tí kò jámọ́ nnkankan rárá.

15. Pípàdánù agbára

0. Mo ṣì ní agbára bíi tí tẹ́lẹ́.

ò. N kò l ágbára tó bí mo ṣe ní i tẹ́lẹ́.

ẹ́. N kò n i agbára tó tó láti ṣe ohun púpọ́.

ẹ́. N kò nì agbára tó tó láti ṣe ohunkóhun.

16.Ìyípadà ní bí o ṣe n sùn

0. N kò tẹ̀ rí ìyípadà kankan ní bí mo ṣe n sún.

1a. Mò n sùn ju t'àtẹ́yìnwá.

1b. Mi ò sùn tó t'àtẹ́yìnwá.

2a. Mò n sùn gan an ju ti àtẹ́yìnwá lọ.

2b. Mi ò sùn tó t'àtẹ́yìnwá rárá, ìyàtọ́ púpọ́ wà.

3a. Ọ̀pọ̀lọpọ̀ igba lóòjọ́ ni mo n sùn

3b. Mo máa n jí bẹ̀ẹ̀ wàkàtí kan si méjì ṣáájú àkókò. mi o kí sí n ní orun sùn padà.

17. Ìmúbínú

0. N kò bí nú ju ti àtẹ́yìnwá lo.

1. Mo máa n bínú ju ti àtẹ́yìnwá lọ.

2. Mo máa n bínú púpọ́ ju ti àtẹ́yìnwá lọ.

3. Mo máa n bínú ní gbogbo ìgbà.

18. Ìyípadà nípa Ìfé̩ láti jé̩un

0. N kò tí rí Ìyípadà kankan nípa ìfé̩ láti jé̩un
1a. Ìfé̩ é̩ mi láti jé̩un dínkù dífé̩ ju ti àté̩yìnwá lo.
1b. Ìfé̩ é̩ mi láti jé̩un pò díé̩ ju ti àté̩yìnwá lo.
2a. Ìfé̩ é̩ mi láti jé̩un dínkù púpò ju ti àté̩yìnwá lo
2b. Ífé̩ é̩ mi lati jé̩un pò púpò ju ti até̩yinwa lò.
3a. N ko ni Ìfé̩ lati jé̩un rara
3b. Mo n yanhanhan fún ounjé̩ ni gbogbo ìgbá.

19. Ìşòro Ìfokàn-sí-nnkan

0. Mo lè f okàn sí nnkan bí mo şe máa n şe látéyìnwá
1. N kò l è fokàn si nnkan bi mo şe màà n şe látéyìnwá
2. Ó ş òro fún mi látí pokànpò lóri ohunkohún fún ìgbà pípé̩.
3. Mo rìi p é n kò le fokàn si ohunkohun.

20. Ríré̩ Tàbí agara

0. Kò kí í n ré̩ mí ju t'àté̩yìnwá lo.
1. Ó màa n tètè ré̩ mi ju t'àté̩yìnwà lo.
2. Ó ré̩ mi p úpò dé bi pé mi ò lè şe òpò ohun ti mo maa n şe té̩lé̩ ri.
3. Ó ré̩ mi púpò púpò dé bi pé òpòlopò ohun ti mo máá n şe té̩lé̩ ri ni mi o lè şe mo.

21. Pípàdànù Ìfé̩ sí Ìbálòpò

0. N kò tí ì ş àkíyèsí ìyípadà kankan ní lóólóó yìí nípa ìfé̩ sí ìbálòpò.
1. Ìfé̩ tí mo ni sí Ìbálòpò kere si t'àté̩yìnwá.
2. Ìfé̩ tí mo ni sí ìbálòpò kere púpò púpò bayìí.
3. Mo ti p àdànú ìfé̩ si ìbálòpò pátápátá.

APPENDIX M: ÀSOMỌ́ KẸRIN

FERRANS AND POWERS QUALITY OF LIFE INDEX (MULTIPLE SCLEROSIS VERSION) - YORUBA TRANSLATION.

APÁ KÍNNÍ: Fún ọkọ̀ọkan àwọn ìbéèrè wọ́nyí, jọ̀wọ́ mú ọkan nínú ìdáhùn tí ó fihàn bí abala kan nínú ìgbé ayé è rẹ ṣe tẹ́ ọ lọ́rùn sí. Jọ̀wọ́ sámì sí ìdáhùn rẹ nípa yíyí òdo sí nọmbà. Kò sí ìdáhùn tó dára tàbí tí kò dára.

Kotẹ́mílọ́rùn rara	1
Kotẹ́mílọ́rùn níwọ̀n	2
Kotẹ́mílọ́rùn díẹ̀	3
O tẹ́mílọ́rùn díẹ̀	4
O tẹ́mìlọ́rùn níwọ̀n	5
O tẹ́mìlọ́rùn gan-an	6

BAWO NI O ṢE NÍ ÌTẸ́LỌ́RÙN SÍ PẸ̀LÚ:

1	Ìlera à rẹ?	1	2	3	4	5	6
2	Ìtójú ìlera à rẹ?	1	2	3	4	5	6
3	Iye ìrora tí o ni?	1	2	3	4	5	6
4	Iye okun tí o ní fún iṣẹ́ ojoojúmọ́?	1	2	3	4	5	6
5	Agbára lati tọ́jú ara à rẹ làìsí ìránlọ́wọ́	1	2	3	4	5	6
6	Agbára lati yan kíri, lọ sí ibi gbogbo?	1	2	3	4	5	6
7	Agbára lati sòrọ́?	1	2	3	4	5	6
8	Iye ìjẹgàba tí o ní lórí ara à rẹ?	1	2	3	4	5	6
9	Àníàánì tí o ní làtí le wà láyé pẹ́ bí o ṣe fẹ́?	1	2	3	4	5	6
10	Ìlera ẹbí rẹ?	1	2	3	4	5	6
11	Àwọn ọmọ ó rẹ?	1	2	3	4	5	6
12	Ìdùnnú ẹbí rẹ?	1	2	3	4	5	6

13	Ìgbé ayé ìbàlòpò rẹ?	1	2	3	4	5	6
14	Aya, olólùfẹ́ tàbí ẹnìkejì rẹ?	1	2	3	4	5	6
15	Àwọn òrẹ́ ẹ rẹ?	1	2	3	4	5	6
16	Ìrànlọ́wọ́ tí ò n rí gbà làtì ọ̀dọ̀ ẹbí rẹ nípa mímọ ìrí-ẹ̀dùn rẹ?	1	2	3	4	5	6
17	Ìrànlọ́wọ́ tí ò n rí gbà làtì ọ́dọ́ àwọn éniyàn tí kì í ṣe ẹbí rẹ?	1	2	3	4	5	6
18	Agbára lati lé ṣe ojúṣe rẹ nínú ẹbí?	1	2	3	4	5	6
19	Bí o ṣe wúlò sí fún àwọn ẹlómíràn?	1	2	3	4	5	6
20	Ìpòrúru ọkan tí o ní?	1	2	3	4	5	6
21	Agbègbè rẹ?	1	2	3	4	5	6
22	Ibùgbé rẹ, iyẹ̀wù rẹ, tàbí ibi tí o n gbé?	1	2	3	4	5	6
23	Iṣẹ́ ẹ rẹ, (tí o bá níṣẹ́)?	1	2	3	4	5	6
24	Àìníṣẹ́ (tí o kò bá nísẹ́, o ti fẹ̀yìntì tàbí jẹ́ alàìlágbára)?	1	2	3	4	5	6
25	Ẹ̀kọ́ tàbí ìwé tí o kà?	1	2	3	4	5	6
26	Bí o ṣe lè mójútó ètò ìṣúnà rẹ?	1	2	3	4	5	6
27	Àwọ́n ohun tí ó n ṣe fún fàájì?	1	2	3	4	5	6
28	Ànfàáàni ti o ní fọ́jọ́ ọ́la tó láyọ̀?	1	2	3	4	5	6
29	Ìbálẹ́ ọkàn tí o ní?	1	2	3	4	5	6
30	Ìgbàgbọ́ ọ̀ rẹ nínú Ọlọ́run?	1	2	3	4	5	6
31	Àwọn ìlépa à rẹ tí o ṣe parí?	1	2	3	4	5	6
32	Ìdùnúù rẹ làpapọ̀?	1	2	3	4	5	6
33	Ìgbé ayé é rẹ làpapọ̀?	1	2	3	4	5	6
34	Bí ìwọ tikalara ṣe n jàde?	1	2	3	4	5	6
35	Ìwọ gan-an làtòkédélẹ̀?	1	2	3	4	5	6

APA KEJI: Fún ọkọ̀ọkan àwọn ìbéèrè wọ̀nyí, jọ̀wọ́ mú ọ̀kan nínú ìdáhùn tí ó fihàn bí abala kan nínú ìgbé ayé è rẹ ṣe ṣe pàtàkì sí. Jọ̀wọ́ sàmì sí dára.

Kò ṣe pàtàkì rárá	1
Kò ṣe pàtàkì níwọ̀n	2
Kò ṣe pàtàkì díẹ̀	3
Ó ṣe pàtàkì díẹ̀	4
Ó ṣe pàtàkì níwọ̀n	5
Ó ṣe pàtàkì ganan	6

BAWO NI Ó ṢE ṢE PÀTÀKÌ SÍ Ọ:

1	Ìlera à rẹ?	1	2	3	4	5	6
2	Ìtọ́jú ìlera à rẹ?	1	2	3	4	5	6
3	Wíwà láìní ìrora?	1	2	3	4	5	6
4	Níní okun tí ó tó fún iṣẹ́ ojoojúmọ́?	1	2	3	4	5	6
5	Ìtọ́jú ara à rẹ láìnílò ìrànlọ́wọ́?	1	2	3	4	5	6
6	Agbára lati yan kiri, lọ sí ibi gbogbo?	1	2	3	4	5	6
7	Agbára lati sọ̀rọ̀?	1	2	3	4	5	6
8	Iye ìjẹgába tí o ní lórí ara à rẹ?	1	2	3	4	5	6
9	Ànfàání tí o ní láti lè pẹ̀ láyé bí o ṣe fẹ́	1	2	3	4	5	6
10	Ìlera ẹbí rẹ?	1	2	3	4	5	6
11	Àwọn ọmọ̀ rẹ?	1	2	3	4	5	6
12	Ìdúnú ẹbí rẹ?	1	2	3	4	5	6
13	Ìgbé ayé ìbálòpọ̀ rẹ?	1	2	3	4	5	6
14	Aya, oíólùfẹ́ tábí ẹnikejí rẹ	1	2	3	4	5	6
15	Àwọn ọ̀rẹ́ ẹ rẹ?	1	2	3	4	5	6
16	Ìrànlọ́wọ́ tí ò n rí gbà l'ọ̀dọ̀ ẹbí rẹ nípa mímọ ìní-ẹ́dún rẹ?	1	2	3	4	5	6
17	Ìrànlọ́wọ́ tí o n rí gbà latì ọ̀dọ̀ àwọn ẹnìyàn tí kì í ṣe ẹbí rẹ?	1	2	3	4	5	6

18	Ṣíṣe ojúṣe rẹ nínú ẹbí?	1	2	3	4	5	6
19	Wíwúlò fún àwọn ẹlómíràn?	1	2	3	4	5	6
20	Wíwà láìní ìpòrúru ọkàn?	1	2	3	4	5	6
21	Agbègbè rẹ	1	2	3	4	5	6
22	Ibùgbé, ìyẹ̀wù rẹ, tàbí ibi tí ò n gbé?	1	2	3	4	5	6
23	Iṣẹ́ ẹ rẹ, (tí o bá níṣẹ́,)	1	2	3	4	5	6
24	Àìníṣẹ́ (tí o kò bá níṣẹ́, ti fẹ̀yìntì tàbí ti ko sí agbára fún iṣẹ́)	1	2	3	4	5	6
25	Ẹ̀kọ́ tàbí ìwé tí o kà?	1	2	3	4	5	6
26	Mímójútó ètò ìṣúnà rẹ?	1	2	3	4	5	6
27	Ṣíṣe ohun tó n fún ọní fàájì?	1	2	3	4	5	6
28	Níní ọjọ́ ọ̀la tó láyọ̀?	1	2	3	4	5	6
29	Ìbálẹ́ ọkàn?	1	2	3	4	5	6
30	Ìgbágbọ́ ọ̀ rẹ nínú Ọlọ́run?	1	2	3	4	5	6
31	Mímú ìlépa rẹ ṣẹ?	1	2	3	4	5	6
32	Ìdùnú ù rẹ làpapọ̀?	1	2	3	4	5	6
33	Níní ìtẹ́lọ́rùn pẹ̀lú ìgbé ayé?	1	2	3	4	5	6
34	Bí ìwọ tìkalára rẹ ṣe rí?	1	2	3	4	5	6
35	Ìwọ tìkararẹ fún ra rẹ?	1	2	3	4	5	6

APPENDIX N: ÀSOMỌ́ KARUN: ÀTÒJỌ ÌBÉÈRÈ TÍ O N FI ÀÌLERA TÀBÍ ÀÌLÁGBÁRA HÀN (TATE SECONDARY HEALTH CONDITIONS/ COMORBIDITIES QUESTIONNAIRE)

(A) Njẹ́ o ti ní ìrírí ọ̀kan nínú àwọn àìlera tàbí àìsàn wọ̀nyí?

	ÀÌLERA TÀBÍ ÀÌSÀN	Bẹ̀ẹ̀ní	Bẹ̀ẹ̀kọ́	N ò mọ̀
1.	Àìlókun tuntun nínú ẹran ara tí kò lókun tẹ́lẹ̀			
2.	Àìlókun tuntun nínú ẹran ara tí ó lókun tẹ́lẹ̀			
3.	Àìlókun gbogbo ara			
4.	Mímọ òtútù àti oru lára lọ́pọ̀lọpọ̀/àìlègba òtútù mọ́ra			
5.	Àìlókun tó tàbí rírẹ̀ ara			
6.	Ìrora ojú pípẹ̀ nínú ẹran ara àti ríkeríke ara			
7.	Ìṣòro àìrórun sùn			
8.	Ọ̀pá ẹ̀yìn tí kò gún régé Wíwọ́lẹ̀gbẹ̀ẹ̀ [ ] Ìbukẹ́ tó hànde [ ] ìbukẹ́ tí kò hànde [ ]			
9.	Àkókò ìrẹ̀wẹ̀sì			
10.	Egungun kíkán			
11.	Sísúnkì tàbí ìfìe ẹran ara àti ìṣan			
12.	Ìsanra àsanjù/sísanra lọ́pọ̀lọpọ̀			
13.	Àìlágbára tó láti ṣiṣẹ́ òòjọ́			
14.	Mo nílò ìrànlọ́wọ́ báyìí láti ṣe iṣẹ́ ojoojúmọ́			
15.	Ilé ìtọ̀ tí kò ṣiṣẹ́ dáadáa			
16.	Ilé ìgbẹ̀ tí kò ṣiṣẹ́ dáadáa			
17.	Ìṣòro láti gbé nnkan mì			
18.	Èró pé mo dáwà			
19.	Àìsàn ìtọ̀ ṣúgà			
20.	Àìsàn ẹ̀jẹ̀ rírú			
21.	Ìṣòro àti rántí nnkan			
22.	Ìṣubú tàbí àwọn ìfarapa mìíràn			
23.	Ìṣòro àìmí dáadáa (kíí ṣe kàtà)			
24.	Àìsàn oríkeríke ara (ágì)			
25.	Egbò tí n múnì nígbà tí ẹ̀ẹ̀yàn kò bá yíhà padà			
26.	Àìsàn ọkàn			
27.	Apá tàbí èjìká dídùn nípa lílo ọ̀pá arọ			
28.	Ìyípadà ìwà ẹni			
29.	Ẹ̀yìn dídùn			
30.	Kíkọ̀kàn sókè lọ́pọ̀ ìgbà tàbí ìdààmú			
31.	Ìṣòro láti ní tàbí rí ọ̀rẹ́			
32.	Àìlánfààní ìbáṣepọ̀ ìfẹ́ lọ́kọláya			
33.	Egungun tí kò lágbára			
34.	Ìṣòro láti gbé ẹ̀jẹ̀ kọjá nínú ara			
35.	Ọwọ́ títa tàbí kíkan			
36.	Ìpọ̀ngbẹ lọ́pọ̀lọpọ̀			
37.	Sẹ̀mìín sẹ̀mìín (àìsàn ìmí pákáleke)			
38.	Àìsàn awọ̀ ara			

(B) Njẹ dókítà tí ṣe àyẹ̀wò tí ó fi hàn pé o ní ọ̀kan nínú àwọn àìsàn wọ̀nyí?

	AILERA TABÍ AISAN	Bẹ́ẹ̀ni	Bẹ́ẹ̀kọ́	N òmo
1.	Àìlókun tuntun nínú ẹran ara tí kò lókun tẹ́lẹ̀			
2.	Àìlókun tuntun nínú ẹran ara tí ó lókun tẹ́lẹ̀			
3.	Àìlókun gbogbo ara			
4.	Mímọ ótútú àti oru lára lọ́pọ̀lọpọ̀/àìlẹ́gbà ótútù mọ́ra			
5.	Àìlókun tó tàbí ara rírẹ̀			
6.	Irora ọlọ́ pípẹ́ nínú ẹran ara atí ríkeríke ara			
7.	Iṣòro àìrórun sùn			
8.	Ọ̀pá ẹ̀yìn tí kò gún régé (Wíwọ́lẹ́gbẹ̀ẹ́ [ ] Ibuké tó hánde [ ] Ibuké tí kò hánde [ ]			
9.	Àkoko ìrẹ̀wẹ̀sì			
10.	Egunọun kíkàn			
11.	Sísúnkì tàbí lílẹ ẹran ara àti ìṣan			
12.	Isanra àsanjù/sísanra lọ́pọ̀lọpọ̀			
13.	Aìlágbára tó lati ṣiṣẹ́ òòjọ́			
14.	Mo níìó ìrànlọ́wọ́ báyìí lati ṣe iṣẹ́ ojoojúmọ́			
15.	Ilé ìlọ́ tí kò ṣiṣẹ́ dáadáa			
16.	Ilé ìgbẹ́ tí kò ṣiṣẹ́ dáadáa			
17.	Iṣòro lati gbé nnkan mì			
18.	Èrò pé mo dáwà			
19.	Àìsàn ìtọ́ ṣúgà			
20.	Àìsàn ẹ̀jẹ̀ rírù			
21.	Iṣòro àti rántí nnkan			
22.	Iṣubú tàbí àwọn ìfarapa mìíràn			
23.	Iṣòro àtìmí dáadáa (kìí ṣe kálà)			
24.	Àìsàn oríkeríke ara (àgì)			
25.	Egbò tí n mùní nígbà tí éèyàn kò bá yíhà padà			
26.	Àìsàn ọkàn			
27.	Apá tàbí èjìká dídùn nípa lílo ọ̀pá aró			
28.	Ìyípadà ìwà ẹnì			
29.	Èyìn dídùn			
30.	Kíkókàn sóké lọ́pọ̀ igbà tàbí ìdáàmú			
31.	Iṣòro lati ní tàbí rí ọ̀rẹ̀			
32.	Aìlanfáàní ìbáṣepọ̀ ìlẹ́ lọ́kọlàya			
33.	Egungun tí kò lágbára			
34.	Iṣòro lati gbé ẹ̀jẹ̀ kọjá ninú ara			
35.	Ọwọ́ tíla tàbí kíkan			
36.	Ìpòngbẹ lọ́pọ̀lọpọ̀			
37.	Sẹ̀mìín sẹ̀mìín (àìsàn imí pákáleke)			
38.	Àìsàn àwọ́ ara			

(D) Báwo ni ìṣòro tí o ní ṣe pọ̀ tó lórí àwọn àìsàn wọ̀nyìí?

	ÀILERA TÀBÍ ÀISÀN	Kíí ṣe ìṣòro	Ìṣòro ni lẹ́ẹ̀kọ̀ọ̀kan	Ìṣòro ni lópọ̀ ìgbà	Ìṣòro ni ní gbogbo ìgbà
1.	Àìlókun tuntun nínú ẹran ara tí kò lókun tẹ́lẹ̀				
2.	Àìlókun tuntun nínú ẹran ara tí ó lókun tẹ́lẹ̀				
3.	Àìlókun gbogbo ara				
4.	Mímọ̀ òtútù áti oru lára lọ́pọ̀lọpọ̀/àìlègba òtútù mọ́ra				
5.	Àìlókun tó tàbí ara rírẹ̀				
6.	Ìrora ọjọ́ pípẹ́ nínú ẹran ara ati ríkeríke ara				
7.	Ìṣòro àìrórun sùn				
8.	Ọpá ẹ̀yìn tí kò gún régé (Wíwọ́lẹ́gbẹ̀ẹ́ [ ] Ibuké tó hánde [ ] ibuké tí kò hánde [ ]				
9.	Àkoko ìrẹ̀wẹ̀sì				
10.	Egungun kíkán				
11.	Sísúnkì tàbí líle ẹran ara àti ìṣan				
12.	Ìsanra àsanjù/sísanra lọpọlọpọ				
13.	Àìlágbára tó lati ṣiṣẹ́ òòjọ́				
14.	Mo nílò ìrànlọ́wọ́ báyìí lati ṣe iṣẹ́ ojoojúmọ́				
15.	Ilé ìtọ́ tí kò ṣiṣẹ́ dáadáa				
16.	Ilé ìgbẹ́ tí kò ṣiṣẹ́ dáadáa				
17.	Ìṣòro lati gbé nnkan mì				
18.	Èrò pé mo dáwà				
19.	Àìsàn ìtọ́ ṣúgà				
20.	Àìsàn ẹ̀jẹ̀ rúru				
21.	Ìṣòro áti rántí nnkan				
22.	Ìṣubú tàbí àwọn ìfarapa mìíràn				
23.	Ìṣòro àtimí dáadáa (kíí ṣe kátá)				
24.	Àìsàn oríkeríke ara (àgì)				
25.	Egbò tí n múni nígbà tí èèyàn kò bá yíhà padà				
26.	Àìsàn ọkàn				
27.	Apá tàbí èjìká dídùn nípa líìlo ọpá arọ				
28.	Iyípadà ìwà ẹni				
29.	Ẹyìn dídùn				
30.	Kíkọ́kàn sókè lọ́pọ̀ ìgbà tàbí ìdàámú				
31.	Ìṣòro lati ní tàbí rí ọ̀rẹ́				
32.	Àìlánfàání ìbáṣepọ̀ ífẹ́ lọ́kọláya				
33.	Egungun tí kò lágbára				
34.	Ìṣòro lati gbé ẹ̀jẹ̀ kọjá nínú ara				
35.	Ọwọ́ títa tàbí kíkan				
36.	Ìpòngbẹ lọ́pọ̀lọpọ̀				
37.	Sọ́mìín sọ́mìín (àìsàn ìmí pákáleke)				
38.	Àìsàn áwọ́ ara				

APPENDIX 01: EXERCISE GROUP'S RAW DATA (CARDIOVASCULAR AND FITNESS VARIABLES)

	HR1	HR2	HR3	HR4	SBP1	SBP2	SBP3	SBP4	DBP1	DBP2	DBP3	DBP4	PBF1	PBF2	PBF3	PBF4	CRF1	CRF2	CRF3	CRF4	
1	82	68	80	84	137	133	132	129	88	83	70	87	7.4	7	6.2	6	3.08	3.42	4.07	4.34	
2	84	76	79	82	138	137	135	130	89	95	90	75	24.4	22	21.4	18.9	4.28	4.34	4.52	5.02	*
3	77	80	82	75	135	130	128	125	81	77	72	70	46.5	43.5	43	42.9	3.2	3.42	3.58	3.97	
4	90	84	86	82	134	131	135	128	82	90	70	70	21.9	20.1	19.6	19.4	5.91	6.07	6.35	6.75	*
5	89	89	92	88	132	130	132	123	89	78	70	68	14.4	13.6	11.4	8.8	3.17	3.35	3.73	3.58	
6	77	74	85	76	128	128	130	126	84	83	80	75	14.1	13.8	13.5	12	4.21	4.39	5.33	5.31	
7	79	79	76	72	130	130	135	130	78	79	72	68	13.1	12.7	12.1	9.5	3.44	3.35	3.75	4.07	
8	84	87	75	80	128	128	130	121	80	70	70	68	11.9	9.8	8.5	8	2.23	2.21	2.31	2.35	
9	68	79	78	75	132	135	135	135	68	70	62	65	28	27.6	20.2	20.1	3.87	3.85	3.94	3.42	
10	86	78	88	78	125	127	129	129	80	80	78	71	32.9	30.1	23.4	22.1	3.72	3.87	4.08	4.22	
11	82	86	78	78	132	130	130	130	72	78	74	72	28.6	27.8	26.6	22.2	3.3	3.23	3.49	3.87	*
12	90	88	79	72	123	129	122	120	85	85	78	75	18.2	16.1	15.5	10.1	3.63	3.97	4.11	4.36	
13	75	73	70	70	128	129	123	119	68	70	65	66	13.4	13.1	12.8	9.9	2.73	2.97	2.87	3.26	
14	81	76	76	70	122	129	128	118	86	76	71	71	15.2	13.5	12.2	11.9	2.67	2.53	3.09	3.4	
15	80	78	80	69	108	109	108	100	70	71	66	70	26	22.2	21.5	19.7	3.82	3.88	3.93	4.08	
16	67	69	67	62	128	128	125	120	74	70	70	68	37	36.8	36.5	33.8	2.1	2.21	2.18	2.63	
17	78	76	74	72	120	130	135	114	77	70	76	70	28.8	25.8	25	23.7	3.26	3.41	3.83	4.14	
18	78	62	62	68	133	131	128	129	62	65	65	62	30.7	29	28.6	25.7	2.02	2.09	2.19	2.47	
19	90	90	82	79	131	131	128	122	87	84	80	78	40.9	39	38.8	34.1	3.5	3.61	3.71	4.16	
20	89	80	80	78	131	128	126	123	85	81	79	75	44.8	43.1	43	40.1	3.52	3.82	3.93	4.72	
21	88	82	74	74	128	128	126	123	84	82	79	75	39.8	37.8	37.5	36	4.6	4.83	4.8	5.03	
22	89	78	74	74	132	132	128	125	90	89	80	74	47.1	44.6	43.9	41	3.02	3.27	3.2	3.53	
23	78	78	75	79	134	129	124	121	67	67	65	65	38.2	37.8	34.2	31.1	3.68	3.79	4.49	5.02	
24	85	82	78	72	135	132	129	120	79	71	70	68	28.1	26.8	25.4	23.1	2.77	2.81	2.94	3.32	
25	77	76	73	70	129	125	125	122	78	78	73	74	35.1	33.3	30	29.3	3.67	4.02	4.37	4.52	
26	82	80	76	72	130	128	124	122	82	80	78	78	40.8	39.5	37.2	33	3.72	3.65	3.99	4.38	
27	72	70	70	68	130	128	126	125	78	79	75	70	42.8	41.3	39.2	37.4	2.51	2.8	3.18	3.87	
28	78	76	72	71	135	135	132	130	79	70	68	68	29.3	28.4	25.8	24.6	2.91	2.83	3.08	3.21	

1-week 1, 2-week 2, 3- week 3, 4- week 4. * Participants who had their exercise sessions at home.
HR- heart rate, SBP- systolic blood pressure, DBP-diastolic blood pressure, PBF- body fat, CRF- cardio-respiratory fitness.

APPENDIX O2: CONTROL GROUP'S RAW DATA (CARDIOVASCULAR AND FITNESS VARIABLES)

SN	HR1	HR2	HR3	HR4	SBP1	SBP2	SBP3	SBP4	DBP1	DBP2	DBP3	DBP4	PBF1	PBF2	PBF3	PBF4	CRF1	CRF2	CRF3	CRF4
1	68	75	75	75	130	130	128	127	82	80	79	79	28.9	31.9	32.2	34.8	2.62	2.65	2.47	2.34
2	82	80	80	81	128	128	127	128	74	75	74	74	34.3	36.8	37.8	39.4	4.84	4.88	5	4.7
3	76	75	76	75	127	126	127	128	75	75	75	75	27.8	27.6	28	29.6	6.45	6.58	6.36	6.09
4	91	90	89	90	135	135	132	130	76	75	75	75	24.6	24	24.6	27	2.83	2.95	2.9	2.52
5	68	66	68	70	120	119	120	122	82	81	80	80	27.1	28.3	28	28.5	3.87	3.52	3.39	3.53
6	76	75	76	78	134	130	132	130	80	78	78	78	29	30.5	30	31.2	6.38	6.28	6.33	5.87
7	70	72	72	72	125	125	124	124	77	77	77	76	25.8	26.4	26	27.6	5.29	5.02	5.21	5.15
8	69	63	65	65	126	126	125	125	76	74	75	74	23.6	25.8	26	25.8	5	5.2	5.09	5.24
9	73	72	72	75	120	117	115	115	75	77	75	75	22.4	22.4	24.1	24.6	5.25	5.37	5.11	5
10	74	75	74	78	139	139	139	139	76	76	76	75	26.2	26.8	26.8	26.5	1.9	1.99	2.03	1.99
11	81	78	76	78	138	135	135	135	80	80	80	80	13.6	12.8	13.1	13	2.06	2.03	2.11	2.18
12	81	78	80	80	115	115	115	113	76	75	75	75	20.5	21.1	22.7	23	2.64	2.43	2.34	2.43
13	81	78	80	80	110	110	110	110	79	77	78	77	35.7	35.8	37	36.9	3.18	3.14	2.82	2.68
14	90	90	89	91	130	130	130	130	73	75	73	73	30.8	31.7	31.5	33	2.36	2.5	2.61	2.23
15	73	77	78	78	137	135	135	133	82	79	79	79	32	32.4	33.6	34.4	3.37	3.51	3.4	3.52
16	72	72	72	75	125	125	123	125	78	78	76	78	21.9	22.2	22.6	25.1	2.46	2.42	2.35	2.3
17	88	88	85	88	139	138	135	135	86	85	85	85	25.2	24.8	24.1	27	1.97	2.09	2.05	1.98
18	81	81	79	80	122	120	121	125	85	82	82	82	28.7	30.8	31.2	32.5	2.77	2.61	2.73	2.42
19	76	78	81	82	132	130	131	132	83	85	84	85	33.1	34	34.4	36.3	1.72	1.95	1.87	1.68
20	96	94	90	88	122	120	120	120	82	80	78	80	35	35.8	36.2	36.5	3.87	4.03	3.73	3.82
21	94	90	89	88	139	138	138	138	85	82	82	80	28.4	25.6	28.8	30.5	2.54	2.79	2.53	2.44
22	82	82	84	82	133	130	132	132	81	80	80	80	36.7	36.5	38.1	39.5	2.75	2.97	2.54	2.48
23	71	74	74	75	131	130	128	128	74	74	74	72	29	31.1	31.1	32.2	2.07	2.2	2.15	1.99
24	83	80	82	80	122	124	125	125	79	78	78	78	39.2	39.9	40	40.4	2.67	2.84	2.08	2.03
25	85	85	85	83	120	122	120	120	78	78	76	75	25.4	27.1	27.8	27.6	4.58	4.59	4.48	4.52
26	76	78	77	75	125	124	125	125	76	76	76	76	27.8	28.1	29.9	30.6	1.7	1.84	1.7	1.76

1-week1, 2-week 2, 3- week 3, 4- week 4.

HR-heart rate, SBP- systolic blood pressure, DBP-diastolic blood Pressure, PBF-percent body fat, CRF-cardio-respiratory fitness

APPENDIX 03: EXERCISE GROUP'S GENERAL HEALTH SCORES

Sn	A W	A W	A W	A W	B W	B W	B W	B W	C W	C W	C W	C W	D W	D W	D W	D W	E W	E W	E W	E W	F W	F W	F W	F W	G W	G W	G W	G W	H W	H W
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
1	3	3	2	2	2	2	2	1	2	2	2	2	1	1	1	1	1	1	1	1	3	3	2	2	3	3	3	3	2	2
2	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	3	3	3	3	2	2	2	1	1	1	1	1	2	2
3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	3	3	3	2	2	2	2	2	3	3	3	3	2	2
4	4	4	3	2	3	2	2	2	4	4	3	2	2	2	1	1	3	2	3	3	3	3	2	2	3	3	3	3	2	1
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	2	2	1	1	1	1	2	2
6	3	3	3	2	3	2	2	2	2	2	2	2	4	3	2	2	1	1	1	1	3	3	3	2	2	2	2	2	3	3
7	2	2	2	2	1	1	1	1	1	1	1	1	2	2	2	2	1	2	2	2	2	2	2	2	2	1	2	2	1	1
8	3	3	3	3	2	2	3	2	1	1	1	1	3	3	3	2	1	2	2	2	2	2	2	2	2	1	1	1	2	2
9	1	1	1	1	2	1	1	1	2	2	2	2	3	3	3	3	1	1	1	1	2	2	2	2	2	2	1	1	1	1
10	2	2	2	2	3	3	2	2	1	1	1	1	3	3	3	2	3	3	2	1	2	2	2	2	2	1	1	1	2	1
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	5	2	2	2	3	3	1	1	4	3	3	2	3	2	2	2	3	2	2	2	3	3	3	3	3	3	3	3	4	2
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	4	4	1	1
14	3	3	2	1	2	2	2	1	2	2	1	1	3	3	2	2	1	1	1	1	3	3	3	2	3	3	3	3	2	1
15	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	3	3
16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	2	1	1	1	2	2	2	2	2	2
17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
18	4	4	3	2	3	3	3	2	4	4	3	3	4	2	2	2	1	1	1	1	4	4	3	2	3	3	3	3	3	3
19	2	2	2	2	2	2	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	3	3
20	2	2	2	2	1	1	2	1	1	1	1	1	1	1	2	1	2	1	1	1	2	2	2	2	2	1	1	1	1	1
21	3	3	3	3	2	2	2	2	2	2	2	2	3	3	3	2	1	1	1	1	2	2	2	2	3	3	3	3	2	2
22	4	4	3	3	3	3	3	2	3	3	2	2	5	4	3	3	3	3	2	2	2	2	2	2	3	3	3	1	1	1
23	4	3	2	2	1	1	1	1	1	1	1	1	3	3	3	3	2	2	2	1	2	2	1	1	1	1	1	1	3	3
24	1	1	1	1	2	2	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	2	2	2	1	1	1	1	5	3
25	4	3	3	3	3	3	3	2	5	5	4	3	3	3	3	1	1	1	1	1	4	3	3	3	4	3	2	2	1	1
26	4	4	4	3	4	3	3	1	4	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	2	2
27	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
28	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5	5	3	3

W-Week, A-feelings domain, B-daily activities, C-social activities, D-pain, E-change in health, F-overall health, G-social support, H-quality of life.

APPENDIX 03: EXERCISE GROUP'S GENERAL HEALTH SCORES

Sn	A W 1	A W 2	A W 3	A W 4	B W 1	B W 2	B W 3	B W 4	C W 1	C W 2	C W 3	C W 4	D W 1	D W 2	D W 3	D W 4	E W 1	E W 2	E W 3	E W 4	F W 1	F W 2	F W 3	F W 4	G W 1	G W 2	G W 3	G W 4	H W 1	H W 2	H W 3	H W 4
1	3	3	2	2	2	2	2	1	2	2	2	2	1	1	1	1	1	1	1	1	3	3	2	2	3	3	3	3	2	2	2	2
2	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	3	3	3	3	2	2	2	1	1	1	1	1	2	2	2	2
3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	3	3	3	2	2	2	2	2	3	3	3	3	2	2	2	2
4	4	4	3	2	3	2	2	2	4	4	3	2	2	2	1	1	3	2	3	3	3	3	2	2	3	3	3	3	2	1	1	1
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	2	2	1	1	1	1	2	2	2	2
6	3	3	3	2	3	2	2	2	2	2	2	2	4	3	2	2	1	1	1	1	3	3	3	2	2	2	2	2	3	3	2	2
7	2	2	2	2	1	1	1	1	1	1	1	1	2	2	2	2	1	2	2	2	2	2	2	1	2	2	2	2	1	1	1	1
8	3	3	3	3	2	2	3	2	1	1	1	1	3	3	3	2	1	2	2	2	2	2	2	2	2	1	1	1	2	2	2	1
9	1	1	1	1	2	1	1	1	2	2	2	2	3	3	3	3	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1
10	2	2	2	2	3	3	2	2	1	1	1	1	3	3	3	2	3	3	2	1	2	2	2	2	1	1	1	1	2	1	1	1
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	5	2	2	2	3	3	1	1	4	3	3	2	3	2	2	2	3	2	2	2	3	3	3	3	3	3	3	3	4	2	1	1
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	4	4	4	4	1	1	1
14	3	3	2	1	2	2	2	1	2	2	1	1	3	3	2	2	1	1	1	1	3	3	3	2	3	3	3	3	2	1	1	1
15	2	1	1	1	2	2	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	3	3	2	2
16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	2	1	1	1	2	2	2	2	2	2	2	2	2
17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
18	4	4	3	2	3	3	3	2	4	4	3	3	4	2	2	2	1	1	1	1	4	4	3	2	3	3	3	3	3	3	2	2
19	2	2	2	2	2	2	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	3	3	3	2
20	2	2	2	2	1	1	2	1	1	1	1	1	1	1	2	1	2	1	1	1	2	2	2	2	1	1	1	1	1	1	2	2
21	3	3	3	3	2	2	2	2	2	2	2	2	3	3	3	2	1	1	1	1	2	2	2	2	3	3	3	3	2	2	2	1
22	4	4	3	3	3	3	3	2	3	3	2	2	5	4	3	3	3	3	2	2	2	2	2	2	3	3	3	1	1	1	1	1
23	4	3	2	2	1	1	1	1	1	1	1	1	3	3	3	3	2	2	2	1	2	2	1	1	1	1	1	1	3	3	2	2
24	1	1	1	1	2	2	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	1	2	2	2	1	1	1	1	5	3	3	2
25	4	3	3	3	3	3	3	2	5	5	4	3	3	3	3	1	1	1	1	1	4	3	3	3	4	3	2	2	1	1	1	1
26	4	4	4	3	4	3	3	1	4	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	2	2	2	1
27	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
28	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5	5	3	3	3	2

W-Week, A-feelings domain, B-daily activities, C-social activities, D-pain, E-change in health, F-overall health, G-social support, H-quality of life.

APPENDIX 04: CONTROL GROUP'S GENERAL HEALTH SCORES

S/n	A W	A W	A W	A W	B W	B W	B W	B W	C W	C W	C W	C W	D W	D W	D W	D W	E W	E W	E W	E W	F W	F W	F W	F W	G W	G W	G W	G W	H W	H W	H W	H W
1	3	2	2	1	1	1	1	1	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1	2	2	2	2
2	1	1	1	1	3	3	3	3	3	3	3	3	2	2	2	2	4	3	2	3	2	2	2	2	4	4	4	4	2	2	2	2
3	2	2	2	2	3	3	3	3	3	3	3	3	2	2	2	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
4	5	4	2	2	4	4	3	3	1	1	2	2	3	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	1	1	1	1	3	3	3	3	1	1	1	1	3	3	3	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	3	3	3	2	2	2	2	2	1	1	1	1	3	2	2	2	3	2	2	2	2	2	2	2	2	1	1	1	1	2	2	2	2
7	2	2	2	2	2	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	1	1	1	1
8	3	3	3	2	2	2	2	2	1	1	1	1	2	2	2	2	2	2	3	3	3	2	2	2	1	1	1	1	2	2	2	2
9	1	1	1	1	1	1	1	1	3	3	3	3	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10	2	2	2	1	3	3	2	2	1	2	2	2	2	2	2	2	5	4	3	2	3	3	3	2	4	4	4	4	3	2	2	2	2
11	1	1	1	1	1	1	1	1	3	3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	5	2	2	2	4	4	4	4	1	2	2	2	3	3	2	1	3	3	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
13	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14	3	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
15	1	1	1	1	1	1	2	2	3	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
16	1	1	1	1	3	2	2	2	1	1	1	2	1	1	1	1	4	4	3	3	3	2	2	2	4	3	3	3	1	1	1	1	1
17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1
18	4	4	4	3	1	1	1	1	2	2	2	2	4	4	3	3	2	2	1	1	1	1	1	1	1	1	1	1	3	3	3	3	2
19	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
20	2	2	2	2	1	1	1	1	1	1	1	1	2	2	1	1	4	4	3	3	3	3	1	1	3	3	3	3	1	1	1	1	1
21	3	3	3	2	1	1	1	1	3	3	3	2	2	2	2	2	4	4	1	1	1	1	1	2	1	1	1	1	2	2	2	2	2
22	4	4	4	3	3	2	2	2	2	3	2	2	2	2	2	2	1	1	2	3	2	2	2	2	1	1	1	1	3	3	3	3	3
23	4	3	3	3	2	2	2	2	1	1	1	2	2	2	2	2	4	3	3	3	3	3	3	3	5	5	5	5	1	1	1	1	1
24	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	4	4	3	3	3	3	3	3	4	4	4	4	2	2	2	2	2
25	3	3	3	2	1	1	1	1	1	1	1	1	3	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3
26	3	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	1	3	3	2	2	2	2	2	3	3	3	3

W-Week, A-feelings domain, B-daily activities, C-social activities, D-pain, E-change in health, F-overall health, G-social support, H-quality of life.

APPENDIX O5: BECK DEPRESSION INVENTORY SCORES FOR EXERCISE AND CONTROL GROUPS

	EXERCISE GROUP				CONTROL GROUP			
s/n	Week 1	Week 2	Week 3	Week 4	Week 1	Week 2	Week 3	Week 4
1	28.0	28.0	27.0	24.0	1.0	1.0	1.0	1.0
2	0.0	0.0	0.0	0.0	26.0	26.0	25.0	23.0
3	10.0	10.0	9.0	9.0	19.0	19.0	19.0	15.0
4	12.0	11.0	11.0	9.0	1.0	1.0	1.0	1.0
5	0.0	0.0	0.0	0.0	12.0	12.0	12.0	10.0
6	17.0	16.0	15.0	15.0	3.0	2.0	2.0	2.0
7	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	3.0	3.0	3.0	3.0
9	4.0	4.0	4.0	4.0	8.0	8.0	8.0	6.0
10	3.0	3.0	3.0	2.0	0.0	0.0	0.0	0.0
11	21.0	21.0	17.0	14.0	0.0	0.0	0.0	0.0
12	4.0	3.0	3.0	3.0	28.0	28.0	27.0	22.0
13	13.0	10.0	10.0	10.0	24.0	24.0	24.0	22.0
14	5.0	5.0	5.0	4.0	5.0	5.0	5.0	5.0
15	0.0	0.0	0.0	0.0	16.0	15.0	14.0	14.0
16	4.0	4.0	4.0	4.0	14.0	14.0	12.0	10.0
17	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
18	7.0	7.0	6.0	6.0	0.0	0.0	0.0	0.0
19	9.0	9.0	9.0	9.0	0.0	0.0	0.0	0.0
20	16.0	16.0	14.0	10.0	4.0	4.0	4.0	4.0
21	7.0	7.0	7.0	5.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	14.0	10.0	10.0	10.0
23	14.0	14.0	13.0	10.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	3.0	3.0	3.0	2.0
25	10.0	10.0	10.0	10.0	0.0	0.0	0.0	0.0
26	24.0	23.0	23.0	19.0	0.0	0.0	0.0	0.0
27	5.0	5.0	5.0	5.0				
28	15.0	15.0	13.0	12.0				

APPENDIX 06: QoL SCORES FOR THE EXERCISE AND CONTROL GROUPS (EXERCISE GROUP: 1-28, CONTROL GROUP: 29-54).

1.	3.0	1.0	2.0	2.0	2.0	1.0	3.0	3.0	1.0	1.0	1.0	1.0	3.0	1.0	3.0	2.0	3.0
	2.0	3.0	5.0	4.0	2.0	5.0	3.0	4.0	3.0	5.0	6.0	5.0	6.0	4.0	4.0	5.0	6.0
	6.0	6.0	6.0	4.0	4.0	4.0	5.0	6.0	4.0	6.0	5.0	6.0	3.0	5.0	5.0	5.0	3.0
	5.0	4.0	4.0	3.0	4.0	3.0	5.0	4.0	5.0	6.0	4.0	6.0	5.0	6.0	6.0	6.0	6.0
2.	3.0	4.0	5.0	4.0	3.0	4.0	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
	4.0	5.0	4.0	4.0	3.0	4.0	4.0	5.0	4.0	5.0	4.0	5.0	6.0	5.0	5.0	5.0	4.0
	5.0	6.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0
3.	6.0	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	6.0
	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0
	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
4.	4.0	4.0	1.0	4.0	4.0	4.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0
	6.0	4.0	4.0	4.0	4.0	4.0	4.0	6.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	6.0	6.0	6.0	6.0	6.0	4.0
5.	5.0	2.0	2.0	4.0	3.0	3.0	4.0	2.0	3.0	3.0	6.0	6.0	4.0	3.0	4.0	5.0	4.0
	5.0	4.0	4.0	5.0	5.0	6.0	3.0	2.0	5.0	2.0	5.0	5.0	6.0	4.0	5.0	5.0	4.0
	4.0	4.0	5.0	5.0	5.0	5.0	4.0	5.0	3.0	6.0	5.0	6.0	4.0	5.0	5.0	5.0	4.0
	5.0	4.0	3.0	4.0	3.0	4.0	3.0	4.0	4.0	5.0	3.0	3.0	5.0	4.0	5.0	6.0	4.0
6.	4.0	4.0	4.0	5.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	3.0	2.0	5.0	4.0
	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0	5.0	6.0	4.0	4.0	4.0	3.0
	3.0	4.0	4.0	6.0	6.0	6.0	6.0	5.0	4.0	5.0	4.0	5.0	4.0	5.0	1.0	4.0	5.0
	5.0	4.0	4.0	6.0	5.0	5.0	5.0	3.0	5.0	6.0	4.0	5.0	5.0	6.0	5.0	4.0	4.0
7.	3.0	3.0	2.0	2.0	2.0	2.0	6.0	6.0	6.0	6.0	5.0	6.0	6.0	6.0	5.0	6.0	6.0
	4.0	5.0	5.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	4.0	4.0
	2.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
8.	4.0	4.0	1.0	3.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	4.0	6.0	2.0
	6.0	3.0	6.0	4.0	6.0	4.0	6.0	3.0	6.0	3.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0
	4.0	6.0	6.0	1.0	3.0	6.0	6.0	3.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	2.0	6.0	3.0	6.0	4.0	6.0	4.0	4.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	6.0	6.0
9.	5.0	5.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	5.0	6.0	5.0	6.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0
10.	1.0	1.0	2.0	4.0	4.0	1.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	2.0	2.0	5.0
	5.0	3.0	4.0	6.0	3.0	4.0	2.0	2.0	2.0	3.0	4.0	5.0	6.0	3.0	5.0	4.0	5.0

	6.0	6.0	6.0	3.0	4.0	5.0	3.0	6.0	4.0	4.0	4.0	4.0	4.0	6.0	6.0	2.0	2.0
	5.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0
11.	6.0	5.0	5.0	3.0	5.0	2.0	6.0	6.0	6.0	4.0	4.0	4.0	6.0	5.0	6.0	4.0	5.0
	5.0	5.0	5.0	4.0	2.0	5.0	2.0	6.0	4.0	4.0	4.0	5.0	6.0	4.0	6.0	5.0	4.0
	5.0	6.0	5.0	4.0	4.0	6.0	4.0	6.0	5.0	5.0	5.0	4.0	4.0	5.0	5.0	5.0	4.0
	4.0	6.0	6.0	5.0	6.0	5.0	5.0	5.0	6.0	6.0	4.0	6.0	6.0	6.0	4.0	5.0	4.0
12.	3.0	6.0	4.0	3.0	5.0	4.0	5.0	6.0	5.0	5.0	5.0	5.0	4.0	4.0	5.0	4.0	6.0
	4.0	5.0	4.0	3.0	4.0	6.0	4.0	5.0	4.0	4.0	4.0	5.0	6.0	6.0	5.0	4.0	5.0
	5.0	5.0	5.0	4.0	4.0	5.0	4.0	5.0	5.0	6.0	5.0	5.0	5.0	4.0	4.0	4.0	5.0
	4.0	6.0	4.0	4.0	4.0	4.0	6.0	5.0	5.0	5.0	4.0	6.0	6.0	6.0	4.0	5.0	5.0
13.	4.0	4.0	3.0	4.0	4.0	5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0	5.0	3.0	4.0	3.0
	4.0	6.0	4.0	4.0	4.0	4.0	4.0	5.0	4.0	5.0	5.0	6.0	6.0	4.0	5.0	6.0	4.0
	5.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	5.0	4.0	5.0
	5.0	6.0	6.0	5.0	5.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
14.	4.0	4.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	4.0	4.0	5.0	6.0	6.0	6.0	5.0	6.0
	4.0	5.0	5.0	6.0	6.0	5.0	4.0	6.0	4.0	6.0	4.0	4.0	6.0	5.0	6.0	4.0	4.0
	5.0	4.0	4.0	6.0	6.0	6.0	5.0	6.0	5.0	6.0	4.0	6.0	5.0	6.0	6.0	6.0	5.0
	6.0	6.0	6.0	6.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
15.	6.0	1.0	4.0	2.0	2.0	1.0	6.0	5.0	6.0	5.0	5.0	6.0	6.0	4.0	6.0	6.0	5.0
	5.0	5.0	4.0	4.0	5.0	5.0	1.0	6.0	3.0	4.0	6.0	5.0	6.0	5.0	6.0	5.0	5.0
	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	5.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
16.	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	4.0	3.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	2.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
17.	1.0	1.0	3.0	1.0	1.0	3.0	3.0	1.0	1.0	3.0	1.0	3.0	3.0	1.0	3.0	1.0	2.0
	6.0	6.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	4.0	4.0	5.0	6.0	6.0	6.0	4.0	6.0	6.0
18.	4.0	3.0	3.0	4.0	4.0	3.0	6.0	4.0	4.0	1.0	4.0	1.0	1.0	1.0	1.0	1.0	3.0
	5.0	6.0	2.0	2.0	2.0	1.0	1.0	3.0	6.0	1.0	4.0	3.0	6.0	1.0	1.0	1.0	6.0
	5.0	6.0	5.0	1.0	4.0	5.0	3.0	6.0	4.0	6.0	1.0	1.0	1.0	1.0	2.0	1.0	1.0
	1.0	6.0	6.0	1.0	1.0	1.0	3.0	3.0	1.0	5.0	1.0	6.0	5.0	6.0	5.0	3.0	5.0
19.	5.0	5.0	5.0	5.0	5.0	3.0	6.0	6.0	6.0	6.0	6.0	5.0	5.0	5.0	6.0	5.0	5.0
	6.0	5.0	2.0	5.0	5.0	5.0	4.0	5.0	5.0	5.0	6.0	6.0	6.0	5.0	6.0	5.0	4.0
	5.0	5.0	6.0	5.0	5.0	6.0	5.0	6.0	5.0	6.0	6.0	6.0	6.0	5.0	5.0	5.0	6.0
	5.0	6.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	5.0	5.0	6.0	6.0	6.0	5.0	6.0	5.0
20.	4.0	4.0	4.0	4.0	5.0	4.0	5.0	6.0	5.0	6.0	2.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	4.0	4.0	3.0	4.0	3.0	4.0	4.0	5.0	5.0	6.0	5.0	4.0	6.0	5.0	5.0

	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
21.	5.0	6.0	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	5.0	6.0	5.0	5.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0
	6.0	6.0	6.0	5.0	5.0	6.0	5.0	6.0	6.0	6.0	6.0	5.0	5.0	6.0	6.0	6.0	6.0
	5.0	6.0	6.0	6.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
22.	5.0	5.0	3.0	5.0	5.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	5.0	5.0	5.0	4.0
	4.0	6.0	3.0	5.0	5.0	5.0	5.0	4.0	3.0	6.0	6.0	5.0	6.0	5.0	5.0	5.0	6.0
	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	5.0
	4.0	6.0	6.0	3.0	5.0	6.0	6.0	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0
23.	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	1.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	1.0	1.0	3.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	1.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
24.	5.0	5.0	2.0	5.0	1.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	2.0
	4.0	5.0	2.0	2.0	4.0	2.0	2.0	2.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	1.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	4.0	6.0	6.0	4.0	4.0	4.0	6.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
25.	6.0	6.0	4.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	5.0	6.0	4.0	2.0	2.0	3.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
26.	6.0	1.0	2.0	2.0	1.0	3.0	6.0	3.0	5.0	6.0	3.0	5.0	1.0	5.0	5.0	3.0	4.0
	1.0	5.0	1.0	5.0	5.0	5.0	1.0	5.0	4.0	4.0	3.0	3.0	5.0	5.0	2.0	1.0	1.0
	2.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
27.	3.0	1.0	1.0	4.0	1.0	6.0	5.0	5.0	3.0	3.0	3.0	3.0	3.0	6.0	6.0	1.0	5.0
	2.0	4.0	5.0	6.0	6.0	2.0	3.0	4.0	2.0	2.0	6.0	6.0	6.0	2.0	6.0	6.0	6.0
	4.0	5.0	5.0	2.0	3.0	3.0	3.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	1.0
	6.0	3.0	6.0	6.0	6.0	6.0	5.0	5.0	4.0	2.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
28.	5.0	4.0	4.0	5.0	2.0	4.0	6.0	5.0	5.0	4.0	4.0	5.0	4.0	2.0	4.0	3.0	3.0
	4.0	3.0	2.0	4.0	3.0	3.0	3.0	6.0	2.0	4.0	5.0	4.0	5.0	4.0	4.0	5.0	5.0
	5.0	6.0	5.0	3.0	5.0	6.0	6.0	6.0	5.0	4.0	6.0	6.0	5.0	6.0	4.0	4.0	3.0
	3.0	6.0	5.0	3.0	4.0	4.0	4.0	4.0	6.0	5.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0
29.	1.0	1.0	1.0	4.0	1.0	3.0	5.0	5.0	5.0	6.0	6.0	4.0	6.0	4.0	6.0	6.0	6.0
	3.0	5.0	3.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0	6.0	5.0	4.0	4.0	4.0
	5.0	5.0	4.0	3.0	5.0	6.0	6.0	6.0	6.0	6.0	5.0	6.0	4.0	5.0	5.0	6.0	6.0
	6.0	6.0	5.0	4.0	6.0	6.0	6.0	5.0	6.0	5.0	4.0	6.0	4.0	6.0	5.0	6.0	6.0
30.	2.0	3.0	6.0	3.0	2.0	3.0	1.0	2.0	2.0	1.0	2.0	5.0	1.0	1.0	2.0	2.0	2.0
	5.0	4.0	4.0	5.0	5.0	4.0	4.0	6.0	4.0	4.0	5.0	6.0	6.0	5.0	6.0	4.0	4.0

	4.0	5.0	5.0	5.0	4.0	4.0	4.0	6.0	6.0	5.0	4.0	4.0	4.0	6.0	2.0	2.0	5.0
	4.0	4.0	4.0	4.0	4.0	4.0	6.0	5.0	6.0	4.0	5.0	6.0	6.0	6.0	6.0	5.0	5.0
31.	5.0	5.0	3.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0
	5.0	5.0	2.0	5.0	2.0	5.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	5.0	6.0	5.0	5.0
	5.0	5.0	5.0	3.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0	6.0	5.0	5.0	5.0	5.0
	6.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0	5.0	5.0	5.0	6.0	6.0	6.0	5.0	5.0	6.0
32.	6.0	5.0	3.0	5.0	6.0	6.0	6.0	3.0	1.0	1.0	4.0	5.0	6.0	6.0	6.0	1.0	4.0
	1.0	6.0	6.0	6.0	1.0	6.0	1.0	1.0	3.0	6.0	6.0	5.0	6.0	1.0	4.0	5.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
33.	5.0	5.0	5.0	5.0	6.0	5.0	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0
	5.0	6.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	5.0	6.0	5.0	5.0
	6.0	6.0	6.0	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	5.0	6.0	6.0	6.0	5.0	6.0	5.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
34.	4.0	4.0	4.0	4.0	4.0	4.0	5.0	6.0	5.0	5.0	5.0	5.0	5.0	5.0	3.0	2.0	5.0
	1.0	6.0	2.0	4.0	4.0	5.0	4.0	4.0	1.0	5.0	6.0	4.0	6.0	4.0	4.0	4.0	4.0
	5.0	4.0	4.0	1.0	3.0	3.0	4.0	5.0	6.0	5.0	5.0	5.0	5.0	5.0	4.0	4.0	4.0
	5.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
35.	2.0	4.0	4.0	3.0	1.0	5.0	1.0	1.0	4.0	1.0	2.0	3.0	1.0	1.0	3.0	1.0	2.0
	4.0	5.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0	3.0	3.0	4.0	4.0	5.0	5.0	4.0	4.0
	3.0	4.0	4.0	4.0	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0
	4.0	4.0	4.0	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
36.	3.0	2.0	3.0	6.0	5.0	5.0	6.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	4.0	4.0	3.0	6.0	6.0	6.0	6.0	6.0	6.0
37.	4.0	5.0	4.0	4.0	3.0	5.0	4.0	5.0	4.0	4.0	4.0	5.0	5.0	4.0	4.0	4.0	4.0
	3.0	3.0	4.0	3.0	3.0	4.0	3.0	2.0	3.0	20	3.0	2.0	4.0	2.0	3.0	3.0	2.0
	3.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
38.	6.0	3.0	4.0	3.0	4.0	2.0	1.0	4.0	4.0	3.0	4.0	1.0	4.0	3.0	3.0	2.0	1.0
	4.0	2.0	4.0	3.0	2.0	3.0	3.0	5.0	4.0	3.0	3.0	4.0	5.0	4.0	3.0	3.0	6.0
	3.0	3.0	4.0	3.0	3.0	3.0	4.0	5.0	3.0	2.0	3.0	4.0	3.0	2.0	3.0	2.0	4.0
	2.0	4.0	2.0	3.0	6.0	3.0	4.0	4.0	4.0	3.0	2.0	3.0	2.0	1.0	3.0	2.0	3.0
39.	5.0	5.0	2.0	5.0	1.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	2.0
	4.0	5.0	2.0	2.0	4.0	3.0	2.0	2.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	1.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	4.0	6.0	6.0	4.0	4.0	4.0	4.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
40.	2.0	5.0	3.0	6.0	6.0	5.0	6.0	4.0	6.0	6.0	6.0	3.0	5.0	3.0	6.0	6.0	6.0
	3.0	5.0	1.0	2.0	1.0	6.0	1.0	1.0	5.0	3.0	6.0	3.0	6.0	6.0	5.0	4.0	5.0

	5.0	6.0	6.0	4.0	1.0	4.0	4.0	1.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	3.0	6.0
	6.0	6.0	3.0	1.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
41.	6.0	5.0	1.0	3.0	3.0	3.0	6.0	5.0	4.0	5.0	6.0	6.0	4.0	5.0	4.0	2.0	5.0
	4.0	4.0	3.0	4.0	4.0	4.0	2.0	3.0	3.0	6.0	6.0	2.0	6.0	5.0	6.0	4.0	2.0
	4.0	6.0	6.0	1.0	1.0	3.0	4.0	6.0	6.0	2.0	6.0	6.0	1.0	5.0	6.0	6.0	4.0
	6.0	6.0	6.0	6.0	5.0	5.0	6.0	4.0	6.0	5.0	6.0	6.0	6.0	6.0	5.0	6.0	6.0
42.	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0
	5.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0
43.	4.0	4.0	4.0	5.0	5.0	4.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	5.0	5.0	1.0	4.0
	4.0	5.0	3.0	4.0	4.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0	6.0	4.0	6.0	4.0	5.0
	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	4.0
	4.0	6.0	6.0	4.0	4.0	5.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
44.	5.0	5.0	3.0	4.0	5.0	4.0	6.0	5.0	5.0	5.0	2.0	4.0	4.0	5.0	4.0	6.0	4.0
	2.0	2.0	3.0	3.0	1.0	2.0	1.0	4.0	3.0	4.0	5.0	6.0	6.0	5.0	6.0	5.0	4.0
	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	4.0
	4.0	5.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
45.	3.0	5.0	3.0	3.0	4.0	4.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	4.0	1.0	2.0
	4.0	5.0	3.0	5.0	5.0	6.0	1.0	1.0	5.0	6.0	6.0	6.0	6.0	5.0	5.0	5.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	4.0
	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0
46.	6.0	6.0	4.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	6.0	6.0
	6.0	6.0	2.0	5.0	6.0	6.0	1.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0
	6.0	6.0	6.0	4.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
47.	4.0	6.0	2.0	3.0	2.0	1.0	5.0	3.0	5.0	6.0	6.0	5.0	4.0	5.0	6.0	6.0	4.0
	4.0	5.0	3.0	4.0	2.0	6.0	2.0	5.0	3.0	3.0	5.0	5.0	6.0	4.0	5.0	4.0	3.0
	3.0	6.0	6.0	4.0	4.0	2.0	1.0	3.0	3.0	5.0	5.0	6.0	6.0	4.0	5.0	5.0	5.0
	3.0	4.0	5.0	4.0	4.0	3.0	6.0	6.0	4.0	3.0	3.0	6.0	5.0	6.0	4.0	4.0	4.0
48.	4.0	4.0	2.0	4.0	5.0	6.0	5.0	4.0	6.0	5.0	6.0	5.0	6.0	3.0	4.0	3.0	4.0
	1.0	3.0	4.0	4.0	4.0	1.0	1.0	3.0	3.0	1.0	3.0	2.0	6.0	3.0	3.0	2.0	2.0
	6.0	5.0	6.0	2.0	4.0	1.0	1.0	5.0	3.0	2.0	4.0	6.0	5.0	1.0	4.0	4.0	3.0
	5.0	5.0	5.0	4.0	4.0	5.0	5.0	2.0	5.0	5.0	5.0	4.0	4.0	6.0	6.0	6.0	6.0
49.	3.0	4.0	1.0	5.0	5.0	1.0	5.0	5.0	6.0	4.0	4.0	3.0	4.0	3.0	3.0	3.0	3.0
	4.0	4.0	4.0	4.0	4.0	5.0	1.0	6.0	4.0	6.0	6.0	5.0	6.0	3.0	5.0	5.0	4.0
	4.0	6.0	6.0	2.0	6.0	5.0	4.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	4.0	4.0	4.0
	4.0	6.0	4.0	3.0	6.0	6.0	6.0	1.0	6.0	5.0	6.0	6.0	6.0	6.0	4.0	5.0	6.0
50.	3.0	4.0	5.0	3.0	4.0	3.0	2.0	2.0	2.0	3.0	2.0	3.0	3.0	3.0	4.0	5.0	3.0
	3.0	5.0	3.0	4.0	3.0	4.0	3.0	4.0	4.0	5.0	3.0	3.0	2.0	3.0	3.0	4.0	3.0

	4.0	6.0	6.0	6.0	6.0	5.0	5.0	4.0	3.0	2.0	6.0	6.0	6.0	5.0	4.0	5.0	5.0
	3.0	4.0	5.0	3.0	4.0	4.0	4.0	4.0	5.0	5.0	5.0	4.0	6.0	5.0	4.0	5.0	5.0
S1.	6.0	6.0	4.0	6.0	6.0	5.0	6.0	4.0	6.0	6.0	5.0	5.0	6.0	6.0	4.0	6.0	6.0
	6.0	5.0	3.0	4.0	3.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	4.0	5.0
	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
S2.	5.0	5.0	5.0	5.0	5.0	3.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	5.0	4.0
	6.0	6.0	5.0	5.0	4.0	5.0	4.0	5.0	5.0	5.0	6.0	6.0	6.0	5.0	6.0	5.0	5.0
	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
S3.	6.0	6.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	3.0	6.0	6.0	4.0
	5.0	6.0	3.0	6.0	6.0	6.0	4.0	6.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	6.0	6.0	6.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	4.0	6.0	6.0
	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
S4.	3.0	5.0	5.0	5.0	4.0	4.0	6.0	6.0	6.0	5.0	6.0	5.0	6.0	3.0	3.0	5.0	5.0
	5.0	3.0	4.0	4.0	4.0	5.0	5.0	5.0	4.0	5.0	5.0	5.0	6.0	5.0	5.0	5.0	5.0
	5.0	6.0	6.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	5.0	5.0	6.0	6.0	5.0	5.0	5.0
	5.0	6.0	5.0	5.0	5.0	5.0	6.0	5.0	6.0	5.0	5.0	6.0	6.0	6.0	6.0	5.0	5.0