STRUCTURAL EQUATION MODELING OF BILATERAL LATENT STRUCTURE OF SATISFACTION WITH LIFE AND QUALITY OF LIFE

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CERTIFICATION

This is to certify that the research reported in this Thesis was written by ALADENIYI, Olabimpe Bodunde, (98/55EG063) in the Department of Statistics, in partial fulfilment of the requirements for the award of Doctor of Philosophy in Statistics of the University of Ilorin, Ilorin, Kwara State, Nigeria and has not been presented elsewhere for the award of a degree, or any other purpose.

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DEDICATION

This work is dedicated to God Almighty who made everything beautiful in His time.

… But verily God hath heard me: he hath attended to the voice of my prayer. Blessed be God, which hath not turned away my prayer, nor his mercy from me. (Psalm 66:19-20).

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ABSTRACT

Structural Equation Modeling (SEM) is a method which uses various types of models to depict relationships among observed variables, with the same basic goal of providing a quantitative test of a theoretical model hypothesized by the researcher. Several instruments including World Health Organization (WHOQoL-BREF) for non HIV patients, WHOQoL-HIV (BREF) for HIV patients and Satisfaction with Life Scale (SWLS) have been provided

for assessing quality of life. These instruments may be non-country or regional specific. The aim of the study therefore, was to investigate the bilateral structure between the instruments as well as to reduce the number of the variables in the instruments. The specific objectives are to (i) assess the impact of the variables of the instruments on their various latent constructs through their bilateral structure; (ii) formulate the SEMs for non-HIV and HIV patients; (iii) compare Maximum Likelihood (ML) and Generalized Least Squares (GLS) estimates of the equations in (ii); (iv) regroup variables in WHOQoL-HIV (BREF) and formulate their SEMs and (v) obtain a reduced instrument from the combined WHO QoL instruments and assess the effectiveness.

The two estimators used on the instruments for parameter estimation in the SEMs were ML and GLS. The binary logistic regression model was also used on the combined instruments. Life data were collected from over 300 patients from each of the two randomly selected states out of the six states in the Southern Western Nigeria. AMOS version 21 Statistical software was used to analyze the data.

The following were the major findings of the study:

i. Most of the variables in the instrument had significant impact on their latent constructs (domains). Also there were variations in the path diagrams for the WHO QoL instruments.
ii. The SEMs were formulated and it was noted that for non-infected patients, psychology domain had the most substantial causal effect on their quality of life, while, physical domain had the most substantial causal effect on the quality of life of HIV patients.
iii. Using some goodness of fit criteria, GLS estimation method was more appropriate in analysing ordinal categorical data, as in this study than ML method.
iv. Reclassification of the domains in the WHOQoL-HIV (BREF) showed that some variables like pain and discomfort; dependence on medication were miss grouped.
v. The study established that not all the models formulated using WHOQoL instruments were admissible in the proposed regrouped variables.
vi. The positive predictive value and the negative predictive value of the merged reduced instrument was as good as the standard WHO quality of life instruments.

In conclusion, the instrument with the merged reduced variables can be used to obtain data for both groups of patients together as well as for each group separately. Moreover, the GLS estimation method should be used when analyzing data from these instruments. It is therefore

recommended that the merged reduced instrument should be used for both patients and the GLS used for analysis.

TABLE OF CONTENTS

	Page
Title Page	i
Certification	ii
Dedication	iii
Acknowledgement	iv
Abstract	v

Table of Contents vii

List of Tables xvi

List of Figures xvii

Chapter One

1.0 Introduction 1

1.1 Human immunodeficiency virus 1

1.2 Quality of Life and its Definitions 2

1.3 Measuring Quality of Life 4

1.3.1 WHO Quality of Life Questionnaires 4

1.3.2 Satisfaction with Life Scale (SWLS) 7

1.4 Structural Equation Modeling 8

1.4.1 Advantages of SEM 10

1.4.2 Path Diagram in Structural Equation Modeling 11

1.5 Statement of Problem 11

1.6 Aim and Objectives 11

1.7 Justification for the Study 12

1.8 Abbreviations and Notations 13

Chapter Two

2.0 Literature Review 16

2.1 Introduction 16

2.2 HIV and Quality of Life 17

2.3 WHOQoL questionnaires 18

2.4 Factor Analysis 19

2.4.1 Principal Component Analysis 20

2.5 Structural Equation Modeling (SEM) 20

2.5.1 Empirical work done on SEM 22

2.6 Structural Equation Modeling Processes 23

2.6.1 Model Fit in Structural Equation Modeling 24

2.6.2 Structural Equation Modeling (SEM) Steps 25

2.6.3 Types of Models in SEM 26

2.6.4 Model Identification in SEM 28

2.6.5 Statistical Assumptions for SEM 29

2.6.6 General structure for existing models of non-HIV data using WHOQoL (BREF) Questionnaire 30

2.6.7 General structure for existing models of HIV data using WHOQoL-HIV (BREF) Questionnaire 31

2.7 Principal Component Analysis for the Proposed Models 34

2.8 Mardia's Multivariate Test for Normality 34

2.9 Estimation Methods 35

2.10 Goodness of Fit Tests 36

2.11 Binary Logistic Regression Model 38

Chapter Three

3.0 Methodology 40

3.1 Introduction 40

3.2 Study Area and Data Collection 40

3.3 General structure for models of non-HIV data using WHOQoL (BREF) Questionnaire 41

3.4 General structure for models of HIV data using WHOQoL-HIV (BREF) Questionnaire 42

3.5 General structure of the proposed model for WHOQoL-HIV (BREF) questionnaire 43

Chapter Four

4.0 Results and Discussion 45

4.1 Introduction 45

4.2 Characteristics of the test data 45

4.3 Results of Analysis on Non-HIV Data 48

4.3.1 Model Fit Comparison for ML and GLS (non-HIV data) 48

4.3.2 Analysis of WHOQoL (BREF) (Model 1) 49

4.3.3 Factor Loading Fitting chart of the Theoretical 4-Component WHOQoL (BREF) Questionnaire 50

4.3.4 CFA Parameter Estimates of the Theoretical 4-Component WHOQOL (BREF) Questionnaire 54

4.3.5 CFA Covariances among Latent Construct of the theoretical 4-Component WHOQoL (BREF) Questionnaire 54

4.3.6 Fit Indices for WHOQoL (BREF) (Model 1) 54

4.3.7 Analysis of WHOQoL (BREF) and one overall QoL question (Model 2) 55

4.3.8 Fitted Structural Equation Model (SEM) of the Theoretical WHOQoL (BREF) Questionnaire and Overall QoL Question 55

4.3.9 SEM Parameters Estimates of the Theoretical WHOQoL (BREF) Questionnaire and Overall QoL Question 57

4.3.10 SEM Covariance among Latent Constructs of the theoretical WHOQOL (BREF) Questionnaire and Overall QoL Question 57

4.3.11 Fit Indices for WHOQoL (BREF) and one overall QoL question (Model 2) 57

4.3.12 Analysis of WHOQoL (BREF) and two overall QoL questions (Model 3) 58

4.3.13 Fitted Structural Equation Model (SEM) of the Theoretical WHOQoL (BREF) Questionnaire and Overall QoL Questions (Two Indicators) 58

4.3.14 SEM Parameter Estimates of the Theoretical WHOQoL (BREF) Questionnaire and the Overall QoL Questions (Two Indicators) 60

4.3.15 SEM Covariance among Latent Constructs of the Theoretical WHOQoL (BREF) Questionnaire and the Overall QoL Questions (Two Indicators) 61

4.3.16 Fit indices for WHOQoL (BREF) and two overall QoL questions (Model 3) 61

4.3.17 Analysis of WHOQoL (BREF) and SWLS questionnaire (Model 4) 61

4.3.18 Fitted Structural Equation Model (SEM) of the Theoretical WHOQoL (BREF) Questionnaire and Satisfaction with Life Scale Questionnaire 61

4.3.19 SEM Parameter Estimates of the Theoretical WHOQoL (BREF) Questionnaire and SWLS Questionnaire 66

4.3.20 SEM Covariance among Latent Constructs of the Theoretical WHOQoL (BREF) Questionnaire and SWLS Questionnaire 64

4.3.21 Fit Indices WHOQoL (BREF) and SWLS questionnaire (Model 4) 64

4.3.22 Analysis of WHOQoL (BREF) and SWLS questionnaire with one overall QoL question (Model 5)
64

4.3.23 Fitted Structural Equation Model (SEM) of the Theoretical WHOQoL (BREF) Questionnaire, Overall QoL Question and SWLS Questionnaire 64

4.3.24 SEM Parameter Estimates of the Theoretical WHOQoL (BREF), Overall QoL Question and SWLS Questionnaire
63

4.3.25 SEM Covariances among Latent Constructs of the Theoretical WHOQoL (BREF) Questionnaire, Overall QoL Question and SWLS Questionnaire 67

4.3.26 Fit Indices for WHOQoL (BREF) and SWLS questionnaire with one overall QoL question (Model 5)
67

4.3.27 Analysis of WHOQoL (BREF) and SWLS questionnaire with two overall QoL questions (Model 6)
67

4.3.28 Fitted structural equation model (SEM) of the theoretical WHOQoL (BREF) questionnaire overall quality of life question (two indicators) and satisfaction with life scale questionnaire

67

4.3.29 SEM Parameter Estimates of the Theoretical WHOQoL (BREF), Overall QoL questions and SWLS Questionnaire
69

4.3.30 SEM Covariance among Latent Constructs of the Theoretical WHOQoL (BREF) Questionnaire, Overall QoL Questions (Two Indicators) and SWLS Questionnaire 70

4.3.31 Fit Indices for WHOQoL (BREF) and SWLS questionnaire with two overall QoL questions (Model 6)
70

4.4 Results of Analysis on HIV Data 70

4.4.1 Model Fit Comparison for ML and GLS (HIV data) 70

4.4.1 Analysis of WHOQoL –HIV (BREF) (Model 7) 71

4.4.2 Factor Loading Fitting Chart of the Theoretical 6-Component WHOQoL-HIV (BREF) Questionnaire
74

4.4.2 CFA Parameter Estimates of the Theoretical 6-Component WHOQOL-HIV (BREF) Questionnaire 77

4.4.3 CFA Covariance among Latent Constructs of the Theoretical 6-Component WHOQOL-HIV (BREF) Questionnaire
77

4.4.4 Fit indices of the models from confirmatory factor analyses of the WHOQOL-HIV (BREF) Questionnaire
78

4.4.5 Analysis of WHOQoL-HIV (BREF) and one overall QoL question (Model 8) 78

4.4.6 Fitted Structural Equation Model (SEM) of the Theoretical WHOQOL-HIV (BREF) questionnaire and Overall QoL question 78

4.4.7 SEM Parameter Estimates of the Theoretical WHOQOL-HIV (BREF) Questionnaire and the Overall QoL Question
80

4.4.8 SEM COVARIANCES among Latent Constructs of the Theoretical WHOQOL-HIV (BREF) and the Overall QoL question 81

4.4.9 Fit Indices for WHOQoL-HIV (BREF) and one overall QoL question (Model 8) 81

4.4.10 Analysis of WHOQoL-HIV (BREF) and 2 overall QoL questions (Model 9) 81

4.4.11 Fitted Structural Equation Model (SEM) of the Theoretical WHOQOL-HIV (BREF) questionnaire and overall QoL questions (two indicators) 81

4.4.12 SEM Parameter estimates of the theoretical WHOQOL-HIV (BREF) questionnaire and the overall QoL questions (Two indicators)

83

4.4.13 SEM Covariances among latent constructs of the theoretical WHOQOL-HIV (BREF) and the Overall QoL questions (two indicators)

84

4.4.14 Fit Indices for WHOQoL-HIV (BREF) and 2 overall QoL questions (Model 9) 84

4.4.15 Analysis of WHOQOL-HIV (BREF) and SWLS questions (Model 10) 84

4.4.16 Fitted Structural Equation Model (SEM) of the theoretical WHOQOL-HIV (BREF) and Satisfaction with Life Scale Questionnaire

84

4.4.17 SEM Parameter estimates of the theoretical WHOQOL-HIV (BREF) questionnaire and satisfaction with life scale questionnaire 86

4.4.18 SEM Covariances among Latent Constructs of the Theoretical WHOQOL-HIV (BREF) and Satisfaction with Life Scale Questionnaire

87

4.4.19 Fit Indices for WHOQOL-HIV (BREF) and SWLS questions (Model 10) 87

4.4.20 Analysis of WHOQOL-HIV (BREF) and SWLS with 1 overall QoL question (Model 11)

87

4.4.22 SEM Parameter estimates of the theoretical WHOQOL-HIV (BREF) questionnaire, overall QoL question and Satisfaction with Life Scale

89

4.4.23 SEM Covariances of the theoretical WHOQOL-HIV (BREF) questionnaire, overall QoL question and satisfaction with life scale 89

4.4.24 Fit Indices for WHOQOL-HIV (BREF) and SWLS with 1 overall QoL question (Model 11)
90

4.4.25 Analysis of WHOQOL-HIV (BREF) and SWLS with two overall QoL question (Model 12)
90

4.4.26 Fitted Structural Equation Model (SEM) of the Theoretical WHO QOL-HIV (BREF), overall QOL questions and Satisfaction with Life Scale questionnaire
90

4.4.27 SEM Parameter Estimates of the Theoretical WHOQOL-HIV (BREF), overall QOL questions and Satisfaction with Life Scale questionnaire 92

4.4.28 SEM Covariances among Latent Constructs of the Theoretical WHOQOL-HIV (BREF), overall QOL questions and Satisfaction with Life Scale questionnaire
93

4.4.29 Fit Indices for WHOQOL-HIV (BREF) and SWLS with two overall QoL question (Model 12)
93

4.5 Analysis for the Proposed Models using the regrouped HIV variables 93

4.5.1 Reliability Test for the Proposed Domains 96

4.5.2 Analysis of regrouped WHOQoL-HIV (BREF) variables 98

4.5.3 Analysis of regrouped WHOQoL-HIV (BREF) (NModel 1) 99

4.5.4 Factor Loading Fitting Chart of the Hypothesized 9-Component WHOQoL-HIV (BREF) Questionnaire
102

4.5.5 CFA Parameter Estimates of the Hypothesized 9-Component WHOQOL-HIV (BREF) Questionnaire
105
4.5.6 CFA Covariances among Latent Constructs of the Hypothesized 9-Component WHOQOL-HIV (BREF) Questionnaire
106
4.5.7 Modification of regrouped WHOQoL-HIV (BREF) (NModel 1) 106
4.5.8 Fit indices of the regrouped WHOQoL-HIV (BREF) (NModel 1) 106
4.5.9 Analysis of the regrouped WHOQoL-HIV (BREF) and SWLS with one overall QoL question (NModel 5) 107
4.5.10 Fitted Structural Equation Model (SEM) of the hypothesized WHOQOL-HIV (BREF), overall QoL question and Satisfaction with Life Scale
107
4.5.11 SEM Parameter estimates of the hypothesized WHOQOL-HIV (BREF) questionnaire, overall QoL question and Satisfaction with Life Scale 109
4.5.12 SEM Covariance of the hypothesized WHOQOL-HIV (BREF) questionnaire for NModel 5
110
4.5.13 Modification of regrouped WHOQoL-HIV (BREF) and SWLS with one overall QoL question (NModel 5) 111
4.5.14 Fit Indices for regrouped WHOQoL-HIV (BREF) and SWLS with one overall QoL question (NModel 5) 112
4.5.15 Analysis of the regrouped WHOQoL-HIV (BREF) and SWLS with two overall QoL questions (NModel 6) 112

4.5.16 Fitted Structural Equation Model (SEM) of the Hypothesized WHO QOL-HIV (BREF), overall QOL questions and Satisfaction with Life Scale questionnaire 112

4.5.17 SEM Parameter Estimates of the Hypothesized WHOQOL-HIV (BREF), overall QOL questions and Satisfaction with Life Scale questionnaire 113

4.5.18 SEM Covariance among Latent Constructs of the Hypothesized WHOQOL-HIV (BREF), overall QOL questions and Satisfaction with Life Scale questionnaire 114

4.5.19 Fit Indices for regrouped WHOQoL-HIV (BREF) and SWLS with two overall QoL questions (NModel 6) 114

4.5.20 Comparison of WHOQoL-HIV (BREF) and the Proposed Models using GLS 114

4.6 Reduction of WHO (BREF) Instruments 116

Chapter Five

5.0 Summary, Conclusions and Recommendations 121

5.1 Overview of the study 121

5.2 Summary 121

5.2.1 Confirmatory Factor Analysis and Structural Equations 121

5.3 Contributions to Knowledge 123

5.4 Conclusions 124

5.5 Recommendations 124

5.5.1 Suggestion for future study 124

REFERENCES 126

APPENDICES 141

LIST OF TABLES

Table 2.1: Model-Fit Criterial 38

Table 4.1: Collinearity Statistics and Variance of the Data 44

Table 4.2: Mardia's Multivariate Normality Test 47

Table 4.3: Comparison of ML & GLS for non-HIV data (Models 1 to 6) 48

Table 4.4: Summary of SEM Parameter Estimates for non-HIV data (Models 1-6) 49

Table 4.5: Summary of Covariance Estimates for non-HIV data (Models 1 to 6) 51

Table 4.6: Fit Indices from CFA for Model 1 54

Table 4.7: Comparison of ML & GLS for HIV data (Models 7 to Model 12) 70

Table 4.8: Summary of SEM Parameter Estimates for HIV data (Models 7 to 12) 72

Table 4.9: Summary of Covariance Estimates for HIV data (Models 7 to 12) 74

Table 4.8: Factor Extraction for the new domains 93

Table 4.9: Distribution of Variables into Components/Domains 95

Table 4.10: Item-Total Statistics for the Proposed Domains 96

Table 4.11: Summary of SEM Parameter Estimates for Regrouped HIV data 99

Table 4.12: Summary of Covariance Estimates for Regrouped HIV data 100

Table 4.13: Summary of Fit Indices for New Model 1 106

Table 4.14: Fit Analysis for regrouped WHOQoL-HIV (BREF) and SWLS with one overall QoL question (NModel 5)
111

Table 4.15: Fit Indices for regrouped WHOQoL-HIV (BREF) and SWLS with two overall QoL questions (NModel 6)
114

Table 4.16: Comparison of WHOQoL-HIV (BREF) & the Proposed Models using GLS 115

Table 4.17a: All 26 variables showing odd ratio values 116

Table 4.17b: Sensitivity and specificity of 26 variables model 117

Table 4.17c: Odd ratios for the 19 Significant Variables 117

Table 4.17d: Sensitivity and specificity of model for 19 variables 118

LIST OF FIGURES

Figure 4.1: Scatter diagram of variables of the data 46

Figure 4.2: Cluster property of the data 46

Figure 4.3: Normal Plots of WHOQoL-HIV, SWLS-HIV, WHOQoL & SWLS-NHIV 47

Figure 4.4. Model 1: Path diagram for Quality of Life for non-HIV patients 52

Figure 4.5. Model 2: Path diagram for Quality of Life with overall indicator for non-HIV data 56

Figure 4.6. Model 3: Path diagram for Quality of Life with two overall indicators for non-HIV data 59

Figure 4.7. Model 4: Path diagram for Quality of Life with Satisfaction with Life Scale (SWLS) for non-HIV data 62

Figure 4.8. Model 5: Path diagram for Quality of Life with overall QoL and Satisfaction with Life Scale (SWLS) for non-HIV data 65

Figure 4.9. Model 6: Path diagram for Quality of Life with two indicators for overall QoL and Satisfaction with Life Scale (SWLS) for non-HIV data 68

Figure 4.10. Model 7: Path diagram for health related Quality of Life for HIV data 75

Figure 4.11. Model 8: Path diagram for health related Quality of Life with the overall QOL for HIV data 79

Figure 4.12. Model 9: Path diagram for health related Quality of Life with two indicators for HIV data 82

Figure 4.13. Model 10: Path diagram for health related Quality of Life and Satisfaction with Life Scale (SWLS) for HIV data 85

Figure 4.14. Model 11: Path diagram for health related Quality of Life with overall QOL and Satisfaction with Life Scale (SWLS) for HIV data 88

Figure 4.14. Model 12: Path diagram for health related Quality of Life with two indicators for overall QOL and Satisfaction with Life Scale (SWLS) for HIV data 91

Figure 4.15. NModel 1: Path diagram for health related Quality of Life for HIV data 103

Figure 4.16. NModel 5: Path diagram for health related Quality of Life with overall QOL and Satisfaction with Life Scale (SWLS) for HIV data 108

Figure 4.17. NModel 6: Path diagram for health related Quality of Life with two indicators for overall QOL and Satisfaction with Life Scale (SWLS) for HIV Positive patients data 112

CHAPTER ONE

1.0 INTRODUCTION

1.1 Human Immunodeficiency Virus

Human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS) are members of a group of viruses called retroviruses. Globally, HIV/AIDS infection is one of the leading causes of mortality among young adults (Selik *et al*., 1993). Current statistics of people living with HIV/AIDS (PLWHA) worldwide stands at 34.2 million with 15.2 million children estimated to be orphans as a result of AIDS (UNAIDS, 2016; Aladeniyi and Oyejola, 2016). Over 75% of deaths caused by AIDS took place in sub-Saharan Africa thereby hindering fiscal development and destroying human capital (UNAIDS, 2007). For instance in Nigeria, 3,459,363 people live with HIV and an estimate of 1,449,166 requires Antiretroviral (ARV), 388,864 new infections occurred in the year 2011 and records showed 217,148 AIDS related deaths (Nigeria GARPR, 2012). While in 2016, Nigeria had 220,000 (150,000 – 310,000) new HIV infections and 160,000 (110,000 – 230,000) AIDS-related deaths, and there were 3,200,000 (2,300,000 – 4,300,000) people living with HIV in 2016, among whom 30% (19% - 42%) were accessing antiretroviral therapy (UNAIDS, 2016). ARV treatment lessens both the mortality and the morbidity of HIV infection, but repetitive access to antiretroviral medication is not accessible in all countries. It is a fact that 70% of the world HIV positive individuals live in Sub-Saharan Africa (Tucker *et al.,* 2005; UNAIDS, 2007). According to Mabayoje and Akinleye (2016), "Nigeria carries the second heaviest burden of HIV in the world and has an expanding population of PLWHA". In the face of challenges in scaling up access, institutional reforms and political obligation to tackle the viruses, the country has seen more citizens placed on life saving medication (Nigeria GARPR, 2012). With respect to HIV treatment, persons requiring ARV were 1,449,166 (Nigeria GARPR, 2012). This rise is attributed to better survival rates for PLWHA and modification of guidelines to place persons on ARV at a cluster designation 4 (CD4) count of < 350 as against 250 in the previous national ART guidelines (NACA, 2011). The number of all adults and children receiving ART was 432,285 as at the end of 2011, a rise of about seventy three thousand from 2010. The achieved ARV coverage in 2010 was less than half of set targets for the subsequent year and even below the baseline. Of total ARV recipients, females constitute 65.7% while 34.3% were males. The number of pregnant women who received ARV during the last 12 months was 37,868 (FMOH, 2010) and most were placed on Maternal Triple ARV regimen. 73.4% of those who were initiated on ART were known to

still be alive and on treatment 12 months after. The overall HIV frequency among women attending Antenatal Clinic in Nigeria was 3.0% ranging from 0.9% to 15.4% across the zones (FMOH, 2014).

But since "the introduction of Highly Active Anti-Retroviral Therapy (HAART), people living with HIV/AIDS have had an appreciable rise in longevity and can pursue their normal activities, however, the need to support their quality of life has become increasingly important" (Mofolorunsho *et al.,* 2013).

1.2 Quality of Life and its Definitions

The quality of life (QoL) concept can be traced back to 1947 (Mweemba, 2011; Grossman *et al.,* 2003). There is lack of precision in the definition of quality of life and associated operational problems in it, but there is urgency in appraising the quality of life in HIV infected individual. According to Wolfensberger (1994), "since 1989, more than ten health related quality of life (HRQOL) instruments have been used in research with HIV infected individuals. These have documented relationships of HRQOL and HIV status, level of symptoms, use of antiretroviral drugs and use of drugs for prophylaxis of opportunistic infections separately".

There exist several definitions of quality of life. A few writers have emphasized that "there are as many as one definition of quality of life per study" (Mweemba, 2008; Skevington, 2002). There are array of definitions from individual achievement to the capability to lead a normal life. It is said that "quality of life encompasses all circumstances of life" (Bowling, 1995). Quality of life is a multi-dimensional conception whose description and assessment remains debatable. Quality of life could also mean well-being. Crisp (2005) described it as a level of happiness, confidence, physical condition and general outlook on life of an individual. A lot of scholars termed Quality of life as a "fighting spirit" associated with longer survival time for individuals (Rabkin *et al*., 1993). Lalremruati (2017) stated that "Quality of life relates both to adequacy of material circumstances and also to personal feelings about these circumstances. It includes overall subjective feelings of wellbeing that are closely related to morale, happiness and satisfaction". Health is largely quoted as one of the most vital bases of comprehensive quality of life and it has been proposed that specific diseases such as AIDS may affect the quality of life of an individual. Quality of life is defined as "individuals' perception of their position in life in the context of the culture and value system in which they live and in relation to their goals, expectations, standards and concerns"

by the World Health Organization (da Silva *et al.*, 2015; WHO, 1995; Sayed *et al.*, 2009). While this description has not yet been fully incorporated by the quality-of-life researchers, it captures most generally agreed upon areas. However, there exist an agreement that quality of life is a multi-dimensional construct defined in terms of an individual's subjective experiences and a concept that cannot be generalized across cultures (Robinson *et al.*, 2006).

QOL can be described as a concept that mirrors several aspects of life, an individual's perception of overall well-being with regard to disease and treatment-related symptoms specifically called the "health related quality of life (HRQOL)" (Kim *et al.*, 2010). QOL has also been defined as a multidimensional theory that includes, at a minimum, physical, functional, psychological and social well-being. Other dimensions include spirituality, sexuality, occupational functioning, treatment satisfaction and the overall rating of the QOL (Montazeri, 2009).

Quality of life (QOL) is of chief concern in evaluative research and improved quality of life is perhaps the most desired outcome of all healthcare policies (Schonnesson, *et al.*, 2005). It has also been referred to as a "descriptive term that refers to people's emotional, social and physical well-being and their ability to function in the ordinary tasks of living" (Sousa and Kwok, 2006). It could also mean the "degree to which a person enjoys the important possibilities of her/his life" (Wilson and Cleary, 1995). Also, "individuals' perception of their position in life in the context of the culture and value system in which they live and in relation to their goals, expectations, standards and concerns" is termed quality of life (Skevington, 2002). These different definitions of quality of life stem from the multi–disciplinary use of the word. Another reason is the fact that life itself is multipart and its significance to every individual is highly subjective. According to Farquahar (1995), "there are four main types of definition namely; global, component, focused, and combinational". The global is the most generally used in defining quality of life. It allows for encompassing many different facets of the quality of life. However, it over simplifies and does not allow enough specificity of the major components to use it practically. The component definition attempts to break down the quality of life into specific elements in terms of dimensions and characteristics dependent on specific purposes, such as research topics and measurement for long-term assignment or policy. The constraint of the component approach is the reliability and validity of each component in the measure of quality of life. However, some dedicated projects use only one or a small number of components to define the quality of life. This component approach is often used to define a very specific quality of life, such as that of a

cancer patient, or one in hospital care. The weakness to this is that it is a very narrow definition and in some cases authors use it too largely and make effort to extend it into a broader interpretation of the quality of life. The final version, the combination or hybrid, is created by combining global and component types. This includes the attendant advantages and disadvantages of both (Schonnesson *et al*., 2005).

However, there is a consensus among researchers that an individual's happiness and satisfaction with life are the two major structural blocks in defining quality of life (Skevington *et al*., 1999). Health related quality of life (HRQOL) on the other hand include domains (aspects) of life that improve when a treatment option is successful. A clinically significant change in HRQOL is indicated by a decline in a domain that leads a physician or health care provider to alter a medication or medical treatment. HRQOL domains minimally include functional status, mental health or emotional wellbeing (e.g. depressive symptoms, positive affect), social engagement (e.g. involvement with others, engagement in activities), and symptom states (e.g. pain, shortness of breath, fatigue). These domains represent typical outcomes in medical and social science research (Sousa *et al*., 1999).

Quality of life (QoL) is recently been considered synonymous to health status, functional status, psychological well-being, happiness with life, satisfaction of needs, and assessment of one's own life. Nigeria has passed through several phases in her response to the epidemic (Odoemelam and Nwachukwu, 2011). However, limited studies have been conducted with the World Health Organization Quality of Life (WHOQoL) (BREF) and World Health Organization Quality of Life (WHOQoL-HIV) (BREF) together to study quality of life in Nigeria.

1.3 Measuring Quality of Life

1.3.1 WHO Quality of Life Questionnaires

Quality of life research has led to the recognition of the importance of quality of life and the need to incorporate quality of life into health care practice (Grossman *et al*., 2003). Clinicians, researchers, policy makers, pharmaceutical companies, and patients have all come to identify the importance of quality of life. Although there are common themes across the studies on quality of life, most researches have been conducted in developed countries making generalizations to developing countries difficult. Little is known and recorded about quality of life in developing countries such as Nigeria (Mweemba, 2008). WHOQoL questionnaire developed in the WHOQoL project established that QoL could be

conceptualized and defined in a uniform way across cultures. Its constituent core domains and facets can be assessed using structured questionnaire methodology, and cross-cultural as well as intra-cultural comparisons can be made. Longer version measures QoL comprehensively while shorter version is most suited for busy clinics. WHOQoL-HIV (BREF) was established to evaluate six latent domains as can be seen in Figure 1 (Zubaran *et al*., 2014). The six domains are physical health, psychological health, level of independence, social relationship, environmental health and spirituality; religion and personal beliefs (Meemon *et al.*). In difference to many other quality of life instruments, WHOQoL contains a domain on environment. This is considered necessary as environment plays a key role in determining health status, mediating disease pathogenesis and restraining or facilitating access to health care. Similar to all other domains in WHOQoL, environmental domain is also measured by a subjective self-report with the underlying belief that even if subjective reports are inconsistent with objective reality, it is the former that determines the quality of life. WHOQoL BREF -a generic instrument could be used in general population to evaluate a wide range of domains applicable to a variety of health states, conditions and diseases (Elisabete *et al*., 2007). The instrument comprised 2 items for the overall QOL and general health, giving a total of 31 items. The WHOQoL BREF comprises of a total of 26 items. These items are spread into four domains as can be seen in Figure 2. The four domains are physical health; psychological well-being; social relationships; and environment. Built in the total are also two items that were observed separately: one which queried about the individual's overall perception of QoL and the other which queried about the individual's overall perception of his or her health. The mean score of items within each domain is used to calculate the domain scores compatible with the scores used in WHOQoL-100 and subsequently transformed to a 0-100 scale. Domain scores were scaled in a positive direction with higher scores denoting higher QoL. Each item was rated on a 5 point likert scale where 1 indicates low, negative perception and 5 indicates high, positive perception (Surur *et al.*, 2017).

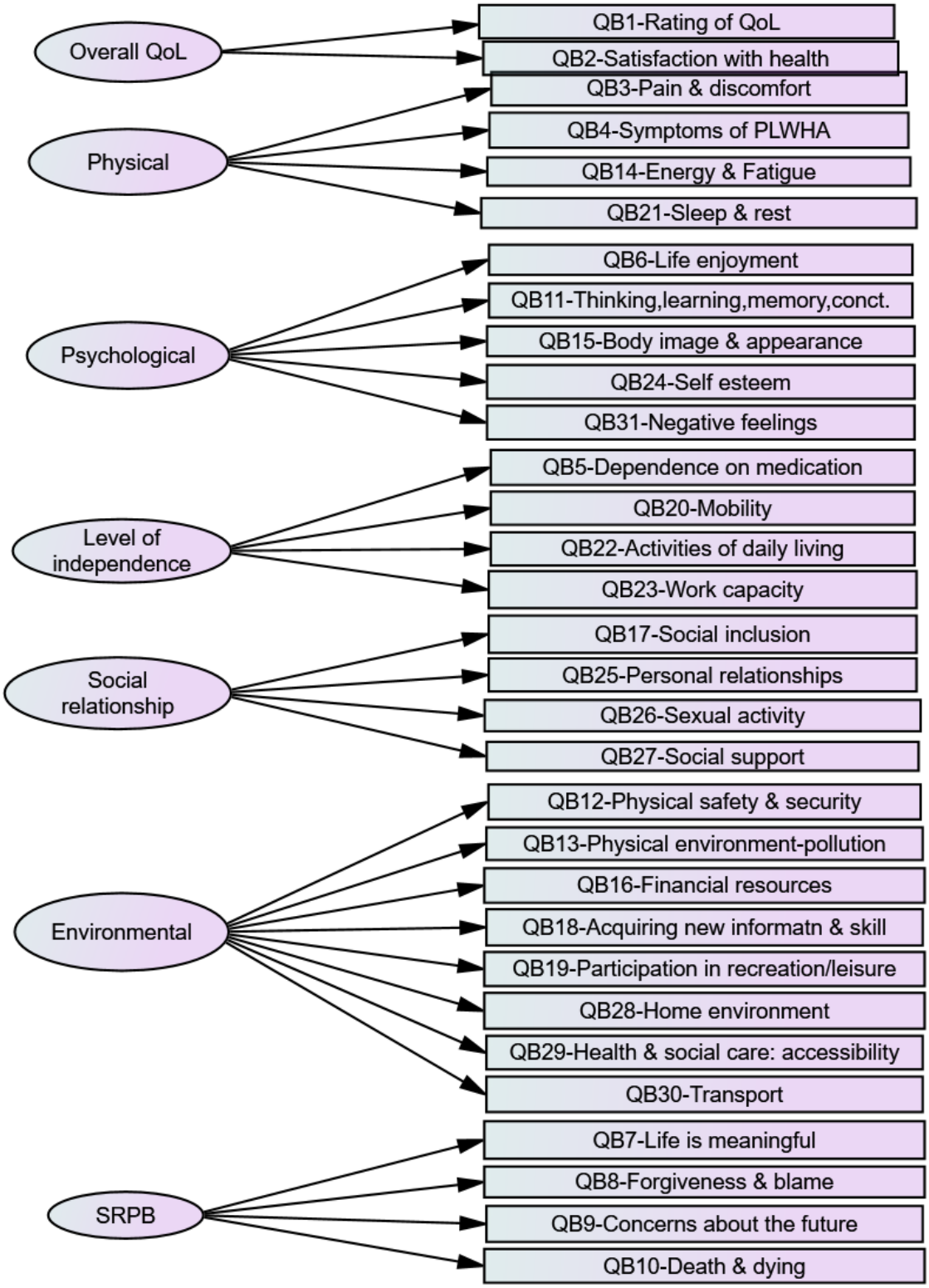


Figure 1: Pictorial view of WHOQoL-HIV (BREF) Questionnaire

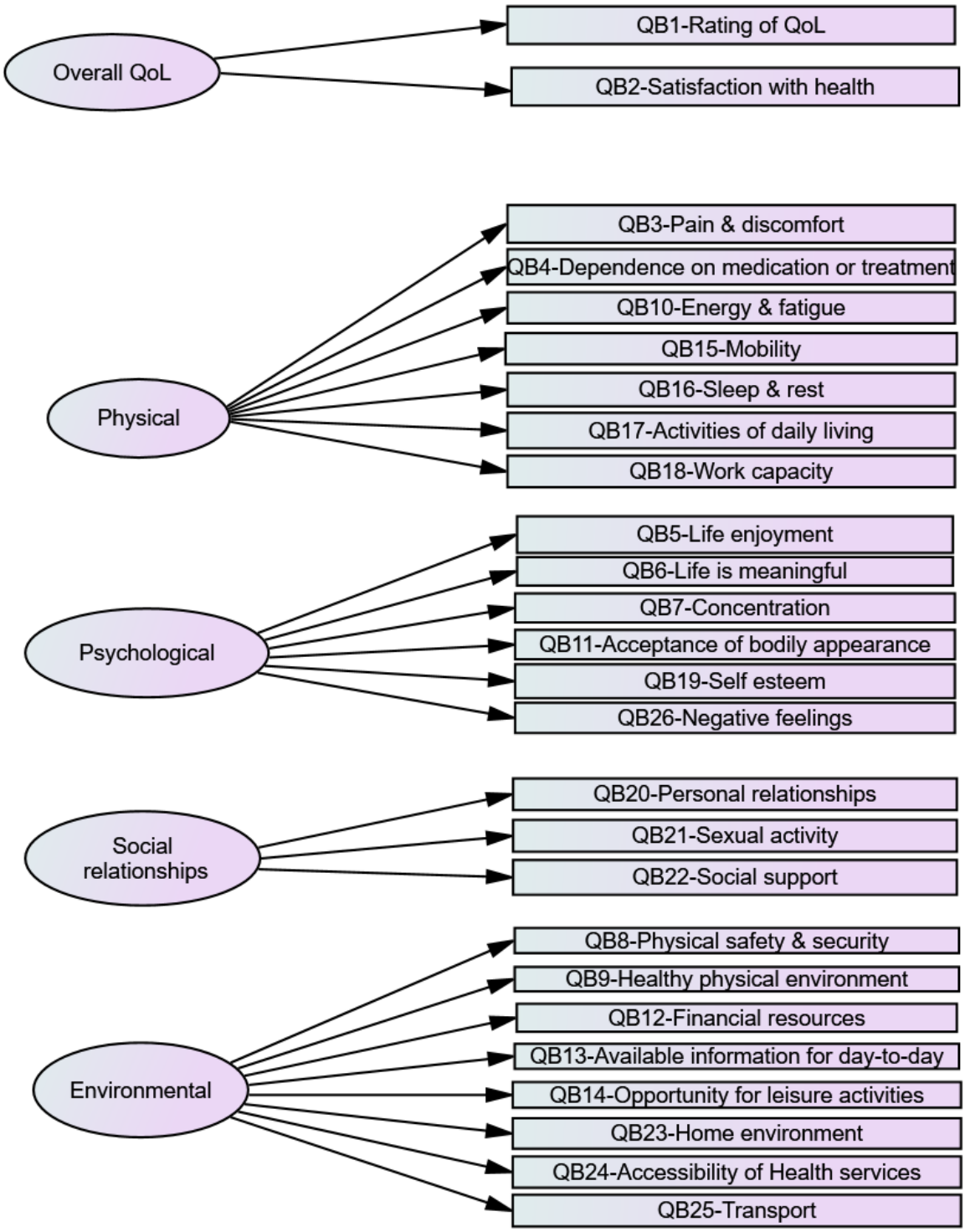


Figure 2: Pictorial view of WHOQoL (BREF) Questionnaire

1.3.2 Satisfaction with Life Scale (SWLS)

The Satisfaction with Life Scale (SWLS) was developed to evaluate how people are satisfied with life as a whole. The scale does not measure satisfaction with particular life domains,

such as health or finances, but allows subjects to incorporate and weigh these domains in whatever way they choose. The SWLS is a short 5-item instrument designed to measure comprehensive cognitive judgments of satisfaction with one's life. It is a 7-point Likert style answer scale. The possible range of scores is 5-35, with a score of 20 signifying a neutral point on the scale. Scores that are between 5-9 indicate the respondent is very dissatisfied with life, whereas scores that are between 31-35 indicate the respondent is extremely satisfied. The coefficient alpha for the scale ranged from 0.79 to 0.89, indicating that the scale has high internal consistency. The scale was also established to have good test-retest correlations (0.84, 0.80 over a month interval). SWLS has been used heavily as a measure of the life satisfaction component of subjective well-being. Scores on the SWLS have been shown to correlate with measures of mental health, and predictive of future behaviours such as suicide attempts. In the area of health psychology, the SWLS has been used to measure the subjective quality of life of people experiencing serious health distresses (Pavot and Diener, 2008). The scale can take people's values and preferences into account as well as the outcomes of their choices. Because the measures are relatively inexpensive and easy to administer, they provide useful complement in assessing the quality of life in societies (Diener *et al.*, 2013). Life satisfaction scores predict health and longevity (Diener *et al.*, 2013).

The five questions are as follows (a) In most ways my life is close to my ideal, (b) The conditions of my life are excellent, (c) I am satisfied with my life, (d) So far I have gotten the important things I want in life, (e) If I could live my life over, I would change almost nothing.

1.4 Structural Equation Modeling

Structural equation modeling (SEM) is a statistical methodology used by social, behavioural, and educational scientists as well as biologists, economists and medical investigators. One reason for its world-wide use in many scientific fields is that SEM provides researchers with a comprehensive method for the quantification and testing of substantive theories. According to Schmaker and Lomax (2010), "SEM uses various types of models to depict relationships among observed variables, with the same basic goal of providing a quantitative test of a theoretical model hypothesized by the researcher". The goal of SEM analysis is to determine the extent to which the theoretical model is supported by sample data (Schmaker and Lomax, 2010). Other major characteristics of structural equation (SE) models are that they explicitly take into account measurement error that is ever-present in most disciplines, and usually contain latent variables. Variables, whether they are detected or latent, can also be defined as

either independent variables or dependent variables. An independent variable is a variable that is not influenced by any other variable in the model. A dependent variable is a variable that is influenced by another variable in the model. Latent variables are theoretical or hypothetical concepts of major importance in many sciences, or alternatively can be viewed as variables that do not have noticed realizations in a sample from a focused population. Hence, latent are such variables for which there are no available observations in a given study.

In structural equation models, relations among latent variables are modelled. These relationships are often of main scientific interest whereas the associations between the observed items and the latent variables are of secondary interest. SEM facilitates the discovery and validation of relationships among multiple variables. Perhaps the most significant strength of SEM is that the relationships among numerous latent constructs can be examined in a way that reduces the error in the model (Hair *et al.*, 2014a). This feature facilitates assessment and ultimately elimination of variables characterized by weak measurement (Hair *et al.*, 2014b). Theoretically, SEM consist of two forms of models: a measurement model and a structural model. The former is concerned with how well the variables measure the latent factors addressing their reliability and validity, and the latter is concerned with modelling the relationships between the latent factors by relating the amount of explained and unexplained variance, which is like to the system of simultaneous regression models (Thanwadee and Sherif, 2007). Paul and Maiti (2008) defined measurement model "as a model used to identify and estimate the relationships between latent constructs and their indicators, whereas the structural model is used to determine the pattern and strength of relationships between these constructs".

In SEM, a variable can function both as a source variable (called an exogenous variable, which is comparable to an independent variable) and a result variable (called an endogenous variable, which is comparable to a dependent variable) in a chain of causal hypotheses. This kind of variable is often called a mediator (Pui-Wa and Qiong, 2007). The measurement model in SEM is evaluated through confirmatory factor analysis (CFA). CFA differs from exploratory factor analysis (EFA) in that factor structures are assumed a priori and verified empirically rather than derived from the data. EFA often allows all indicators to load on all factors and does not permit correlated residuals. Solutions for different number of factors are often examined in EFA and the most sensible solution is interpreted. In contrast, the number of factors in CFA is assumed to be known. In SEM, these factors correspond to the latent constructs represented in the model. CFA allows an indicator to load on multiple factors (if it

is believed to measure multiple latent constructs). It also allows residuals or errors to correlate (if these indicators are said to have common causes other than the latent factors included in the model). Once the measurement model has been indicated, structural relations of the latent factors are then modelled essentially the same way as they are in path models. The combination of CFA models with structural path models on the latent constructs represents the general SEM framework in analysing covariance structures. Because the scale of a latent variable is random, another basic principle of identification is that all latent variables must be scaled so that their values can be interpreted (Pui-Wa and Qiong, 2007).

1.4.1 Advantages of Structural Equation Modeling

The benefits of SEM include its provision of an integrative function, that is, a single umbrella of methods under leading programs (Bagozzi and Yi, 2012; Henseler, 2011; Ringle *et al*, 2012). It helps researchers to be more accurate in their specification of hypotheses and operationalisations of constructs; takes into account reliability of measures in tests of hypotheses in ways beyond the averaging of multi-measures of constructs; guides exploratory and confirmatory research in a manner combining self-insight and modelling skills with theory. It often suggests novel hypotheses originally not considered and opens up new possibilities for research. It is useful in experimental or survey research, cross-sectional or longitudinal studies, measurement or hypothesis testing, within and across groups and institutional or cultural contexts; and is easy to use. SEM has the ability to model latent variables, correct for measurement error, specify errors and their covariance structures and estimate entire theories simultaneously. It allows a researcher to model and predict relationships between construct variables in the hypothesised method.

SEM is generally preferred to other modelling procedures due to the following reasons: it takes a confirmatory rather than an exploratory approach to data analysis while most other methods including regression equations are descriptive, i.e. exploratory; it provides explicit estimates for measuring errors that traditional multivariate procedures are incapable of either assessing or correcting; the sample size can easily be regulated; it can be used for non-normal data; it allows for the use of formatively measured latent variables; data analysis using SEM incorporate both observed and unobserved variables unlike other methods incorporating only the observable variables; it tests a priori relationship rather than allowing the technique or data to define the nature of relationship between the variables; and it provides alternate methods for modeling multivariate relations (Oke *et. al.*, 2012).

The general objective of structural equation modeling is to establish that a model derived from theory has a close fit to the sample data in terms of the variance between the sample and model-predicted covariance matrices.

1.4.2 Path Diagram in Structural Equation Modeling

Structural equation modeling (SEM) is one of the highest commonly used statistical techniques for explaining linear relations in multivariate data among behavioral scientists (Steiger, J. H., 2011). Such complex relationships are commonly expressed in either algebraic form or graphical format. The latter representation is usually referred to as a path diagram. The path diagram, which originated with Wright (1921), has become the method of choice for communicating abstract statistical models within the SEM community and is virtually a "must have" in all publications involving SEM procedures. Many researchers find that a path diagram is a clearer and more efficient way of demarcating the relationships among multivariate data than an algebraic system of equations. As a visual presentation tool, a path diagram not only aids the SEM user's thought process for model formulation but also provides an easy communication platform.

According to Hoyle (2012), "a path diagram provides a systematic visual representation of the linear relationships among a set of variables". SEM beginners typically find path diagrams easier to comprehend and less intimidating than algebraic formulations involving a system of equations or matrices. Also, advanced modelers generally appreciate being able to present conceptual models in a compact form, while still being able to derive linear equations directly from a diagram when needed, due to the isomorphic connections between visual and mathematical model representations.

1.5 Statement of Problem

A number of works have been done on the discrete ordinal nature of the scale items under QoL analyses (Fayers and Hand, 1997; Fayers and Machin, 1998; Lee *et al*, 2005). Research works carried out under SEM had been by the use of the common principle of maximum likelihood (ML) approach (Lee *et al*., 2005).

In this study, we investigated (a) the use of GLS instead of the most used ML (b) inclusion of both HIV negative and positive patients in the analysis, (c) the use of both WHOQoL (BREF) and WHOQoL-HIV (BREF) questionnaire, (d) the inclusion of two latent endogenous variables in SEM, and (e) regrouping of the existing domains to reveal some domains uncharacterized by WHO but of significance to the studied population.

1.6 Aim and Objectives

The aim of this research work was to investigate the bilateral structure between the WHOQoL (BREF), WHOQoL-HIV (BREF) instruments and Satisfaction with Life Scale (SWLS) as well as to reduce the number of the variables in the instruments.

The objectives of this research work were to:

(i) assess the impact of the variables of WHOQoL (BREF), WHOQoL-HIV (BREF0 and SWLS on their various latent constructs through their bilateral structure;

(ii) formulate the SEMs for non-HIV and HIV patients;

(iii) compare Maximum Likelihood (ML) and Generalized Least Squares (GLS) estimates of the equations in (ii);

(iv) re-group variables in WHOQoL-HIV (BREF) and formulate their SEMs; and

(v) obtain a reduced instrument from the combined WHO QoL instruments and assess the effectiveness.

1.7 Justification for the Study

Given the longevity attainable with the current prophylactic and therapeutic strategies for PLWHA, quality of life has emerged as a substantial measure of health outcome and quality of life enhancement as an important goal (Mofolorunsho *et al.*, 2013; Bachmann, 2006; Douaihy and Singh, 2001). However, limited researches have been conducted using specifically the World Health Organization quality of life HIV (WHOQoL-HIV) BREF in Nigeria. Many researchers had used the instrument for non HIV patients (WHOQoL (BREF)) on HIV patients, hence the need to incorporate the two instruments into each other and still have reliable results. Both the World Health Organization Quality of Life (WHOQoL) conceptual model and instrument were developed and tested in a unique way (Mweemba, 2008). The WHOQoL model and questionnaire were developed in multiple cultures/values in both developing and developed countries and intended to be culturally sensitive and take into consideration the subjective well-being of the individual.

There are no substantial records of a qualitative identification of quality of life determinants as well as the health and social support needs and constraints of PLWH in the HIV/AIDs response programmes. This gap does not allow for a proper understanding of the scope and effect of the known quantitative determinants of quality of life and the responsiveness of the existing programmes (Igumbor, *et al.*, 2012). Such evidence is also needed to corroborate the application of existing HRQOL instruments in Nigeria and suggests the need for a novel or revised quantitative instrument. There is, however, limited record of its validation across the Nigerian society. With this little information, it becomes difficult to establish if the

questionnaire can be used effectively in Nigeria given its unique HIV/AIDs response programmes and state of its AIDs epidemic. In this regard, the available body of knowledge about the link between both markers may not be applicable to developing countries. In addition, the length of the existing WHOQoL-HIV questionnaire does not permit its use in routine patient care. However, the WHOQoL-HIV was found to be valid and reliable in Zambia which is an African country (Mweemba *el at*., 2011).

The review of existing literature has revealed that there are similar QoL models and questionnaires developed to meet the specific needs for some countries of the world particularly, sub-Sahara Africa. Examples include WHOQoL-Hindi; Iran; WHOQoL-HIV in IsiXhosa language, Eastern Cape Province, South Africa; MOS-HIV Instrument with focus mainly on HIV population.

However, WHO QoL instruments do not emphasize some unique factors that are peculiar to the Nigerian population, while some items on the instruments could be de-emphasized to have more dependable results. This study therefore filled the identified gaps and dealt with the problem of misspecification of models.

1.8 Abbreviations and Notations in SEMS

PLWHA	People living with HIV/AIDS
PHD	Physical Domain
PSD	Psychological Domain
LID	Level of Independence Domain
SRD	Social Relationship Domain
END	Environmental Domain
SPD	Spirituality Religion and Personal Believe Domain
Q1	Age
Q2	Sex
Q3	Marital status
Q4	Do you have children?
Q5	Number of Children
Q6	Education
Q7	Residence
Q8	Employment
Q9	Occupation
Q10	Last occupation

Q12	Medical Aid
Q13	Does your medical aid pay your medical expenses?
Q14	How is your health?
Q15	Have you disclosed your HIV status to anyone?
Q16	If not are you planning to disclose it soon?
Q17	Do you belong to a support group?
Q18	When were you diagnosed with HIV?
Q19	Are you taking ARVS?
Q21	Did you experience side effect?
Q23	Have the side effect be resolved?
Q24	How has your HIV status affected your life?
qb1	Quality of life rating
qb2	Satisfaction with your health
qb3	Pain and discomfort
qb5	Dependence on medication or treatment
qb6	Positive feelings
qb7	SRPB: Spirituality, Religion and Personal Believe
qb11	Thinking, learning, memory and concentration
qb12	Physical safety and security
qb13	Physical environment-pollution
qb14	Energy and Fatigue
qb15	Body image and appearance
qb16	Financial resources
qb18	Opportunities for acquiring new information and skill
qb19	Participation in recreation/leisure activities
qb20	Mobility
qb21	Sleep and rest
qb22	Activities of daily living
qb23	Work capacity
qb24	Self esteem
qb25	Personal relationships
qb26	Sexual activity
qb27	Social support
qb28	Home environment

qb29	Health & social care: accessibility and quantity
qb30	Transport
qb31	Negative Feelings
qc1	In most ways my life is close to my ideal
qc2	The conditions of my life are excellent
qc3	I am satisfied with my life
qc4	So far I have gotten the important things I want in life
qc5	If I could live my life over, I would change almost nothing

N	Number of observations
m	Number of latent endogenous variables
n	Number of latent exogenous variables
p	Number of indicators of latent endogenous variables
q	Number of indicators of latent exogenous variable
$\underbrace{\eta_i}_{mx1}$	Latent endogenous variables (for observation i)
$\underbrace{\xi_i}_{nx1}$	Latent exogenous variables
$\underbrace{\zeta_i}_{mx1}$	Structural disturbances (errors in equations)
$\underbrace{\mathrm{B}_i}_{mxm}$	Structural parameters relating latent endogenous variables
$\underbrace{\Gamma_i}_{mxn}$	Structural parameters relating latent endogenous to exogenous variables
$\underbrace{\mathrm{y}_i}_{px1}$	Indicators of latent endogenous variables
$\underbrace{\mathrm{x}_i}_{qx1}$	Indicators of latent exogenous variables
$\underbrace{\varepsilon_i}_{px1}$	Measurement errors in endogenous indicators
$\underbrace{\delta_i}_{qx1}$	Measurement errors in exogenous indicators
$\underbrace{\Lambda_y}_{pxm}$	Factor loadings relating indicators to latent variables y
$\underbrace{\Lambda_x}_{qxn}$	Factor loadings relating indicators to latent variables x
$\underbrace{\Phi}_{nxn}$	Covariances among latent exogenous variables
$\underbrace{\Psi}_{mxm}$	Covariances among structural disturbances
$\underbrace{\Theta_\varepsilon}_{pxp}$	Covariances among measurement errors
$\underbrace{\Theta_\delta}_{qxq}$	Covariances among measurement errors
$\underbrace{\Sigma}_{(p+qxp+q)}$	Covariances among observed (indicator) variables

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

Sub-Saharan Africa conveys a disproportionate weight of HIV, accounting for more than 70% of the global burden of infection. Ayesha and Quarraisha (2016) highlighted how countries like South Africa, Swaziland, Lesotho, Zimbabwe, Botswana, Mozambique, Namibia and Zambia contributed to new infections universally. The work also suggested some prevention services that could moderate the load of HIV in sub-Sahara Africa and globally. These include a geospatial ordering with targeted HIV prevention facilities within and between countries, an improved understanding of structural, biological and behavioral features, including the chains of transmission by applying molecular methods and phylogenetic analysis of HIV-1 sequences.

Chrystelle (2009) considered what energies HIV/AIDs epidemic in sub-Saharan Africa. The paper decomposed the effect of the determinants of the evolution of HIV/AIDs virus in sub-Saharan Africa from 1997 to 2005. Their results show that epidemiological and sociocultural variables have a greater influence than socioeconomic ones. More importantly, within the group of socioeconomic variables, education and women's economic freedom and income disparity determine the spread of the pandemic.

Awofala and Ogundele (2016) surveyed the dynamics of HIV transmission in Nigeria, its emerging trends and the sentinel surveillance system put in place by the governmental, non-governmental institutions and international organizations. They concluded that epidemiological data in Nigeria on HIV/AIDS, as in other African countries, stem mostly from the HIV/AIDS surveillance system. Most cases of HIV infection in Nigeria occur via heterosexual means with epidemics more pronounced among the females. Also young people recorded the most prevalence of HIV/AIDs in the country.

The results from a study by Akpa and Oyejola (2008) shows that the HIV/AIDS epidemics were not uniform across gender. It was estimated that in 2006, about 177 and 154 thousand female and male individuals (respectively) were infected while a projected estimates of 202 and 175 thousand females and males respectively were infected in year 2010. The study also revealed that the female gender in Nigeria is experiencing HIV/AIDS epidemic that is different (and higher) than that of the male gender. The comparison of HIV prevalence by

zones between 2008 and 2011 showed that prevalence had enlarged in the North Central, South East and South West Zones respectively. Prevalence fell in North West (NW) and South South (SS) but remained unchanging in the North East (NE). The adult HIV occurrence had enlarged from 1.8% in 1991 through 4.5% in 1996 to 5.8% in 2001 but a decrease in 2003, when the National HIV Sero-prevalence Sentinel Survey (FMOH, 2004) stated a prevalence rate of 5.0%, 4.4% in 2005, 4.6% in 2008 and 4.1% in 2010.

2.2 HIV and Quality of Life

With the frightening increase in the HIV/AIDs endemic in developing countries, and the inadequate accessibility and handiness of highly active antiretroviral therapy (HAART), the bulk of people living with HIV/AIDs (PLWHA) continue to suffer with the disease, with a severe impact on their quality of life (QoL).

Nigeria had experienced several stages in her reaction to the epidemic. In 2010 National Action Committee on AIDs (NACA) launched its all-inclusive National Strategic Framework to cover 2010 to 2015 which required an estimated ₦756 billion (around USD 5 billion) to carry out (AllAfrica 2010). Some of the main aims included in the framework were to touch 80 percent of sexually active adults and 80 percent of most at-risk populations with HIV counseling and test by 2015; ensure 80 percent of fit adults and 100 percent of eligible children received ART by 2015; and to advance access to excellence care and support services to at least 50 percent of people living with HIV by 2015 (NACA, 2010; NACA, 2014). The introduction of antiretroviral therapy (ART) facilities in the country was also launched by the Global HIV/AIDs Initiative Nigeria (GHAIN) in April 2005.

AIDs has a lingering debilitating course and as such, determining the influence on the QoL in PLWHA is vital for estimating the burden of the disease (Wig *et al*., 2006). QoL is a term that is commonly use to express an overall sense of well-being and comprises of aspects, such as happiness and satisfaction with life as a whole. QoL relates both to the adequacy of material conditions and to personal feelings about these conditions with overall subjective feelings of well-being that is related to morale, happiness, and satisfaction (Rabkin *et al.*, 1993). QoL has lately been considered identical with health status, functional status, psychological well-being, happiness with life, satisfaction of needs, and assessment of one's own life (Manhas, 2014; Elisabete *et al*., 2007). Some instruments for assessing QoL have been developed and defined (McDowell and Newell, 1996). The validity of the WHOQoL-HIV BREF instrument used amid HIV/AIDs patient has also been documented (Saxena *et al*.,

2002).

Recent advances in ART have continued to provide treatment combinations that promote adherence, improve treatment potency, tolerance, more stable viral suppression and better safety with early treatment initiation. These gains have seen the reduction in the risks of ART but increased concerns about the risks of prolonged untreated viremia (Thompson *et al*., 2010). It has been shown that unmanaged HIV proliferation and immune activation results in chronic inflammation and subsequently in end-stage organ damage and other co-morbidities that are not directly related to AIDs. This chain of events perpetuates lingering immune initiation and potentially permanent immune loss associated with protracted immune reduction (Harrison *et al*., 2010). With this, it has been found that mortality from non-AIDs related morbidities is higher when compared to the morbidities from AIDs related opportunistic diseases (Palella *et al*., 2010; Kitahata *et al*., 2009). Consequently, many recent studies support early initiation of treatment (Levin, 2010; Johansson *et al*., 2010).

Four conceptual models were set aside and commonly used in quality of life in HIV/AIDS studies. These are (a) The World Health Organization Quality of Life Model (Skevington and O'Conell, 2003), (b) Wilson and Cleary Health Related Quality of Life Model (Sousa *et al*., 1999; Tsai, *et al*., 2005), (c) Clou and Holzemer Model, (Chou and Holzemer, 2004), and (d) The Chronic Illness Quality of Life Model (Heckman, 2003).

2.3 WHOQoL questionnaires

The WHOQoL-HIV instrument was established to determine assessment of germane aspects of quality of life as experienced by PLWHA. The WHOQoL-HIV instrument was intended to aid in better planning, delivery, and evaluation of people living with HIV/AIDs in different cultures. It may also provide for evaluation of outcome of antiretroviral medication and for policy decisions regarding resource allocation (Skevington *et al*., 2000; WHOQoL-HIV, 2003; Mweemba, 2008).

The WHOQoL-HIV has been validated across different cultures and settings around the world (WHOQoL-HIV, 2004). The cross-cultural validation of the instrument is in view of the widely reported cultural variations and limitations of HRQOL instruments (Collinge *et al*, 2002; Tchen *et al*, 2003; Jeff *et al*, 2013). This concern is underscored by the description of HRQOL as an individual's awareness of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. With this, the value of validating the WHOQoL-HIV becomes critical in countries with multicultural composition. The only known usage of the WHOQoL-HIV in South Africa

was in IsiXhosa Language in the Eastern Cape Province (Peltzer and Phaswana-Mafuya, 2008; Friend-du and Peltzer; 2009). The later study showed that the tool had moderate to low reliability in some domains. On the converse, a pilot study of the tool in Zambia found the tool to be highly reliable (Mweemba *et al*., 2011).

Furthermore, quality of life researches in HIV have typically been cross-sectional in nature and dedicated mainly on issues such as functioning, adherence to treatment and awareness about HRQOL (Louwagie *et al*, 2007; Hughes *et al*, 2004; Nicholas *et al*, 2004). The use of cross-sectional designs opposes the argument that authenticating the relationship between clinical measure of HIV and AIDs and HRQOL would require concurrent repeated measurements of the variables (Weinfurt *et al*, 1999). This claim should also be read against the backdrop that the bio-psychosocial effects of HIV vary over time (Gurunathan *et al*, 2009). Nojomi *et al*, (2008) examined the correlations between demographic and medical variables and health-related quality of life (HRQOL) in a sample of HIV/AIDs patients directed to the Disease Behavioural Consulting Centre in west of Tehran. Martin *et al*, (2013) explored the properties of a Luganda type of the WHOQOL-BREF in a sample with both PLWH and people without HIV. Akinboro *et al*, (2014) appraised the QoL of Nigerians living with HIV/AIDS using the WHOQoL-BREF instrument and evaluated the impact of demographic, laboratory and disease-related variables on QoL.

2.4 Factor Analysis

In general terms, factor analysis is a modeling method for reviewing hypothetical constructs by using a variety of observable proxies or indicators that can be directly measured. The analysis is considered exploratory, also referred to as exploratory factor analysis (EFA), when the required is with defining how many factors, or latent constructs, are needed to explain well the interactions among a given set of observed measures. Alternatively, the analysis is confirmatory, formally called confirmatory factor analysis (CFA), when a pre-existing structure of the relationships among the measures is being quantified and tested.

The mathematical model in relation to data matrix is

$$X_{(Nxp)} = F_{(NxK)}A'_{(Kxp)} + E_{(Nxp)} \tag{2.1}$$

Where X is the data matrix, F is the matrix of factor scores, A is the matrix of factor loadings, E is the matrix of residuals or error terms, k is the number of factors to be used and p is the number of variables.

For any particular row x,

$$X = Af + e \tag{2.2}$$

where the product Af produces a vector of estimates of x, the vector e stands for the difference between this estimate and the observed vector.

2.4.1 Principal Component Analysis

Principal component analysis (PCA) is one of the most widely employed and useful tools in the field of exploratory analysis. It shows the relationship that exists among objects as well as between objects and variables. Matijevi *et al* (2014) applied PCA to a data matrix comprising 24 questions (variables) and 108 respondents for the first part of their survey to reduce the plenty number of the obtained data sets as well as to explain the mutual relations between the examined interrelated variables. The main aspect of the analysis was to summarize linear correlation analysis of a large number of distributed multivariate quantitative correlated variables in terms of their reducing into a smaller number of components, i.e. new variables that are uncorrelated with each other with minimal loss of information. After finding the principal components applied to an orthogonal varimax rotation factor by conversion to obtain simple structures (i.e. to get as autonomous components as possible), the criterion under which only those factors that have eigenvalues higher than one is often used. The goal of the iterative procedure is to extract as much of the total variance as possible in the first few principal components which is reflected in the cumulative percentages of total variance and thus to cut the number of original variables.

2.5 Structural Equation Modeling (SEM)

Under the history of SEM, there are basically four types of levels or models, which are: regression, path, confirmatory factor and structural equation models (Schmaker and Lomax, 2010). The foremost model involves linear regression models that make use of correlation coefficient and the least squares criterion to compute regression weights. Regression models were made possible because Pearson (1938) created a formula for the correlation coefficient in 1896 that provides an index for the relationship between two variables. The regression model allows the prediction of dependent observed variable scores (Y scores) given a linear weighting of a set of independent observed scores (X scores) that minimizes the sum of squared residual error values. The mathematical root for the linear regression model is found in basic algebra. Regression analysis provides a test of a theoretical model that may be suitable for prediction. In an example studied by Delucchi (2006), regression analysis was used to forecast student exam marks in statistics (dependent variable) from a series of collaborative learning group assignments (independent variables).

Some years later, Spearman (1904, 1927) used the correlation coefficient to decide which items were correlated to create the factor model. His basic idea was that if a set of items is correlated, individual responses to the set of items could be summed to yield a score that would measure, explain, or deduce a construct. Spearman was the first to use the term factor analysis in defining a two-factor construct for a theory of intelligence. During the 1940s, Thurstone and his associates make popular "multiple factor analysis," an extension of Spearman's model. The decade witnessed a number of statistical and computational developments of major impact, including the introduction and widespread reception of the simple structure concept as a solution to the rotation problem, and Lawley's ground-breaking work in maximum likelihood factor analysis (Steiger, 1979). Most of the aptitude, achievement, diagnostic tests, surveys, and inventories in use today were generated using factor analytic techniques. The term confirmatory factor analysis (CFA) in use today is founded on earlier work of Howe (1955), Anderson and Rubin (1956) and Lawley (1958). The CFA method was more completely developed by Joreskog (1963) to test whether a set of items defined a construct. Joreskog (1969) published the first article on CFA and subsequently helped to develop the first CFA software program. Factor analysis has been used for over 100 years to create measurement instruments in many academic disciplines, while today CFA is used to exam the existence of these theoretical constructs. In an example study, CFA was used to endorse the "Big Five" model of personality by Goldberg (1990). The five-factor model of extraversion, agreeableness, conscientiousness, neuroticism, and intellect was confirmed through the use of multiple indicator variables for each of the five hypothesized factors.

Wright (1918, 1921, 1934), a biologist, established the third type of model, a path model. Path models use correlation coefficients and regression analysis to model more complex relationships amongst observed variables. The first usages of path analysis dealt with models of animal behaviour. Unfortunately, path analysis was largely disregarded until econometricians reconsidered it in the 1950s as a form of simultaneous equation modelling and sociologists rediscovered it in the 1960s (Schmaker and Lomax, 2010). In many respects, path analysis includes solving a set of simultaneous regression equations that theoretically establish the relationship among the observed variables in the path model.

The final model type is structural equation modeling (SEM). SEM basically combines path models and confirmatory factor models; that is, SEM incorporates both latent and observed variables. The early improvement of structural equation models was due to Joreskog (1969,

1973), Keesling (1972) and Wiley (1973). This methodology was originally known as the JKW model. However, this later became linear structural relations model (LISREL) with the development of the first software program, LISREL, in 1973.

Indeed, the field of structural equation modeling across all disciplines had extended since 1994. Hershberger (2003) found that between 1994 and 2001 the number of journal articles concerned with SEM increased, the number of journals publishing SEM research increased, SEM became a popular choice amongst multivariate methods (Schmaker and Lomax, 2010).

2.5.1 Empirical work done on SEM

Fayers and Hand (1997); and Fayers and Machin (1998) worked extensively on the discrete ordinal nature of the scale items under QoL analyses approach. Lall *et al*. (2002) and Lee (2007) noted that models such as item response and ordinal regression models that take into notice the ordinal nature are more applicable in analyses. Lee *et al* (2005) worked on the application of structural equation models to Quality of life using Maximum Likelihood as the estimation method.

Lei and Lomax (2005) used simulated data of four sample sizes to investigate the robustness of structural equation modelling to different degrees of non-normality with two estimation methods, generalized least squared and maximum likelihood.

Sousa and Kwok (2006) examined the five major concepts of Wilson and Cleary HRQOL model simultaneously by means of structural equation modeling on patients living with HIV from the AIDS Time-Oriented Health Outcomes Study.

Howe *et al* (2011) presented and developed a computationally feasible approach to analyse categorical, dichotomous and mixed data sets in SEMs called Gifi transformation. The Gifi transformation has the advantage of a one-to-one mapping of the non-linear values to the linear values. They also presented and derived information theoretic model selection criteria with information-theoretic measure of complexity ICOMP criterion as the best.

Lee (2007), in his work, treated discrete data as observations from a concealed continuous distribution with the use of threshold specification. He, however, introduced Bayesian approach to analyse SEMs with categorical data set. This method could still not solve the complicated computational analysis associated with the Gibbs sampler method in the approach.

Oke *et al* (2012) and Xiong *et al* (2014) had been able to establish an agreeable position for the use of structural equation modeling in construction and management studies.

Logie *et al* (2016) carried out structural equation modeling using maximum likelihood estimation to evaluate the hypothesized conceptual model of the pathways connecting HIV-related stigma, racial discrimination, housing insecurity and wellbeing.

Safamejad and Izazola-Licea (2017) examined the interaction effects of multiple enablers on program activities and outcomes in the AIDS response using structural equation modeling. They also articulated the enablers relevant to an effective AIDS response, and weighs their impact on program activities and outcomes.

Olsson *et al* (2000) in their study on the performance of ML, GLS, and WLS estimation in structural equation modeling under conditions of misspecification and non-normality, considered the reason why ML provides results that vary from those obtained with GLS and WLS to be that misspecification causes the model-based estimated covariances in the weight matrix for ML to be different, from the observed covariances inserted in the weight matrices of GLS and WLS. Their simulation study showed that the empirical fit of misspecified models (in the sense of being parsimonious representations of the true model) can easily be overestimated. Also, ML and GLS vary with respect to theoretical and empirical fit. They also concluded that the apparent supremacy of GLS relative to ML in terms of empirical fit was attained at the expense of higher parameter distortion, that is, lower theoretic fit. They, however suggested that for severely misspecified models, estimated standard errors for ML seem to be more accurate than that of GLS.

However, simulation study by Lei and Lomax (2005) revealed that the ML and GLS estimators are fairly similar in the case of small to moderate non-normality for interval data (bias is generally quite small and, in fact, ML tends to slightly outperform GLS). In the case of severe non-normality for interval data, one of the distribution free or weighted procedures (ADF, WLS, or GLS) is suggested. In dealing with non-interval variables, study indicates that only when categorical data show small to moderate skewness and kurtosis values (range of −1 to +1, or −1.5 to +1.5) should ML be used (Schmaker and Lomax, 2010).

2.6 Structural Equation Modeling Processes

Structural Equation Modeling (SEM) is an unconventional multivariate method to examine multiple dependence relationships between variables concurrently (Oke *et. al*., 2012). SEM describes the relationships between two kinds of variables, latent and observed variables. Latent variables cannot be detected directly due to their abstract character. In contrast, observed variables contain objective facts or use an item rating scale in a questionnaire.

Several observed variables can reflect one latent variable (Xiong *et. al.*, 2014). A two-step modeling method is usually used to develop structural equation model in preference to establishing the model directly. This comprises, first, a confirmatory factor analysis (CFA) followed by SEM (Xiong *et. al.*, 2014). Exploratory factor analysis was carried out to examine the dimensions of each construct, each factor was then interpreted and named according to the subset of items having high loadings on the factor. (Skrondal and Rabe-Hesketh, 2004).

According to Garson (Ng *et. al.*, 2010), the procedure of SEM comprises two main steps. The first step approves the validity of the indicators in measuring the latent variables. The indicators for measuring the latent factors were then checked by confirmatory factor analysis using SEM. The second step is to fit the factors and indicators into the structural model in order to form the relationship between the variables through the regression or path analysis with the latent variables in the structural model. Variables with low correlations are removed to improve the goodness-of-fit of the model.

2.6.1 Model Fit in Structural Equation Modeling

Model fit determines the extent to which the sample variance–covariance data fit the structural equation model. The traditional process of constructing structural equation models demands for performing a chi-square test of the null hypothesis that the observed and the expected matrices are identical. The model is accepted if the test fails to reject the null hypothesis. However, in large samples, such tests can lead to the rejection of good models on the basis of unimportant misspecifications (Alfgeir *et al.*, 2010). While the Chi-Square test maintains its popularity as a fit statistic, there exist a number of severe limitations in its use. Firstly, this test assumes multivariate normality and severe deviations from normality may result in model rejections even when the model is properly specified (McIntosh, 2006). Secondly, because the Chi-Square statistic is in principle a statistical significance test, it is sensitive to sample size which means that the Chi-Square statistic nearly always rejects the model when large samples are used (Jöreskog and Sörbom, 1993). On the other hand, where small samples are used, the Chi-Square statistic lacks power and because of this may not discriminate between good fitting models and poor fitting models (Kenny and McCoach, 2003). Hence, we used a blend of goodness-of-fit indices to assess fit of the model to the data. There are a number of goodness-of-fit indices that are calculated by the AMOS program, each of which has various strengths and weaknesses and evaluates fit in different ways. Prior work by McDonald and Ho (2002) suggested that two of these indices, the Comparative Fit Index (CFI) and root mean square error of approximation (RMSEA), along

with the chi-square statistic, would constitute appropriate measures for examining the fit of the proposed theoretical model. These criteria are based on the difference between the sample covariance matrix $\boldsymbol{S}$ and the model-implied covariance matrix ($\hat{\theta}$).

Generally, three types of model fit measures are used to judge the fitness of the measurement components: absolute fit, incremental fit and parsimonious fit (Ong and Musa 2012). Models are considered a good fit if the CFI is greater than 0.90 and the RMSEA, a measure of lack of fit of the model to the population covariance matrix per degree of freedom for the model, is less than 0.05 (Alfgeir *et al.*, 2010). If χ^2/df value is between 1 and 3, this indicates an acceptable fit (Schermelleh-Engel *et al.*, 2003). The Akaike information criterion (AIC) is a special type of fit index that takes into account both the measure of fit and model complexity (Akaike, 1987). It is used to compare models with differing numbers of latent variables and resembles the so-called Bayesian information criterion (BIC). The two indices, AIC and BIC, are widely used in applied statistics for purposes of model comparison (Raykov and Marcoulides, 2006). Since it is well identified that *AIC* has several disadvantages, i.e., there is an overfitting tendency and there is no model selection consistency, to penalize the over-parametrization more strongly, Bozdogan improved and extended AIC analytically in several ways. These extensions make AIC asymptotically consistent, and that over-parameterization is penalized more stringently to pick the simplest of the true models whenever there is nothing to be lost in doing so. Note that CAIC polishes the model more stringently than does AIC (Howe *et. al*., 2011).

2.6.2 Structural Equation Modeling Steps

SEM entails the following six steps: model specification, model identification, construct operationalization, parameter estimation, hypotheses evaluation, and, model re-specification (Kline, 2011).

(1) Model Specification

The first step is model specification which means the depiction of the research hypotheses in the form of structural models. This includes drawing a model diagram using a set of more or less standard graphical symbols or writing of series of equations. These equations describe the model's parameters which correspond to presumed relations among observed and/or latent variables that will be estimated with sample data.

(2) Model identification and parameter estimates

The model is identified if there is a theoretical possibility to develop a unique estimate for each parameter of the model. One of the main goals of the SEM is to assess as precise as possible the values of model parameters.

(3) Testing of hypotheses

The third step is a selection of measures which will be represented by variables in the model. This step also includes data collection and their screening.

(4) Model analysis

The fourth step is model analysis which involves assessing the parameters values and their fit to the collected data. There are many methods used to estimate parameters, but the methods used in this work are maximum likelihood and generalized least squares.

(5) Model evaluation

The second to last step is the evaluation of the proposed model with the observed data.

(6) Model re-specification

If the proposed model does not fit well to the observed data, re-specification and evaluation of the revised model should be done on the same data which is the last step (Natalija, 2012).

2.6.3 Types of Models in SEM

There are basically two models in SEM, they are:

(1) Measurement model

$$\underbrace{X}_{q\,x\,1} = \underbrace{\Lambda_x}_{q\,x\,n}\ \underbrace{\xi}_{n\,x\,1} + \underbrace{\delta}_{q\,x1} \tag{2.3}$$

$$\underbrace{Y}_{p\,x\,1} = \underbrace{\Lambda_y}_{p\,x\,m}\ \underbrace{\eta}_{m\,x\,1} + \underbrace{\varepsilon}_{p\,x1} \tag{2.4}$$

$$E(\delta) = 0$$

$Cov(\delta) = \theta_\delta$ (it is symmetric)

$$Cov(\xi_\delta) = 0$$

Covariance structure for Measurement Equation

$$cov(X) = \Sigma_{pxp} \tag{2.5}$$

$$cov(\xi) = \phi_{m\,x\,m} \tag{2.6}$$

$$cov(\delta) = \theta_{p\,x\,p}(assume\ as\ diagonal)$$

$$Cov(X) = \Lambda\phi\Lambda^T + \theta \quad if\ \phi = I, orthogonal$$

$$\Lambda: p\ x\ m$$

$$\phi: m\ x\ m \qquad \ldots \frac{m(m+1)}{2} \qquad since\ symmetric$$

$$\theta_\delta: diagonal: p$$

(2) Structural model

$$\underset{m\,x\,1}{\underset{\sim}{\eta}} = \underset{m\,x\,m}{\underset{\sim}{\beta}}\ \underset{m\,x\,1}{\underset{\sim}{\eta}} + \underset{m\,x\,n}{\underset{\sim}{\Gamma}}\ \underset{n\,x\,1}{\underset{\sim}{\xi}} + \underset{m\,x\,1}{\underset{\sim}{\zeta}} \tag{2.7}$$

Let $\phi = E(\xi\xi^T)$ (2.8)

$\psi = E(\zeta\zeta^T)$ (2.9)

From (2.7) $(I - B)\eta = \Gamma\xi + \zeta$

$\eta = (I - B)^{-1}(\Gamma\xi + \zeta)$ (2.10)

Where

$$\xi \sim N_n(0, \phi)$$

$$\zeta \sim N_m(0, \psi)$$

$$E(\xi\zeta^1) = E(\zeta\xi^T) = 0$$

$$I - \beta\ is\ non - singular$$

Covariance Structure for Structural Model

$$\Sigma_{\eta\eta^T} = E(\eta\eta^T)$$

Recall $\eta = (I - \beta)^{-1}\Gamma\xi + (I - \beta)^{-1}\zeta$

$= D\Gamma\xi + D\zeta \quad where\ D = (I - \beta)^{-1}$ (2.11)

Then, $E(\eta\eta^T) = E[(D\Gamma\xi + D\zeta\ )(D\Gamma\xi + D\zeta\ )^T]$ (2.12)

$$= E[D\Gamma\xi\xi^T\Gamma^T D^T + D\Gamma\xi\zeta^T D^T + D\zeta\xi^T\Gamma^T D^T + D\zeta\zeta^T D^T]$$

$$= D\Gamma E(\xi\xi^T)\Gamma^T D^T + D\Gamma E(\xi\zeta^T)D^T + DE(\zeta\xi^T)\Gamma^T D^T + DE(\zeta\zeta^T)D^T$$

$$= D\Gamma\phi\Gamma^T D^T + 0 + 0 + D\psi D^T$$

$= D(\Gamma\phi\Gamma^T + \psi)D^T = (1 - \beta)^{-1}(\Gamma\phi\Gamma^T + \psi)(1 - \beta)^{-1^T}$ (2.13)

Recall Equation (2.11)

$$\eta = D\Gamma\,\xi + D\zeta$$

Then, $$\Sigma_{\xi\eta^T} = E(\xi\eta^T)$$

$$\Sigma_{\eta\xi^T} = E(\eta\xi^T)$$

$$\eta\xi^T = D\Gamma\xi\xi^T + D\,\zeta\xi^T \tag{2.14}$$

$$E(\eta\xi^T) = D\Gamma E(\xi\xi^T) + DE(\zeta\xi^T) \tag{2.15}$$

$$= D\Gamma\phi + 0 \tag{2.16}$$

Recall that $D = (I - \beta)^{-1}$

From (2.16), $(I - \beta)^{-1}\Gamma\phi$ (2.17)

Then, $\xi\eta^T = \xi\xi^T\Gamma^T D^T + \xi\,\zeta D^T$

$$E(\xi\eta^T) = E(\xi\xi^T)\Gamma^T D^T + E(\xi\,\zeta^T)D^T \tag{2.18}$$

Then, $$E(\xi\eta^T) = \Gamma^T D^T\phi$$

$$\xi\eta^T = \Gamma^T(I - \beta)^{-1}\phi$$

$$E(\xi\xi^T) = \phi \tag{2.19}$$

$$\Sigma_{(m+n)(m+n)} = \begin{bmatrix} E(\eta\eta^T) & E(\eta\xi^T) \\ E(\xi\eta^T) & E(\xi\xi^T) \end{bmatrix} \tag{2.20}$$

$$\Sigma(\phi)_{(m+n)(m+n)} = \begin{bmatrix} (1-\beta)^{-1}(\Gamma\phi\Gamma^T + \psi)(1-\beta)^{-1^T} & (1-\beta)^{-1}\Gamma\phi \\ \Gamma^T D^T\phi & \phi \end{bmatrix}$$

where X is a q $\times$ 1 vector of observable indicators of the independent latent variables ξ; Y is a p $\times$ 1 vector of observable indicators of the dependent latent variables η; η is a m $\times$ 1 vector of dependent (endogenous) latent variables; ξ is a n $\times$ 1 vector of independent (exogenous) latent variables; ζ is a m $\times$ 1 vector of latent (structural) errors; ε is a p $\times$ 1 vector of measurement errors for Y; δ is a q $\times$ 1 vector of measurement errors for X; Λ_y is a $p \times m$ matrix of coefficients relating Y to η; Λ_x is a $q \times n$ matrix of coefficients relating X to ξ; Γ is a $m \times n$ matrix of coefficients for the latent exogenous variables; B is a $m \times m$ matrix of coefficients for the latent endogenous variables.

2.6.4 Model Identification in Structural Equation Modeling

There are three stages of model identification and these are as follows:

1. A model is under-identified (or not identified) if one or more parameters may not be uniquely determined because there is not sufficient information in the matrix S.

2. A model is just-identified if all of the parameters are uniquely determined because there is just sufficient information in the matrix S.

3. A model is over-identified when there is more than one way of estimating a parameter (or parameters) because there is more than sufficient information in the matrix S.

If a model is either just or over-identified, then the model is identified. Specifically, if the system of equations relating the elements of the sample covariance matrix S with their equals in the model-implied matrix $\Sigma(\gamma)$ contains less parameter than equations, then the model will be identified.

The following are used to obtain the identification status:

$$t = pm + \frac{m(m+1)}{2} + p \tag{2.21}$$

$$t > \frac{p(p+1)}{2} \quad \ldots \quad model\ is\ unidentified \tag{2.22}$$

$$t = \frac{p(p+1)}{2} \quad \ldots \quad uniquely\ identified \tag{2.23}$$

$$t < \frac{p(p+1)}{2} \quad \ldots \quad model\ is\ Over\ identified \tag{2.24}$$

where t is the total number of parameters to be estimated, p is the observed variables and m is the latent endogenous variables.

2.6.5 Statistical Assumptions for SEM

The statistical assumptions are:

(1) $E(\eta) = 0$

(2) $E(\xi) = 0$

(3) $E(\zeta) = 0$

(4) ζ is uncorrelated with ξ

(5) $(I - B)$ is non-singular

Moreover, the associated covariance matrices are: $Cov(\xi) = \Phi_{p\,x\,p}$: covariances between the independent variables ξ; $Cov(\varepsilon) = \Theta_{\varepsilon(p\,x\,p)}$: covariances between the measurement

errors in Y; $Cov(\delta) = \Theta_{\delta(q\ x\ q)}$: covariances between the measurement errors in X; $Cov(\zeta) = \Psi_{m\ x\ m}$: covariances between the structural errors ζ.

The $(p + q)$ model-implied covariance matrix $\Sigma(\theta)$ of the observed variables can be partitioned into four matrices $\Sigma_{yy}(\theta), \Sigma_{yx}(\theta), \Sigma_{xy}(\theta)$ and $\Sigma_{xx}(\theta)$ that denote the model-implied covariance between the Y observed variables; the X observed variables; and X and Y observed variables, respectively.

2.6.6 General structure for existing models of non-HIV data using WHOQoL (BREF) Questionnaire

The data from the non-HIV patients were used to produce six (6) path diagrams also called models. Models 1 to 3 already existed and they are discussed as follows:

Model 1 incorporates the WHOQoL (BREF) questionnaire only.

Model 2 incorporates the addition of one QoL overall question to Model 1.

Model 3 incorporates the addition of the two QoL overall questions to Model 2.

The general measurement model therefore showed the matrix formation of the 24 indicator variables which are represented by x exogenous variables, the latent exogenous variables which are the four domains represented by ξ with different number of variables in each domain, the error terms for x represented by δ. The structural part showed the overall questions for QoL on WHOQoL (BREF), the latent endogenous variable which is the domain for QoL represented by η, the error term for y endogenous variables represented by ϵ, the influence from exogenous latent variable on endogenous latent variables represented by Γ and the residual error represented by ζ.

$$X = \Lambda_X \xi + \delta \tag{2.3}$$

$$\begin{pmatrix} X_{i1} \\ . \\ . \\ X_{l4} \end{pmatrix} = \begin{pmatrix} \lambda_{i1} & . & . & . \\ . & \lambda_{j2} & . & . \\ . & . & \lambda_{k3} & . \\ . & . & . & \lambda_{l4} \end{pmatrix} \begin{pmatrix} \xi_1 \\ . \\ . \\ \xi_4 \end{pmatrix} + \begin{pmatrix} \delta_1 \\ . \\ . \\ \delta_{24} \end{pmatrix}$$

Where

$$\underline{X}_{i1}\ is\ a\ column\ vector\ (i = 7\ variables\ of\ Domain\ 1)$$

$$\underline{X}_{j2}\ is\ a\ column\ vector\ (j = 6\ variables\ of\ Domain\ 2)$$

$$\underline{X}_{k3}\ is\ a\ column\ vector\ (k = 3\ variables\ of\ Domain\ 3)$$

$$\underline{X}_{l4}\ is\ a\ column\ vector\ (l = 8\ variables\ of\ Domain\ 4)$$

1. Model to WHOQoL (BREF) questionnaire only (Model 1)

Measurement Model $$X_{(24\times1)} = \Lambda_{x(24\times4)}\xi_{(4\times1)} + \delta_{(24\times1)} \quad (2.25)$$

X are the 24 indicators, that is, the questions on WHOQoL (BREF) questionnaire, ξ are the four domains and δ are the error terms for X.

24 observed exogenous variables, 4 latent exogenous variables.

2. Model to WHOQoL (BREF) questionnaire with one overall QoL question (Model 2)

Measurement Model $$X_{(24\times1)} = \Lambda_{x(24\times4)}\xi_{(4\times1)} + \delta_{(24\times1)}$$

Indicator Model $$Y_{(1\times1)} = \Lambda_{y(1\times1)}\eta_{1(1\times1)} + \epsilon_{(1\times1)} \quad (2.26)$$

Structural Model $$\eta_{(1\times1)} = \Gamma_{(1\times4)}\xi_{(4\times1)} + \zeta_{(1\times1)}$$

Y is the one question for overall QoL on WHOQoL (BREF), η_1 is the single domain for QoL, ϵ is the error term for Y, η is the structural part, Γ is Influence from exogenous latent variable on endogenous latent variables and ζ is the residual error, other terms are as in Model 1.

24 observed exogenous variables, 4 latent exogenous variables, 1 observed endogenous variable and 1 latent endogenous variable.

3. Model to WHOQoL (BREF) questionnaire with the two overall QoL questions (Model 3)

Measurement Model $$X_{(24\times1)} = \Lambda_{x(24\times4)}\xi_{(4\times1)} + \delta_{(24\times1)}$$

Indicator Model $$Y_{(2\times1)} = \Lambda_{y(2\times1)}\eta_{1(1\times1)} + \epsilon_{(2\times1)} \quad (2.27)$$

Structural Model $$\eta_{(1\times1)} = \Gamma_{(1\times4)}\xi_{(4\times1)} + \zeta_{(1\times1)}$$

Y are the two overall QoL questions on WHOQoL (BREF) questionnaire, other terms are as in Model 2.

24 observed exogenous variables, 4 latent exogenous variables, 2 observed endogenous variables and 1 latent endogenous variable.

2.6.7 General structure for existing models of HIV data using WHOQoL-HIV (BREF) Questionnaire

The data from the HIV patients were also used to produce six (6) path diagrams also called models. Models 7 to 9 already existed and they are discussed as follows:

Model 7 incorporates the WHOQoL-HIV (BREF) questionnaire only.

Model 8 incorporates the addition of one QoL overall question to Model 7.

Model 9 incorporates the addition of the two QoL overall questions to Model 8.

The general measurement model therefore showed the matrix formation of the 29 indicator variables which are represented by x exogenous variables, the latent exogenous variables which are the six domains represented by ξ with different number of variables in each domain, the error terms for x represented by δ. The structural part showed the overall questions for QoL on WHOQoL-HIV (BREF), the latent endogenous variables which is the domain for QoL represented by η, the error term for y endogenous variables represented by ϵ, the influence from exogenous latent variable on endogenous latent variables represented by Γ and the residual error represented by ζ.

$$X = \Lambda_X \xi + \delta$$

$$X_1 = \lambda_{11}\xi_1 + \delta_1 \qquad (2.28)$$

. . . .

. . . .

. . . .

$$X_{29} = \lambda_{29,6}\xi_6 + \delta_{29}$$

$$\begin{pmatrix} X_{i1} \\ X_{j2} \\ . \\ . \\ . \\ X_{n6} \end{pmatrix} = \begin{pmatrix} \lambda_{i1} & . & . & . & . & . \\ . & \lambda_{j2} & . & . & . & . \\ . & . & \lambda_{k3} & . & . & . \\ . & . & . & \lambda_{l4} & . & . \\ . & . & . & . & \lambda_{m5} & . \\ . & . & . & . & . & \lambda_{n6} \end{pmatrix} \begin{pmatrix} \xi_1 \\ \xi_2 \\ . \\ . \\ . \\ \xi_6 \end{pmatrix} + \begin{pmatrix} \delta_1 \\ \delta_2 \\ . \\ . \\ . \\ \delta_6 \end{pmatrix}$$

Where

$$\underline{X_{i1}}\ is\ a\ column\ vector\ (i = 4\ variables\ of\ Domain\ 1)$$

$$\underline{X_{j2}}\ is\ a\ column\ vector\ (j = 5\ variables\ of\ Domain\ 2)$$

$$\underline{X_{k3}}\ is\ a\ column\ vector\ (k = 4\ variables\ of\ Domain\ 3)$$

$$\underline{X_{l4}}\ is\ a\ column\ vector\ (l = 4\ variables\ of\ Domain\ 4)$$

$$\underline{X_{m5}}\ is\ a\ column\ vector\ (m = 8\ variables\ of\ Domain\ 5)$$

$$\underline{X_{n6}}\ is\ a\ column\ vector\ (n = 4\ variables\ of\ Domain\ 6)$$

1. Model for WHOQoL-HIV (BREF) questionnaire only (Model 7)

Measurement Model $$X_{(29\times1)} = \Lambda_{x(29\times6)}\xi_{(6\times1)} + \delta_{(29\times1)} \quad (2.29)$$

X are the 29 indicators, that is, the questions on WHOQoL-HIV (BREF) questionnaire, ξ are the six domains and δ are the error terms for X.

29 observed exogenous variables and 6 latent exogenous variables

2. Model for WHOQoL-HIV (BREF) questionnaire with one overall QoL question (Model 8)

Measurement Model $$X_{(29\times1)} = \Lambda_{x(29\times6)}\xi_{(6\times1)} + \delta_{(29\times1)}$$

Indicator Model $$Y_{(1\times1)} = \Lambda_{y(1\times1)}\eta_{1(1\times1)} + \epsilon_{(1\times1)} \quad (2.30)$$

Structural Model $$\eta_{(1\times1)} = \Gamma_{(1\times6)}\xi_{(6\times1)} + \zeta_{(1\times1)}$$

Y is the one question for overall QoL on WHOQoL-HIV (BREF), η_1 is the single domain for QoL, ϵ is the error term for Y, η is the structural part, Γ is Influence from exogenous latent variable on endogenous latent variables and ζ is the residual error, other terms are as in Model 7.

29 observed exogenous variables, 6 latent exogenous variables, 1 observed endogenous variable and 1 latent endogenous variable.

3. Model for WHOQoL-HIV (BREF) questionnaire with the two overall QoL questions (Model 9)

Measurement Model $$X_{(29\times1)} = \Lambda_{x(29\times6)}\xi_{(6\times1)} + \delta_{(29\times1)}$$

Indicator Model $$Y_{(2\times1)} = \Lambda_{y(2\times1)}\eta_{1(1\times1)} + \epsilon_{(2\times1)} \quad (2.31)$$

Structural Model $$\eta_{(1\times1)} = \Gamma_{(1\times6)}\xi_{(6\times1)} + \zeta_{(1\times1)}$$

Y are the two overall QoL questions on WHOQoL-HIV (BREF) questionnaire, other terms are as in Model 8.

29 observed exogenous variables, 6 latent exogenous variables, 2 observed endogenous variables and 1 latent endogenous variable.

2.7 Principal Component Analysis for the Proposed Models

PCA is the method of dimensionality reduction, which converts data in the high-dimensional space to space of lower dimensions. Some benefits of this subspace are firstly, the abridged dimension has the effect of retaining the most of the useful information while reducing noise and other undesirable artefacts. Secondly, it helps us recognise new meaningful underlying variables.

Indeed, PCA itself does not reduce the dimension of the data set. It only rotates the axes of data space along lines of maximum variance. The axis of the greatest variance is called the first principal component. Another axis, which is orthogonal to the previous one and positioned to represent the next greatest variance, is called the second principal component, and so on. The dimension reduction is done by using only the first few principal components as a basis set for the new space. Therefore, this subspace tends to be small and may be dropped with minimal loss of information (Parinya, 2012).

The factor model specifies $y = \Lambda\eta + \varepsilon$y, (2.32)

where y is a vector of p observables, η is a vector of m latent factors, where $(m < p)$, Λ is a $p \times m$ matrix of loadings, and ε is a vector of p error terms representing "unique" variance in y (Hoyle, 2012).

It could also be a linear combinations of X's as follows:

$$P_1 = a_{11}X_1 + a_{12}X_2 + \cdots + a_{1k}X_k \quad (2.33)$$

where $k = 1, 2, \ldots, n$

For the proposed models, eigen value of equal or greater than 1.00 was used to determine the number of extractions.

2.8 Mardia's Multivariate Test for Normality

Mardia (1970) proposed a multivariate normality test which is based on multivariate extensions of skewness ($(\hat{\gamma}_{1,p})$ and kurtosis $(\hat{\gamma}_{2,p})$ measures as follows:

$$\hat{\gamma}_{1,p} = \frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n} m_{ij}^3 \quad \text{and} \quad \hat{\gamma}_{2,p} = \frac{1}{n}\sum_{j=1}^{n} m_{ii}^2 \tag{2.34}$$

Where $m_{ij} = (x_i - \bar{x})' S^{-1}(x_j - \bar{x})$, is the squared of the Mahalanobis distance p is the number of variables.

The test statistic for skewness $\left(\frac{n}{6}\right)\ \hat{\gamma}_{1,p}$ follows a Chi-square distribution with degree of freedom= $\frac{p(p+1)(p+2)}{6}$

The test statistic for kurtosis, $\hat{\gamma}_{2,p}$ follows a normal distribution with mean= $p(p+2)$, and variance=$\frac{8p(p+2)}{n}$

2.9 Estimation Methods

(1) Method using Maximum Likelihood (ML)

Assume a two-variable model $Y_i = \beta_1 + \beta_2 X_i + \mu_i$ (2.35)

The Y_i are normally and independently distributed with $mean = \beta_1 + \beta_2 X_i$ and $variance = \sigma^2$. The joint probability function is given as $f(Y_1, Y_2, \dots, Y_n I \beta_1 + \beta_2 X_i, \sigma^2)$. This can be written as a product of *n* individual density functions as $f(Y_1, Y_2, \dots, Y_n I \beta_1 + \beta_2 X_i, \sigma^2) = f(Y_1 I \beta_1 + \beta_2 X_i, \sigma^2) f(Y_2 I \beta_1 + \beta_2 X_i, \sigma^2) \dots f(Y_n I \beta_1 + \beta_2 X_i, \sigma^2)$ (2.36)

Where $f(Y_i) = \frac{1}{\sigma\sqrt{2\pi}} exp\left\{-\frac{1}{2}\frac{(Y_i - \beta_1 - \beta_2 X_i)^2}{\sigma^2}\right\}$ (2.37)

Substituting (2.37) for each Y_i into (2.36) gives

$$f(Y_i, Y_2, \dots, Y_n I \beta_1 + \beta_2 X_i, \sigma^2) = \frac{1}{\sigma^n (\sqrt{2\pi})^n} exp\left\{-\frac{1}{2}\Sigma\frac{(y_i - \beta_1 - \beta_2 X_i)^2}{\sigma^2}\right\} \tag{2.38}$$

If the parameters are known, the function in (2.38) is called a likelihood function. It is written as $LF(\beta_1, \beta_2, \sigma^2) = \frac{1}{\sigma^n (\sqrt{2\pi})^n} exp\left\{-\frac{1}{2}\Sigma\frac{(y_i - \beta_1 - \beta_2 X_i)^2}{\sigma^2}\right\}$ (2.39)

$$L(\beta, \sigma^2; \Omega) = \left(\frac{1}{2}\pi\sigma^2\right)^{n/2} \left|\Omega^{-1/2}\right| \exp\left\{-\frac{(\mathrm{y}-\mathrm{X}\beta)^I \Omega^{-1}(\mathrm{y}-\mathrm{X}\beta)}{2\sigma^2}\right\} \tag{2.38}$$

Taking the natural logarithm of (2.38) to obtain the maximum likelihood function:

$$Ln\ LF = -nln\sigma - \frac{n}{2}\ln(2\pi) - \frac{1}{2}\Sigma\frac{(y_i - \beta_1 - \beta_2 X_i)^2}{\sigma^2}$$

$$= -\frac{n}{2} ln\sigma^2 - \frac{n}{2}\ln(2\pi) - \frac{1}{2}\Sigma\frac{(y_i-\beta_1-\beta_2 X_i)^2}{\sigma^2} \quad (2.39)$$

(2) Method using Generalized Least Square (GLS)

The generalized least squares model can be defined as

$$Y = XB + U \quad (2.40)$$

With addition assumption that $E(UU^I) = \sigma^2\Omega$, where Ω is the unknown symmetric positive definite matrix P, we obtain

$$PY = PX\beta + PU \quad (2.41)$$

The error terms now become PU with $E(PU) = 0$ and $E(PUU^I P^I) = \sigma^2 \mathrm{P}\Omega P^I$.

Thus, if it is possible to specify P such that $\mathrm{P}\Omega P^I = I$ implying that $P^I P = \Omega^{-1}$, then the OLS estimates of the transformed variable PY and PX in equation (2.41) have all the optimal properties of OLS and so the usual inferences could be valid.

Redefining equation (2.41) as

$$Y^* = X^* B + U^* \quad (2.42)$$

Where $Y^* = PY$, $X^* = PX$ and $U^* = PU$.

By Guass-Markov theorem; (Markov,1900), the best linear unbiased estimator of β via the transformed model (2.42) is

$$\beta_{(GLS)} = (X^{*I}X^*)^{-1}X^{*I}Y = (X^I P^I PX)^{-1}X^I P^I Y$$

$$= (X^I \Omega^{-1} X)^{-1} X^I \Omega^{-1} Y \quad (2.43)$$

The variance co-variance matrix becomes

$$V\left(\hat{\beta}_{(GLS)}\right) = \sigma^2(X^{*I}X^*)^{-1} = \sigma^2(X^I P^I PX)^{-1}$$

$$= \sigma^2(X^I \Omega^{-1} X)^{-1} \quad (2.44)$$

This estimator is shown by Aitken's theorem (Aitken, 1935), to be efficient among the class of linear, unbiased estimators of β.

If the assumption of normality of the error term also holds, the maximum Likelihood of estimator of β is still the same as the GLS estimators.

Thus,

$$\hat{\beta}_{(GLS)} = (X^{*I}X^{*})^{-1}X^{*I}Y = (X^{I}\Omega^{-1}X)^{-1}X^{I}\Omega^{-1}Y \quad (2.45)$$

It should be noted that in obtaining $\hat{\beta}$ we assume Ω is known. When Ω is not known, as it is often the case, we resort to estimating Ω by $\hat{\Omega}$ to have Feasible Generalized Least Squares Estimator.

2.10 Goodness of Fit Tests

(1) The model was assessed with the logistic classification, the prediction is done using:

$\hat{Y}$= 0 when $\pi_i \geq \pi_0$

$\hat{Y}$= 1 when $\pi_i < \pi_0$ for some cut off π_0

Let Y denote the true state of an individual with categories with values

0 denoting an unhealthy individual

1 denoting a healthy individual

Let $\hat{Y}$ denote the outcome of diagnostic test of an individual with categories with values

Sensitivity = P(Y=1/$\hat{Y}$=1)

Specificity = P(Y=0/$\hat{Y}$=0)

(2) Model fit determines the degree to which the sample variance–covariance of the data fit the structural equation model. In this work, the following goodness of fit methods were adopted:

(a) The χ^2 test statistic was used for hypothesis testing to evaluate the appropriateness of a structural equation model.

$$\chi^2(df) = (N-1)F[S, \Sigma(\overline{\theta})]$$

(b) χ^2/df: If χ^2/df is between 1 and 3, it indicates an acceptable fit (Schermelleh-Engel *et. al.*, 2003).

(c) RMSEA is estimated by $\widehat{\varepsilon_a}$, the square root of the estimated discrepancy due to approximation per degree of freedom:

that is $\varepsilon_a = \sqrt{\max\left\{\left(\frac{F(S,\Sigma(\overline{\theta}))}{df}\right) - \frac{1}{N-1}\right), 0\}}$

(d) GFI = $1 - \frac{F_t}{F_n} = 1 - \frac{\chi_t^2}{\chi_n^2}$

(e) The Akaike information criterion (AIC) is a special type of fit index that takes into account both the measure of fit and model complexity (Akaike, 1987), it was used to compare models with differing numbers of latent variables and resembles the so-called Bayesian information criterion (BIC). The two indices, AIC and BIC, are widely used in applied statistics for purposes of model comparison (Raykov and Marcoulides, 2006).

AIC = $-2logL + 2t$

Table 2.1 shows the acceptable level and decision rules of some model-fit criterial.

Table 2.1: Model-Fit Criterial

Model-Fit Criterion	**Acceptable Level**	**Decision Rule/Interpretation**
Chi-square	Tabled χ^2 value	Compares obtained χ^2 value with tabled value for given *df*
Goodness-of-fit index (GFI)	0 (no fit) to 1 (perfect fit)	Value close to .90 or .95 reflect a good fit
Adjusted GFI (AGFI)	0 (no fit) to 1 (perfect fit)	Value adjusted for *df*, with .90 or .95 a good model fit
Root-mean-square error of approximation (RMSEA)	.05 to .08	Value of .05 to .08 indicate close fit
Akaike information criterion (AIC)	0 (perfect fit) to positive value (poor fit)	Compares values in alternative models

2.11 Binary Logistic Regression Model

Since the probability of an event must lie between 0 and 1, it is impractical to model probabilities with linear regression techniques, because the linear regression model allows the dependent variable to take values greater than 1 or less than 0. The logistic regression model is a type of generalized linear model that extends the linear regression model.

A binary logistic regression model is used to predict the probabilities of a discrete outcome when the dependent variable is dichotomous, that is, it only contains data coded as 1 with probability of success π(x) or 0 with a probability of failure 1-π(x), while the independent variable may be continuous, discrete or categorical or a mix of any of these.

The logistic regression model is of the form:

$$Z_i = \log\left(\frac{\pi_i}{1-\pi_i}\right) \qquad (2.46)$$

where $\pi_i$is the probability that the i^{th} case experiences the event of interest.

Z_i is the value of the unobserved continuous variables for the i^{th} case.

The model also assumes that Z is linearly related to the predictors

$$Z_i = b_0 + b_1 x_{i1} + b_2 x_{i2} + \cdots + b_j x_{ij} \quad (2.47)$$

where x_{ij} is the j^{th} predictor for the j^{th} case.

b_j is the j^{th} coefficient

j is the number of predictors

Since Z is unobserved, we relate the predictors to the probability of interest by substituting for Z.

$$\pi_i = \frac{1}{1+e^{-(b_0+b_1 x_{i1}+\cdots+b_j x_{ij})}} \quad (2.48)$$

x terms $x_1, x_2 \ldots x_i$ are the independent variables, some of which may be interaction terms.

For this study, $x_1 = q_{b1}$; $x_2 = qb_2$; $x_3 = qb_3$; $x_4 = qb_5$; $x_5 = qb_6$; $x_6 = qb_7$; $x_7 = qb_{11}$; $x_8 = qb_{12}$; $x_9 = qb_{13}$; $x_{10} = qb_{14}$; $x_{11} = qb_{15}$; $x_{12} = qb_{16}$; $x_{13} = qb_{18}$; $x_{14} = qb_{19}$; $x_{15} = qb_{20}$; $x_{16} = qb_{21}$; $x_{17} = qb_{22}$; $x_{18} = qb_{23}$; $x_{19} = qb_{24}$; $x_{20} = qb_{25}$; $x_{21} = qb_{26}$; $x_{22} = qb_{27}$; $x_{23} = qb_{28}$; $x_{24} = qb_{29}$; $x_{25} = qb_{30}$; $x_{26} = qb_{31}$

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

In this chapter, some features of the study area and the method of data collection were high-lighted. The proposed statistical models for non-HIV and HIV data from the existing models were considered, while the proposed method also for the WHOQoL-HIV (BREF) questionnaire alone was presented and discussed.

3.2 Study Area and Data Collection

The study was approved by the Ethical Review Committee of Ondo State Ministry of Health (AD 4693/79) and Ekiti State University Teaching Hospital, Ado-Ekiti Ethics and Research Committee (EKSUTH A 67/2014/02/004).

Akure is a city in the southwestern region of Nigeria, and is the largest city and capital of Ondo State. The city has a population of approximately 387,087. The people are of the Yoruba ethnic group. Ekiti State is also in the South West of Nigeria. The state was carved out of the territory of old Ondo State, it covers the former twelve local government areas that made up the Ekiti Zone of old Ondo State. Ado-Ekiti is the state capital of Ekiti State. It occupies about 293 Square Kilometres (km^2) with a population of approximately 424,340 (Worldometers, 2017).

The data used in this study are primary data collected by direct interview and filling of the WHOQoL-HIV (BREF) and Satisfaction with Life Scale (SWLS) questionnaires by 564 PLWHA attending Haematology/Virology clinic at Ondo State Specialist Hospital, Akure and Ekiti State University Teaching Hospital, Ado-Ekiti. The relative or control data were also collected by interview and filling of WHOQoL (BREF) and Satisfaction with Life Scale (SWLS) questionnaires by 806 non-infected persons. A descriptive, cross-sectional study of 1,370 persons was conducted among PLWHA and non- infected persons using the WHOQoL BREF, the WHOQoL-HIV BREF and Satisfaction with life scale questionnaires. Furthermore, structural equation modelling approach was used to check the bilateral relationships among the instruments. The study identified contributing factors for poor QoL in the population of people living with HIV/AIDs in Nigeria, and finally, the impact of HIV/AIDs was determined on QoL of PLWHA in Nigeria with the proposed models.

Two hospitals/centres that met the study criteria were purposefully selected from a list of hospitals/centres from each of the two states. That is, hospitals/centres that pre-test and post-

test counselling for HIV patients, testing for HIV/AIDs, initiation of antiretroviral therapy, conducting routine blood work (liver function test, kidney function test, and CD4 count) for monitoring patients and have support groups among others.

3.3 General structure for models of non-HIV data using WHOQoL (BREF) Questionnaire

The data from the non-HIV patients were used to produce six (6) path diagrams out of which Models 1 to 3 already existed as seen in equations (2.25), (2.26) and (2.27), the remaining three models are as discussed below:

Model 4 incorporates the combination of WHOQoL (BREF) questionnaire and SWLS only. Model 5 incorporates the addition of one QoL overall question to WHOQoL (BREF) questionnaire and SWLS.

Finally, Model 6 incorporates the addition of the two QoL overall questions to WHOQoL (BREF) questionnaire and SWLS.

1. Model to WHOQoL (BREF) questionnaire and SWLS only (Model 4)

Measurement Model $X_{(24\times1)} = \Lambda_{x(24\times4)}\xi_{(4\times1)} + \delta_{(24\times1)}$

Indicator Model $Y_{(5\times1)} = \Lambda_{y(5\times1)}\eta_{1(1\times1)} + \epsilon_{(5\times1)}$ (3.1)

Structural Model $\eta_{(1\times1)} = \Gamma_{(1\times4)}\xi_{(4\times1)} + \zeta_{(1\times1)}$

Y are the 5 questions on SWLS questionnaire.

24 observed exogenous variables, 4 latent exogenous variables, 5 observed endogenous variables and 1 latent endogenous variable.

2. Model to WHOQoL (BREF) questionnaire and SWLS with one overall QoL question (Model 5)

Measurement Model $X_{(24\times1)} = \Lambda_{x(24\times4)}\xi_{(4\times1)} + \delta_{(24\times1)}$

Indicator Model $Y_{(6\times1)} = \Lambda_{y(6\times2)}\eta_{1(2\times1)} + \epsilon_{(6\times1)}$ (3.2)

Structural Model $\eta_{(2\times1)} = \mathrm{B}_{(2\times2)}\eta_{1(2\times1)} + \Gamma_{(2\times4)}\xi_{(4\times1)} + \zeta_{(2\times1)}$

Y are the 6 questions for both one overall QoL question and 5 questions on SWLS and B is relationship between endogenous latent variables, other terms are as in Model 4.

24 observed exogenous variables, 4 latent exogenous variables, 6 observed endogenous variables and 2 latent endogenous variables.

3. Model to WHOQoL (BREF) questionnaire and SWLS with the two overall QoL questions (Model 6)

Measurement Model $X_{(24\times1)} = \Lambda_{x(24\times4)}\xi_{(4\times1)} + \delta_{(24\times1)}$

Indicator Model $Y_{(7\times1)} = \Lambda_{y(7\times2)}\eta_{1(2\times1)} + \epsilon_{(7\times1)}$ (3.3)

Structural Model $\eta_{(2\times1)} = \mathrm{B}_{(2\times2)}\eta_{1(2\times1)} + \Gamma_{(2\times4)}\xi_{(4\times1)} + \zeta_{(2\times1)}$

Y are the 7 questions for both two overall QoL questions and 5 questions on SWLS, other terms are as in Model 5.

24 observed exogenous variables, 4 latent exogenous variables, 7 observed endogenous variables and 2 latent endogenous variables.

3.4 General structure for models of HIV data using WHOQoL-HIV (BREF) Questionnaire

The data from the HIV patients were also used to produce six (6) path diagrams out of which Models 7 to 9 already existed as seen in equations (2.29), (2.30) and (2.31), the remaining three models are as discussed below:

Model 10 incorporates the combination of WHOQoL-HIV (BREF) questionnaire and SWLS only.

Model 11 incorporates the addition of one QoL overall question to WHOQoL-HIV (BREF) questionnaire and SWLS.

Finally, Model 12 incorporates the addition of the two QoL overall questions to WHOQoL-HIV (BREF) questionnaire and SWLS.

1. Model for WHOQoL-HIV (BREF) questionnaire with SWLS questionnaire (Model 10)

Measurement Model $X_{(29\times1)} = \Lambda_{x(29\times6)}\xi_{(6\times1)} + \delta_{(29\times1)}$

Indicator Model $Y_{(5\times1)} = \Lambda_{y(5\times1)}\eta_{1(1\times1)} + \epsilon_{(5\times1)}$ (3.4)

Structural Model $\eta_{(1\times1)} = \Gamma_{(1\times6)}\xi_{(6\times1)} + \zeta_{(1\times1)}$

Y are the 5 questions on SWLS questionnaire.

29 observed exogenous variables, 6 latent exogenous variables, 5 observed endogenous variables and 1 latent endogenous variable.

2. Model for WHOQoL-HIV (BREF) questionnaire with SWLS questionnaire and one overall QoL question (Model 11)

Measurement Model $X_{(29\times1)} = \Lambda_{x(29\times6)}\xi_{(6\times1)} + \delta_{(29\times1)}$

Indicator Model $Y_{(6\times1)} = \Lambda_{y(6\times2)}\eta_{1(2\times1)} + \epsilon_{(6\times1)}$ (3.5)

Structural Model $\eta_{(2\times1)} = \mathrm{B}_{(2\times2)}\eta_{1(2\times1)} + \Gamma_{(2\times6)}\xi_{(6\times1)} + \zeta_{(2\times1)}$

Y are the 6 questions for both one overall QoL question and 5 questions on SWLS and B is relationship between endogenous latent variables, other terms are as in Model 10.

29 observed exogenous variables, 6 latent exogenous variables, 6 observed endogenous variables and 2 latent endogenous variables.

3. Model for WHOQoL-HIV (BREF) questionnaire with SWLS questionnaire and the two overall QoL questions (Model 12)

Measurement Model $X_{(29\times1)} = \Lambda_{x(29\times6)}\xi_{(6\times1)} + \delta_{(29\times1)}$

Indicator Model $Y_{(7\times1)} = \Lambda_{y(7\times2)}\eta_{1(2\times1)} + \epsilon_{(7\times1)}$ (3.6)

Structural Model $\eta_{(2\times1)} = \mathrm{B}_{(2\times2)}\eta_{1(2\times1)} + \Gamma_{(2\times6)}\xi_{(6\times1)} + \zeta_{(2\times1)}.$

Y are the 7 questions for both two overall QoL questions and 5 questions on SWLS, other terms are as in Model 11.

29 observed exogenous variables, 6 latent exogenous variables, 7 observed endogenous variables and 2 latent endogenous variables.

3.5 General structure of the proposed model for WHOQoL-HIV (BREF) questionnaire

In the proposed models, the WHOQoL-HIV (BREF) variables were regrouped into n-components at different stages using principal component analysis; where n represents the number of Principal Components (factors) whose eigen values are greater than one (1). The extraction for the rotated component matrix was placed at a minimum of 3.0 to give room for

all the variables on the WHOQoL-HIV (BREF) in the proposed models. The 29 variables are grouped into each component by taking into consideration their correlation with each component. A variable is therefore, considered to belong to a component if that is where it has highest correlation with the component. Following this, is the construction of the path diagram showing the relationship of the indicator variables to their corresponding domains.

The general measurement model therefore showed the matrix formation of the 29 indicator variables for WHOQoL-HIV (BREF) which are represented by exogenous variables (X), the latent exogenous variables which are the (n) domains represented by ξ with different number of variables in each domain, the error terms for X represented by δ. The structural part showed the overall questions for QoL and SWLS on hypothesized WHOQoL-HIV (BREF), the latent endogenous variables which is the domain for QoL represented by η, the error term for endogenous variables (Y) represented by ϵ as seen in the existing equations (2), (3) and (4), the influence from exogenous latent variable on endogenous latent variables represented by Γ and the residual error represented by ζ. The proposed measurement model is presented as:

$$X = \Lambda_X \xi + \delta$$

$$X_1 = \lambda_{11} \xi_1 + \delta_1$$

. . . .

. . . .

. . . .

$$X_{29} = \lambda_{29,n} \xi_n + \delta_{29} \quad (3.7)$$

Also, the following model (3.8) is a sample of the proposed structural model as presented:

$$\eta_{(2\times1)} = \mathrm{B}_{(2\times2)} \eta_{1(2\times1)} + \Gamma_{(2\times n)} \xi_{(n\times1)} + \zeta_{(2\times1)} \quad (3.8)$$

The models were examined using the statistical package AMOS version 21.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Introduction

In this Chapter, the assumptions of SEM on the data used in this work were investigated using the combined data of both HIV positive and non-HIV positive. The comparisons of the estimation methods were carried out for all the models from both non-HIV and HIV data using structural equation modelling. The graphical frame work and the estimation of the preferred models were also stated. Also, the variables in the HIV data were regrouped using principal component analysis into n-component WHOQoL-HIV (BREF) to form the proposed models in this study. Furthermore, a reduced version of the WHO quality of life instrument was proposed from the combined quality of life questionnaires.

4.2 Characteristics of the test data

The following assumptions of SEM were investigated on the data set before carrying out the analysis.

1 Multicollinearity and Homogeneity of Variance

The 31 items on the WHOQoL-HIV (BREF) were investigated using collected data to check the violation of the assumption of multicollinearity. Table 4.1 below shows that the data set does not violate the assumption since no collinearity tolerance was less than 0.01 and the variance inflation factor (VIF) values were not greater than 10. It also showed that the assumption that the variance of any of the measured variables cannot be greater than ten times any other variance was not violated.

Table 4.1: Collinearity Statistics and Variance of the Data

Variable Name	**Collinearity Statistics**		**Variance**
	Tolerance	VIF	
Rating of quality of life	.529	1.889	.487
Satisfaction with health	.572	1.749	.666
Pain & discomfort	.586	1.708	1.182
Symptoms of PLWA	.506	1.977	1.321
Dependence on medication or treatment	.676	1.478	1.503
Positive feelings	.652	1.534	.798
SRPB	.726	1.377	.748
Forgiveness & blame	.726	1.377	1.282

Concerns about the future	.468	2.135	1.514
Death & dying	.491	2.036	1.358
Thinking, learning, memory & concentration	.738	1.355	.805
Physical safety & security	.520	1.922	.494
Physical environment-pollution	.684	1.462	.429
Energy & Fatigue	.498	2.007	.781
Body image & appearance	.636	1.571	.744
Financial resources	.751	1.331	1.119
Social inclusion	.835	1.198	.736
Opportunities for acquiring new information & skill	.745	1.342	.820
Participation in recreation /leisure activities	.826	1.211	.781
Mobility	.571	1.753	.432
Sleep & rest	.585	1.709	.627
Activities of daily living	.513	1.949	.484
Work capacity	.521	1.921	.531
Self esteem	.460	2.173	.496
Personal relationships	.630	1.587	.533
Sexual activity	.708	1.412	1.113
Social support	.690	1.449	1.014
Home environment	.654	1.529	.534
Health & social care: accessibility & quantity	.622	1.609	.592
Transport	.737	1.356	.817
Negative feelings	.717	1.395	1.075

Source: Results from computer output

2. Adequacy of sample size

Analysis was carried out on the data using Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy tests to check whether the partial correlations among variables are small. The result was 0.815, which shows that factor analysis should yield distinct and reliable factors from the data thereby confirming that the data is adequate for the study (Field, 2005).

3. Linearity

Few items were chosen at random to check if the data violated the assumption of linearity. Figure 4.1 shows that most of the charts have linear relationships which signifies that the assumption of linearity was not violated.

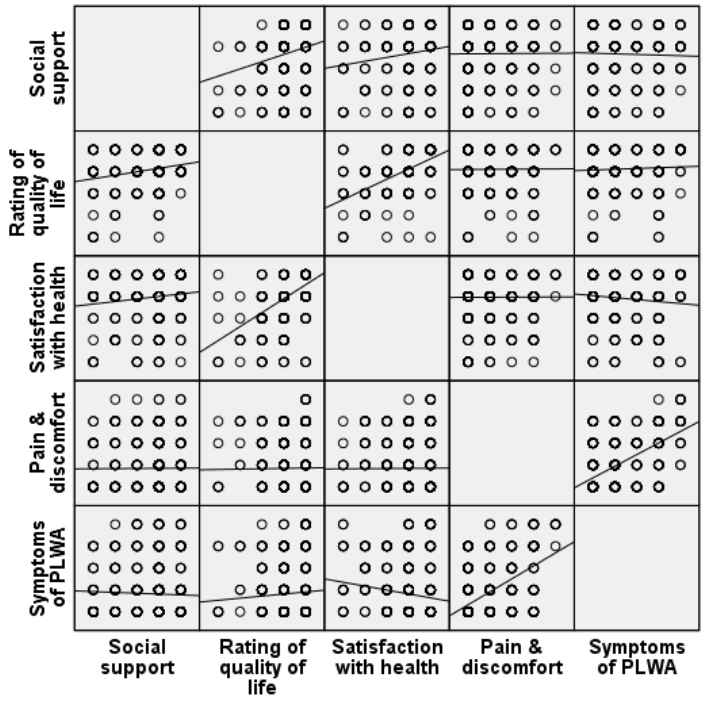


Figure 4.1: Scatter diagram of variables of the data

4. Test for homoscedacity

Analysis was carried out on the data to check for the violation of the assumption of homoscedacity. Figure 4.2 shows that the assumption was not violated.

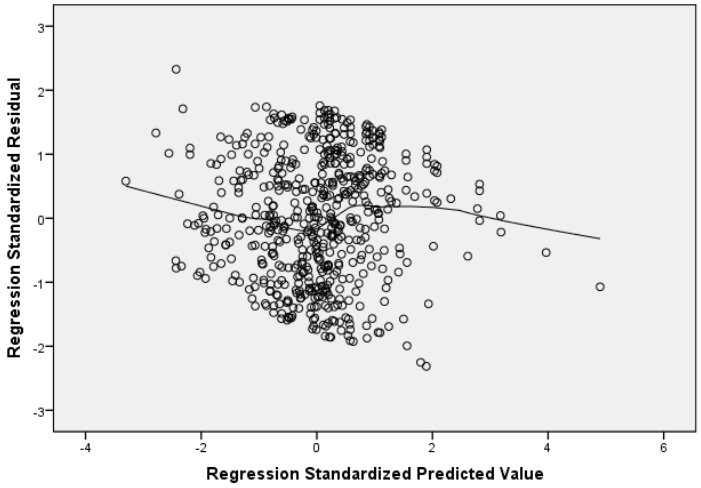


Figure 4.2: Cluster property of the data

5. Assessment of Multivariate Normality Using Mardia's Test

Test of Hypothesis

H_0: Data are multivariate normal

H_1: Data are not multivariate normal

Level of significance (α): 0.05

Table 4.2 shows the results of the Mardia's multivariate normality test on the two instruments using both HIV positive and negative population.

Table 4.2: Mardia's Multivariate Normality Test

	Skewness (P-value)	**Kurtosis (P-value)**	**Conclusion**
WHOQoL-HIV	210.8909 (<0.001)	1290.827 (<0.001)	Since the p- value is less than 0.05, we conclude that the data are not multivariate normal
SWLS-HIV	4.7107 (<0.001)	45.6087 (<0.001)	Since the p- value is less than 0.05, we conclude that the data are not multivariate normal
WHOQoL	306.2472 (<0.001)	1301.63 (<0.001)	Since the p- value is less than 0.05, we conclude that the data are not multivariate normal
SWLS-NHIV	12.6421 (<0.001)	64.3428 (<0.001)	Since the p- value is less than 0.05, we conclude that the data are not multivariate normal

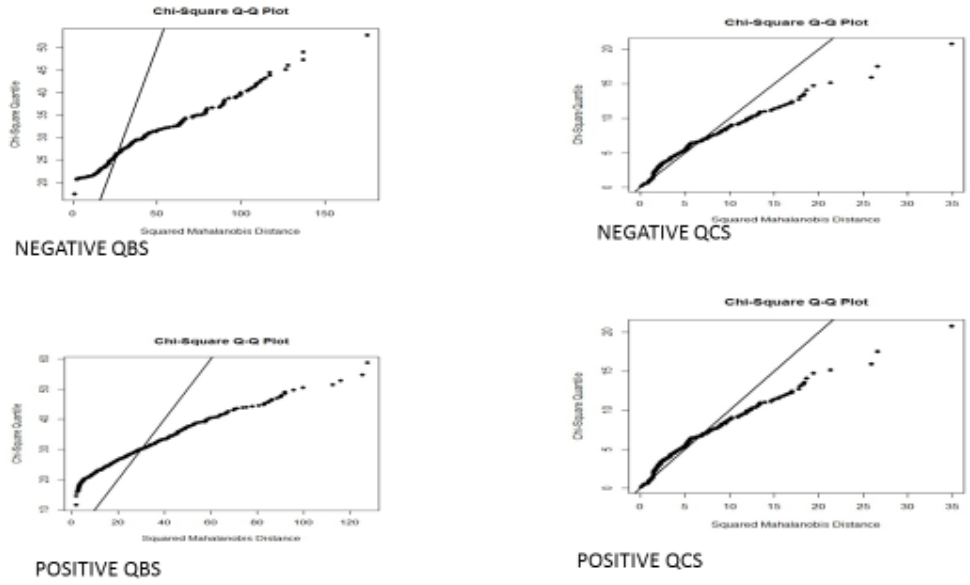


Figure 4.3: Normal Plots of WHOQoL-HIV, SWLS-HIV, WHOQoL & SWLS-NHIV

Following the directions of the plots in Figure 4.3, it can be seen that the data used in this work do not exhibit normality, hence the use of GLS in the estimation of the coefficients and the goodness of fit indices become useful. This was done with the application of AMOS version 21 software.

4.3 Results of Analysis on Non-HIV Data

The results of the theoretical 4-component, Physical, Psychological, Social Relationship, and Environmental domains of the WHOQoL (BREF) questionnaire with SWLS questions for non-HIV data using SEM are presented as follows.

4.3.1 Model Fit Comparison for ML and GLS (non-HIV data)

Comparison of the various model fit indices were made using ML estimation and GLS for the data as shown in Table 4.3.

Table 4.3: Comparison of ML & GLS for non-HIV data (Models 1 to 6)

Model fit Indices		**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
χ^2	ML	2370.195	2476.704	2662.148	3296.465	3557.400	3894.202
	GLS	1490.66	1523.53	1690.010	1982.481	2199.93	2366.163
Df	ML	246	268	292	368	396	426
	GLS	237	257	282	356	388	415
χ^2/df	ML	9.635	9.241	9.117	8.958	8.983	9.141
	GLS	6.290	5.928	5.993	5.569	5.670	5.702
GFI	ML	0.793	0.793	0.790	0.772	0.764	0.761
	GLS	0.845	0.848	0.838	0.830	0.817	0.810
RMSEA	ML	0.104	0.101	0.101	0.100	0.097	0.101
	GLS	0.081	0.078	0.079	0.075	0.076	0.077
AIC	ML	2478.195	2590.704	2780.148	3430.465	3695.400	4034.202
	GLS	1616.662	1659.525	1828.010	2140.481	2353.930	2528.163

Source: Results from computer output

Table 4.3 clearly shows that the estimation method by GLS performs better than that of ML for the data used in this work. It also reveals that for both estimation methods, Model 1

performs better using χ^2, Df and AIC fit indices, Model 4 performs better using χ^2/df. While Model 6 performs better using GFI and RMSEA fit indices. It also showed that the values for GFI were closer to 1 in GLS than in ML. Furthermore, RMSEA values were between 0.05 and 0.08 in all the Models for GLS estimation method. Therefore, it is concluded that the sample variance-covariance of the data used fit the structural equation models.

4.3.2 Analysis of WHOQoL (BREF) (Model 1)

Analysis was carried out on the theoretical 4-component WHOQoL (BREF) and the following results are obtained.

Table 4.4: Summary of SEM Parameter Estimates for non-HIV data (Models 1-6)

			Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Indicator Variable		**Latent Construct**	**Estimates**					
SWLS	<---	Domain3				-0.730		
SWLS	<---	Domain4				1.416		
SWLS	<---	Domain2				2.850		
SWLS	<---	Domain1				-2.937*		
QoL	<---	Domain3		-0.873*	-0.821*		-0.312	-0.855*
QoL	<---	Domain4		0.946	0.959		1.619	0.842
QoL	<---	Domain2		3.930*	3.732*		1.865*	4.713*
QoL	<---	Domain1		-3.627*	-3.649*		-2.260*	-4.496*
SWLS	<---	QoL					0.714*	0.152*
*QB3	<---	Domain1	0.553	0.598	0.542	0.564	0.543	0.119
QB4	<---	Domain1	0.560*	0.577*	0.516*	0.587*	0.603*	0.504*
QB10	<---	Domain1	0.698*	0.717*	0.702*	0.739*	0.757*	0.745*
QB15	<---	Domain1	0.541*	0.544*	0.529*	0.567*	0.550*	0.429*
QB16	<---	Domain1	0.654*	0.664*	0.630*	0.642*	0.678*	0.602*
QB17	<---	Domain1	0.481*	0.519*	0.387*	0.498*	0.537*	0.376*
QB18	<---	Domain1	0.768*	0.754*	0.744*	0.780*	0.768*	0.662*
*QB5	<---	Domain2	0.466	0.520	0.400	0.452	0.502	0.299
QB6	<---	Domain2	0.672*	0.639*	0.568*	0.594*	0.688*	0.547*
QB7	<---	Domain2	0.673*	0.696*	0.677*	0.652*	0.670*	0.596*

QB11	<---	Domain2	0.681*	0.664*	0.612*	0.696*	0.716*	0.652*
QB19	<---	Domain2	0.750*	0.690*	0.628*	0.639*	0.772*	0.718*
QB26	<---	Domain2	0.555*	0.514*	0.539*	0.534*	0.538*	0.393*
*QB20	<---	Domain3	0.593	0.644	0.476	0.586	0.630	0.522
QB21	<---	Domain3	0.684*	0.683*	0.727*	0.678*	0.683*	0.714*
QB22	<---	Domain3	0.756*	0.760*	0.714*	0.732*	0.741*	0.626*
*QB8	<---	Domain4	0.778	0.794	0.775	0.763	0.786	0.749
QB9	<---	Domain4	0.573*	0.573*	0.600*	0.661*	0.565*	0.216*
QB12	<---	Domain4	0.499*	0.475*	0.484*	0.514*	0.525*	0.448*
QB13	<---	Domain4	0.510*	0.520*	0.514*	0.549*	0.543*	0.369*
QB14	<---	Domain4	0.318*	0.247*	0.335*	0.395*	0.358*	0.296*
QB23	<---	Domain4	0.531*	0.553*	0.480*	0.596*	0.572*	0.347*
QB24	<---	Domain4	0.228*	0.250*	0.187*	0.314*	0.254*	-0.025
QB25	<---	Domain4	0.634*	0.624*	0.641*	0.713*	0.694*	0.560*
QB1	<---	QoL		1.000	1.000		0.591	1.000
QB2	<---	QoL			0.315*			0.382*
QC1	<---	SWLS				0.484	0.453	0.215
QC2	<---	SWLS				0.723*	0.703*	0.633*
QC3	<---	SWLS				0.814*	0.798*	0.667*
QC4	<---	SWLS				0.245*	0.274*	0.143*
QC5	<---	SWLS				0.383*	0.321*	0.286*

Note: *Significant at 5% level of significance
*Reference variables
Source: Results from computer output

Table 4.4 shows the SEM parameters for the four theoretical models from the WHOQoL (BREF) and SWLS questionnaires as follows: Model 4 shows that the physical physique of non-infected persons has a significant effect on their satisfaction with life.

It also shows that only Model 5 did not have a significant impact of social relationship on the overall quality of life of a non-infected person.

None of the models shows a significant impact of the environment on the overall quality of life of a non-infected person.

Models 5 and 6 shows that satisfaction of life of a non-infected .person has significant impact on the overall quality of life.

Models 3 and 6 shows that the satisfaction of a non-infected person with his or her health has a significant impact on the overall quality of life.

Furthermore, in all the Models, Domains 1, 2, 3 and 4 have all their indicator variables significant except for the variables that were constrained to the value of one for us to have models that will converge with minimum iterations. Similarly, indicator QC1"in most ways my life is close to my ideal" is not a good indicator of SWLS.

Table 4.5: Summary of Covariance Estimates for non-HIV data (Models 1 to 6)

			Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Domain	<---	Domain	Estimates					
1	<---	2	0.122*	0.157*	0.089*	0.111*	0.110*	0.011*
1	<---	3	0.148*	0.183*	0.084*	0.130*	0.130*	0.014*
1	<---	4	0.319	0.353*	0.280*	0.272*	0.263*	0.043*
2	<---	3	0.088*	0.117*	0.045*	0.075*	0.088*	0.03*
2	<---	4	0.168*	0.206*	0.135*	0.137*	0.158*	0.078*
3	<---	4	0.234*	0.268*	0.154*	0.192*	0.225*	0.129*

***** Significant at 0.01 level of significance
Source: Results from computer output

The covariance among the four (4) latent exogenous constructs of the 4–component WHOQoL (BREF) questionnaire are presented in Table 4.5. The covariance are significantly different from zero at 0.01 level of significance which implies that the variables in the domains are depending on each other in all the models except in Model 1, Domain 4.

4.3.3 Factor Loading Fitting chart of the Theoretical 4-Component WHOQoL (BREF) Questionnaire

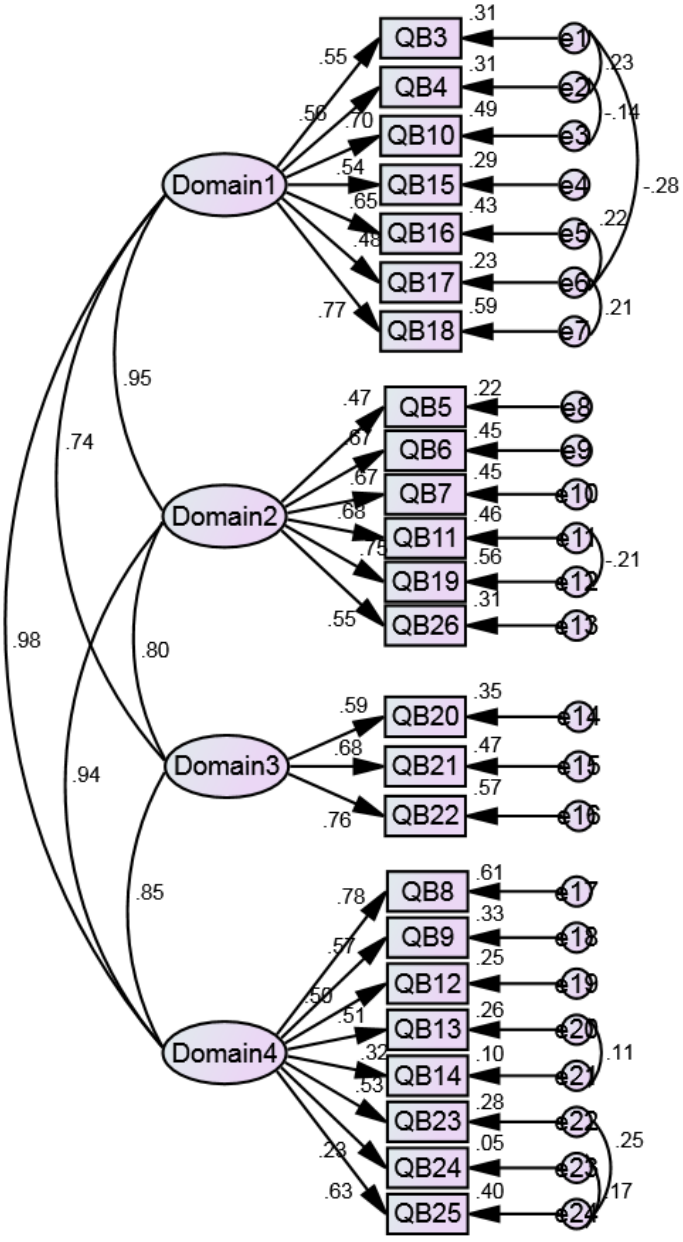


Figure 4.4. Model 1: Path diagram for Quality of Life for non-HIV patients

The estimated path diagram with the standardized path coefficients as well as the coefficients between the latent constructs for the theoretical 4-componet WHOQoL (BREF) questionnaire (Model 1) are presented in Figure 4.4. The latent constructs were highly correlated rating

(between 0.74 and 0.98). The model also showed the correlation among some selected error terms which improved the model fit. It also showed that most of the indicators contributed significantly to the different domains using 0.5 as a standard as follows: In Domain 1, it is evident that all the seven items related to physical appearance loaded well. QB18 (Satisfaction with capacity for work) and QB10 (Enough energy for everyday life) variables appear to be the best indicators of Domain 1. Their standardized regression weights are 0.77 and 0.70 respectively. Additionally, Domain 1 explained about 59% of the variance in QB18 and 49% of the variance in QB10. QB17 (Satisfaction with ability to perform daily living activities) is the poorest among the physical indicators of Domain 1 with an R^2 of 0.23 and a standardized regression weight of 0.48.

In Domain 2, it is evident that all the six items related to psychology loaded well. QB19 (Satisfaction with yourself) and QB11 (Acceptance of bodily appearance) variables appear to be the best indicators of Domain 2. Their standardized regression weights are 0.75 and 0.68 respectively. Additionally, Domain 2 explained about 56% of the variance in QB19 and 46% of the variance in QB11. QB5 (How much do you enjoy life?) is the poorest among the psychology indicators of Domain 2 with an R^2 of 0.22 and a standardized regression weight of 0.47.

In Domain 3, it is evident that the three items related to social relationship loaded well. QB22 (Satisfaction with support from friends) and QB21 (Satisfaction with sexuality) variables appear to be the best indicators of Domain 3. Their standardized regression weights are 0.76 and 0.68 respectively. Additionally, Domain 3 explained about 57% of the variance in QB22 and 47% of the variance in QB21. QB20 (Satisfaction with personal relationship) is the poorest among the social relationship indicators of Domain 3 with an R^2 of 0.35 and a standardized regression weight of 0.59.

In Domain 4, it is evident that seven out of the eight items related to the environment loaded moderately. QB8 (Safety in your daily life) and QB25 (Satisfaction with transportation) variables appear to be the best indicators of Domain 4. Their standardized regression weights are 0.78 and 0.63 respectively. Additionally, Domain 4 explained about 60% of the variance in QB8 and 40% of the variance in QB25. QB24 (Satisfaction with access to health services) is the poorest among the environmental indicators of Domain 4 with an R^2 of 0.05 which indicate that Domain 5 explains little or no variance in it, and a standardized regression weight of 0.23.

4.3.4 CFA Parameter Estimates of the Theoretical 4-Component WHOQOL (BREF) Questionnaire

The values of the standardized coefficients are presented in the summary Table 4.4. All the indicator variables were significantly related to their respective latent constructs at 1 % level of significance. The standardized error terms were used to compute the R^2 values, an indication that the proportions of variation in the latent constructs were as explained by each particular indicator. A comprehensive table showing the standardized coefficients, the associated standard error, z-value and R^2 value of each indicator variable in Model 1 is presented in the Appendix.

Measurement model for WHOQoL (BREF) questionnaire (Model 1)

$X_1 = 0.55\xi_1$

. .

. .

. .

$X_{24} = 0.63\xi_4$

4.3.5 CFA Covariances among Latent Construct of the theoretical 4-Component WHOQoL (BREF) Questionnaire

The covariance among the four (4) latent exogenous constructs of the 4–component WHOQoL (BREF) questionnaire are presented in Table 4.5. The absolute z- statistics are greater than 1.65 which implies that the covariance are significantly different from zero at 0.01 level of significance and that the domains are depending on each other.

4.3.6 Fit Indices for WHOQoL (BREF) (Model 1)

The summary of the fit indices of the fitted Model 1 using GLS estimation method are presented in Table 4.6. Only the information criterion indicated that the data set fit the Model.

Table 4.6: Fit Indices from CFA for Model 1

Model	χ^2/df	***GFI***	***RMSEA***	***AIC***
Model 1	6.290	0.845	0.081	1616.662

Note: x^2 =Chi-square statistics; df=degree of freedom; GFI=Goodness-of-Fit index; RMSEA=Root Mean Square error of approximation; AIC=Akaike's information criterion

The values from the indices indicate that the data fit the Model. GFI was close to 1 while RMSEA also showed a perfect fit of between 0.05 and 0.08.

4.3.7 Analysis of WHOQoL (BREF) and one overall QoL question (Model 2)

Analysis was carried out on the theoretical 4-component WHOQoL (BREF) and the endogenous 1-component overall QoL question.

4.3.8 Fitted Structural Equation Model (SEM) of the Theoretical WHOQoL (BREF) Questionnaire and Overall QoL Question

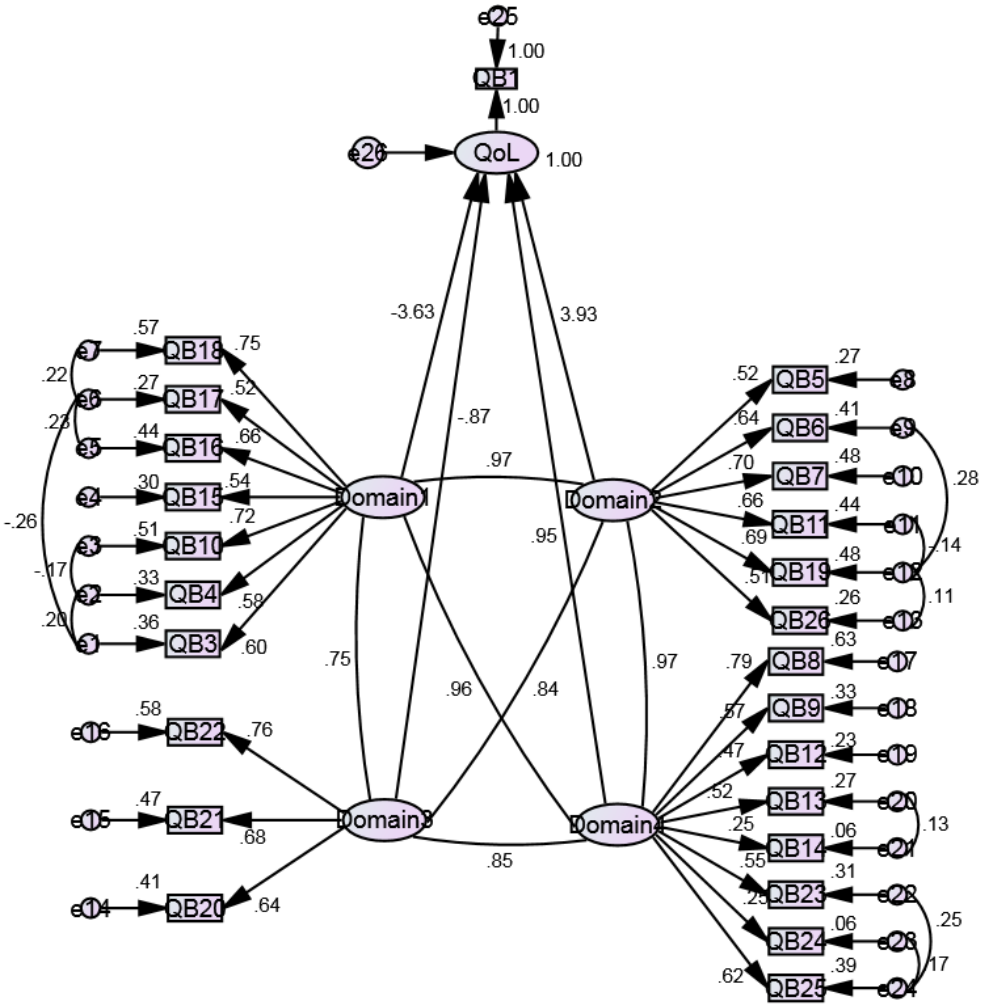


Figure 4.5. Model 2: Path diagram for Quality of Life with overall indicator for non-HIV data

The estimated path diagram with the standardized path coefficients as well as the coefficient between the latent constructs for the theoretical 4-componet exogenous WHOQoL (BREF) questionnaire and 1-component endogenous overall QoL question (Model 2) are presented in Figure 4.5. The comprehensive result of Model 1 is in the Appendix. The significant effect of the overall question QB1 can be seen in Model 2. The estimation results from path analysis

were different from some of the constructs in Model 1. Model 2 also had the structural part which revealed that while psychology domain had a positive impact on the non-infected persons, physical domain had the highest negative impact on their quality of life. Also, QoL explains all the variances in the model.

4.3.9 SEM Parameters Estimates of the Theoretical WHOQoL (BREF) Questionnaire and Overall QoL Question

The values of the standardized coefficients are presented in Table 4.4. All the indicator variables were significantly related to their respective latent construct at 1% level of significance except for those variables constrained to the value of one during the analysis to enable the models converge with minimum iterations.

Measurement model for WHOQoL (BREF) and one overall QoL question (Model 2)

$X_1 = 0.60\xi_1$

. .

. .

. .

$X_{24} = 0.62\xi_4$

$z_1 = 1.00\omega_1$

Structural model for WHOQoL (BREF) and one overall QoL question (Model 2)

$\eta = -3.63\xi_1 + 3.93\xi_2 - 0.87\xi_3 + 0.95\xi_4$ where $R^2 = 1.00$

4.3.10 SEM Covariance among Latent Constructs of the theoretical WHOQOL (BREF) Questionnaire and Overall QoL Question

The covariances between the four (4) latent exogenous constructs of the 4-component WHOQoL (BREF) questionnaire are presented in Table 4.5. Most of the variables in any particular domain depend on each other.

4.3.11 Fit Indices for WHOQoL (BREF) and one overall QoL question (Model 2)

The chi-square goodness-of-fit test of the model with other baseline fit indices are shown in Table 4.3.

4.3.12 Analysis of WHOQoL (BREF) and two overall QoL questions (Model 3)

Analysis was carried out on the theoretical 4-component WHOQoL (BREF) and the endogenous 2-component overall QoL questions using the suggested modification indices to give a model with minimum iteration.

4.3.13 Fitted Structural Equation Model (SEM) of the Theoretical WHOQoL (BREF) Questionnaire and Overall QoL Questions (Two Indicators)

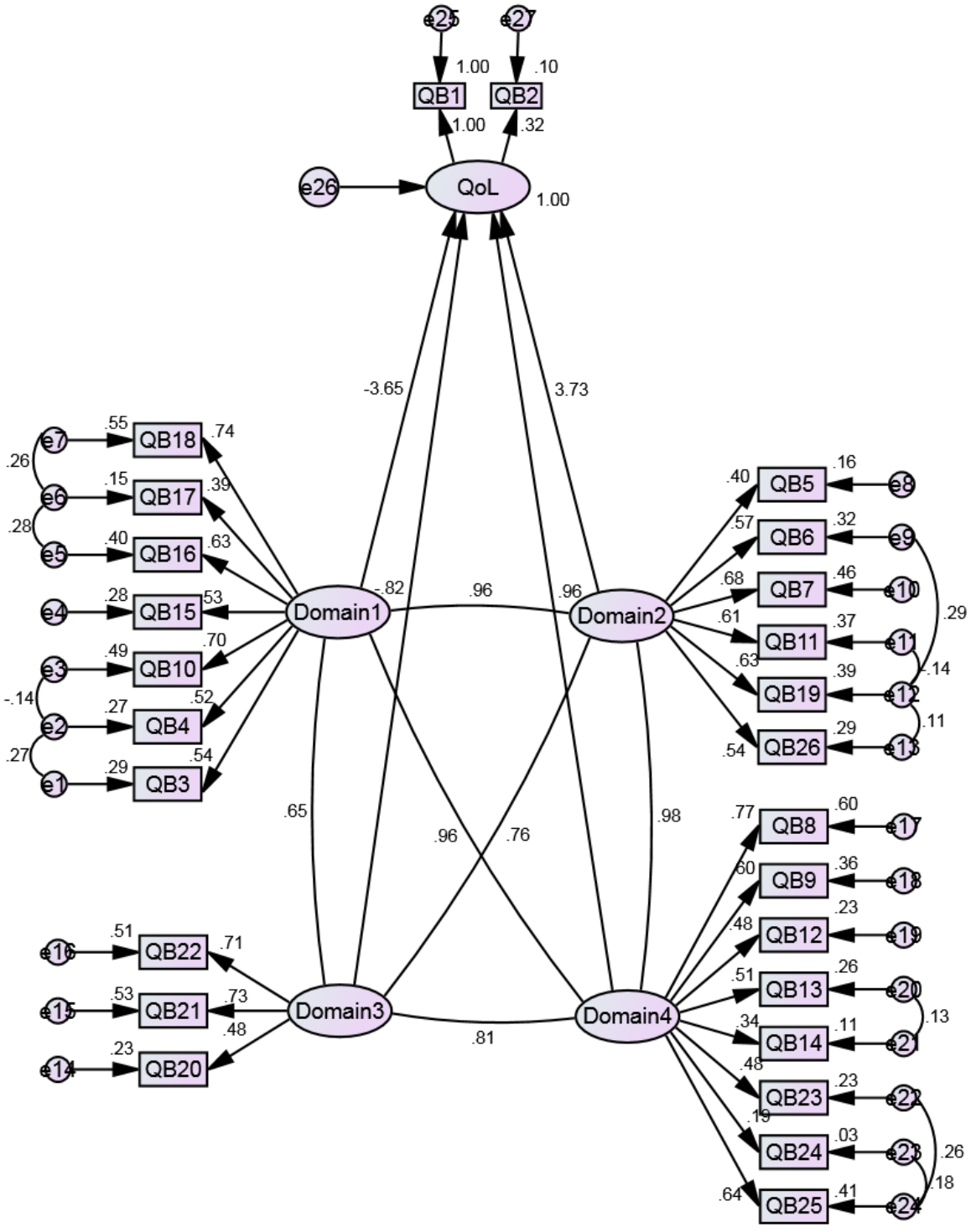


Figure 4.6. Model 3: Path diagram for Quality of Life with two overall indicators for non-HIV data

The estimated path diagram with the standardized path coefficients as well as the coefficient between the exogenous latent constructs for the theoretical 4-component WHOQoL (BREF) and the endogenous 2-component overall QoL questions (Model 3) are presented in Figure

4.6. The comprehensive result is as presented in the Appendix. The significant effect of the overall questions QB1 and QB2 can be seen in Model 3. The estimation results from path analysis were different from some of the constructs in Model 2. Model 3 also reveals that while psychology domain had a positive impact on the non-infected persons, physical domain has the highest negative impact on their quality of life. Also, QoL explains all the variances in the model.

4.3.14 SEM Parameter Estimates of the Theoretical WHOQoL (BREF) Questionnaire and the Overall QoL Questions (Two Indicators)

The values of the standardized coefficients, and their significance level are presented in Table 4.4. All the indicator variables were significantly related to their respective latent constructs at 1% level of significance. The table also revealed that there were negative relationship between domains 3 (LID), 1 (PHD) and QoL which implies that for every unit increase in the level of independence and physical appearance of an HIV negative person, there is a corresponding reduction or decline in his or her quality of life. A comprehensive table showing the standardized coefficients, the associated standard error, z-value and R^2 value of each indicator variable in Model 3 is presented in the Appendix.

Measurement model for WHOQoL (BREF) and two overall QoL questions (Model 3)

$X_1 = 0.54\xi_1$

. .

. .

. .

$X_{24} = 0.64\xi_4$

$z_1 = 1.00\omega_1 + 0.32\omega_2$

Structural model for WHOQoL (BREF) and two overall QoL questions (Model 3)

$\eta = -3.65\xi_1 + 3.73\xi_2 - 0.82\xi_3 + 0.96\xi_4$ where R^2= 1.00

4.3.15 SEM Covariance among Latent Constructs of the Theoretical WHOQoL (BREF) Questionnaire and the Overall QoL Questions (Two Indicators)

The covariance among the four (4) latent exogenous constructs of the theoretical 4-component WHOQoL (BREF) questionnaire and 2-component endogenous overall QOL questions are shown in Table 4.5. Most of the variables in any particular domain depend on each other.

4.3.16 Fit indices for WHOQoL (BREF) and two overall QoL questions (Model 3)

The chi-square goodness-of-fit test of the model with other baseline fit indices are shown in Table 4.3.

4.3.17 Analysis of WHOQoL (BREF) and SWLS questionnaire (Model 4)

Analysis was carried out on the theoretical 4-component WHOQoL (BREF) and satisfaction with life questionnaire.

4.3.18 Fitted Structural Equation Model (SEM) of the Theoretical WHOQoL (BREF) Questionnaire and Satisfaction with Life Scale Questionnaire

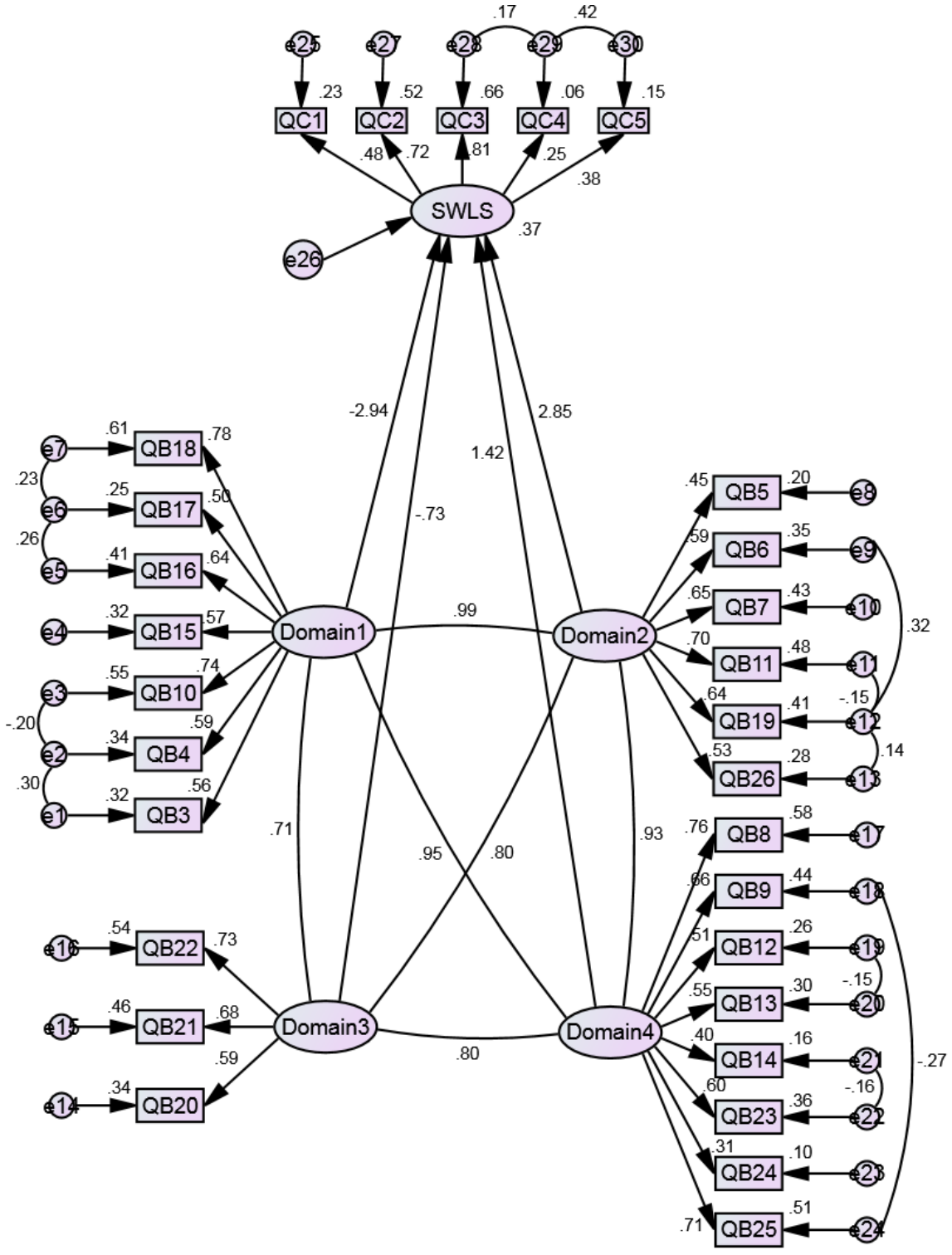


Figure 4.7. Model 4: Path diagram for Quality of Life with Satisfaction with Life Scale (SWLS) for non-HIV data

The estimated path diagram with standardized path coefficients as well as the coefficient between the latent exogenous constructs for the theoretical 4-component WHOQoL (BREF)

and the 5-component endogenous SWLS question (Model 4) are presented in Figure 4.7. The significant effect of a structural part SWLS can be seen in Model 4. The estimation results from path analysis were different from some of the constructs in Model 3. The model also gave information on the structural part showing that only indicators QC2 (The conditions of my life are excellent) and QC3 (I am satisfied with my life) had high impact on the endogenous variable SWLS. SWLS only explains about 37% variance of the model.

4.3.19 SEM Parameter Estimates of the Theoretical WHOQoL (BREF) Questionnaire and SWLS Questionnaire

The values of the standardized coefficients are presented in Table 4.4. All the indicator variables were significantly related to their respective latent constructs at 1% level of significance. The table also revealed that there were negative relationship between domains 3 (LID), 1 (PHD) and SWLS which implies that for every unit increase in the level of independence and physical appearance of a non-infected person, there is a corresponding reduction or decline in his or her satisfaction with life. A comprehensive table showing the standardized coefficients, the associated standard error, z-value and R^2 value of each indicator variable in Model 4 is presented in the Appendix.

Measurement model for WHOQoL (BREF) and SWLS questionnaire (Model 4)

$X_1 = 0.56\xi_1$

. .

. .

. .

$X_{24} = 0.71\xi_4$

$Y_1 = 0.48\alpha_1$

$Y_2 = 0.72\alpha_1$

$Y_3 = 0.81\alpha_1$

$Y_4 = 0.25\alpha_1$

$Y_5 = 0.38\alpha_1$

Structural model for WHOQoL (BREF) and SWLS questionnaire (Model 4)

$\eta = -2.94\xi_1 + 2.85\xi_2 - 0.73\xi_3 + 1.42\xi_4$ where $R^2 = 0.366$

4.3.20 SEM Covariance among Latent Constructs of the Theoretical WHOQoL (BREF) Questionnaire and SWLS Questionnaire

The covariance among the four (4) latent exogenous constructs of the 4-component WHOQoL (BREF) and 5-component endogenous SWLS questionnaire are presented in Table 4.5. Most of the variables in any particular domain depend on each other.

4.3.21 Fit Indices WHOQoL (BREF) and SWLS questionnaire (Model 4)

The chi-square goodness-of-fit test of the model with other baseline fit indices are shown in Table 4.3.

4.3.22 Analysis of WHOQoL (BREF) and SWLS questionnaire with one overall QoL question (Model 5)

Analysis was carried out on the theoretical 4-component WHOQoL (BREF), satisfaction with life scale questionnaire and the endogenous 1-component overall QoL question.

4.3.23 Fitted Structural Equation Model (SEM) of the Theoretical WHOQoL (BREF) Questionnaire, Overall QoL Question and SWLS Questionnaire

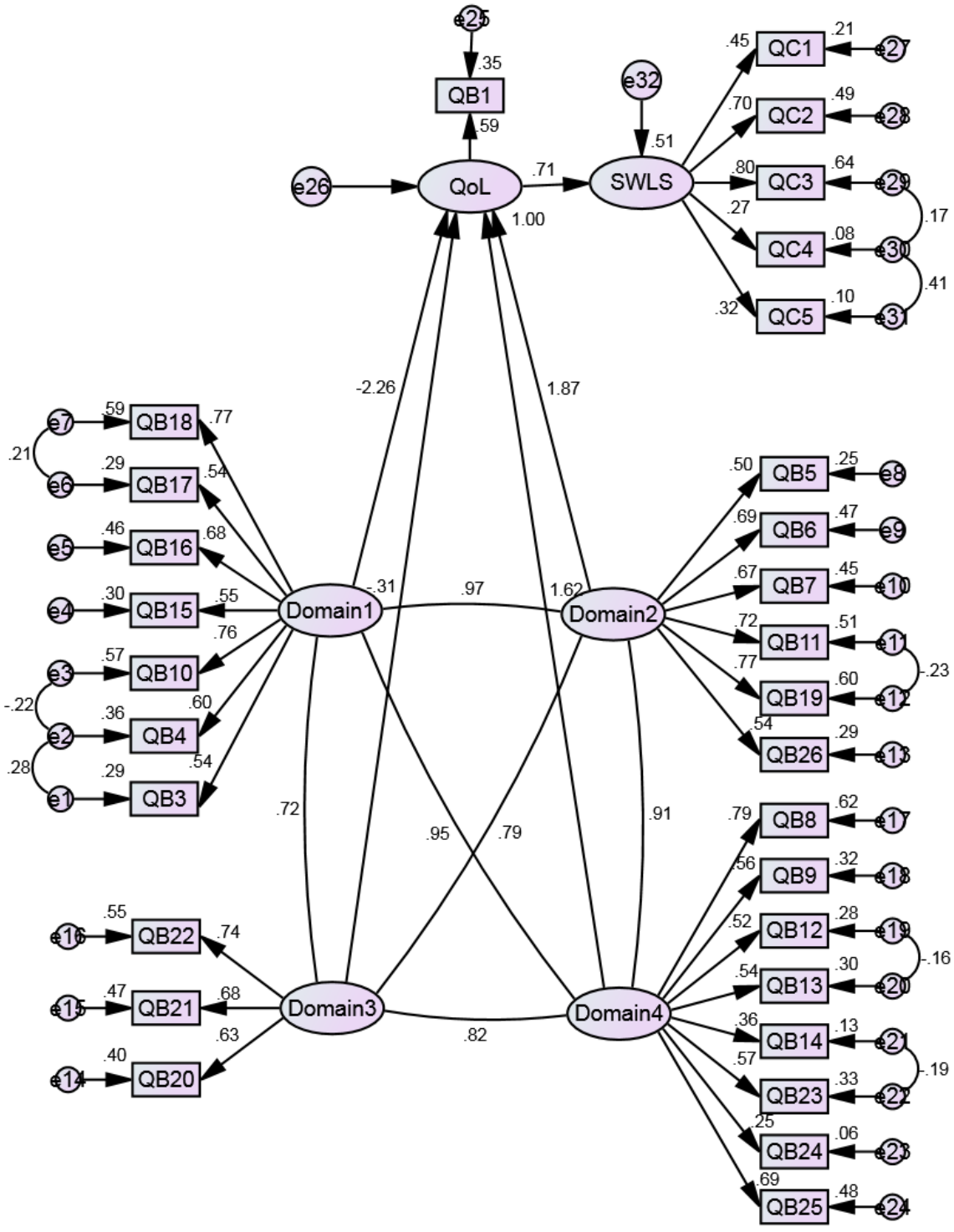


Figure 4.8. Model 5: Path diagram for Quality of Life with overall QoL and Satisfaction with Life Scale (SWLS) for non-HIV data

The estimated path diagram with standardized path coefficients as well as the coefficient between the exogenous latent constructs for the theoretical 4-component WHOQoL (BREF),

the 1-component endogenous QoL question and the 5-component exogenous SWLS questions (Model 5) are presented in Figure 4.8. The model also showed the correlation among some selected error terms which were used to improve the model fit.

The model gave information on the structural part as follows: QB1 had high impact on QoL, while only indicators QC2 (The conditions of my life are excellent) and QC3 (I am satisfied with my life) had very high impact on the endogenous variable SWLS. Where β coefficient is 0.71 indicating a high impact of SWLS on the QoL of a non-infected person. The causal effect of the Domains is on QoL as follows: psychology domain (ξ_2) had the most substantial causal effect on QoL (η) which is slightly higher than environmental domain (ξ_4), while as physical domain (ξ_1) and social relationship domain (ξ_3) increases, there is a decline in the quality of life of a non-infected person. Also, the estimated residual variance on SWLS was good (0.51). The significant effect of two structural parts on Model 5 can be seen in the high impact of SWLS on the QoL. The estimation results from path analysis were different from some of the constructs in Model 4. The model also gave information on the structural part that indicators QC2 (The conditions of my life are excellent) and QC3 (I am satisfied with my life) had high impact on the endogenous variable SWLS. Model 5 also reveals that while psychology domain had a positive impact on the non-infected persons, physical domain has the highest negative impact on their quality of life. Also, QoL explains more than 50% of the variances in SWLS.

4.3.24 SEM Parameter Estimates of the Theoretical WHOQoL (BREF), Overall QoL Question and SWLS Questionnaire

The values of the standardized coefficients are presented in Table 4.4. All the indicator variables were significantly related to their respective latent constructs at 1% level of significance. The table also showed that there were negative relationships between domains 3 (LID), 1 (PHD) and QOL which implies that for every unit increase in the level of dependence and physical appearance of a non-infected person, there is a corresponding reduction or decline in the perception of quality of life of the person. A comprehensive table showing the standardized coefficients, the associated standard error, z-value and R^2 value of each indicator variable in Model 5 is presented in the Appendix.

Measurement model for WHOQoL (BREF) and SWLS questionnaire with one overall QoL question (Model 5)

$X_1 = 0.54\xi_1$

. .

. .

. .

$X_{24} = 0.69\xi_4$

$z_1 = 0.59\omega_1$

$Y_1 = 0.45\alpha_1$

$Y_2 = 0.70\alpha_1$

$Y_3 = 0.80\alpha_1$

$Y_4 = 0.27\alpha_1$

$Y_5 = 0.32\alpha_1$

Structural model for WHOQoL (BREF) and SWLS questionnaire with one overall QoL question (Model 5)

$\eta = 0.71\eta_1 - 2.26\xi_1 + 1.87\xi_2 - 0.31\xi_3 + 1.62\xi_4$ where $R^2 = 0.510$

4.3.25 SEM Covariances among Latent Constructs of the Theoretical WHOQoL (BREF) Questionnaire, Overall QoL Question and SWLS Questionnaire

The covariance among the four (4) latent exogenous constructs of the 4-component WHOQoL (BREF), 1-component endogenous overall QoL question and 5-component exogenous SWLS questions are presented in Table 4.5. Most of the variables in any particular domain depend on each other.

4.3.26 Fit Indices for WHOQoL (BREF) and SWLS questionnaire with one overall QoL question (Model 5)

The chi-square goodness-of-fit test of the model with other baseline fit indices are shown in Table 4.3.

4.3.27 Analysis of WHOQoL (BREF) and SWLS questionnaire with two overall QoL questions (Model 6)

Analysis was carried out on the theoretical 4-component WHOQoL (BREF), satisfaction with life scale questionnaire and the endogenous 2-component overall QoL question.

4.3.28 Fitted structural equation model (SEM) of the theoretical WHOQoL (BREF) questionnaire overall quality of life question (two indicators) and satisfaction with life scale questionnaire

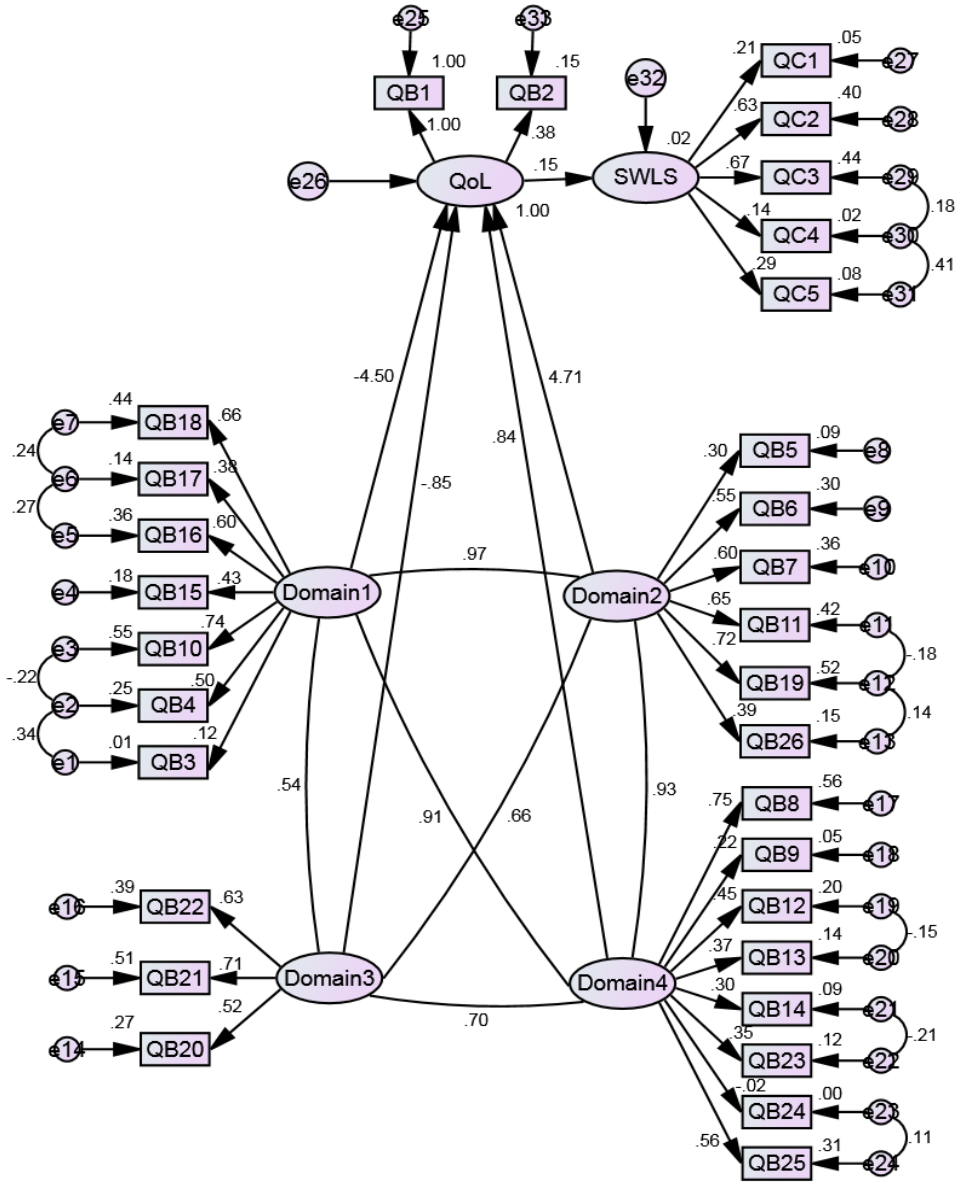


Figure 4.9. Model 6: Path diagram for Quality of Life with two indicators for overall QoL and Satisfaction with Life Scale (SWLS) for non-HIV data

The estimated path diagram with standardized path coefficients as well as the coefficient between the exogenous latent constructs for the theoretical 4-component WHOQoL (BREF), the 2-component endogenous QoL questions and the 5-component exogenous SWLS questions (Model 6) are presented in Figure 4.9. The model also showed the correlation among some selected error terms which were used to improve the model fit. The β coefficient is 0.15 indicating a low impact of SWLS on the QoL of a non-infected person. The estimated residual variance was very small (0.02) meaning that the QoL explains practically no variance in SWLS. The significant effect of an additional quality of life overall

question QB2 can be seen in the estimation results from the path analysis which were different from some of the constructs in Model 5. The model also shows that QB1 had a very high impact on QoL, a lower impact of SWLS on QoL and that QoL explains practically no variance in SWLS of the model.

4.3.29 SEM Parameter Estimates of the Theoretical WHOQoL (BREF), Overall QoL questions and SWLS Questionnaire

The values of the standardized coefficients are presented in Table 4.4. All the indicator variables were significantly related to their respective latent component at 1% level of significance. The table also showed that there were negative relationships between domains 3 (LID), 1 (PHD) and QoL, also, between domain 4 (SRD) and QB24 (How satisfied are you with your life?) which implies that for every unit increase in the level of dependence and physical appearance of a non-infected person there is a corresponding reduction or decline in their quality of life, also an increase in the social relationship of the person reduces personal satisfaction of life of the person. A comprehensive table showing the standardized coefficients, the associated standard error, z-value and R^2 value of each indicator variable in Model 6 is presented in the Appendix.

Measurement model for WHOQoL (BREF) and SWLS questionnaire with two overall QoL questions (Model 6)

$$X_1 = 0.12\xi_1$$

. .

. .

. .

$$X_{24} = 0.56\xi_4$$

$$z_1 = 1.00\omega_1 + 0.38\omega_2$$

$$Y_1 = 0.21\alpha_1$$

$$Y_2 = 0.63\alpha_1$$

$$Y_3 = 0.67\alpha_1$$

$$Y_4 = 0.14\alpha_1$$

$$Y_5 = 0.29\alpha_1$$

Structural model for WHOQoL (BREF) and SWLS questionnaire with two overall QoL questions (Model 6)

$\eta = 0.15\eta_1 - 4.50\xi_1 + 4.71\xi_2 - 0.85\xi_3 + 0.84\xi_4$

$R^2 = 0.023$

4.3.30 SEM Covariance among Latent Constructs of the Theoretical WHOQoL (BREF) Questionnaire, Overall QoL Questions (Two Indicators) and SWLS Questionnaire

The covariance among the four (4) latent exogenous constructs of the 4-component WHOQOL (BREF), 2-component endogenous QoL questions and 5-component exogenous SWLS questions are presented in Table 4.5. Most of the variables in any particular domain depend on each other.

4.3.31 Fit Indices for WHOQoL (BREF) and SWLS questionnaire with two overall QoL questions (Model 6)

The chi-square goodness-of-fit test of the model with other baseline fit indices are shown in Table 4.3.

4.4 Results of Analysis on HIV Data

The results of the theoretical 6-component of the WHOQoL-HIV (BREF) questionnaire was used with the SWLS questions for HIV data under SEM, the results obtained are as presented. The components are Physical; Psychological; Level of Independence; Social Relationship; Environmental; and Spirituality Religion and Personal Believe.

4.4.1 Model Fit Comparison for ML and GLS (HIV data)

Comparison of the various model fit indices were made using ML estimation and GLS for the modified models as shown in Table 4.7 below.

Table 4.7: Comparison of ML & GLS for HIV data (Models 7 to Model 12)

Model fit Indices		**Model 7**	**Model 8**	**Model 9**	**Model 10**	**Model 11**	**Model 12**
χ^2	ML	3027.413	2680.255	2259.273	2575.929	3169.598	2761.815
	GLS	1053.94	1149.00	1214.98	1508.79	1559.46	1649.48

Df	ML	379	387	414	507	541	573
	GLS	352	385	412	507	539	573
χ^2/df	ML	7.988	6.926	5.457	5.081	5.859	4.819
	GLS	2.994	2.984	2.949	2.976	2.893	2.879
GFI	ML	0.686	0.769	0.787	0.780	0.764	0.779
	GLS	0.871	0.864	0.861	0.842	0.842	0.837
RMSEA	ML	0.111	0.103	0.089	0.085	0.093	0.082
	GLS	0.060	0.059	0.059	0.059	0.058	0.058
AIC	ML	3139.413	2836.255	2423.273	2751.929	3347.598	2947.815
	GLS	1219.935	1308.995	1382.976	1684.785	1741.459	1835.484

Source: Results from computer output

Table 4.7 clearly shows that the estimation method by GLS performs better than that of ML for the models. It also revealed a different pattern from the non-HIV data. Using χ^2 fit indices, Model 7 performs better under GLS than Model 9 which performed best under ML. Using DF indices, Model 7 performs better than other Models under GLS. Using χ^2/df and RMSEA indices, Model 12 performs better than other Models under GLS. While using GFI indices, Model 7 under ML performs better than Model 12 which was the best under GLS. Also, using AIC indices, Model 7 performs better under GLS than Model 9 which was the best under ML.

It also showed that the values for GFI were closer to 1 in GLS than in ML. Furthermore, RMSEA values were between 0.05 and 0.08 in all the Models for GLS estimation method. Therefore, it is concluded that the sample variance-covariance of the data used fit the structural equation models.

4.4.1 Analysis of WHOQoL –HIV (BREF) (Model 7)

Analysis was carried out on the theoretical 6-component WHOQOL-HIV (BREF) only and the following results are obtained.

Table 4.8: Summary of SEM Parameter Estimates for HIV data (Models 7 to 12)

			Model 7	**Model 8**	**Model 9**	**Model 10**	**Model 11**	**Model 12**
Indicator Variable		**Latent Construct**	**Estimates**					
SWLS	<---	Domain2				0.251		
SWLS	<---	Domain5				-0.055		
SWLS	<---	Domain3				-0.513		
SWLS	<---	Domain4				0.031		
SWLS	<---	Domain6				0.017		
SWLS	<---	Domain1				0.401		
QoL	<---	Domain2		0.356	0.499		0.711	0.484
QoL	<---	Domain5		-0.757	-0.013		-0.367	-0.073
QoL	<---	Domain3		-9.294*	-4.576		-1.101	-0.95
QoL	<---	Domain4		-1.136	-0.782		-0.056	-0.246
QoL	<---	Domain6		0.790	0.703		0.076	0.062
QoL	<---	Domain1		8.206	4.598		0.939	0.751
SWLS	<---	QoL					0.536*	0.418*
*QB3	<---	Domain1	0.636	0.358	0.474	0.676	0.661	0.655
QB4	<---	Domain1	0.724*	0.357*	0.589*	0.746*	0.729*	0.687*
QB14	<---	Domain1	-0.548*	-0.727*	-0.583*	-0.503*	-0.566*	-0.575*
QB21	<---	Domain1	-0.466*	-0.645*	-0.520*	-0.445*	-0.483*	-0.538*
*QB6	<---	Domain2	0.223	0.321	0.197	0.258	0.305	0.298
QB11	<---	Domain2	0.203*	0.297*	0.238*	0.199*	0.216*	0.143*
QB15	<---	Domain2	0.360*	0.533*	0.3958*	0.324*	0.381*	0.381*
QB24	<---	Domain2	0.639*	0.775*	0.6998*	0.621*	0.649*	0.705*
*QB5	<---	Domain3	0.540	0.284	0.507	0.567	0.547	0.495
QB20	<---	Domain3	-0.324*	-0.591*	-0.342*	-0.314*	-0.397*	-0.419*
QB22	<---	Domain3	-0.597*	-0.700*	-0.618*	-0.584*	-0.612*	-0.624*
QB23	<---	Domain3	-0.598*	-0.727*	-0.642*	-0.558*	-0.585*	-0.639*
*QB17	<---	Domain4	0.352	0.280	0.271	0.349	0.361	0.345
QB25	<---	Domain4	0.607*	0.803*	0.757*	0.606*	0.605*	0.607*

QB26	<---	Domain4	0.548*	0.489*	0.473*	0.543*	0.540*	0.552*
QB27	<---	Domain4	0.488*	0.677*	0.644*	0.478*	0.517*	0.53*
*QB12	<---	Domain5	0.352	0.596	0.468	0.340	0.426	0.405
QB13	<---	Domain5	0.463*	0.430*	0.461*	0.477*	0.494*	0.47*
QB16	<---	Domain5	0.218*	0.373*	0.231*	0.199*	0.182*	0.208*
QB18	<---	Domain5	0.303*	0.300*	0.289*	0.312*	0.350*	0.314*
*QB7	<---	Domain6	0.054	0.090	0.057	0.049	0.075	0.048
QB8	<---	Domain6	-0.385	-0.326	-0.376	-0.397	-0.408	-0.393
QB9	<---	Domain6	-0.878	-0.795	-0.833	-0.900	-0.893	-0.881
*QB10	<---	Domain6	-0.765	-0.793	-0.799	-0.762	-0.766	-0.764
QB31	<---	Domain2	-0.476*	-0.165*	-0.409*	-0.511*	-0.485*	-0.434*
QB19	<---	Domain5	0.313*	0.294*	0.272*	0.319*	0.324*	0.307*
QB28	<---	Domain5	0.489*	0.608*	0.537*	0.47*	0.480*	0.52*
QB29	<---	Domain5	0.550*	0.635*	0.621*	0.554*	0.575*	0.577*
QB30	<---	Domain5	0.561*	0.478*	0.515*	0.568*	0.546*	0.552*
QB1	<---	QoL		1.000*	0.480		0.496	
QB2	<---	QoL			1.000*			0.709*
*QC1	<---	SWLS				0.495	0.496	0.473
QC2	<---	SWLS				0.812*	0.806*	0.787*
QC3	<---	SWLS				0.779*	0.781*	0.802*
QC4	<---	SWLS				0.540*	0.544*	0.514*
QC5	<---	SWLS				0.426*	0.430*	0.408*

Note: *Significant at 1% level of significance
*Reference variables
Source: Results from computer output

Table 4.8 shows the SEM parameter for the six theoretical models from the WHOQoL-HIV (BREF) and SWLS questionnaires as follows: Model 8 shows that quality of life has a significant impact on the level of dependence of an infected person. It also shows that how an infected person rated his or her quality of life has a significant effect on the overall quality of life.

Model 9 and 12 show that the satisfaction of an infected person with his or her health has a significant impact on the overall quality of life.

Models 11 and 12 show a significant impact of satisfaction with life on the overall quality of life of an infected person.

Furthermore, in all the Models, Domains 1, 2, 3, 4 and 5 have all their indicator variables significant except for the variables that were constrained to the value of one for us to have

models that will converge with minimum iterations. But for Domain 6 which is the spirituality, region and personal believe construct, none of the indicator variable was significant in all the models. Similarly, none of the models was significant with the indicator in most ways my life is close to my ideal.

Table 4.9: Summary of Covariance Estimates for HIV data (Models 7 to 12)

			Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Domain	<---	Domain	Estimates					
1	<---	2	-0.070*	-0.053*	-0.045*	-0.080*	-0.092*	-0.083*
1	<---	3	0.327*	0.076*	0.220*	0.362*	0.332*	0.278*
1	<---	4	-0.078*	-0.032*	-0.039*	-0.081*	-0.084*	-0.076*
1	<---	5	-0.048*	-0.060*	-0.054*	-0.043*	-0.061*	-0.051*
1	<---	6	-0.011	-0.006	-0.008	-0.010	-0.015	-0.008
2	<---	3	-0.070*	-0.052*	-0.054*	-0.080*	-0.090*	-0.081*
2	<---	4	0.024*	0.030*	0.014*	0.026*	0.034*	-0.032*
2	<---	5	0.018*	0.060*	0.022*	0.017*	0.028*	0.025*
2	<---	6	0.003	0.005	0.003	0.003	0.005	0.003
3	<---	4	-0.096*	-0.036*	-0.058	-0.095*	0.099*	-0.082*
3	<---	5	-0.043*	-0.062*	-0.067*	-0.037*	-0.053*	-0.047*
3	<---	6	-0.009	-0.005	0.002	-0.008	-0.012	-0.006
4	<---	5	0.028*	0.046*	0.027*	0.024*	-0.035*	0.032*
4	<---	6	0.004	0.003	0.002	0.003	0.005	0.003
5	<---	6	0.002	0.005	0.003	0.002	0.004	0.002

***** Significant at 0.01 level of significance

Source: Results from computer output

The covariance among the six (6) latent exogenous constructs of the theoretical 6-component WHOQoL-HIV (BREF) questionnaire are shown in Table 4.9. Most of the estimates were significantly different from zero at 0.01 and 0.05 levels of significance, except for the covariance between Domain 12 and every other domain.

4.4.2 Factor Loading Fitting Chart of the Theoretical 6-Component WHOQoL-HIV (BREF) Questionnaire

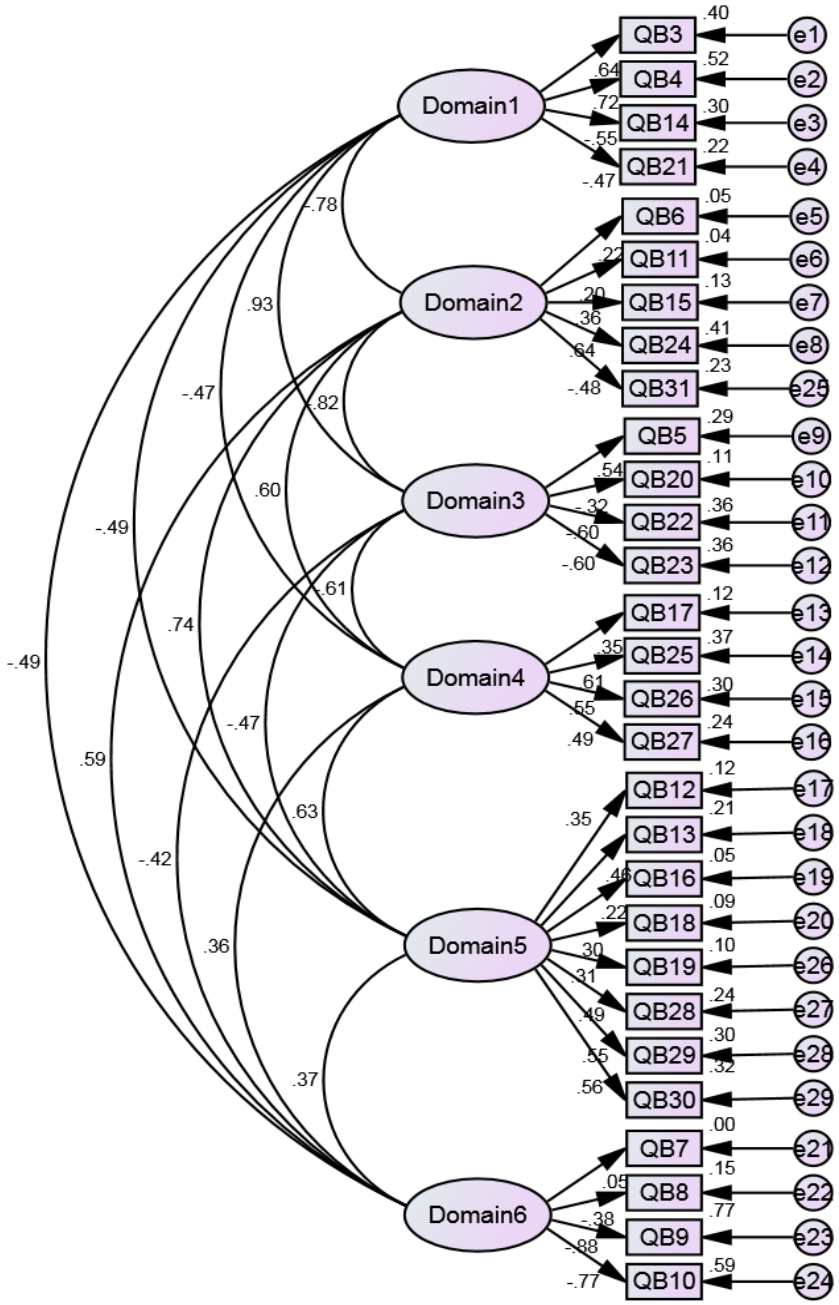


Figure 4.10. Model 7: Path diagram for health related Quality of Life for HIV data

The estimated path diagram with the standardized path coefficients the coefficients between the latent constructs for the 6 components WHOQoL-HIV (BREF) questionnaire (Model 7) are presented in Figure 4.10. The standardized error term of each indicator variable was also reported. The latent constructs were moderately and highly correlated rating (between -0.78

and 0.93). Under the first level or direct correlation between the domains, the path diagram showed that Domains 5 and 6 had a very weak relationship while Domains 2 and 3 had a very strong relationship. Fig. 4.10 also showed that most of the indicators contributed significantly to the different domains using 0.5 as a standard as follows: In Domain 1, it is evident that the four items related to physical appearance loaded well. QB3 (To what extent do physical pain prevents you?) and QB4 (How much are you bothered by any physical problems?) variables appear to be the best indicators of Domain 1. Their standardized regression weights are 0.64 and 0.72 respectively. Additionally, Domain 1 explained about 40% of the variance in QB3 and 52% of the variance in QB4. QB21 (How satisfied are you with sleep?) is the poorest among the physical indicators of Domain 1 with an R^2 of 0.22 and a standardized regression weight of -0.47.

In Domain 2, it is evident that only three out of five items related to psychology loaded well. QB24 (How satisfied are you with yourself?) and QB31 (How often do you have negative feelings?) variables appear to be the best indicators of Domain 2. Their standardized regression weights are 0.64 and -0.48 respectively. Additionally, Domain 2 explained about 41% of the variance in QB24 and 23% of the variance in QB31. QB11 (How well are you able to concentrate?) is the poorest among the psychology indicators of Domain 2 with an R^2 of 0.04 and a standardized regression weight of 0.20.

In Domain 3, it is evident that the four items related to level of dependence loaded well. QB22 (Satisfaction with ability to perform daily activities) and QB23 (Satisfaction with capacity to work) variables appear to be equal and best indicators of Domain 3. Their standardized regression weights are -0.60. Additionally, Domain 3 explained about 36% each of the variances in both QB22 and QB23. QB20 (How well are you able to get around?) is the poorest among the level of dependence indicators of Domain 3 with an R^2 of 0.11 and a standardized regression weight of 0.32.

In Domain 4, it is evident that the four items related to social relationship loaded well. QB25 (Satisfaction with personal relationships) and QB26 (Satisfaction with sexuality) variables appear to be the best indicators of Domain 4. Their standardized regression weights are 0.61 and 0.55 respectively. Additionally, Domain 4 explained about 37% of the variance in QB25 and 30% of the variance in QB26. QB17 (Extent of acceptability by people) is the poorest among the social relationship indicators of Domain 4 with an R^2 of 0.12 and a standardized regression weight of 0.35.

In Domain 5, it is evident that the seven out of the eight items related to the environment loaded moderately. QB30 (Satisfaction with transportation) and QB29 (Satisfaction with

access to health services) variables appear to be the best indicators of Domain 5. Their standardized regression weights are 0.56 and 0.55 respectively. Additionally, Domain 5 explained about 32% of the variance in QB30 and 30% of the variance in QB29. QB16 (Have you enough money to meet your needs?) is the poorest among the environmental indicators of Domain 5 with an R^2 of 0.05 which indicate that Domain 5 explains little or no variance in it, it has a standardized regression weight of 0.22.

In Domain 6, it is evident that only three out of four items related to the spirituality loaded well. QB9 (Fear of the future) and QB10 (Worry about death) variables appear to be the best indicators of Domain 6. Their standardized regression weights are -0.88 and -0.77 respectively. Additionally, Domain 6 explained about 77% of the variance in QB9 and 59% of the variance in QB10. QB7 (To what extent do you think your life is meaningful?) is the poorest among the spirituality indicators of Domain 6 with an R^2 of 0.00 meaning that Domain 6 explains practically no variance in it, it has a standardized regression weight of 0.05.

4.4.2 CFA Parameter Estimates of the Theoretical 6-Component WHOQOL-HIV (BREF) Questionnaire

The values of the standardized coefficients, the associated standard error and z-value of each indicator variable are presented in Table 4.8. All the indicator variables were significantly related to their respective latent constructs at 1% level of significance except the indicator variables that loaded on Domain 6 (SPD). The indicator variables without p-values were constrained to the value of one during the analysis.

Measurement model for WHOQoL -HIV(BREF) (Model 7)

$X_1 = 0.64\xi_1$

. .

. .

. .

$X_{29} = -0.77\xi_6$

4.4.3 CFA Covariance among Latent Constructs of the Theoretical 6-Component WHOQOL-HIV (BREF) Questionnaire

The covariance among the six (6) latent exogenous constructs of the theoretical 6-component WHOQoL-HIV (BREF) questionnaire are shown in Table 4.9. Most of the estimates were significantly different from zero at 0.01 level of significance, except for the covariance between Domain 1 and 6; Domain 2 and 6; Domain 3 and 6; Domain 4 and 6; Domain 5 and 6.

4.4.4 Fit indices of the models from confirmatory factor analyses of the WHOQOL-HIV (BREF) Questionnaire

The chi-square goodness-of-fit test of the model with other baseline fit indices using GLS estimation method are as shown in Table 4.7. The chi-square was significant, an indication that there is difference between the observed and expected covariance matrices. However the chi-square indicator is highly dependent on sample size, so relative chi-square $\chi^2(\chi^2/df < 3 = 2.994)$ which adjusted for the sample size shown. The fit indices (GFI = 0.871, RMSEA= 0.060) and the information criterion (AIC = 1219.935) confirmed that the model fit the independent dataset set.

4.4.5 Analysis of WHOQoL-HIV (BREF) and one overall QoL question (Model 8)

Analysis was carried out on the theoretical 6-component WHOQoL-HIV (BREF) and the endogenous 1-component overall QoL question, but the solution was inadmissible, that is the model could not converge at the end of iteration. Therefore, the suggested modification indices were incorporated to give a model with minimum iteration.

4.4.6 Fitted Structural Equation Model (SEM) of the Theoretical WHOQOL-HIV (BREF) questionnaire and Overall QoL question

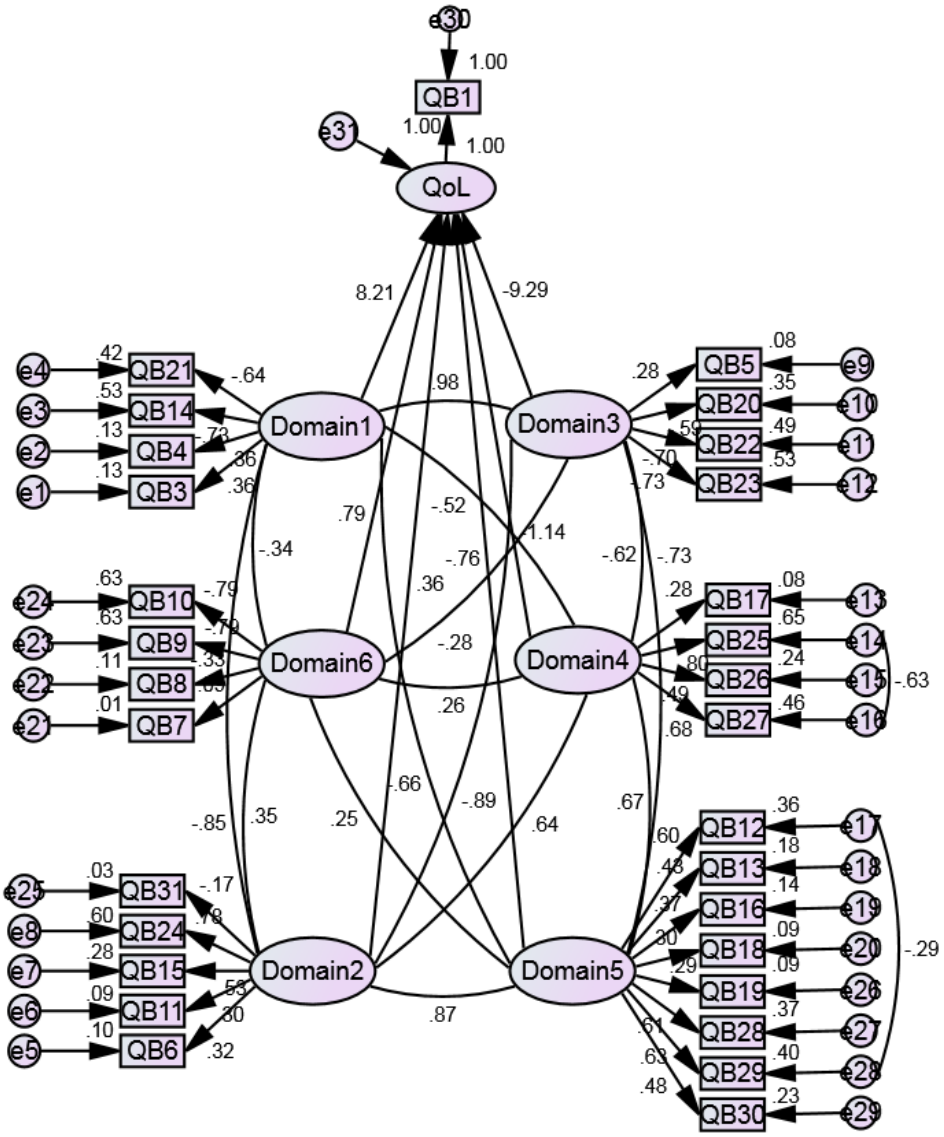


Figure 4.11. Model 8: Path diagram for health related Quality of Life with the overall QOL for HIV data

The estimated path diagram with the standardized path coefficients as well as the coefficient between the exogenous latent constructs for the theoretical 6-component WHOQOL-HIV

(BREF) and the endogenous 1-component overall QoL question (Model 8) are presented in Figure 4.11. The model gave information on the structural part as follows: the indicator variable QB1 had a very high impact on QoL which is also the endogenous variable. The estimated structural equation indicated that physical domain (ξ_1) had the most substantial causal effect on QoL (η) which was much more higher than spirituality (ξ_6) and psychological domain (ξ_2), while as level of independence (ξ_3), social relationship (ξ_4) and environmental domain (ξ_5) increases, quality of life declines. Also, the estimated residual variance was large (1.0). The significant effect of the overall question QB1 can be seen in Model 8. The estimation results from the path analysis were obviously different from those of Model 7 in most of the constructs except for Domain 6. Also, Model 8 has a structural part which shows that while physical domain has a positive impact on the infected persons, level of independence has the highest negative impact on their quality of life.

4.4.7 SEM Parameter Estimates of the Theoretical WHOQOL-HIV (BREF) Questionnaire and the Overall QoL Question

The values of the standardized coefficients, the associated standard error, the z-value and R^2 of each indicator variable are presented in summary Table 4.8. Most of the indicator variables were significantly related to their respective latent factors at 1% level of significance except for the indicator variables on Domain 6 (Spirituality religion and personal believe). The standardized error term of each indicator variable was also reported. The table also shows that there are negative relationships between domains 3, 4, 5 and QoL which implies that for every unit increase in the level of independence, change in environment and social relationship of an HIV infected person, there is a corresponding reduction or decline in his/her quality of life. A comprehensive table showing the standardized coefficients, the associated standard error, z-value and R^2 value of each indicator variable in Model 8 is presented in the Appendix.

Measurement model for WHOQoL-HIV (BREF) and one overall QoL question (Model 8)

$X_1 = 0.36\xi_1$

. .

. .

. .

$X_{29} = -0.79\xi_6$

$Y_1 = 1.00\omega_1$

Structural model for WHOQoL-HIV (BREF) and one overall QoL question (Model 8)

$\eta = 8.21\xi_1 + 0.36\xi_2 - 9.29\xi_3 - 1.14\xi_4 - 0.76\xi_5 + 0.79\xi_6$ where R^2= 1.00

4.4.8 SEM COVARIANCES among Latent Constructs of the Theoretical WHOQOL-HIV (BREF) and the Overall QoL question

The covariances among the six (6) latent exogenous constructs of the theoretical 6–components WHOQoL-HIV (BREF) questionnaire and 1-component endogenous overall QoL question are presented in Table 4.9. Most of the variables in any particular domain depend on each other except for Domain 6.

4.4.9 Fit Indices for WHOQoL-HIV (BREF) and one overall QoL question (Model 8)

The chi-square goodness-of-fit test of the model with other baseline fit indices are shown in Table 4.7.

4.4.10 Analysis of WHOQoL-HIV (BREF) and 2 overall QoL questions (Model 9)

Analysis was carried out on the theoretical 6-component WHOQoL-HIV (BREF) and the endogenous 2-component overall QoL questions, but the solution was inadmissible. Therefore, the suggested modification indices were incorporated to give a model with minimum iteration.

4.4.11 Fitted Structural Equation Model (SEM) of the Theoretical WHOQOL-HIV (BREF) questionnaire and overall QoL questions (two indicators)

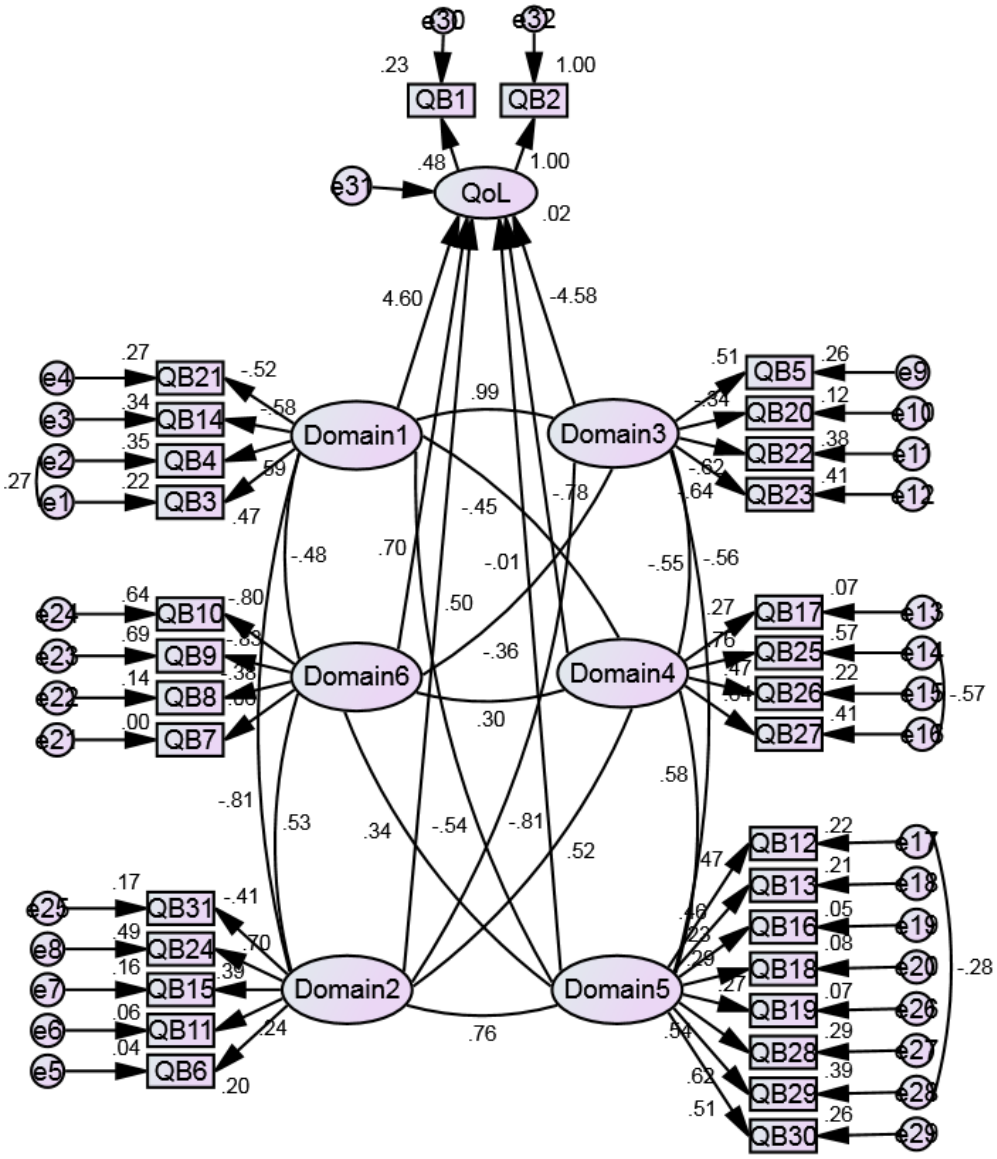


Figure 4.12. Model 9: Path diagram for health related Quality of Life with two indicators for HIV data

The estimated path diagram with the standardize path coefficients as well as the coefficients between the exogenous latent constructs for the theoretical 6-component WHOQoL-HIV

(BREF) and the 2-component endogenous overall QoL questions (Model 9) are presented in Figure 4.12. The estimated residual variance was very small (0.02). The significant effect of an additional quality of life indicator QB2 can be seen in Model 9. The estimation results from the path analysis were different in some constructs, but there were similarities in Domain 4, 5 and 6 with Model 8. The Model also shows physical domain to have the most substantial causal effect of 4.60 on QoL, while level of independence negatively impact the quality of life of an infected person. But QoL explains practically little or no variance in the Model.

4.4.12 SEM Parameter estimates of the theoretical WHOQOL-HIV (BREF) questionnaire and the overall QoL questions (Two indicators)

The values of the standardized coefficients are presented in Table 4.8. Most of the indicator variables were significantly related to their respective latent construct at 1% level of significance except for the indicator variables on domain 6 (SPD) and all the domains on QoL. The standardized error term of each indicator variable was also reported. The table also shows that there were negative relationships between domains 3, 5, 4 and QoL which implies that for every unit increase in the level of independence, change in environment and social relationship of an HIV infected person, there is a corresponding reduction or decline in the quality of life of the person. A comprehensive table showing the standardized coefficients, the associated standard error, z-value and R^2 value of each indicator variable in Model 9 is presented in the Appendix.

Measurement model for WHOQoL-HIV (BREF) and 2 overall QoL questions (Model 9)

$X_1 = 0.47\xi_1$

. .

. .

. .

$X_{29} = -0.80\xi_6$

$z_1 = 0.48\omega_1$

$z_2 = 1.00\omega_2$

Structural model for WHOQoL-HIV (BREF) and 2 overall QoL questions (Model 9)

$\eta = 4.60\xi_1 + 0.50\xi_2 - 4.58\xi_3 - 0.78\xi_4 - 0.01\xi_5 + 0.70\xi_6$ where R^2= 0.022

4.4.13 SEM Covariances among latent constructs of the theoretical WHOQOL-HIV (BREF) and the Overall QoL questions (two indicators)

The covariances among the six (6) latent exogenous constructs of the theoretical 6–component WHOQOL-HIV (BREF) questionnaire and 2-component endogenous overall Qol questions are presented in Table 4.9. Most of the variables in any particular domain depend on each other.

4.4.14 Fit Indices for WHOQoL-HIV (BREF) and 2 overall QoL questions (Model 9)

The chi-square goodness-of-fit test of the model with other baseline fit indices are shown in Table 4.7.

4.4.15 Analysis of WHOQOL-HIV (BREF) and SWLS questions (Model 10)

Analysis was carried out on the theoretical 6-component WHOQOL-HIV (BREF) and 5-component endogenous SWLS, the solution was admissible with minimum iteration.

4.4.16 Fitted Structural Equation Model (SEM) of the theoretical WHOQOL-HIV (BREF) and Satisfaction with Life Scale Questionnaire

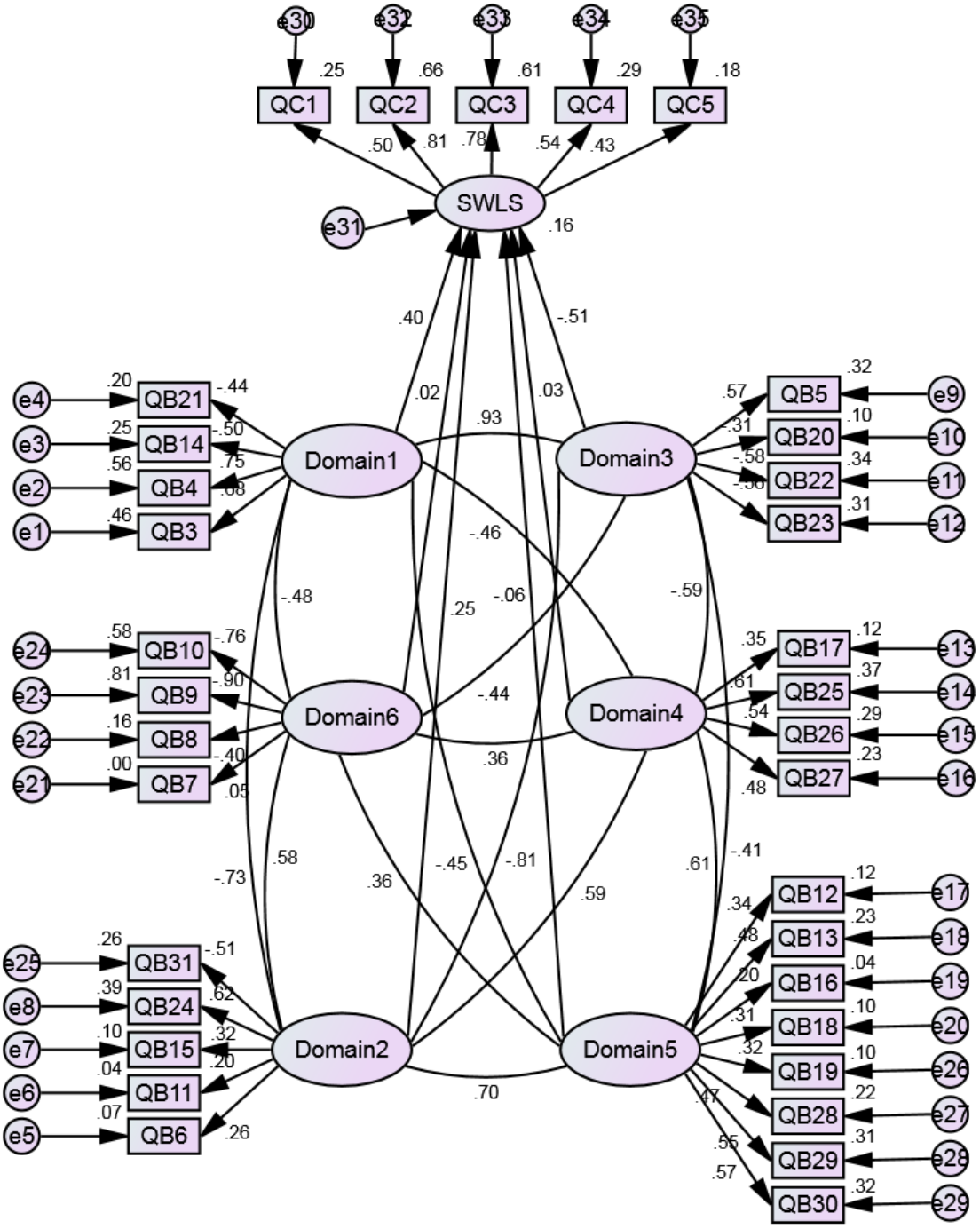


Figure 4.13. Model 10: Path diagram for health related Quality of Life and Satisfaction with Life Scale (SWLS) for HIV data

The estimated path diagram with the standardized path coefficients as well as the coefficients between the exogenous latent constructs for the theoretical 6-component WHOQOL-HIV

(BREF) and 5-component endogenous SWLS Questionnaire (Model 10) are presented in Figure 4.13. The model also gave information on the structural part as follows: the indicators on the endogenous variable SWLS gave sufficient information except for QC5 (If I could live my life over, I would change almost nothing) which had an average impact on SWLS. The estimated structural equation indicated that physical domain (ξ_1) had the most substantial causal effect on SWLS (η) was more than psychological domain (ξ_2) which was in turn higher than the causal effects of social relationship domain (ξ_4) and spirituality domain (ξ_6), while as level of independence (ξ_3), and environmental domain (ξ_5) increases, quality of life declines. Also, the estimated residual variance was small (0.16)**.** The significant effect of an addition of structural part SWLS can be seen in Model 10. The estimation results were different from that of Model 9, but has great similarities with the estimates of Model 7. SWLS only explains 16% variance in the Model.

4.4.17 SEM Parameter estimates of the theoretical WHOQOL-HIV (BREF) questionnaire and satisfaction with life scale questionnaire

The values of the standardized coefficients are presented in Table 4.8. Most of the indicator variables were significantly related to their respective latent constructs at 1% level of significance except for the indicator variables on Domain 6 (SPD) and all the domains on SWLS. The standardized error term of each indicator variable was also reported. The table also shows that there were negative relationships between domains 3, 5 and SWLS which implies that for every unit increase in the level of dependence and change in the environment of an HIV infected person, there is a corresponding reduction or decline in the satisfaction with life of the person. A comprehensive table showing the standardized coefficients, the associated standard error, z-value and R^2 value of each indicator variable in Model 10 is presented in the Appendix.

Measurement model for WHOQOL-HIV (BREF) and SWLS questions (Model 10)

$X_1 = 0.68\xi_1$

. .

. .

. .

$X_{29} = -0.76\xi_6$

$Y_1 = 0.50\alpha_1$

$Y_2 = 0.81\alpha_1$

$Y_3 = 0.78\alpha_1$

$Y_4 = 0.54\alpha_1$

$Y_5 = 0.43\alpha_1$

Structural model for WHOQOL-HIV (BREF) and SWLS questions (Model 10)

$\eta = 0.40\xi_1 + 0.25\xi_2 - 0.51\xi_3 + 0.03\xi_4 - 0.05\xi_5 + 0.02\xi_6$ where R^2= 0.164

4.4.18 SEM Covariances among Latent Constructs of the Theoretical WHOQOL-HIV (BREF) and Satisfaction with Life Scale Questionnaire

The covariances among the six (6) latent exogenous constructs of the theoretical 6-component WHOQoL-HIV (BREF) questionnaire and endogenous SWLS questionnaire are presented in Table 4.9. Most of the variables in any particular domain depend on each other.

4.4.19 Fit Indices for WHOQOL-HIV (BREF) and SWLS questions (Model 10)

The chi-square goodness-of-fit test of the model with other baseline fit indices are shown in Table 4.7.

4.4.20 Analysis of WHOQOL-HIV (BREF) and SWLS with 1 overall QoL question (Model 11)

Analysis was carried out on the theoretical 6-component WHOQOL-HIV (BREF), 5-component endogenous SWLS and 1-component endogenous overall QoL question, the solution was admissible with minimum iteration.

4.4.21 Fitted Structural Equation Model (SEM) of the theoretical WHOQOL-HIV (BREF), overall QoL question and Satisfaction with Life Scale

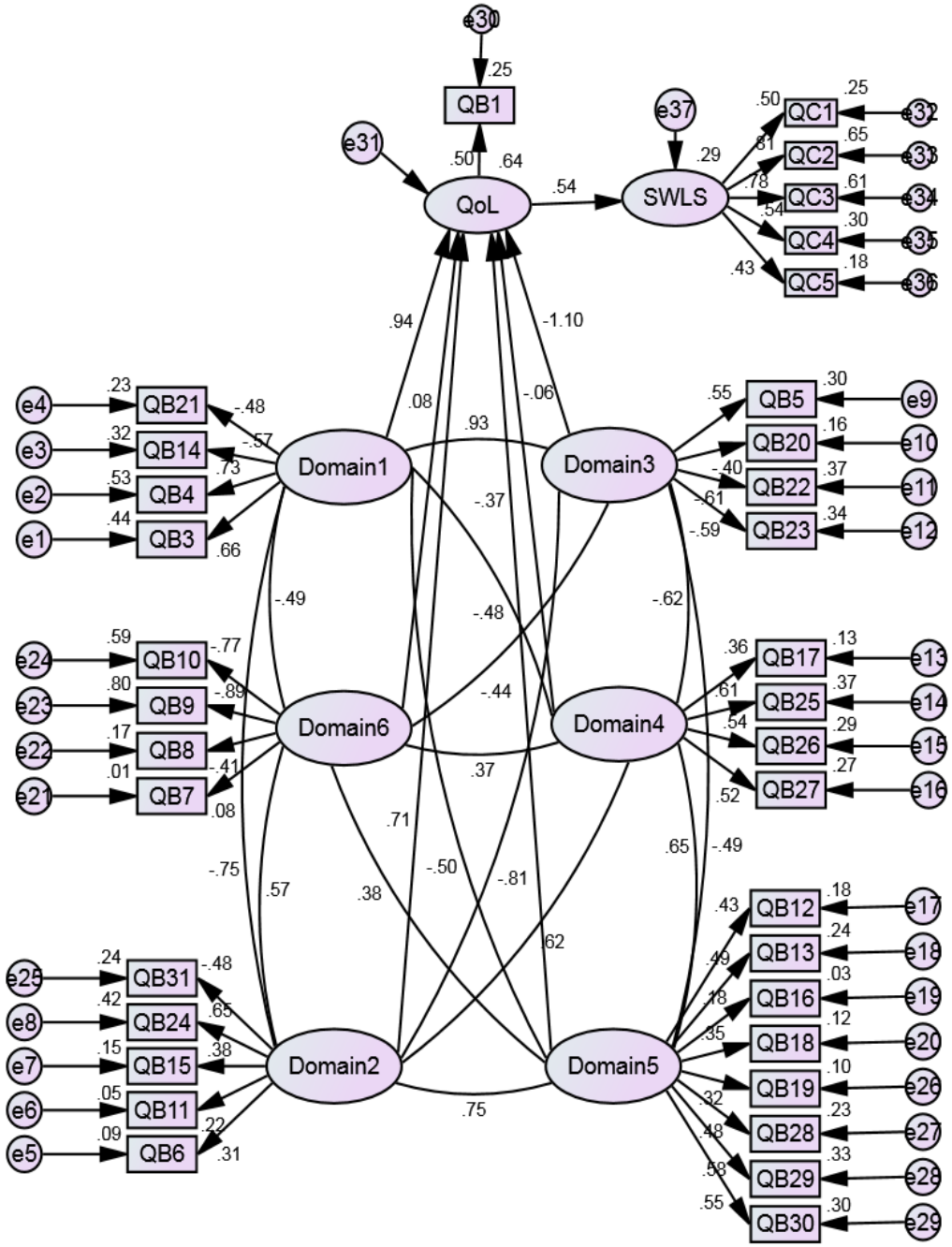


Figure 4.14. Model 11: Path diagram for health related Quality of Life with overall QOL and Satisfaction with Life Scale (SWLS) for HIV data

The estimated path diagram with the standardized path coefficients as well as the coefficients between the exogenous latent constructs for the theoretical 6-component WHOQOL-HIV (BREF), 5–component SWLS and 1-component endogenous overall QoL question (Model 11) are presented in Figure 4.14. The β coefficient is 0.54 indicating high impact of SWLS

on the QOL of an infected person. Also, the estimated residual variance was small (0.29)**.** The significant effect of two structural parts on the Model 11 was seen in the averagely high impact of SWLS on the QoL. The estimation results were the same with that of Model 10 except in Domain 5 where there is a slight difference. The Model also showed that while physical domain has a positive impact on the infected persons, level of independence has the highest negative impact on their quality of life.

4.4.22 SEM Parameter estimates of the theoretical WHOQOL-HIV (BREF) questionnaire, overall QoL question and Satisfaction with Life Scale

The values of the standardized coefficients are presented in Table 4.8. Most of the indicator variables were significantly related to their respective latent constructs at 1% level of significance except for the indicator variables on domain 6 (SRD) and all domains on QoL. The standardized error term of each indicator variable was also reported. The table also showed that there were negative relationships between domains 3, 4, 5 and QoL which implies that for every unit increase in change in environment, level of independence, and social relationship of an HIV infected person, there is a corresponding reduction or decline their quality of life. A comprehensive table showing the standardized coefficients, the associated standard error, z-value and R^2 value of each indicator variable in Model 11 is presented in the Appendix.

Measurement model WHOQOL-HIV (BREF) and SWLS with 1 overall QoL question (Model 11)

$X_1 = 0.66\xi_1$

. .

. .

. .

$X_{29} = -0.77\xi_6$

$z_1 = 0.50\omega_1$

$Y_1 = 0.50\alpha_1$

$Y_2 = 0.81\alpha_1$

$Y_3 = 0.87\alpha_1$

$Y_4 = 0.54\alpha_1$

$Y_5 = 0.43\alpha_1$

Structural model WHOQOL-HIV (BREF) and SWLS with 1 overall QoL question (Model 11**)**

$\eta = 0.54\eta_1 + 0.94\xi_1 + 0.71\xi_2 - 1.10\xi_3 - 0.06\xi_4 - 0.37\xi_5 + 0.08\xi_6$

where R^2= 0.288

4.4.23 SEM Covariances of the theoretical WHOQOL-HIV (BREF) questionnaire, overall QoL question and satisfaction with life scale

The covariances among the six (6) latent exogenous constructs of the theoretical 6-component WHOQOL-HIV (BREF), overall QoL question and endogenous SWLS questionnaire are presented in Table 4.9. Most of the variables in any particular domain depend on each other.

4.4.24 Fit Indices for WHOQOL-HIV (BREF) and SWLS with 1 overall QoL question (Model 11)

The chi-square goodness-of-fit test of the model with other baseline fit indices are shown in Table 4.7.

4.4.25 Analysis of WHOQOL-HIV (BREF) and SWLS with two overall QoL question (Model 12)

Analysis was carried out on the theoretical 6-component WHOQOL-HIV (BREF), 5-component endogenous SWLS and 2-component endogenous overall QoL questions, the solution was admissible with minimum iteration.

4.4.26 Fitted Structural Equation Model (SEM) of the Theoretical WHO QOL-HIV (BREF), overall QOL questions and Satisfaction with Life Scale questionnaire

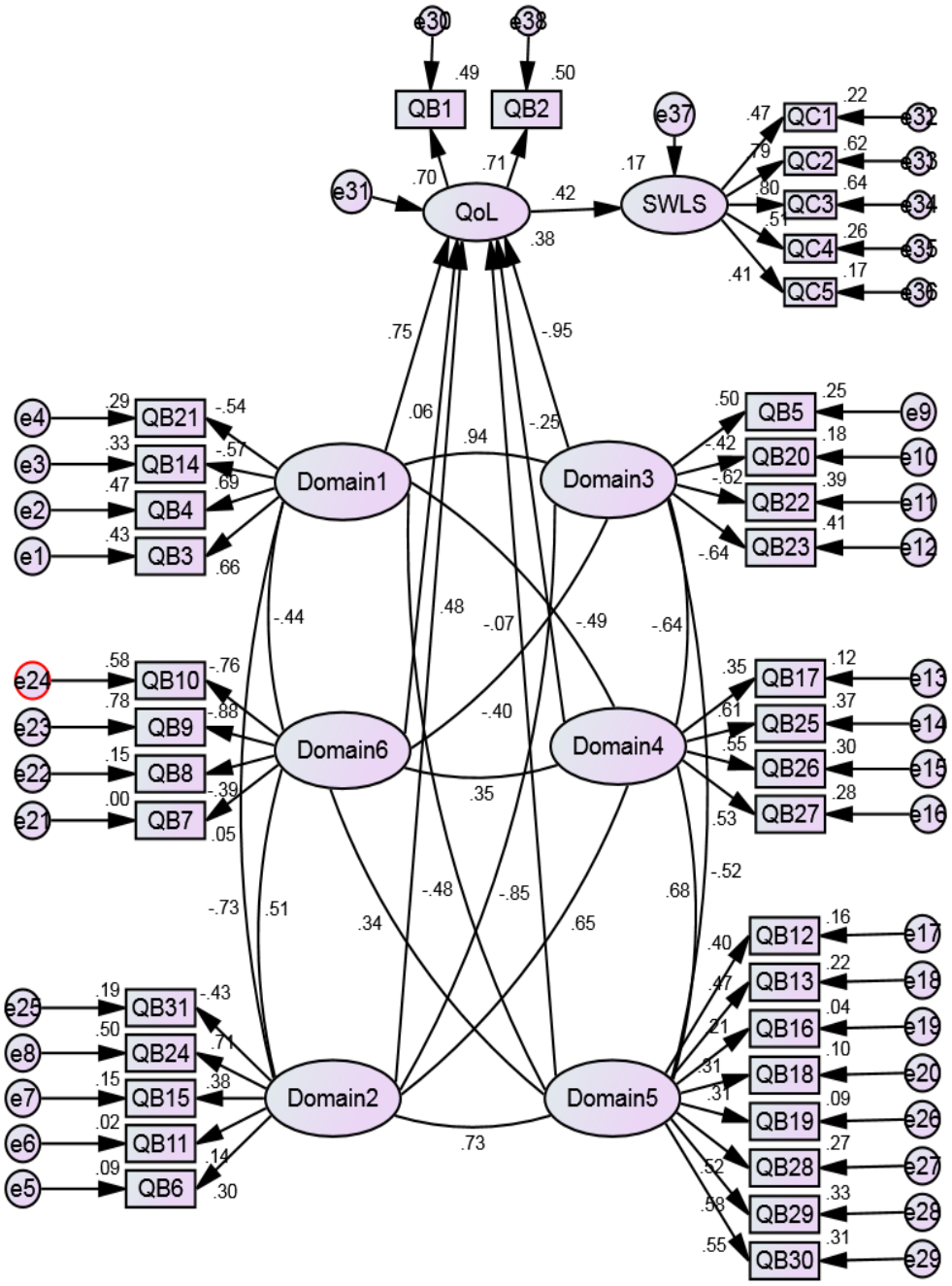


Figure 4.14. Model 12: Path diagram for health related Quality of Life with two indicators for overall QOL and Satisfaction with Life Scale (SWLS) for HIV data

The estimated path diagram with the standardized path coefficients as well as the coefficients between the latent constructs for the theoretical 6-component exogenous WHOQOL-HIV (BREF), 5-component exogenous SWLS and 2-component endogenous overall QOL questions (Model 6) are presented in Figure 4.14. The model also gave information on the

structural part as follows: the two indicator variables QB1 and QB2 had very high impact on QoL, while, QC1 (In most ways my life is close to my ideal) and QC5 (If I could live my life over, I would change almost nothing) had little or no impact on SWLS. The β coefficient is 0.42 indicating an averagely high impact of SWLS on the QOL of an infected person. Also, the estimated residual variance of SWLS on QoL was small (0.17)**.** For Model 12, there is no significant effect of adding QB2 to the Model except for its effect on QoL with a high regression weight of 0.71 and an R^2 of 50%. Model 12 has a similar estimation results with Model 11 but with a lower impact of SWLS on QoL. QoL only explained 17% variance in the Model. These results showed that Model 11 is preferable to Model 12. These results show that just as Model 5 was preferred to Model 6, Model 11 should be preferred to Model 12.

4.4.27 SEM Parameter Estimates of the Theoretical WHOQOL-HIV (BREF), overall QOL questions and Satisfaction with Life Scale questionnaire

The values of the standardized coefficients are presented in Table 4.8. Most of the indicator variables were significantly related to their respective latent constructs at 1% level of significantly except for indicators on domain 6 (SPD) and all domains on QOL. The standardized error terms were used to compute the R^2 values, an indication that the proportions of variation in the latent constructs were as explained by each particular indicator. This shows that the model provided a good fit to the independent dataset. The table also revealed that there were negative relationships between domains 3, 4, 5 and QOL, which implies that for every unit increase in the change in the environment, level of independent and social relationship of an HIV infected person, there is a corresponding reduction or decline in the quality of life of the person. A comprehensive table showing the standardized coefficients, the associated standard error, z-value and R^2 value of each indicator variable in Model 12 is presented in the Appendix.

Measurement model for WHOQOL-HIV (BREF) and SWLS with two overall QoL question (Model 12)

$X_1 = 0.66\xi_1$

. .

. .

. .

$X_{29} = 0.55\xi_6$

$z_1 = 0.70\omega_1$

$z_2 = 0.71\omega_2$

$Y_1 = 0.47\alpha_1$

$Y_2 = 0.79\alpha_1$

$Y_3 = 0.80\alpha_1$

$Y_4 = 0.51\alpha_1$

$Y_5 = 0.41\alpha_1$

Structural model for WHOQOL-HIV (BREF) and SWLS with two overall QoL question (Model 12)

$\eta = 0.42\eta_1 + 0.75\xi_1 + 0.48\xi_2 - 0.95\xi_3 - 0.25\xi_4 - 0.07\xi_5 + 0.06\xi_6$

where R^2 of SWLS on QoL is 0.17.

4.4.28 SEM Covariances among Latent Constructs of the Theoretical WHOQOL-HIV (BREF), overall QOL questions and Satisfaction with Life Scale questionnaire

The variances among the six (6) latent exogenous constructs of the 6-component WHOQOL-HIV (BREF), 2-component overall QOL questions and 5-component endogenous SWLS questionnaire are presented in Table 4.9. Most of the variables in any particular domain depend on each other except for Domain 6.

4.4.29 Fit Indices for WHOQOL-HIV (BREF) and SWLS with two overall QoL question (Model 12)

The chi-square goodness-of-fit test of the model with other baseline fit indices are shown in Table 4.7.

4.5 Analysis for the Proposed Models using the regrouped HIV variables

In this section, confirmatory analysis was used to regroup the data set for HIV positive population into (n) new domains. Initially, the rotation was fixed to six (6) in relation to WHO instrument, but the factor extraction did not give a good result. The result is as seen in the Appendix 20.

Table 4.8: Factor Extraction for the new domains

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.701	19.658	19.658	5.701	19.658	19.658	2.943	10.148	10.148
2	2.828	9.752	29.409	2.828	9.752	29.409	2.267	7.816	17.964
3	1.933	6.665	36.074	1.933	6.665	36.074	2.137	7.370	25.334
4	1.606	5.539	41.613	1.606	5.539	41.613	2.059	7.101	32.435
5	1.277	4.404	46.018	1.277	4.404	46.018	2.048	7.061	39.496
6	1.210	4.173	50.191	1.210	4.173	50.191	1.872	6.454	45.950
7	1.129	3.894	54.085	1.129	3.894	54.085	1.538	5.303	51.253
8	1.080	3.725	57.810	1.080	3.725	57.810	1.530	5.275	56.527
9	1.017	3.507	61.316	1.017	3.507	61.316	1.389	4.789	61.316
10	.917	3.163	64.480						
11	.859	2.962	67.442						
12	.825	2.846	70.288						
13	.736	2.537	72.825						
14	.722	2.488	75.313						
15	.692	2.385	77.699						
16	.660	2.275	79.974						
17	.609	2.099	82.072						
18	.605	2.085	84.157						
19	.554	1.912	86.069						
20	.528	1.821	87.890						
21	.508	1.751	89.641						
22	.470	1.621	91.262						
23	.437	1.507	92.770						
24	.420	1.447	94.216						
25	.391	1.347	95.564						
26	.387	1.336	96.899						
27	.348	1.200	98.099						
28	.289	.996	99.095						
29	.262	.905	100.000						

Extraction Method: Principal Component Analysis
Source: Results from computer output

Using the Eigen value greater than 1, it can be seen from Table 4.8 that the first nine factors explained 61.316 of the variance. This is relatively fair. First component has 19.658% in the un-rotated sum of squared loading and 10.148% in the rotated. On the ground of Kaiser's rule, some of the variables do not performance well in their communality value since their values are less than 0.5. However, since the sample is very large this may not be serious and because we want to incorporate all the variables in WHO questionnaires. Hence, a 9-component model is suggested for the data set.

Table 4.9: Distribution of Variables into Components/Domains

Variables	Component								
	1	2	3	4	5	6	7	8	9
Mobility	.576	.425							
Sleep & rest	.758								
Activities of daily living	.773								
Work capacity	.657								
Self esteem	.566								
Thinking, learning, memory & concentration		.382							
Physical safety & security		.674							
Body image & appearance		.598							
Energy & Fatigue	.462	.640							
Negative feelings		.404							
Pain & discomfort			.812						
Symptoms of PLWA			.792						
Dependence on medication or treatment			.727						
Forgiveness & blame				.501					
Concerns about the future				.821					
Death & dying				.885					
Personal relationships					.642				
Home environment					.590				
Health & social care: accessibility & quantity					.431				
Life enjoyment						.736			
Life is meaningful						.765			
Physical environment-pollution							.469		
Social inclusion							.736		
Opportunities for acquiring new information & skill							.558		
Participation in recreation/leisure activities							.393		
Sexual activity								.694	
Social support								.714	
Transport					.426				.533
Financial resources									.757

Rotation Method: Varimax with Kaiser Normalization
Rotation converged in 14 iterations
Source: Results from computer output

Table 4.9 shows the distribution of the variables into nine (9) new groups called domains. The pattern of these domains are different from the grouping by WHO.

4.5.1 Reliability Test for the Proposed Domains

In this section, reliability test was carried out to know how consistent, dependable, and stable the new scale created are.

The reliability test for all the 29 items was carried out using Cronbach's alpha, and this revealed a strong reliability of 0.754, which shows that the instrument is reliable and can be used on Nigeria data. This was further carried out on the new domain as shown in Table 4.27.

Table 4.10: Item-Total Statistics for the Proposed Domains

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha for Domain
New Domain 1 (Activities Domain)					
Mobility	16.05	5.136	.485	.779	0.792
Sleep & rest	16.16	4.442	.582	.750	
Activities of daily living	16.18	4.652	.625	.736	
Work capacity	16.23	4.702	.563	.755	
Self esteem	16.20	4.674	.605	.742	
New Domain 2 (Physical Domain)					
Thinking, learning, memory & concentration	14.23	5.020	.298	.512	0.698
Physical safety & security	13.93	4.844	.545	.396	
Energy & Fatigue	13.87	4.473	.474	.404	
Body image & appearance	13.82	4.707	.420	.440	

New Domain 3 (Symptoms Domain)					
Pain & discomfort	4.59	4.135	.549	.634	
Symptoms of PLWA	4.62	3.710	.613	.552	
Dependence on medication or treatment	3.66	3.907	.482	.719	0.724
New Domain 4 (Concern Domain)					
Forgiveness & blame	3.70	4.770	.362	.796	
Concerns about the future	3.40	3.537	.603	.507	0.705
Death & dying	3.58	3.689	.624	.484	
New Domain 5 (Personal Domain)					
Personal relationships	7.94	1.419	.399	.413	
Home environment	7.97	1.516	.331	.517	
Health & social care: accessibility & quantity	7.99	1.369	.380	.442	0.560
New Domain 6 (Believe Domain)					
Life enjoyment	3.88	.748	.438	.	
Life is meaningful	3.72	.798	.438	.	0.609
New Domain 7 (Social Domain)					
Physical environment-pollution	11.20	3.230	.346	.415	
Social inclusion	11.29	2.970	.259	.475	
Opportunities for acquiring new information & skill	11.30	2.636	.346	.393	0.509

Participation in recreation/leisure activities	11.49	2.876	.272	.464	
New Domain 8 (Relationship Domain)					
Sexual activity	3.68	1.014	.369	.	0.539
Social support	3.80	1.113	.369	.	
New Domain 9 (Finance Domain)					
Financial resources	3.65	.817	.271	.	0.422
Transport	2.57	1.119	.271	.	

Table 4.10 shows the item-total statistics for variables in each of the new domain. New Domain 1 named 'Activities Domain' revealed a strong reliability of 0.792 for all its five items. While New Domain 2 named 'Physical Domain' revealed a strong reliability of 0.698 after the item Negative feeling which had the weakest correlation was removed from its five items. For New Domain 3 named 'Symptoms Domain', a strong reliability of 0.724 was revealed for its three items. For New Domain 4 named 'Concerns Domain', a strong reliability of 0.705 was also revealed for its three items. For New Domain 5 named 'Personal Domain', a weak reliability of 0.560 was revealed for its three items. For New Domain 6 named 'Believe Domain', an averagely strong reliability of 0.609 was revealed for its two items. For New Domain 7 named 'Social Domain', a weak reliability of 0.509 was revealed for its four items. For New Domain 8 named 'Relationship Domain', a weak reliability of 0.539 was revealed for its two items. Also, New Domain 9 named 'Finance Domain' revealed a weak reliability of 0.422 for its two items.

The result above implies that the items on activities, physical and concern domains are peculiar to the Nigerian population and should be emphasized. While, item negative feelings and items on finance domain could be de-emphasized for maximum results.

4.5.2 Analysis of regrouped WHOQoL-HIV (BREF) variables

In this session, the hypothesized 9-component of the WHOQoL-HIV (BREF) questionnaire was used with the SWLS questions on the HIV positive population for analysis using SEM.

4.5.3 Analysis of regrouped WHOQoL-HIV (BREF) (NModel 1)

Analysis was carried out on the hypothesized 9-component WHOQOL-HIV (BREF) only.

Table 4.11: Summary of SEM Parameter Estimates for Regrouped HIV data

			NModel 1	**NModel 5**	**NModel 6**
Indicator Variable		**Latent Construct**	**Estimates**		
QoL	<---	ND1		0.230*	0.640*
QoL	<---	ND2		0.043	0.095
QoL	<---	ND3		0.120	0.093
QoL	<---	ND4		-0.073	-0.049
QoL	<---	ND5		-0.180	-0.203
QoL	<---	ND6		0.396*	0.284*
QoL	<---	ND7		-0.227	-0.249
QoL	<---	ND8		-0.084	-0.085
QoL	<---	ND9		0.344*	0.331*
SWLS	<---	QoL		0.491*	0.463*
qb20	<---	ND1	0.583*	0.625*	0.640*
*qb21	<---	ND1	0.602	0.790*	0.573
qb22	<---	ND1	0.637*	0.727*	0.641*
qb23	<---	ND1	0.724*	0.642*	0.717*
qb24	<---	ND1	0.795*	0.587	0.799*
qb11	<---	ND2	0.470*	0.428*	0.424*
qb12	<---	ND2	0.740*	0.761*	0.762*
*qb14	<---	ND2	0.742	0.731	0.717
qb15	<---	ND2	0.603*	0.604*	0.611*
*qb31	<---	ND2	0.036		
qb3	<---	ND3	0.644*	0.573	0.712*
qb4	<---	ND3	0.825	0.806*	0.791
qb5	<---	ND3	0.564*	0.681*	0.554*
qb8	<---	ND4	0.470*	0.496*	0.428*
qb9	<---	ND4	0.089*	0.884*	0.894*
*qb10	<---	ND4	0.798	0.772	0.773
*qb25	<---	ND5	0.665	0.648	0.675

qb28	<---	ND5	0.590*	0.604*	0.611*
qb29	<---	ND5	0.635*	0.681*	0.654*
*qb6	<---	ND6	0.658	0.690	0.677
*qb7	<---	ND6	0.643	0.682	0.676
qb13	<---	ND7	0.671*	0.669*	0.664*
qb17	<---	ND7	0.381*	0.381*	0.386*
*qb18	<---	ND7	0.479	0.514	0.521
qb19	<---	ND7	0.351*		
qb26	<---	ND8	0.650	0.636	0.634
qb27	<---	ND8	0.668	0.670	0.669
qb16	<---	ND9	0.532	0.549	0.553
qb30	<---	ND9	0.615	0.630	0.619
qb1	<---	QoL		0.745	0.817
qb2	<---	QoL			0.727
QC1	<---	SWLS			0.519*
*QC2	<---	SWLS			0.818
QC3	<---	SWLS			0.808*
QC4	<---	SWLS			0.416*
QC5	<---	SWLS			0.295*

Note: *Significant at 5% level of significance
*Reference variables
Source: Results from computer output

Table 4.11 shows the SEM parameter for the nine hypothesized models from the WHOQoL-HIV (BREF) and SWLS questionnaires as follows: New Models 5 and 6 showed that the activity, believe and finance of an infected person has significant impact on the overall quality of life. Also the satisfaction with life of an infected person has significant impact on the overall quality of life.

Furthermore, it was revealed that more than half of the indicator variables have significant impact on the various proposed component or construct. Similarly, only the indicator variable "conditions of my life are excellent" was not significant on satisfaction with life of an infected person in the proposed models.

Table 4.12: Summary of Covariance Estimates for Regrouped HIV data

			New Model 1	New Model 5	New Model 6
Domain	<---	Domain	Estimates		
ND1	<---	ND1	1	1	1
ND1	<---	ND2	0.174*	0.159*	0.153*

ND1	<---	ND3	-0.009	-0.032*	-0.036
ND1	<---	ND4	-0.038	-0.048*	-0.055*
ND1	<---	ND5	0.158*	0.151*	0.141*
ND1	<---	ND6	0.091*	0.096*	0.095*
ND1	<---	ND7	0.073*	0.074*	0.075*
ND1	<---	ND8	0.134*	0.128*	0.125*
ND1	<---	ND9	0.113*	0.110*	0.102*
ND2	<---	ND2	1	1	1
ND2	<---	ND3	-0.109*	-0.062*	-0.068*
ND2	<---	ND4	-0.087*	-0.073*	-0.053*
ND2	<---	ND5	0.172*	0.167*	0.160*
ND2	<---	ND6	0.147*	0.146*	0.145*
ND2	<---	ND7	0.159*	0.163*	0.165*
ND2	<---	ND8	0.181*	0.191*	0.189*
ND2	<---	ND9	0.141*	0.143*	0.140*
ND3	<---	ND3	1	1	1
ND3	<---	ND4	0.385*	0.252*	0.284*
ND3	<---	ND5	-0.036	-0.018	-0.015
ND3	<---	ND6	0.010	-0.014	-0.018
ND3	<---	ND7	-0.042	-0.035*	-0.045
ND3	<---	ND8	-0.060	-0.072*	-0.083*
ND3	<---	ND9	-0.086*	-0.052	-0.058
ND4	<---	ND4	1	1	1
ND4	<---	ND5	-0.051	-0.047*	-0.032
ND4	<---	ND6	0.017	0.011	0.009
ND4	<---	ND7	-0.061	-0.056*	-0.048*
ND4	<---	ND8	-0.070	-0.093*	-0.076*
ND4	<---	ND9	-0.099*	-0.084*	-0.041
ND5	<---	ND5	1	1	1
ND5	<---	ND6	0.086*	0.090*	0.085*
ND5	<---	ND7	0.103*	0.107*	0.107*
ND5	<---	ND8	0.171*	0.173*	0.168*
ND5	<---	ND9	0.152*	0.143*	0.139*
ND6	<---	ND6	1	1	1
ND6	<---	ND7	0.078*	0.088*	0.088*
ND6	<---	ND8	0.146*	0.150*	0.149*
ND6	<---	ND9	0.066*	0.067*	0.067*
ND7	<---	ND7	1	1	1
ND7	<---	ND8	0.069*	0.075*	0.076*
ND7	<---	ND9	0.099*	0.095*	0.095*
ND8	<---	ND8	1	1	1
ND8	<---	ND9	0.128	0.135*	0.131*
ND9	<---	ND9	1	1	1

***** Significant at 0.01 level of significance

Source: Results from computer output

The covariance among the nine (9) latent exogenous constructs of the hypothesized 9-component WHOQoL-HIV (BREF) questionnaire are shown in Table 4.12. Most of the

estimates were significantly different from zero at 0.01 and 0.05 levels of significance, except for the following: New Domain 1 (between ND3 and 4 under Model 1); for New Domain 3 (between ND5 and 6 under Model 1, 5 and 6); for New Domain 4 (between ND5, 6, 7 and 8 under Model 1) and between ND4 and 6 under Model 5 and 6.

4.5.4 Factor Loading Fitting Chart of the Hypothesized 9-Component WHOQoL-HIV (BREF) Questionnaire

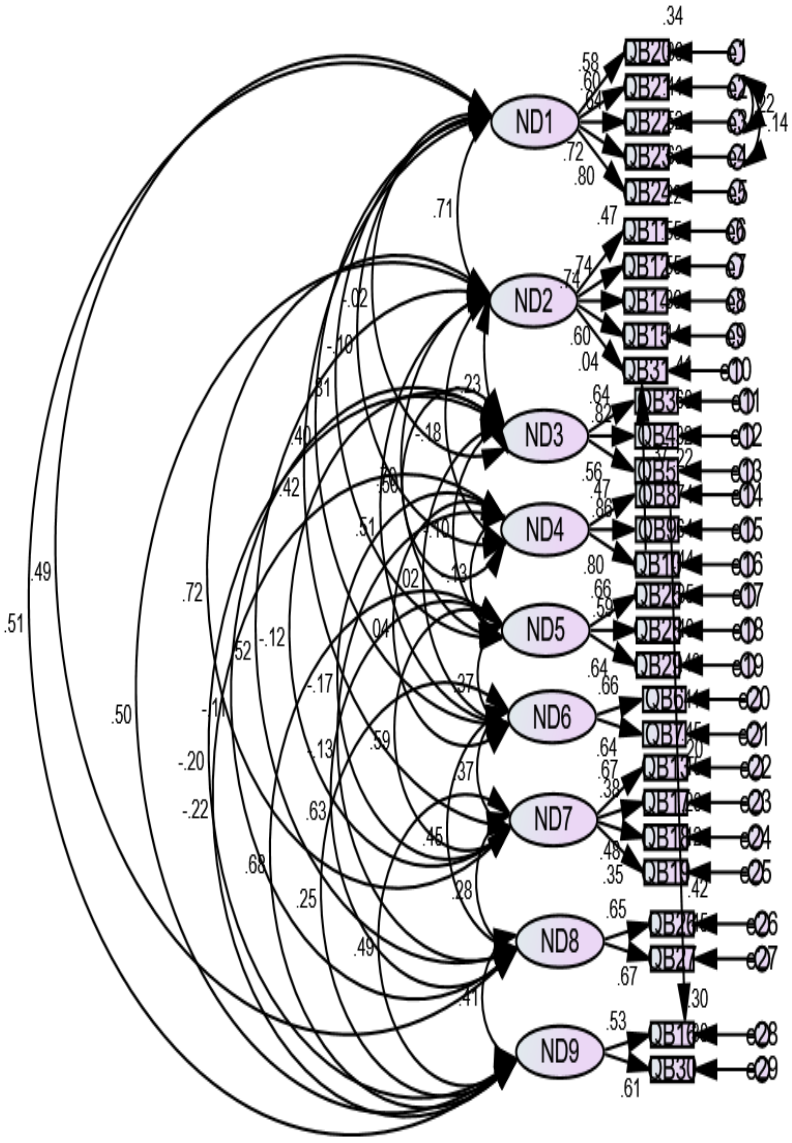


Figure 4.15. NModel 1: Path diagram for health related Quality of Life for HIV data

The estimated path diagram with the standardized path coefficients, the coefficients between the latent constructs for the 9 components WHOQoL-HIV (BREF) questionnaire (NModel 1) as presented with its modification in Figure 4.15. The standardized error term of each indicator variable was also reported. The latent constructs were correlated rating (between 0.021 and 0.812) which is between NDomain 3 and 6; also between NDomain 1and

NDomain 5 respectively. Figure 4.15 also showed that most of the indicators contributed significantly to the different domains using 0.4 as a standard with the exception of ND 2, indicator QB31 (Negative feelings?); ND 7, indicator QB19 and QB17 (Participation in recreation/leisure activities? and Social inclusion?) as follows: In ND 1, it is evident that the five items related to activities loaded well. QB24 (self-esteem) and QB23 (work capacity) variables appear to be the best indicators of ND 1. Their standardized regression weights are 0.80 and 0.72 respectively. Additionally, ND 1 explained about 63% of the variance in QB24 and 52% of the variance in QB23. QB20 (mobility) is the poorest among the activities indicators with an R^2 of 0.34 and a standardized regression weight of 0.58.

In ND 2, it is evident that four out of five items related to their physical look loaded well. QB12 (physical safety & security) and QB14 (energy & fatigue) variables appear to be the best indicators of ND 2 with equal standardized regression weight of 0.74. Additionally, ND 2 explained about 55% of the variances in QB12 and QB14. QB31 (negative feelings) is the poorest among the physical indicators with an R^2 of 0.14 and a standardized regression weight of 0.04.

In ND 3, it is evident that the three items related to symptoms loaded well. QB4 (symptoms of PLWA) and QB3 (pain & discomfort) variables appear to be best indicators of ND 3. Their standardized regression weights are 0.83 and 0.64 respectively. Additionally, ND 3 explained about 69% of the variance in QB4 and 42% of the variance in QB3. QB5 (dependence on medication or treatment) is the poorest among the symptoms indicators with an R^2 of 0.32 and a standardized regression weight of 0.56.

In ND 4, it is evident that two out of the three items related to concern loaded well. QB9 (concern about the future) and QB10 (death & dying) variables appear to be the best indicators of ND 4. Their standardized regression weights are 0.86 and 0.80 respectively. Additionally, ND 4 explained about 74% of the variance in QB9 and 64% of the variance in QB10. QB8 (forgiveness & blame) is the poorest among the indicators with an R^2 of 0.22 and a standardized regression weight of 0.47.

In ND 5, it is evident that the three items related to the personal domain loaded well. QB25 (personal relation) and QB29 (health & social care) variables appear to be the best indicators of ND 5. Their standardized regression weights are 0.67 and 0.64 respectively. Additionally, ND 5 explained about 44% of the variance in QB25 and 40% of the variance in QB29. QB28 (home environment) is the poorest among the indicators with an R^2 of 0.35 and a standardized regression weight of 0.59.

In ND 6, the two items related to believe loaded well. QB6 (life enjoyment) and QB7 (life is meaningful) variables with their standardized regression weights 0.66 and 0.64 respectively. Additionally, ND 6 explained about 43% of the variance in QB6 and 41% of the variance in QB7.

In ND 7, it is evident that only two of the three items related to the social domain loaded well. QB13 (physical environment-pollution) and QB18 (opportunities for acquiring new information & skill) variables appear to be the best indicators of ND 7. Their standardized regression weights are 0.67 and 0.48 respectively. Additionally, ND 7 explained about 45% of the variance in QB13 and 23% of the variance in QB18. QB17 (social inclusion) is the poorest among the indicators with an R^2 of 0.15 and a standardized regression weight of 0.38.

In ND 8, the two items related to the relationship loaded well. QB27 (social support) and QB26 (sexual activities) with their standardized regression weights 0.67 and 0.65 respectively. Additionally, ND 8 explained about 45% of the variance in QB27 and 42% of the variance in QB26.

In ND 9, the two items related to finance loaded averagely. QB30 (transport) and QB16 (financial resources) with their standardized regression weights 0.62 and 0.53 respectively. Additionally, ND 9 explained about 38% of the variance in QB30 and 30% of the variance in QB16.

4.5.5 CFA Parameter Estimates of the Hypothesized 9-Component WHOQOL-HIV (BREF) Questionnaire

The values of the standardized coefficients, the associated standard error and z-value of each indicator variable are presented in Table 4.11. All the indicator variables were significantly related to their respective latent factors at 1% level of significance except the indicator variable QB31 that loaded on ND 2. The indicator variables without p-values were constrained to the value of one during the analysis. Details in Appendix.

Measurement model for regrouped WHOQoL-HIV (BREF) (NModel 1)

$X_1 = 0.58\xi_1$

. .

. .

. .

$X_{29} = 0.61\xi_9$

4.5.6 CFA Covariances among Latent Constructs of the Hypothesized 9-Component WHOQOL-HIV (BREF) Questionnaire

The covariance among the nine (9) latent exogenous constructs of the hypothesized 9-component WHOQoL-HIV (BREF) questionnaire are shown in Table 4.12. Most of the estimates were significantly different from zero at 0.01 level of significance, except for the covariance between ND 1 and 3; ND 3 and 5; ND 3 and 6; ND 4 and 6. Details in Appendix.

4.5.7 Modification of regrouped WHOQoL-HIV (BREF) (NModel 1)

A modified analysis was carried out by excluding variables QB31 and QB19 from ND2 and ND7 respective on NModel 1, this gave an admissible solution indicating that the minimum iteration was achieved. It also gave a better goodness of fit.

4.5.8 Fit indices of the regrouped WHOQoL-HIV (BREF) (NModel 1)

The chi-square goodness-of-fit test of the model with other baseline fit indices are as shown in Table 4.13.

Table 4.13: Summary of Fit Indices for New Model 1

Model	χ^2	*Df*	χ^2/df	*GFI*	*RMSEA*	*AIC*
NModel 1	686.057	285	2.407	0.910	0.050	872.057

Note: x^2 =Chi-square statistics; df=degree of freedom; GFI=Goodness-of-Fit index; RMSEA=Root Mean Square error of approximation; AIC=Akaike's information criterion

The values from the indices indicate that the data fit the Model. GFI was close to 1 while RMSEA also showed a perfect fit of between 0.05 and 0.08.

4.5.9 Analysis of the regrouped WHOQoL-HIV (BREF) and SWLS with one overall QoL question (NModel 5)

Analysis was carried out on the hypothesized 9-component WHOQOL-HIV (BREF), 5-component endogenous SWLS and 1-component endogenous overall QoL question, the solution was admissible with minimum iteration.

4.5.10 Fitted Structural Equation Model (SEM) of the hypothesized WHOQOL-HIV (BREF), overall QoL question and Satisfaction with Life Scale

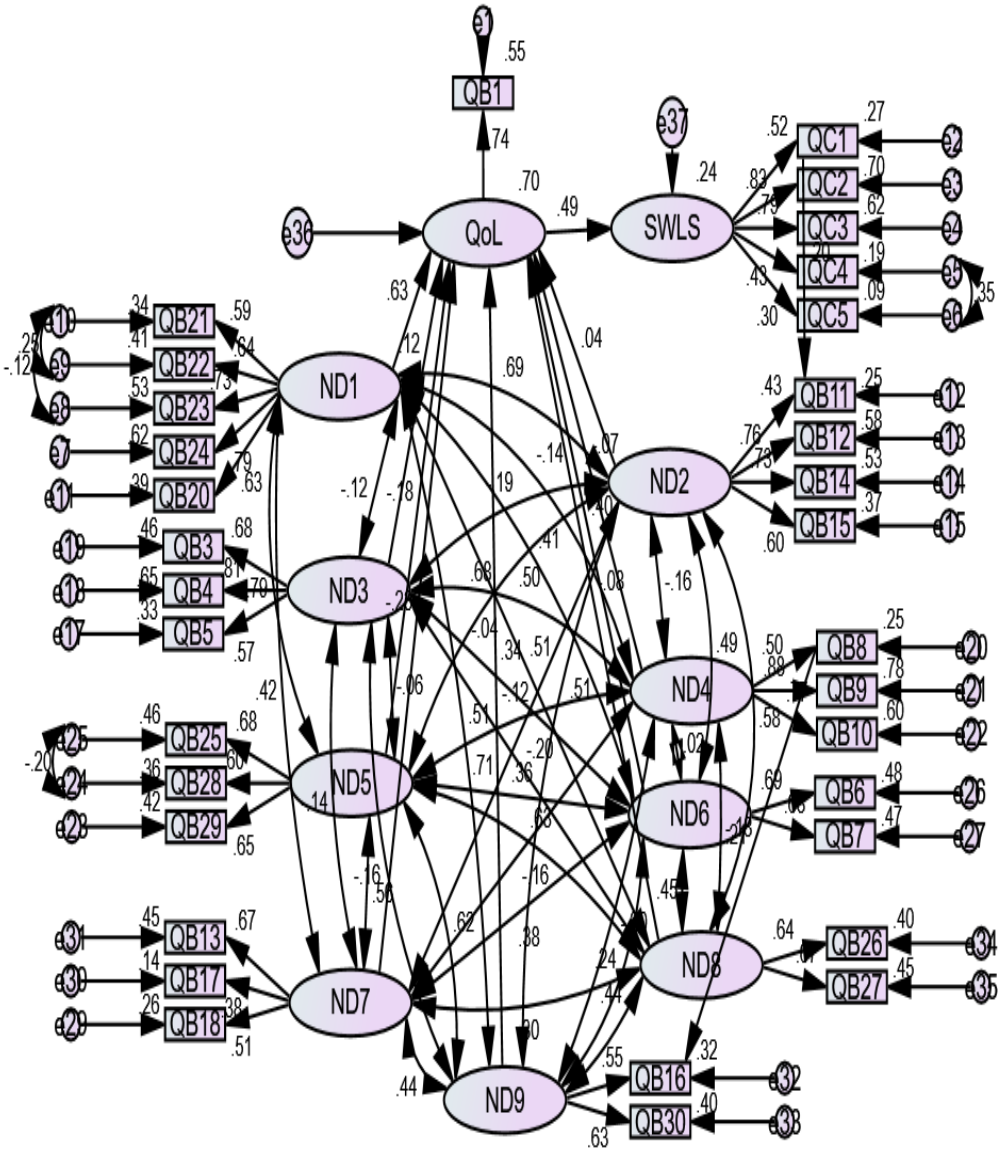


Figure 4.16. N Model 5: Path diagram for health related Quality of Life with overall QOL and Satisfaction with Life Scale (SWLS) for HIV data

The estimated path diagram with the standardized path coefficients as well as the coefficients between the exogenous latent constructs for the hypothesized 9-component WHOQOL-HIV (BREF), 5–component SWLS and 1-component endogenous overall QoL question with its

modifications (NModel 5) are presented in Figure 4.15. The correlation of about half of the latent constructs were weak, with the weakest correlation between ND 4 and 6, while the strongest correlation was between ND 1 and 5. The model also gave information on the structural part as follows: the indicator variable QB1 had a high impact on QoL which is also the endogenous variable, while all indicators except QC5 (If I could live my life over, I would change almost nothing) had a low impact on SWLS. Where β coefficient is 0.49 indicating an averagely high impact of SWLS on the QOL of an infected person. The estimated structural equation indicated that activities domain (ξ_1) had the most substantial causal effect on QoL (η) which was more than believe domain (ξ_6) which was in turn higher than the causal effects of finance domain (ξ_9). Furthermore, as physical domain(ξ_2), level of concerns(ξ_4), personal domain (ξ_5), social domain (ξ_7) and relationship domain (ξ_8) increases, quality of life declines. Also, the estimated residual variance was small (0.24).

The significant effect of the structural part could be seen in the following areas: NModel 5 was different from NModel 1 for ND 1 where the variable with the least impact was QB20 (mobility) while it was QB21 (sleep & rest) for ND 5. The variables QB31 (negative feeling) and QB19 (participation in leisure activities) were removed from ND 2 and ND 7 respectively for NModel 5 because their estimates were small and therefore with negligible impact. The Model also showed a lower impact of SWLS on QoL compared to Model 5.

4.5.11 SEM Parameter estimates of the hypothesized WHOQOL-HIV (BREF) questionnaire, overall QoL question and Satisfaction with Life Scale

The values of the standardized coefficients indicating their significant levels are presented in Table 4.11. Most of the indicator variables were significantly related to their respective latent construct at 1% level of significance. The standardized error term of each indicator variable was also reported because the solution was admissible and was used to compute the R^2 values which indicated the proportion of variation in the latent constructs as explained by each particular indicator. The table also showed that there were negative relationships between ND 4, 5, 7, 8 and QoL which implies that for every unit increase in the concerns, personal, social and relationship life of an HIV infected person, there is a corresponding reduction or decline

in his/her quality of life. A comprehensive table showing the standardized coefficients, the associated standard error, z-value and R^2 value of each indicator variable in NModel 5 is presented in the Appendix.

Measurement model for regrouped WHOQoL-HIV (BREF) and SWLS with one overall QoL question (NModel 5)

$X_1 = 0.62\xi_1$

. .

. .

. .

$X_{27} = 0.63\xi_9$

$z_1 = 0.74\omega_1$

$Y_1 = 0.52\alpha_1$

$Y_2 = 0.83\alpha_1$

$Y_3 = 0.79\alpha_1$

$Y_4 = 0.43\alpha_1$

$Y_5 = 0.30\alpha_1$

Structural model regrouped WHOQoL-HIV (BREF) and SWLS with one overall QoL question (NModel 5)

$\eta = 0.49\eta_1 + 0.63\xi_1 - 0.04\xi_2 + 0.12\xi_3 - 0.07\xi_4 - 0.18\xi_5 + 0.39\xi_6 - 0.27\xi_7 - 0.08\xi_8 + 0.34\xi_9$

where $R^2 = 0.202$

4.5.12 SEM Covariance of the hypothesized WHOQOL-HIV (BREF) questionnaire for NModel 5

The covariance among the nine (9) latent exogenous constructs of the hypothesized 9-component WHOQOL-HIV (BREF), overall QoL question and endogenous SWLS questionnaire with the modifications are presented in Table 4.12. Details in the Appendix.

4.5.13 Modification of regrouped WHOQoL-HIV (BREF) and SWLS with one overall QoL question (NModel 5)

A modified analysis was carried out by excluding variables QB31 and QB19 from ND2 and ND7 respective on NModel 5, this gave an admissible solution indicating that the minimum iteration was achieved. It also gave a better goodness of fit.

4.5.14 Fit Indices for regrouped WHOQoL-HIV (BREF) and SWLS with one overall QoL question (NModel 5)

The chi-square goodness-of-fit test of the model with other baseline fit indices are shown in Table 4.14.

Table 4.14: Fit Analysis for regrouped WHOQoL-HIV (BREF) and SWLS with one overall QoL question (NModel 5)

Model	χ^2	***Df***	χ^2/df	***GFI***	***RMSEA***	***AIC***
NModel 5	1009.980	446	2.265	0.891	0.047	1239.980

Note: x^2 =Chi-square statistics; df=degree of freedom; GFI=Goodness-of-Fit index; RMSEA=Root Mean Square error of approximation; AIC=Akaike's information criterion

The values from the indices indicate that the data fit the Model. GFI was close to 1 while RMSEA also showed a perfect fit of between 0.05 and 0.08.

4.5.15 Analysis of the regrouped WHOQoL-HIV (BREF) and SWLS with two overall QoL questions (NModel 6)

Analysis was carried out on the hypothesized 9-component WHOQoL-HIV (BREF), 5-component endogenous SWLS and 2-component endogenous overall QoL questions, the solution was admissible with minimum iterations.

4.5.16 Fitted Structural Equation Model (SEM) of the Hypothesized WHO QOL-HIV (BREF), overall QOL questions and Satisfaction with Life Scale questionnaire

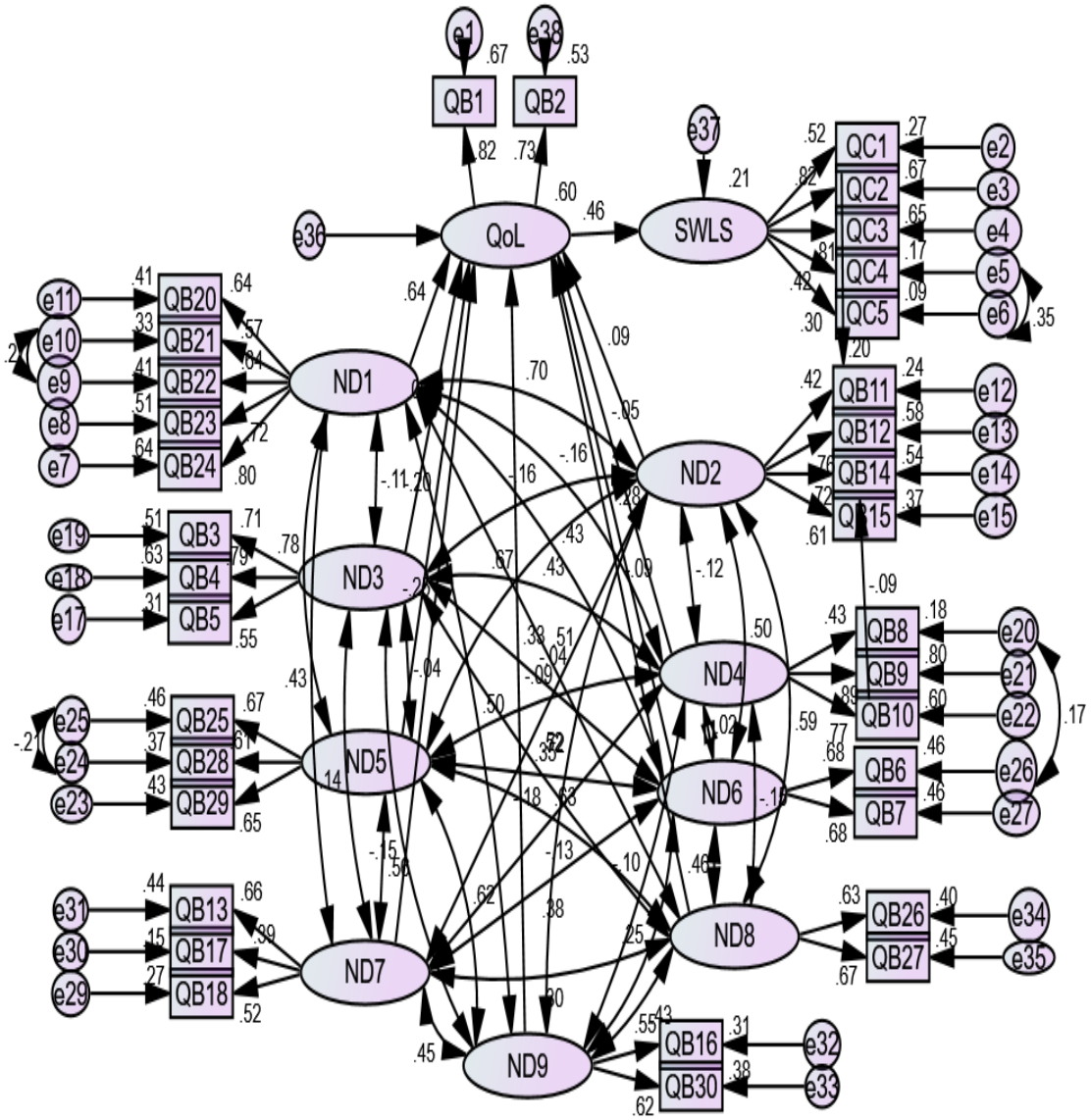


Figure 4.17. NModel 6: Path diagram for health related Quality of Life with two indicators for overall QOL and Satisfaction with Life Scale (SWLS) for HIV Positive patients data

The estimated path diagram with the standardized path coefficients as well as the coefficients between the latent construct for the hypothesized 9-component exogenous WHOQOL-HIV (BREF), 5-component exogenous SWLS and 2-component endogenous overall QOL

questions (NModel 6) with its modifications are presented in Figure 4.17. The estimated residual variance of SWLS on QoL was small (0.21). The significant effect of the structural part could be seen in that all the variables. For instance, ND 1 loaded well close to what can be seen in NModel 1. Also SWLS explains about 21% of QoL which is slightly higher than what we have in Model 6. The Model showed a lower impact of SWLS on QoL compared to NModel 5, this makes NModel 5 preferred to NModel 6 just as we preferred Model 5 to Model 6.

Measurement model for regrouped WHOQoL-HIV (BREF) and SWLS with two overall QoL questions (NModel 6)

$X_1 = 0.64\xi_1$

. .

. .

. .

$X_{29} = 0.62\xi_9$

$z_1 = 0.82\omega_1$

$z_2 = 0.73\omega_2$

$Y_1 = 0.52\alpha_1$

$Y_2 = 0.82\alpha_1$

$Y_3 = 0.81\alpha_1$

$Y_4 = 0.42\alpha_1$

$Y_5 = 0.30\alpha_1$

Structural model regrouped WHOQoL-HIV (BREF) and SWLS with two overall QoL questions (NModel 6)

$$\eta = 0.46\eta_1 + 0.640\xi_1 + 0.095\xi_2 + 0.093\xi_3 - 0.049\xi_4 - 0.203\xi_5 + 0.284\xi_6 - 0.249\xi_7 - 0.085\xi_8 + 0.331\xi_9$$

where R^2 of SWLS on QoL is 0.215.

4.5.17 SEM Parameter Estimates of the Hypothesized WHOQOL-HIV (BREF), overall QOL questions and Satisfaction with Life Scale questionnaire

The values of the standardized coefficients indicating their significant levels are presented in Table 4.11. Most of the indicator variables were significantly related to their respective latent constructs at 1% level of significantly except the indicator variable QB31 on ND 2 which was low. The standardized error term of each indicator variable was also reported because the

solution was admissible and was used to compute the R^2 values which indicated the proportion of variation in the latent components as explained by each particular indicator. The table also showed that there were negative relationships between ND 4, ND 5, ND 7, ND 8 and QoL which implies that for every unit increase in the concerns, personal, social and relationship of an HIV infected person, there is a corresponding reduction or decline in the quality of life of the person. A comprehensive table showing the standardized coefficients, the associated standard error, z-value and R^2 value of each indicator variable in NModel 6 is presented in the Appendix.

4.5.18 SEM Covariance among Latent Constructs of the Hypothesized WHOQOL-HIV (BREF), overall QOL questions and Satisfaction with Life Scale questionnaire

The covariance among the nine (9) latent exogenous constructs of the 9-component WHOQOL-HIV (BREF), 2-component overall QOL questions and 5-component endogenous SWLS questionnaire are presented in Table 4.12. Details in the Appendix

4.5.19 Fit Indices for regrouped WHOQoL-HIV (BREF) and SWLS with two overall QoL questions (NModel 6)

The chi-square goodness-of-fit test of the model with other baseline fit indices are shown in Table 4.15.

Table 4.15: Fit Indices for regrouped WHOQoL-HIV (BREF) and SWLS with two overall QoL questions (NModel 6)

Model	χ^2	*Df*	χ^2/df	*GFI*	*RMSEA*	*AIC*
NModel 6b	1086.965	479	2.269	0.886	0.047	1318.965

Note: x^2 =Chi-square statistics; df=degree of freedom; GFI=Goodness-of-Fit index; RMSEA=Root Mean Square error of approximation; AIC=Akaike's information criterion

The values from the indices indicate that the data fit the Model. GFI was close to 1 while RMSEA also showed a perfect fit of between 0.05 and 0.08.

4.5.20 Comparison of WHOQoL-HIV (BREF) and the Proposed Models using GLS

In Table 4.37, a comparison was drawn out to see whether the grouping of the existing domains in the WHOQoL-HIV (BREF) performs better than the proposed regrouped WHOQoL-HIV (BREF) variables using GLS estimation method.

Table 4.16: Comparison of WHOQoL-HIV (BREF) & the Proposed Models using GLS

Model fit Indices		**Model 1**	**Model 5**	**Model 6**
χ^2	NModel	686.057	1009.980	1086.965
	WHO	1053.94	1559.46	1649.484
Df	NModel	285	446	479
	WHO	352	539	573
χ^2/df	NModel	2.407	2.265	2.269
	WHO	2.994	2.893	2.879
GFI	NModel	0.910	0.891	0.886
	WHO	0.871	0.842	0.837
RMSEA	NModel	0.050	0.047	0.047
	WHO	0.060	0.058	0.058
AIC	NModel	872.057	1239.980	1318.965
	WHO	1219.935	1741.459	1835.484
BIC	NModel	1275.217	1738.511	1821.832
	WHO	1579.749	2135.949	2238.644
CAIC	NModel	1368.217	1853.511	1937.832
	WHO	1662.745	2226.949	2331.644

Table 4.16 clearly shows the comparison of WHO and the proposed models using GLS. It also shows that some models were not admissible and therefore could not converge to produce results they were not therefore indicated in Table 4.16. Using χ^2, DF, AIC, BIC and CAIC indices, Model 1 performs better than other Models, while Models 5 and 6 performs equally using RMSEA. Using χ^2/df indices, Model 5 performs better for the proposed

models, while Model 6 performs better for WHO models. Using GFI indices, Model 6 performs better. Conclusively, the data is more suitable for the proposed models than the WHO models.

4.6 Reduction of WHO (BREF) Instruments

In this section, indicator variables common to both WHO quality of life instruments that is, WHOQoL (BREF) and WHOQoL-HIV (BREF) were used. Binary logistic regression which is most useful statistic to model the event probability for a categorical response variable was applied to the data in this work.

Let Y denote the true state of an individual with categories:

0 denoting an HIV infected individual

1 denoting a non-HIV infected individual

Table 4.17a: All 26 variables showing odd ratio values

Variable	B	S.E.	Wald	Df	Sig.	Exp(B)
qb1	-0.826	0.187	19.417	1	0.000	0.438
qb2	0.659	0.167	15.564	1	0.000	1.932
qb3t	-1.416	0.113	157.033	1	0.000	0.243
qb5t	0.079	0.112	.492	1	0.483	1.082
qb6	-0.148	0.143	1.066	1	0.302	0.863
qb7	0.439	0.127	12.037	1	0.001	1.552
qb11	0.318	0.151	4.457	1	0.035	1.374
qb12	-0.457	0.156	8.584	1	0.003	0.633
qb13	-0.396	0.160	6.127	1	0.013	0.673
qb14	0.572	0.168	11.613	1	0.001	1.771
qb15	-0.122	0.124	0.965	1	0.326	0.885
qb16	0.890	0.127	49.465	1	0.000	2.435
qb18	-0.146	0.138	1.106	1	0.293	0.865
qb19	-0.105	0.127	.688	1	0.407	0.900
qb20	-0.894	0.176	25.892	1	0.000	0.409
qb21	-0.525	0.148	12.635	1	0.000	0.591
qb22	0.684	0.165	17.150	1	0.000	1.981
qb23	-0.288	0.166	2.998	1	0.083	0.750
qb24	-0.329	0.162	4.104	1	0.043	0.720
qb25	-0.526	0.158	11.059	1	0.001	0.591
qb26	0.440	0.132	11.155	1	0.001	1.553
qb27	-0.065	0.142	.210	1	0.647	0.937
qb28	-0.703	0.149	22.429	1	0.000	0.495

qb29	-0.283	0.134	4.459	1	0.035	0.753
qb30	-0.267	0.135	3.889	1	0.049	0.766
qb31t	-0.853	0.103	68.887	1	0.000	0.426

Table 4.17a shows all the twenty six (26) variables that are common to both infected and non-infected persons, their levels of significance at 0.05 significant level and their odd ratios using logistic regression. qb2, qb5, qb7, qb11, qb14, qb16, qb22 and qb26 were the variables that contributed more to the quality of non-infected individuals compared to infected individuals.

The model for the 26 variables was derived from the discriminant function coefficients as stated below:

$$Y = 0.178x_1 - 0.185x_2 + 0.772x_3 + 0.038x_5 + 0.063x_6 - 0.229x_7 - 0.094x_{11} + 0.141x_{12} + 0.166x_{13} - 0.168x_{14} + 0.018x_{15} - 0.313x_{16} + 0.050x_{18} + 0.096x_{19} + 0.230x_{20} + 0.182x_{21} - 0.222x_{22} + 0.078x_{23} + 0.156x_{24} + 0.213x_{25} - 0.118x_{26} - 0.007x_{27} + 0.208x_{28} + 0.061x_{29} + 0.084x_{30} + 0.367x_{31}$$

The model shows that most of the variables with odd ratios greater than one have corresponding negatively signed coefficients.

To calculate the sensitivity and the specificity of the model above, a cut-off point of 0.258 was set. Therefore, for an individual, if $Y_0 \geq 0.258$ implies infected and if $Y_0 < 0.258$ implies non-infected.

Table 4.17b: Sensitivity and specificity of 26 variables model

		Actual status of respondents	
Actual status from model		Infected	Non-Infected
	Infected	495	55
	Non-Infected	69	749

Sensitivity = 88%

Specificity = 93%

Positive Predictive Value (PPV) = 90%

Negative Predictive Value (NPV) = 92%

Table 4.17c: Odd ratios for the 19 Significant Variables

Variable	B	S.E.	Wald	Df	Sig.	Exp(B)
qb1	-0.776	0.183	18.005	1	0.000	0.460
qb2	0.628	0.165	14.560	1	0.000	1.874
qb3t	-1.378	0.098	198.378	1	0.000	0.252
qb7	0.394	0.122	10.410	1	0.001	1.483
qb11	0.302	0.148	4.179	1	0.041	1.353

qb12	-0.465	0.154	9.121	1	0.003	0.628
qb13	-0.514	0.149	11.885	1	0.001	0.598
qb14	0.438	0.153	8.207	1	0.004	1.550
qb16	0.822	0.121	46.007	1	0.000	2.275
qb20	-1.032	0.164	39.625	1	0.000	0.356
qb21	-0.530	0.143	13.755	1	0.000	0.588
qb22	0.618	0.157	15.493	1	0.000	1.855
qb24	-0.478	0.143	11.135	1	0.001	0.620
qb25	-0.503	0.152	11.000	1	0.001	0.605
qb26	0.411	0.125	10.840	1	0.001	1.508
qb28	-0.603	0.136	19.495	1	0.000	0.547
qb29	-0.351	0.128	7.540	1	0.006	0.704
qb30	-0.352	0.126	7.756	1	0.005	0.703
qb31t	-0.843	0.099	72.831	1	0.000	0.430

Source: Results from computer output

Table 4.17c shows only nineteen (19) out of the twenty six (26) variables that are significant at 0.05 significant level and their odd ratios using logistic regression. qb2, qb7, qb11, qb14, qb16, qb22 and qb26 were the variables that contributed more to the quality of life of non-infected individuals compared to infected individuals.

The model for the 19 variables was derived from the discriminant function coefficients as stated below:

$$Y = 0.180x_1 - 0.172x_2 + 0.795x_3 - 0.231x_7 - 0.084x_{11} + 0.131x_{12} + 0.191x_{13} - 0.132x_{14} - 0.289x_{16} + 0.262x_{20} + 0.180x_{21} - 0.208x_{22} + 0.189x_{24} + 0.200x_{25} - 0.107x_{26} + 0.206x_{28} + 0.078x_{29} + 0.117x_{30} + 0.372x_{31}$$

Variables with odd ratios greater than one have corresponding negatively signed coefficients. To calculate the sensitivity and the specificity of the model above, a cut-off point for nineteen significant variables was set to be 0.255. Therefore, for an individual, if $Y_0 \geq 0.255$ implies infected and if $Y_0 < 0.255$ implies non-infected.

Table 4.17d: Sensitivity and specificity of model for 19 variables

		Actual status of respondents	
Actual status from model		Infected	Non-Infected
	Infected	497	67
	Non-Infected	63	741

Sensitivity = 89%

Specificity = 92%

Positive Predictive Value (PPV) = 88%

Negative Predictive Value (PPV) = 92%

Discussion: PPV is the percentage of patients with positive test who actually have the disease, that is, PPV tells us about how many of test positives are true positives, and if this number is higher or as close to 100 as possible, then it suggests that this new test is doing as good as the gold standard. While, NPV is the percentage of patients with a negative test who do not have the disease, that is, NPV tells us how many of test negatives are true negatives, and if this number is higher or close to 100, then it suggests that this new test is doing as good as the gold standard. Therefore, from the results above, the PPV and NPV of the reduced measurement is as good as the standard WHO quality of life measurements. Consequent upon these, the reduced measurement of 19 variables can be used instead of the measurements with 26 variables, using the Nigerian data as a trial.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview of the study

The primary aim of this study was to investigate the bilateral structure explaining the association between quality of life and satisfaction with life among HIV infected in Ondo and Ekiti States as a sample for the Nigerian population.

The study started by examining the characteristics of the data used in this research work to determine if the data were suitable for structural equation modelling. The results showed that none of the assumption was violated. Mardia's test of multivariate normality established that both data sets do not exhibit normality. We proceeded to carry out the estimation processes by comparing the maximum likelihood and the generalized least squared estimation methods with the application of AMOS version 21 software. These were followed by the formulation of structural equations models for the different models in the groups. Furthermore, the HIV quality of life instrument was reclassified into new models and the effectiveness of the reduced version of the WHO quality of life instruments was estimated. Finally, suggestions for further research were made.

5.2 Summary

In this study, the characteristics of the three instruments and formulated models using a sample of the Nigerian population had been investigated.

5.2.1 Confirmatory Factor Analysis and Structural Equations

Testable models were specified and consequently examined using structural equation modeling (SEM) approach for the three study groups.

For the non-HIV data, theoretical 4-component of the WHOQoL (BREF) questionnaire was used with the SWLS questions on the non-infected population. The components Domain 1 to 4 are physical, psychological, social relationship and environmental. Eleven models were formulated from the six path diagrams with their standardized coefficients that is direct and indirect correlation estimates; covariance estimates; and their corresponding loading on the various latent constructs as seen in the path diagrams and the summary tables on parameters and covariance estimates (Tables 4.4 & 4.5). Table 4.4 revealed that the physical physique of non-infected persons has a significant effect on their satisfaction with life. Also, only one

Model did not have a significant impact of social relationship on the overall quality of life of a non-infected person. None of the models showed a significant impact of the environment on the overall quality of life. Moreover, the satisfaction of a non-infected person with his or her health has a significant impact on the overall quality of life. Furthermore, in all the Models, indicator variables are significantly related to most of the domains.

For HIV data, theoretical 6-component of the WHOQoL-HIV (BREF) questionnaire was used with the SWLS questions. The components are Domain 1 to 6 namely: physical; psychological; level of independence; social relationship; environment; and spirituality religion and personal believe. Eleven models were also formulated from the six path diagrams with their standardized coefficients, which are direct and indirect correlation estimates; covariance estimates; and their corresponding loading on the various latent constructs as seen in the path diagrams and the summary tables on parameters and covariance estimates (Tables 4.8 & 4.9). Table 4.8 revealed that the quality of life has a significant impact on the level of dependence of an infected person. Also that how an infected person rated his or her quality of life has a significant effect on the overall quality of life. Moreover, the satisfaction of an infected person with his or her health has a significant impact on the overall quality of life. Furthermore, in all the Models, indicator variables are significantly related to most of the domains.

It could be noted that the two groups followed the trend in literature as can be seen that while physical appearance of both infected and non-infected persons has impact on their quality of life, social and environment were of less importance. Also that domain 6 which is the spirituality religion and personal believe have little or no relationship with other domains. The bilateral relationship between WHOQoL instruments and SWLS can be seen that the satisfaction of life of an infected person has a significant impact on his or her overall quality of life. In addition, the indicator “in most ways my life is close to my ideal” was not significant in any of the models.

For the regrouped HIV data, hypothesized 9-component of the regrouped WHOQoL-HIV (BREF) questionnaire was used with the SWLS questions on the infected patients. Only three path diagrams were admissible for modeling by SEM as against six in the existing models. The proposed components are ND1 to ND9 namely: activities, physical, symptoms, concerns, personal, believe, social, relationship and finance. The reliability test for the proposed domains carried out using Cronbach’s alpha revealed a strong reliability of 0.754. It was also

noted that social domain as indicated in literatures has a weak reliability for our data set. However, domains like activities, symptoms, concern and believe should be emphasized within the Nigerian context. Five models were formulated from the three path diagrams with their standardized coefficients that is direct and indirect correlation estimates; covariance estimates; and their corresponding loading on the various latent constructs as seen in the path diagrams and the summary tables on parameters and covariance estimates (Tables 4.11 & 4.12). Table 4.11 revealed that the activity, believe and finance of an infected person has significant impact on the overall quality of life; also satisfaction with life of an infected person has significant impact on the overall quality of life.

Furthermore, it was revealed that more than half of the indicator variables have significant impact on the various proposed component or construct. Similarly, only the indicator variable "conditions of my life are excellent" was not significant on satisfaction with life of an infected person in the proposed models.

For the reduced WHOQoL instruments, it was revealed that the positive predictive value and the negative predictive value for the 26 items on both WHOQoL (BREF) and WHOQoL-HIV (BREF) were 90% and 92% respectively. While the PPV and NPV for the instrument with 19 reduced items were 88% and 92% respectively. Therefore, from the results, the PPV and NPV of the reduced measurement is as good as the standard WHO quality of life measurements. Consequent upon these, the reduced measurement of 19 variables can be used instead of the measurements with 26 variables, using the Nigerian data as a trial.

5.3 Contributions to Knowledge

The following contributions were made to knowledge from the discoveries in this research work.

Firstly, the study established that the use of GLS estimation method in ordinal non-normal data is more appropriate.

Secondly, the study also established that not all models in the WHO quality of life are admissible in SEM.

Furthermore, regrouping WHOQoL variables using principal component analysis produce better results.

Lastly, the reduced version of the WHOQoL questionnaires can be used for both HIV positive and negative patients.

5.4 Conclusions

The findings in this work is at variance with the work by Schermelleh-Engel *et. al.* (2003) which stated that Maximum Likelihood estimation seems to perform better than GLS and should be preferred. The reason why some findings indicated that GLS provided better empirical fit than ML (Browne, 1974; Ding *et al*., 1995; Olsson *et al*., 1999) was that the estimators are no longer equivalent when models are miss-specified.

Under the choice of sample size in relation to data, it was in agreement with the work of Schermelleh-Engel *et. al*. (2003) that as data become more non-normal, larger sample sizes are needed.

The fit indices chosen in this study are the frequently used in publications, they are sensitive to model misspecifications and do not depend on sample size as strongly as χ^2 and gives important information.

This study also supported other research works that a model with fewer indicators per factor may have a higher fit than a model with more indicators per factor, but more indicators per factor gives a more powerful and precise test.

5.5 Recommendations

Following the results in this research work, the study recommended that during the administration of WHOQoL instrument in Nigeria, emphasises needs to be placed on the items included in the listed domains: activities, symptoms, concern, physical and believe.

Secondly, the social aspect of the quality of life of Nigerians needs be improved upon.

Thirdly, the study recommended the use of the reduced instrument instead of the WHOQoL (BREF) for clinical routine.

5.5.1 Suggestion for future study

(a) Future research work could consider the extension of this work in more states or regions of Nigeria;

(b) The WHOQoL instrument could be used on other diseases.

(c) The variables identified not to be contributing to the impact of quality of life in Nigeria can be totally removed for future research;

(d) The proposed instrument (which includes the two instruments) could be used to carry out future interview or survey;

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APPENDICES

1. CFA Parameter Estimates, standard error estimates (S.E), Z-values and P-values for Model 1

Indicator Variable		Latent Construct	Estimate	S.E.	Z-value	P-value
QB3	<---	Domain1	0.636			
QB4	<---	Domain1	0.724	0.098	11.538	<0.001
QB14	<---	Domain1	-0.548	0.074	-7.600	<0.001
QB21	<---	Domain1	-0.466	0.071	-6.596	<0.001
QB6	<---	Domain2	0.223			
QB11	<---	Domain2	0.203	0.365	2.734	0.006
QB15	<---	Domain2	0.360	0.494	3.342	<0.001
QB24	<---	Domain2	0.639	0.620	3.715	<0.001
QB5	<---	Domain3	0.540			
QB20	<---	Domain3	-0.324	0.059	-4.662	<0.001
QB22	<---	Domain3	-0.597	0.076	-7.319	<0.001
QB23	<---	Domain3	-0.598	0.081	-7.172	<0.001
QB17	<---	Domain4	0.352			
QB25	<---	Domain4	0.607	0.254	5.267	<0.001
QB26	<---	Domain4	0.548	0.364	5.001	<0.001
QB27	<---	Domain4	0.488	0.312	4.850	<0.001
QB12	<---	Domain5	0.352			
QB13	<---	Domain5	0.463	0.317	4.955	<0.001
QB16	<---	Domain5	0.218	0.379	3.090	0.002
QB18	<---	Domain5	0.303	0.361	4.067	<0.001
QB7	<---	Domain6	0.054			
QB8	<---	Domain6	-0.385	10.376	-0.980	0.327
QB9	<---	Domain6	-0.878	27.865	-0.979	0.328
QB10	<---	Domain6	-0.765	22.370	-0.984	0.325
QB31	<---	Domain2	-0.476	0.806	-3.498	<0.001
QB19	<---	Domain5	0.313	0.400	3.941	<0.001
QB28	<---	Domain5	0.489	0.393	4.687	<0.001
QB29	<---	Domain5	0.550	0.460	4.573	<0.001
QB30	<---	Domain5	0.561	0.620	4.672	<0.001

Note: Level of significance is 1%
S.E= Standard Error

2. Parameter estimates, standard error estimates (S.E), and Z-value for Model 2

Indicator Variable		Latent Construct	Estimate	S.E.	Z-value	P-value	R^2
QoL	<---	Domain3	-9.294	10.436	-2.007	0.045	
QoL	<---	Domain6	0.790	7.903	1.013	0.311	
QoL	<---	Domain1	8.206	8.960	1.953	0.051	
QoL	<---	Domain2	0.356				
QoL	<---	Domain5	-0.757	1.748	-0.835	0.404	
QoL	<---	Domain4	-1.136	2.471	-1.300	0.193	
QB3	<---	Domain1	0.358				0.128
QB4	<---	Domain1	0.357	0.166	5.526	<0.001	0.127
QB14	<---	Domain1	-0.727	0.334	-5.668	<0.001	0.528
QB21	<---	Domain1	-0.645	0.292	-5.371	<0.001	0.415
QB6	<---	Domain2	0.321				0.103
QB11	<---	Domain2	0.297	0.239	4.300	<0.001	0.088
QB15	<---	Domain2	0.533	0.346	5.353	<0.001	0.284
QB24	<---	Domain2	0.775	0.392	5.815	<0.001	0.601
QB5	<---	Domain3	0.284				0.081
QB20	<---	Domain3	-0.591	0.273	-4.473	<0.001	0.349
QB22	<---	Domain3	-0.700	0.330	-4.782	<0.001	0.490
QB23	<---	Domain3	-0.727	0.372	-4.776	<0.001	0.529
QB17	<---	Domain4	0.280				0.079
QB25	<---	Domain4	0.803	0.499	5.008	<0.001	0.645
QB26	<---	Domain4	0.489	0.419	5.040	<0.001	0.239
QB27	<---	Domain4	0.677	0.597	4.795	<0.001	0.459
QB12	<---	Domain5	0.596				0.355
QB13	<---	Domain5	0.430	0.099	7.486	<0.001	0.185
QB16	<---	Domain5	0.373	0.174	6.057	<0.001	0.139
QB18	<---	Domain5	0.300	0.134	5.452	<0.001	0.090
QB7	<---	Domain6	0.090				0.008
QB8	<---	Domain6	-0.326	3.339	-1.522	0.128	0.106
QB9	<---	Domain6	-0.795	9.015	-1.534	0.125	0.631
QB10	<---	Domain6	-0.793	8.63	-1.548	0.122	0.630
QB31	<---	Domain2	-0.165	0.231	-2.627	0.009	0.027
QB19	<---	Domain5	0.294	0.142	5.282	<0.001	0.087
QB28	<---	Domain5	0.608	0.149	8.563	<0.001	0.370
QB29	<---	Domain5	0.635	0.163	8.333	<0.001	0.403
QB30	<---	Domain5	0.478	0.169	7.174	<0.001	0.229
QB1	<---	QoL	1.000				1.000

Note: Level of significance is 1%
S.E= Standard Error

Fitted Structural Equation Model (SEM) for Model 2

The estimated path diagram with the standardized path coefficients as well as the coefficient between the latent constructs for the theoretical 4-componet exogenous WHOQoL (BREF) questionnaire and 1-component endogenous overall QoL question (Model 2) are presented in Figure 7. The latent constructs were highly correlated rating (between 0.75 and 0.97). The model also showed the correlation among some selected error terms that were used to improve the model fit. It also showed that most of the indicators contributed significantly to the different domains using 0.5 as the standard as follows: In Domain 1, it is evident that all the seven items related to physical appearance loaded well. QB18 (Satisfaction with capacity for work) and QB10 (Enough energy for everyday life) variables appear to be the best indicators of Domain 1. Their standardized regression weights are 0.75 and 0.72 respectively. Additionally, Domain 1 explained about 57% of the variance in QB18 and 51% of the variance in QB10. QB17 (Satisfaction with ability to perform daily living activities) is the poorest among the physical indicators of Domain 1 with an R^2 of 0.27 and a standardized regression weight of 0.52.

In Domain 2, it is evident that all the six items related to psychology loaded well. QB7 (Level of concentration) and QB19 (Satisfaction with yourself) variables appear to be the best indicators of Domain 2. Their standardized regression weights are 0.70 and 0.69 respectively. Additionally, Domain 2 explained about 48% of the variance each in QB7 and QB19. QB26 (Negative feelings) is the poorest among the psychology indicators of Domain 2 with an R^2 of 0.26 and a standardized regression weight of 0.51.

In Domain 3, it is evident that the three items related to social relationship loaded well. QB22 (Satisfaction with support from friends) and QB21 (Satisfaction with sexuality) variables appear to be the best indicators of Domain 3. Their standardized regression weights are 0.76 and 0.68 respectively. Additionally, Domain 3 explained about 58% of the variance in QB22 and 47% of the variance in QB21. QB20 (Satisfaction with personal relationship) is the poorest among the social relationship indicators of Domain 3 with an R^2 of 0.41 and a standardized regression weight of 0.64.

In Domain 4, it is evident that six out of the eight items related to the environment loaded moderately. QB8 (Safety in your daily life) and QB25 (Satisfaction with transportation) variables appear to be the best indicators of Domain 4. Their standardized regression weights are 0.79 and 0.62 respectively. Additionally, Domain 4 explained about 63% of the variance in QB8 and 39% of the variance in QB25. QB14 and QB24 (Satisfaction with access to

health services) are the poorest among the environmental indicators of Domain 4 with R^2 of 0.06 and a standardized regression weight of 0.25 each.

It also gave information on the structural part that the indicator variable QB1 had a very high impact on QoL which is also the endogenous variable. The model also gave information on the estimated structural equation indicating that psychology domain (ξ_2) had the most substantial causal effect on QoL (η) which was much more higher than environmental domain (ξ_4), while as physical domain (ξ_1) and social relationship (ξ_3) increases, there is a decline in the quality of life of a non-infected person. Also, the estimated residual variance was large (1.0).

3: SEM Parameter estimates, standard error estimates (S.E), and Z-value for Model 3

Indicator Variable		**Latent Construct**	**Estimate**	**S.E.**	**Z-value**	**P**	**R^2**
QoL	<---	Domain3	-4.576	7.417	-0.306	0.760	
QoL	<---	Domain1	4.598	8.895	0.307	0.758	
QoL	<---	Domain2	0.499				
QoL	<---	Domain5	-0.013	0.534	-0.027	0.979	
QoL	<---	Domain4	-0.782	2.900	-0.338	0.735	
QoL	<---	Domain6	0.703	17.274	0.273	0.785	
QB3	<---	Domain1	0.474				0.224
QB4	<---	Domain1	0.589	0.138	9.099	<0.001	0.347
QB14	<---	Domain1	-0.583	0.131	-6.69	<0.001	0.34
QB21	<---	Domain1	-0.520	0.124	-6.124	<0.001	0.271
QB6	<---	Domain2	0.197				0.039
QB11	<---	Domain2	0.238	0.506	2.722	0.006	0.057
QB15	<---	Domain2	0.395	0.703	3.049	0.002	0.156
QB24	<---	Domain2	0.699	0.928	3.27	0.001	0.489
QB5	<---	Domain3	0.507				0.257
QB20	<---	Domain3	-0.342	0.068	-4.649	<0.001	0.117
QB22	<---	Domain3	-0.618	0.094	-7.03	<0.001	0.382
QB23	<---	Domain3	-0.642	0.103	-7.044	<0.001	0.413
QB17	<---	Domain4	0.271				0.073
QB25	<---	Domain4	0.757	0.532	4.403	<0.001	0.573
QB26	<---	Domain4	0.473	0.461	4.604	<0.001	0.224
QB27	<---	Domain4	0.644	0.66	4.210	<0.001	0.415
QB12	<---	Domain5	0.468				0.219
QB13	<---	Domain5	0.461	0.177	6.228	<0.001	0.213
QB16	<---	Domain5	0.231	0.243	3.579	<0.001	0.053
QB18	<---	Domain5	0.289	0.210	4.604	<0.001	0.084
QB7	<---	Domain6	0.057				0.003

QB8	<---	Domain6	-0.376	9.267	-1.009	0.313	0.141
QB9	<---	Domain6	-0.833	23.843	-1.008	0.313	0.694
QB10	<---	Domain6	-0.799	21.748	-1.014	0.311	0.639
QB31	<---	Domain2	-0.409	0.880	-3.071	0.002	0.167
QB19	<---	Domain5	0.272	0.222	4.226	<0.001	0.074
QB28	<---	Domain5	0.537	0.238	6.123	<0.001	0.288
QB29	<---	Domain5	0.621	0.289	6.175	<0.001	0.386
QB30	<---	Domain5	0.515	0.311	5.862	<0.001	0.265
QB1	<---	QoL	0.480				0.230
QB2	<---	QoL	1.000	0.25	10.824	<0.001	1.000

Note: Level of significance is 1%
S.E= Standard Error

Fitted Structural Equation Model (SEM) for Model 3

The estimated path diagram with the standardized path coefficients, as well as the coefficient between the exogenous latent constructs for the theoretical 4-component WHOQoL (BREF) and the endogenous 2-component overall QoL questions (Model 3) are presented in Figure 8. The latent constructs were also moderately and highly correlated rating (between 0.65 and 0.98). The model also showed the correlation among some selected error terms which were used to improve the model fit. It further showed that most of the indicators contributed significantly to their corresponding domains using 0.5 as a standard as follows: In Domain 1, it is evident that all the seven items related to physical appearance loaded well. QB18 (Satisfaction with capacity for work) and QB10 (Enough energy for everyday life) variables appear to be the best indicators of Domain 1. Their standardized regression weights are 0.74 and 0.70 respectively. Additionally, Domain 1 explained about 55% of the variance in QB18 and 49% of the variance in QB10. QB17 (Satisfaction with ability to perform daily living activities) is the poorest among the physical indicators of Domain 1 with an R^2 of 0.15 and a standardized regression weight of 0.39.

In Domain 2, it is evident that all the six items related to psychology loaded well. QB7 (Level of concentration) and QB19 (Satisfaction with yourself) variables appear to be the best indicators of Domain 2. Their standardized regression weights are 0.68 and 0.63 respectively. Additionally, Domain 2 explained about 46% of the variance in QB7 39% of the variance in QB19. QB5 (How much do you enjoy life) is the poorest among the psychology indicators of Domain 2 with an R^2 of 0.16 and a standardized regression weight of 0.40.

In Domain 3, it is evident that the three items related to social relationship loaded well. QB21 (Satisfaction with sexuality) and QB22 (Satisfaction with support from friends) variables appear to be the best indicators of Domain 3. Their standardized regression weights are 0.73

and 0.71 respectively. Additionally, Domain 3 explained about 53% of the variance in QB21 and 51% of the variance in QB22. QB20 (Satisfaction with personal relationship) is the poorest among the social relationship indicators of Domain 3 with an R^2 of 0.23 and a standardized regression weight of 0.48.

In Domain 4, it is evident that seven out of the eight items related to the environment loaded moderately. QB8 (Safety in your daily life) and QB25 (Satisfaction with transportation) variables appear to be the best indicators of Domain 4. Their standardized regression weights are 0.77 and 0.64 respectively. Additionally, Domain 4 explained about 60% of the variance in QB8 and 41% of the variance in QB25. QB24 (Satisfaction with access to health services) is the poorest among the environmental indicators of Domain 4 with R^2 of 0.03 and a standardized regression weight of 0.19.

It also gave information on the structural part that the indicator variable QB1 had a very high impact on QoL which is also the endogenous variable. The model also gave information on the estimated structural equation indicated that psychology domain (ξ_2) had the most substantial causal effect on QoL (η) which was much more higher than environmental domain (ξ_4), while as physical domain (ξ_1) and social relationship (ξ_3) increases, there is a decline in the quality of life of a non-infected person. Also, the estimated residual variance was large (1.0).

4: SEM Parameter estimates, standard error estimates (S.E), and Z-value for Model 4

Indicator Variable		Latent Construct	Estimate	S.E.	Z-value	P-value	R^2
SWLS	<---	Domain2	0.251				
SWLS	<---	Domain5	-0.055	0.608	-0.405	0.685	
SWLS	<---	Domain3	-0.513	0.632	-0.909	0.364	
SWLS	<---	Domain4	0.031	0.463	0.164	0.87	
SWLS	<---	Domain6	0.017	1.695	0.212	0.832	
SWLS	<---	Domain1	0.401	0.531	0.773	0.439	
QB3	<---	Domain1	0.676				0.457
QB4	<---	Domain1	0.746	0.091	11.949	<0.001	0.556
QB14	<---	Domain1	-0.503	0.064	-7.207	<0.001	0.253
QB21	<---	Domain1	-0.445	0.062	-6.494	<0.001	0.198
QB6	<---	Domain2	0.258				0.067
QB11	<---	Domain2	0.199	0.304	2.769	0.006	0.039
QB15	<---	Domain2	0.324	0.372	3.471	<0.001	0.105
QB24	<---	Domain2	0.621	0.473	4.095	<0.001	0.385
QB5	<---	Domain3	0.567				0.322

QB20	<---	Domain3	-0.314	0.055	-4.591	<0.001	0.098
QB22	<---	Domain3	-0.584	0.07	-7.454	<0.001	0.341
QB23	<---	Domain3	-0.558	0.072	-6.9	<0.001	0.312
QB17	<---	Domain4	0.349				0.122
QB25	<---	Domain4	0.606	0.26	5.151	<0.001	0.367
QB26	<---	Domain4	0.543	0.369	4.882	<0.001	0.295
QB27	<---	Domain4	0.478	0.31	4.743	<0.001	0.229
QB12	<---	Domain5	0.34				0.116
QB13	<---	Domain5	0.477	0.368	4.73	<0.001	0.228
QB16	<---	Domain5	0.199	0.4	2.752	0.006	0.04
QB18	<---	Domain5	0.312	0.41	3.928	<0.001	0.097
QB7	<---	Domain6	0.049				0.002
QB8	<---	Domain6	-0.397	13.862	-0.869	0.385	0.158
QB9	<---	Domain6	-0.9	36.906	-0.868	0.385	0.81
QB10	<---	Domain6	-0.762	28.944	-0.872	0.383	0.581
QB31	<---	Domain2	-0.511	0.689	-3.896	<0.001	0.262
QB19	<---	Domain5	0.319	0.446	3.768	<0.001	0.102
QB28	<---	Domain5	0.47	0.421	4.42	<0.001	0.221
QB29	<---	Domain5	0.554	0.523	4.363	<0.001	0.307
QB30	<---	Domain5	0.568	0.705	4.462	<0.001	0.323
QC1	<---	SWLS	0.495				0.245
QC2	<---	SWLS	0.812	0.16	9.221	<0.001	0.659
QC3	<---	SWLS	0.779	0.143	9.419	<0.001	0.607
QC4	<---	SWLS	0.540	0.161	7.235	<0.001	0.291
QC5	<---	SWLS	0.426	0.156	6.472	<0.001	0.181

Note: Level of significance is 1%
S.E= Standard Error

Fitted Structural Equation Model (SEM) for Model 4

The estimated path diagram with standardized path coefficients, as well as the coefficient between the latent exogenous constructs for the theoretical 4-component WHOQoL (BREF) and the 5-component endogenous SWLS question (Model 4) are presented in Figure 9. The latent constructs were highly correlated rating (between 0.71 and 0.99). The model also showed the correlation among some selected error terms which were used to improve the model fit. It further showed that most of the indicators contributed significantly to their corresponding domains as follows: In Domain 1, it is evident that all the seven items related to physical appearance loaded well. QB18 (Satisfaction with capacity for work) and QB10

(Enough energy for everyday life) variables appear to be the best indicators of Domain 1. Their standardized regression weights are 0.78 and 0.74 respectively. Additionally, Domain 1 explained about 61% of the variance in QB18 and 55% of the variance in QB10. QB17 (Satisfaction with ability to perform daily living activities) is the poorest among the physical indicators of Domain 1 with an R^2 of 0.25 and a standardized regression weight of 0.50.

In Domain 2, it is evident that all the six items related to psychology loaded well. QB11 (Acceptability of bodily appearance) and QB7 (Level of concentration) variables appear to be the best indicators of Domain 2. Their standardized regression weights are 0.70 and 0.65 respectively. Additionally, Domain 2 explained about 48% of the variance in QB11 and 43% of the variance in QB7. QB5 (How much do you enjoy life) is the poorest among the psychology indicators of Domain 2 with an R^2 of 0.20 and a standardized regression weight of 0.45.

In Domain 3, it is evident that the three items related to social relationship loaded well. QB22 (Satisfaction with support from friends) and QB21 (Satisfaction with sexuality) variables appear to be the best indicators of Domain 3. Their standardized regression weights are 0.73 and 0.68 respectively. Additionally, Domain 3 explained about 54% of the variance in QB22 and 46% of the variance in QB21. QB20 (Satisfaction with personal relationship) is the poorest among the social relationship indicators of Domain 3 with an R^2 of 0.34 and a standardized regression weight of 0.59.

In Domain 4, it is evident that all the eight items related to the environment loaded moderately. QB8 (Safety in your daily life) and QB25 (Satisfaction with transportation) variables appear to be the best indicators of Domain 4. Their standardized regression weights are 0.76 and 0.71 respectively. Additionally, Domain 4 explained about 58% of the variance in QB8 and 51% of the variance in QB25. QB24 (Satisfaction with access to health services) is the poorest among the environmental indicators of Domain 4 with R^2 of 0.10 and a standardized regression weight of 0.31.

It also gave information on the structural part that only indicators QC2 (The conditions of my life are excellent) and QC3 (I am satisfied with my life) had high impact on the endogenous variable SWLS. The model also gave information on the estimated structural equation that psychology domain (ξ_2) had the most substantial causal effect on SWLS (η) which was much more higher than environmental domain (ξ_4), while as physical domain (ξ_1) and social relationship (ξ_3) increases, there is a decline in the satisfaction with life of a non-infected person. Also, the estimated residual variance was small (0.37).

5: SEM Parameter estimates, standard error estimates (S.E), and Z-value for Model 5

Indicator Variable		Latent Construct	Estimate	S.E.	Z-value	P-value	R^2
QoL	<---	Domain2	0.711				
QoL	<---	Domain5	-0.367	0.344	-1.519	0.129	
QoL	<---	Domain3	-1.101	0.525	-1.02	0.308	
QoL	<---	Domain4	-0.056	0.356	-0.155	0.877	
QoL	<---	Domain6	0.076	0.858	0.503	0.615	
QoL	<---	Domain1	0.939	0.427	0.965	0.335	
SWLS	<---	QoL	0.536	0.301	4.297	<0.001	
QB3	<---	Domain1	0.661				0.437
QB4	<---	Domain1	0.729	0.092	11.757	<0.001	0.531
QB14	<---	Domain1	-0.566	0.071	-7.891	<0.001	0.32
QB21	<---	Domain1	-0.483	0.066	-6.962	<0.001	0.234
QB6	<---	Domain2	0.305				0.093
QB11	<---	Domain2	0.216	0.249	3.146	0.002	0.047
QB15	<---	Domain2	0.381	0.317	4.169	<0.001	0.145
QB24	<---	Domain2	0.649	0.368	4.829	<0.001	0.421
QB5	<---	Domain3	0.547				0.300
QB20	<---	Domain3	-0.397	0.061	-5.391	<0.001	0.157
QB22	<---	Domain3	-0.612	0.077	-7.599	<0.001	0.374
QB23	<---	Domain3	-0.585	0.079	-7.074	<0.001	0.343
QB17	<---	Domain4	0.361				0.131
QB25	<---	Domain4	0.605	0.239	5.414	<0.001	0.367
QB26	<---	Domain4	0.540	0.337	5.094	<0.001	0.291
QB27	<---	Domain4	0.517	0.305	5.075	<0.001	0.267
QB12	<---	Domain5	0.426				0.182
QB13	<---	Domain5	0.494	0.238	5.907	<0.001	0.244
QB16	<---	Domain5	0.182	0.279	2.771	0.006	0.033
QB18	<---	Domain5	0.350	0.287	4.849	<0.001	0.122
QB7	<---	Domain6	0.075				0.006
QB8	<---	Domain6	-0.408	6.136	-1.312	0.190	0.167
QB9	<---	Domain6	-0.893	15.811	-1.310	0.190	0.797
QB10	<---	Domain6	-0.766	12.555	-1.320	0.187	0.586

QB31	<---	Domain2	-0.485	0.481	-4.446	<0.001	0.235
QB19	<---	Domain5	0.324	0.296	4.449	<0.001	0.105
QB28	<---	Domain5	0.480	0.270	5.468	<0.001	0.231
QB29	<---	Domain5	0.575	0.337	5.482	<0.001	0.331
QB30	<---	Domain5	0.546	0.418	5.525	<0.001	0.299
QB1	<---	QoL	0.496				0.246
QC1	<---	SWLS	0.496				0.246
QC2	<---	SWLS	0.806	0.158	9.235	<0.001	0.649
QC3	<---	SWLS	0.781	0.142	9.415	<0.001	0.610
QC4	<---	SWLS	0.544	0.162	7.270	<0.001	0.296
QC5	<---	SWLS	0.430	0.157	6.508	<0.001	0.185

Note: Level of significance is 1%
S.E= Standard Error

Fitted Structural Equation Model (SEM) for Model 5

The estimated path diagram with standardized path coefficients, as well as the coefficient between the exogenous latent constructs for the theoretical 4-component WHOQoL (BREF), the 1-component endogenous QoL question and the 5-component exogenous SWLS questions (Model 5) are presented in Figure 10. The model also showed the correlation among some selected error terms which were used to improve the model fit. The latent constructs were highly correlated rating (between 0.72 and 0.97). It further showed that most of the indicators contributed significantly to their corresponding domains as follows: In Domain 1, it is evident that all the seven items related to physical appearance loaded well. QB18 (Satisfaction with capacity for work) and QB10 (Enough energy for everyday life) variables appear to be the best indicators of Domain 1. Their standardized regression weights are 0.77 and 0.76 respectively. Additionally, Domain 1 explained about 59% of the variance in QB18 and 57% of the variance in QB10. QB3 (Effect of physical pain) and QB17 (Satisfaction with ability to perform daily living activities) are the poorest among the physical indicators of Domain 1 with R^2 of 0.29 and standardized regression weight of 0.54 each.

In Domain 2, it is evident that all the six items related to psychology loaded well. QB19 (Satisfaction with yourself) and QB7 (Level of concentration) variables appear to be the best indicators of Domain 2. Their standardized regression weights are 0.77 and 0.72 respectively. Additionally, Domain 2 explained about 60% of the variance in QB19 and 51% of the variance in QB7. QB5 (How much do you enjoy life) is the poorest among the psychology indicators of Domain 2 with an R^2 of 0.25 and a standardized regression weight of 0.50.

In Domain 3, it is evident that the three items related to social relationship loaded well. QB22 (Satisfaction with support from friends) and QB21 (Satisfaction with sexuality) variables appear to be the best indicators of Domain 3. Their standardized regression weights are 0.74 and 0.68 respectively. Additionally, Domain 3 explained about 55% of the variance in QB22 and 47% of the variance in QB21. QB20 (Satisfaction with personal relationship) is the poorest among the social relationship indicators of Domain 3 with an R^2 of 0.40 and a standardized regression weight of 0.63.

In Domain 4, it is evident that seven out of the eight items related to the environment loaded moderately. QB8 (Safety in your daily life) and QB25 (Satisfaction with transportation) variables appear to be the best indicators of Domain 4. Their standardized regression weights are 0.79 and 0.69 respectively. Additionally, Domain 4 explained about 62% of the variance in QB8 and 48% of the variance in QB25. QB24 (Satisfaction with access to health services) is the poorest among the environmental indicators of Domain 4 with R^2 of 0.06 and a standardized regression weight of 0.25.

The model also gave information on the structural part as follows: QB1 had high impact on QoL, while only indicators QC2 (The conditions of my life are excellent) and QC3 (I am satisfied with my life) had very high impact on the endogenous variable SWLS. Where β coefficient is 0.71 indicating a high impact of SWLS on the QoL of a non-infected person. The estimated structural equation indicated that psychology domain (ξ_2) had the most substantial causal effect on QoL (η) which is slightly higher than environmental domain (ξ_4), while as physical domain (ξ_1) and social relationship domain (ξ_3) increases, there is a decline in the quality of life of a non-infected person. Also, the estimated residual variance on SWLS was good (0.51).

6: SEM Parameter estimates, standard error estimates (S.E), and Z-value for Model 6

Indicator Variable		Latent Construct	Estimate	S.E.	Z-value	P-value	R^2
QoL	<---	Domain2	0.484				
QoL	<---	Domain5	-0.073	0.349	-0.451	0.652	
QoL	<---	Domain3	-0.95	0.55	-1.361	0.173	
QoL	<---	Domain4	-0.246	0.362	-1.024	0.306	
QoL	<---	Domain6	0.062	1.562	0.494	0.622	
QoL	<---	Domain1	0.751	0.409	1.213	0.225	
SWLS	<---	QoL	0.418	0.129	5.118	<0.001	

QB3	<---	Domain1	0.655				0.429
QB4	<---	Domain1	0.687	0.093	10.833	<0.001	0.472
QB14	<---	Domain1	-0.575	0.078	-7.797	<0.001	0.33
QB21	<---	Domain1	-0.538	0.075	-7.32	<0.001	0.289
QB6	<---	Domain2	0.298				0.089
QB11	<---	Domain2	0.143	0.233	2.262	0.024	0.02
QB15	<---	Domain2	0.381	0.334	4.079	<0.001	0.145
QB24	<---	Domain2	0.705	0.435	4.756	<0.001	0.498
QB5	<---	Domain3	0.495				0.245
QB20	<---	Domain3	-0.419	0.074	-5.432	<0.001	0.176
QB22	<---	Domain3	-0.624	0.096	-7.242	<0.001	0.389
QB23	<---	Domain3	-0.639	0.104	-7.028	<0.001	0.409
QB17	<---	Domain4	0.345				0.119
QB25	<---	Domain4	0.607	0.267	5.24	<0.001	0.369
QB26	<---	Domain4	0.552	0.383	4.963	<0.001	0.305
QB27	<---	Domain4	0.53	0.347	4.944	<0.001	0.281
QB12	<---	Domain5	0.405				0.164
QB13	<---	Domain5	0.47	0.255	5.497	<0.001	0.22
QB16	<---	Domain5	0.208	0.309	3.068	0.002	0.043
QB18	<---	Domain5	0.314	0.3	4.383	<0.001	0.099
QB7	<---	Domain6	0.048				0.002
QB8	<---	Domain6	-0.393	14.021	-0.85	0.396	0.154
QB9	<---	Domain6	-0.881	36.512	-0.847	0.397	0.776
QB10	<---	Domain6	-0.764	29.564	-0.851	0.395	0.583
QB31	<---	Domain2	-0.434	0.454	-4.234	<0.001	0.188
QB19	<---	Domain5	0.307	0.316	4.124	<0.001	0.094
QB28	<---	Domain5	0.52	0.324	5.343	<0.001	0.271
QB29	<---	Domain5	0.577	0.38	5.174	<0.001	0.333
QB30	<---	Domain5	0.552	0.477	5.238	<0.001	0.305
QB1	<---	QoL	0.698				0.487
QC1	<---	SWLS	0.473				0.224
QC2	<---	SWLS	0.787	0.174	8.689	<0.001	0.62

QC3	<---	SWLS	0.802	0.167	8.782	<0.001	0.642
QC4	<---	SWLS	0.514	0.172	6.745	<0.001	0.264
QC5	<---	SWLS	0.408	0.17	6.063	<0.001	0.166
QB2	<---	QoL	0.709	0.158	7.612	<0.001	0.502

Note: Level of significance is 1%
S.E= Standard Error

Fitted Structural Equation Model (SEM) for Model 6

The estimated path diagram with standardized path coefficients as well as the coefficient between the exogenous latent constructs for the theoretical 4-component WHOQoL (BREF), the 2-component endogenous QoL questions and the 5-component exogenous SWLS questions (Model 6) are presented in Figure 11. The model also showed the correlation among some selected error terms which were used to improve the model fit. The latent constructs were moderately and highly correlated rating (between 0.54 and 0.97). It further showed that more than half of the total indicators contributed significantly to their corresponding domains using as follows: In Domain 1, it is evident that six out of the seven items related to physical appearance loaded well. QB10 (Enough energy for everyday life) and QB18 (Satisfaction with capacity for work) variables appear to be the best indicators of Domain 1. Their standardized regression weights are 0.74 and 0.66 respectively. Additionally, Domain 1 explained about 55% of the variance in QB10 and 44% of the variance in QB18. QB3 (Effect of physical pain) is the poorest among the physical indicators of Domain 1 with R^2 of 0.01 meaning that Domain 1 explains practically no variance in the variable and standardized regression weight of 0.12 each.

In Domain 2, it is evident that all the six items related to psychology loaded moderately. QB19 (Satisfaction with yourself) and QB11 (Acceptance of bodily appearance) variables appear to be the best indicators of Domain 2. Their standardized regression weights are 0.72 and 0.65 respectively. Additionally, Domain 2 explained about 52% of the variance in QB19 and 42% of the variance in QB11. QB5 (How much do you enjoy life) is the poorest among the psychology indicators of Domain 2 with an R^2 of 0.09 and a standardized regression weight of 0.30.

In Domain 3, it is evident that the three items related to social relationship loaded well. QB21 (Satisfaction with sexuality) and QB22 (Satisfaction with support from friends) variables appear to be the best indicators of Domain 3. Their standardized regression weights are 0.71 and 0.63 respectively. Additionally, Domain 3 explained about 51% of the variance in QB21 and 39% of the variance in QB22. QB20 (Satisfaction with personal relationship) is the

poorest among the social relationship indicators of Domain 3 with an R^2 of 0.27 and a standardized regression weight of 0.52.

In Domain 4, it is evident that six out of the eight items related to the environment loaded moderately. QB8 (Safety in your daily life) and QB25 (Satisfaction with transportation) variables appear to be the best indicators of Domain 4. Their standardized regression weights are 0.75 and 0.56 respectively. Additionally, Domain 4 explained about 56% of the variance in QB8 and 31% of the variance in QB25. QB24 (Satisfaction with access to health services) is the poorest among the environmental indicators of Domain 4 with R^2 of 0.00 meaning that Domain 4 explains practically no variance in the variable and a standardized regression weight of -0.02.

The model also gave information on the structural part as follows: QB1 had high impact on QoL, while only indicators QC2 (The conditions of my life are excellent) and QC3 (I am satisfied with my life) had averagely high impact on the endogenous variable SWLS. Where β coefficient is 0.15 indicating a low impact of SWLS on the QoL of a non-infected person. The estimated structural equation indicated that psychological domain (ξ_2) had the most substantial causal effect on QoL (η) which is higher than environmental domain while as physical domain (ξ_1) and social relationship domain (ξ_3) increases, there is a decline in the quality of life of a non-infected person. Also, the estimated residual variance was very small (0.02) meaning that the QoL explains practically no variance in SWLS.

7: CFA Parameter estimates, standard error estimates (S.E), and Z-value for Model 7

Indicator Variable		**Latent Construct**	**Estimate**	**S.E.**	**Z-value**	**P-value**	**R^2**
QB3	<---	Domain1	0.553				0.306
QB4	<---	Domain1	0.560	0.082	11.614	<0.001	0.313
QB10	<---	Domain1	0.698	0.098	10.668	<0.001	0.488
QB15	<---	Domain1	0.541	0.077	10.134	<0.001	0.292
QB16	<---	Domain1	0.654	0.096	10.918	<0.001	0.428
QB17	<---	Domain1	0.481	0.078	8.797	<0.001	0.231
QB18	<---	Domain1	0.768	0.111	11.377	<0.001	0.590
QB5	<---	Domain2	0.466				0.217
QB6	<---	Domain2	0.672	0.229	9.249	<0.001	0.452
QB7	<---	Domain2	0.673	0.174	9.876	<0.001	0.452
QB11	<---	Domain2	0.681	0.258	8.875	<0.001	0.464
QB19	<---	Domain2	0.750	0.239	9.237	<0.001	0.562
QB26	<---	Domain2	0.555	0.235	7.749	<0.001	0.308
QB20	<---	Domain3	0.593				0.352

QB21	<---	Domain3	0.684	0.131	10.765	<0.001	0.467
QB22	<---	Domain3	0.756	0.117	12.146	<0.001	0.572
QB8	<---	Domain4	0.778				0.605
QB9	<---	Domain4	0.573	0.046	12.259	<0.001	0.329
QB12	<---	Domain4	0.499	0.052	11.243	<0.001	0.249
QB13	<---	Domain4	0.510	0.047	12.245	<0.001	0.260
QB14	<---	Domain4	0.318	0.051	6.023	<0.001	0.101
QB23	<---	Domain4	0.531	0.049	12.530	<0.001	0.282
QB24	<---	Domain4	0.228	0.053	5.180	<0.001	0.052
QB25	<---	Domain4	0.634	0.053	15.618	<0.001	0.402

Note: Level of significance is 1%
S.E= Standard Error

8: SEM Parameter estimates, standard error estimates (S.E), and Z-value for Model 8

Indicator Variable		**Latent Variable**	**Estimate**	**S.E.**	**Z-value**	**P-value**	**R^2**
QoL	<---	Domain3	-0.873	0.474	-2.956	0.003	
QoL	<---	Domain4	0.946				
QoL	<---	Domain2	3.930	1.561	6.035	<0.001	
QoL	<---	Domain1	-3.627	0.737	-6.763	<0.001	
QB4	<---	Domain1	0.577	0.072	12.402	<0.001	0.333
QB10	<---	Domain1	0.717	0.086	11.449	<0.001	0.514
QB15	<---	Domain1	0.544	0.067	10.647	<0.001	0.296
QB16	<---	Domain1	0.664	0.084	11.692	<0.001	0.441
QB17	<---	Domain1	0.519	0.071	9.629	<0.001	0.269
QB5	<---	Domain2	0.520				0.271
QB6	<---	Domain2	0.639	0.177	10.532	<0.001	0.409
QB7	<---	Domain2	0.696	0.139	11.444	<0.001	0.484
QB11	<---	Domain2	0.664	0.193	10.092	<0.001	0.441
QB19	<---	Domain2	0.690	0.171	10.494	<0.001	0.476
QB26	<---	Domain2	0.514	0.175	8.391	<0.001	0.264
QB20	<---	Domain3	0.644				0.415
QB21	<---	Domain3	0.683	0.111	11.549	<0.001	0.467
QB22	<---	Domain3	0.760	0.099	13.206	<0.001	0.577
QB9	<---	Domain4	0.573	0.044	12.287	<0.001	0.329
QB12	<---	Domain4	0.475	0.049	10.701	<0.001	0.225
QB13	<---	Domain4	0.520	0.045	12.449	<0.001	0.270
QB14	<---	Domain4	0.247	0.048	4.667	<0.001	0.061
QB23	<---	Domain4	0.553	0.048	13.133	<0.001	0.305
QB24	<---	Domain4	0.250	0.052	5.695	<0.001	0.063
QB1	<---	QoL	1.000				1.000
QB3	<---	Domain1	0.598				0.357

QB18	<---	Domain1	0.754	0.091	12.014	<0.001	0.569
QB8	<---	Domain4	0.794				0.631
QB25	<---	Domain4	0.624	0.050	15.533	<0.001	0.389

Note: Level of significance is 1%
S.E= Standard Error

Fitted Structural Equation Model (SEM) for Model 8

The estimated path diagram with the standardized path coefficients as well as the coefficient between the exogenous latent constructs for the theoretical 6-component WHOQOL-HIV (BREF) and the endogenous 1-component overall QoL question (Model 8) are presented in Figure 13. The standardized error term for each indicator variable was also reported. This suggests that the modified SEM model provide a better fit to the independent data set. The latent constructs were highly correlated rating (between -0.89 and 0.98). Under the direct effect, Domain 1 and Domain 3 had a very strong relationship. Fig. 13 also showed that most of the indicators contributed significantly to the different domains using 0.5 as the standard as follows: In Domain 1, it is evident that the four items related to physical appearance loaded well. QB14 (Do you have enough energy for daily work?) and QB21 (How satisfied are you with sleep?) variables appear to be the best indicators of Domain 1. Their standardized regression weights are -0.73 and -0.64 respectively. Additionally, Domain 1 explained about 53% of the variance in QB14 and 42% of the variance in QB21. The remaining variables are the same with R^2 of 0.13 and standardized regression weight of 0.36 each.

In Domain 2, it is evident that only two out of five items related to psychology loaded well. QB24 (How satisfied are you with yourself?) and QB15 (Acceptance of your bodily appearance) variables appear to be the best indicators of Domain 2. Their standardized regression weights are 0.78 and 0.53 respectively. Additionally, Domain 2 explained about 60% of the variance in QB24 and 28% of the variance in QB15. QB31 (Negative feelings) is the poorest among the psychology indicators of Domain 2 with an R^2 of 0.03 and a standardized regression weight of -0.17.

In Domain 3, it is evident that three out of the four items related to level of dependence loaded well. QB23 (Satisfaction with capacity to work) and QB22 (Satisfaction with ability to perform daily activities) variables appear to be the best indicators of Domain 3. Their standardized regression weights are -0.73 and -0.70 respectively. Additionally, Domain 3 explained about 53% of the variance in QB23 and 49% of the variance in QB22. QB5 (Dependence on medication) is the poorest among the level of dependence indicators of Domain 3 with an R^2 of 0.08 and a standardized regression weight of 0.28.

In Domain 4, it is evident that the four items related to social relationship loaded well. QB25 (Satisfaction with personal relationships) and QB27 (Satisfaction with support) variables appear to be the best indicators of Domain 4. Their standardized regression weights are 0.80 and 0.68 respectively. Additionally, Domain 4 explained about 65% of the variance in QB25 and 46% of the variance in QB27. QB17 (Extent of acceptability by people) is the poorest among the social relationship indicators of Domain 4 with an R^2 of 0.08 and a standardized regression weight of 0.28.

In Domain 5, it is evident that the eight items related to the environment loaded moderately. QB29 (Satisfaction with access to health services) and QB28 (Satisfaction with living place) variables appear to be the best indicators of Domain 5. Their standardized regression weights are 0.63 and 0.61 respectively. Additionally, Domain 5 explained about 40% of the variance in QB29 and 37% of the variance in QB28. QB19 (Opportunities for leisure activities) is the poorest among the environmental indicators of Domain 5 with an R^2 of 0.09 which indicate that Domain 5 explains little or no variance in it and a standardized regression weight of 0.29.

In Domain 6, it is evident that only three out of four items related to the spirituality loaded well. QB9 (Fear of the future) and QB10 (Worry about death) variables appear to be the best and equal indicators of Domain 6. Their standardized regression weights are -0.79 each. Additionally, Domain 6 explained about 63% of the variances in both variables. QB7 (To what extent do you think your life is meaningful?) is the poorest among the spirituality indicators of Domain 6 with an R^2 of 0.01 meaning that Domain 6 explains practically no variance in it and a standardized regression weight of 0.09.

The model also gave information on the structural part as follows: the indicator variable QB1 had a very high impact on QoL which is also the endogenous variable. The estimated structural equation indicated that physical domain (ξ_1) had the most substantial causal effect on QoL (η) which was much more higher than spirituality (ξ_6) and psychological domain (ξ_2), while as level of independence (ξ_3), social relationship (ξ_4) and environmental domain (ξ_5) increases, quality of life declines. Also, the estimated residual variance was large (1.0).

9: SEM Parameter estimates, standard error estimates (S.E), and Z-value for Model 9

Indicator Variable		Latent Variable	Estimate	S.E.	Z-value	P-value	R^2
QoL	<---	Domain3	-0.821	0.623	-3.129	0.002	

QoL	<---	Domain4	0.959				
QoL	<---	Domain2	3.732	2.356	5.242	<0.001	
QoL	<---	Domain1	-3.649	0.877	-6.424	<0.001	
QB4	<---	Domain1	0.516	0.087	10.197	<0.001	0.266
QB10	<---	Domain1	0.702	0.114	9.794	<0.001	0.493
QB15	<---	Domain1	0.529	0.088	9.263	<0.001	0.280
QB16	<---	Domain1	0.630	0.108	9.908	<0.001	0.397
QB17	<---	Domain1	0.387	0.080	6.890	<0.001	0.150
QB5	<---	Domain2	0.400				0.160
QB6	<---	Domain2	0.568	0.311	7.355	<0.001	0.323
QB7	<---	Domain2	0.677	0.278	7.963	<0.001	0.458
QB11	<---	Domain2	0.612	0.352	7.108	<0.001	0.375
QB19	<---	Domain2	0.628	0.306	7.289	<0.001	0.395
QB26	<---	Domain2	0.539	0.354	6.525	<0.001	0.291
QB20	<---	Domain3	0.476				0.227
QB21	<---	Domain3	0.727	0.261	8.210	<0.001	0.528
QB22	<---	Domain3	0.714	0.202	8.865	<0.001	0.510
QB9	<---	Domain4	0.600	0.048	12.579	<0.001	0.360
QB12	<---	Domain4	0.484	0.053	10.528	<0.001	0.234
QB13	<---	Domain4	0.514	0.049	11.945	<0.001	0.264
QB14	<---	Domain4	0.335	0.053	6.160	<0.001	0.112
QB23	<---	Domain4	0.480	0.050	10.902	<0.001	0.230
QB24	<---	Domain4	0.187	0.055	4.186	<0.001	0.035
QB1	<---	QoL	1.000				1.000
QB3	<---	Domain1	0.542				0.293
QB18	<---	Domain1	0.744	0.122	10.276	<0.001	0.554
QB8	<---	Domain4	0.775				0.600
QB25	<---	Domain4	0.641	0.055	15.357	<0.001	0.410
QB2	<---	QoL	0.315	0.036	7.622	<0.001	0.099

Note: Level of significance is 1%
S.E= Standard Error

Fitted Structural Equation Model (SEM) for Model 9

The estimated path diagram with the standardize path coefficients, as well as the coefficients between the exogenous latent constructs for the theoretical 6-component WHOQoL-HIV (BREF) and the 2-component endogenous overall QoL questions (Model 9) are presented in Figure 14. The standard error term for each indicator variable was also reported. The latent constructs were also moderately and highly correlated rating (between -0.81 and 0.99). The model showed a very strong relationship between Domains 1 and 3; and a very weak relationship between Domains 4 and 6. The model also showed the correlation among some selected error terms which improved the model fit. It further showed that most of the

indicators contributed significantly to their corresponding domains using 0.5 as a standard as follows: In Domain 1, it is evident that the four items related to physical appearance loaded well. QB4 (Bothered by physical problems) and QB14 (Do you have enough energy for daily work?) variables appear to be the best indicators of Domain 1. Their standardized regression weights are 0.59 and -0.58 respectively. Additionally, Domain 1 explained about 35% of the variance in QB4 and 34% of the variance in QB14. QB3 (Physical pain) is the poorest among the physical indicators of Domain 1 with an R^2 of 0.22 and a standardized regression weight of -0.47.

In Domain 2, it is evident that three out of five items related to psychology loaded well. QB24 (How satisfied are you with yourself?) and QB31 (Negative feelings) variables appear to be the best indicators of Domain 2. Their standardized regression weights are 0.70 and -0.41 respectively. Additionally, Domain 2 explained about 49% of the variance in QB24 and 17% of the variance in QB31. QB6 (How much do you enjoy life?) is the poorest among the psychology indicators of Domain 2 with an R^2 of 0.04 and a standardized regression weight of 0.20.

In Domain 3, it is evident that all the four items related to level of dependence loaded well. QB23 (Satisfaction with capacity to work) and QB22 (Satisfaction with ability to perform daily activities) variables appear to be the best indicators of Domain 3. Their standardized regression weights are -0.64 and -0.62 respectively. Additionally, Domain 3 explained about 41% of the variance in QB23 and 38% of the variance in QB22. QB20 (How well are you able to move around?) is the poorest among the level of dependence indicators of Domain 3 with an R^2 of 0.12 and a standardized regression weight of -0.34.

In Domain 4, it is evident that three of the four items related to social relationship loaded well. QB25 (Satisfaction with personal relationships) and QB27 (Satisfaction with support) variables appear to be the best indicators of Domain 4. Their standardized regression weights are 0.76 and 0.64 respectively. Additionally, Domain 4 explained about 57% of the variance in QB25 and 41% of the variance in QB27. QB17 (Extent of acceptability by people) is the poorest among the social relationship indicators of Domain 4 with an R^2 of 0.07 and a standardized regression weight of 0.27.

In Domain 5, it is evident that seven out of the eight items related to the environment loaded moderately. QB29 (Satisfaction with access to health services) and QB28 (Satisfaction with living place) variables appear to be the best indicators of Domain 5. Their standardized regression weights are 0.39 and 0.29 respectively. Additionally, Domain 5 explained about 62% of the variance in QB29 and 54% of the variance in QB28. QB16 (Have you enough

money to meet your needs?) is the poorest among the environmental indicators of Domain 5 with an R^2 of 0.05 and a standardized regression weight of 0.23.

In Domain 6, it is evident that three out of four items related to the spirituality loaded well. QB9 (Fear of the future) and QB10 (Worry about death) variables appear to be the best indicators of Domain 6. Their standardized regression weights are -0.83 and -0.80 respectively. Additionally, Domain 6 explained about 69% of the variance in QB9 and 64% in QB10. QB7 (To what extent do you think your life is meaningful?) is the poorest among the spirituality indicators of Domain 6 with an R^2 of 0.00 meaning that Domain 6 explains practically no variance in it and a standardized regression weight of 0.06.

The model also gave information on the structural part as follows: one of the indicator variables QB2 had a very high impact on QoL which is also the endogenous variable. The estimated structural equation indicated that physical domain (ξ_1) had the most substantial causal effect on QoL (η) which was much more higher than spirituality (ξ_6) and psychological domain (ξ_2), while as level of independence (ξ_3), social relationship (ξ_4) and environmental domain (ξ_5) increases, quality of life declines. Also, the estimated residual variance was very small (0.02).

10: SEM Parameter estimates, standard error estimates (S.E), and Z-value for Model 10

Indicator Variable		**Latent Variable**	**Estimate**	**S.E.**	**Z-value**	**P-value**	**R^2**
SWLS	<---	Domain3	-.730	0.467	-1.735	0.083	
SWLS	<---	Domain4	1.416				
SWLS	<---	Domain2	2.850	3.216	1.600	0.11	
SWLS	<---	Domain1	-2.937	1.383	-1.972	0.049	
QB4	<---	Domain1	.587	0.088	11.579	<0.001	0.345
QB10	<---	Domain1	.739	0.106	10.660	<0.001	0.547
QB15	<---	Domain1	.567	0.084	10.283	<0.001	0.322
QB16	<---	Domain1	.642	0.097	10.592	<0.001	0.412
QB17	<---	Domain1	.498	0.080	8.766	<0.001	0.248
QB5	<---	Domain2	.452				0.204
QB6	<---	Domain2	.594	0.242	8.365	<0.001	0.353
QB7	<---	Domain2	.652	0.200	9.073	<0.001	0.425
QB11	<---	Domain2	.696	0.310	8.311	<0.001	0.484
QB19	<---	Domain2	.639	0.244	8.313	<0.001	0.409
QB26	<---	Domain2	.534	0.267	7.150	<0.001	0.285

QB20	<---	Domain3	.586				0.343
QB21	<---	Domain3	.678	0.141	10.098	<0.001	0.460
QB22	<---	Domain3	.732	0.124	11.355	<0.001	0.536
QB9	<---	Domain4	.661	0.055	13.472	<0.001	0.437
QB12	<---	Domain4	.514	0.058	11.161	<0.001	0.264
QB13	<---	Domain4	.549	0.054	12.572	<0.001	0.302
QB14	<---	Domain4	.395	0.057	6.918	<0.001	0.156
QB23	<---	Domain4	.596	0.056	12.932	<0.001	0.355
QB24	<---	Domain4	.314	0.060	6.778	<0.001	0.098
QC1	<---	SWLS	.484				0.235
QB3	<---	Domain1	.564				0.318
QB18	<---	Domain1	.780	0.119	11.194	<0.001	0.608
QB8	<---	Domain4	.763				0.582
QB25	<---	Domain4	.713	0.063	15.735	<0.001	0.509
QC2	<---	SWLS	.723	0.212	9.187	<0.001	0.522
QC3	<---	SWLS	.814	0.265	9.465	<0.001	0.663
QC4	<---	SWLS	.245	0.137	4.999	<0.001	0.060
QC5	<---	SWLS	.383	0.166	6.720	<0.001	0.147

Note: Level of significance is 1%
S.E= Standard Error

Fitted Structural Equation Model (SEM) for Model 10

The estimated path diagram with the standardized path coefficients, as well as the coefficients between the exogenous latent constructs for the theoretical 6-component WHOQOL-HIV (BREF) and 5-component endogenous SWLS Questionnaire (Model 10) are presented in Figure 15. The standardized error term of each indicator variable were reported. The latent constructs were also moderately and highly correlated rating (between -0.81 and 0.94). The model had a very strong relationship between Domains 1 and 3, and a weak relationship between Domains 4 and 6. It further showed that most of the indicators contributed significantly to their corresponding domains using 0.5 as a standard as follows: In Domain 1, it is evident that the four items related to physical appearance loaded well. QB4 (Bothered by physical problems) and QB3 (Physical pain) variables appear to be the best indicators of Domain 1. Their standardized regression weights are 0.75 and 0.68 respectively. Additionally, Domain 1 explained about 56% of the variance in QB4 and 46% of the variance in QB3. QB21 is the poorest among the physical indicators of Domain 1 with an R^2 of 0.20 and a standardized regression weight of -0.44.

In Domain 2, it is evident that three out of five items related to psychology loaded well. QB24 (How satisfied are you with yourself?) and QB31 (Negative feelings) variables appear to be the best indicators of Domain 2. Their standardized regression weights are 0.62 and -

0.51 respectively. Additionally, Domain 2 explained about 39% of the variance in QB24 and 26% of the variance in QB31. QB11 (How well are you able to concentrate?) is the poorest among the psychology indicators of Domain 2 with an R^2 of 0.04 and a standardized regression weight of 0.20.

In Domain 3, it is evident that all the four items related to level of dependence loaded well. QB22 (Satisfaction with ability to perform daily activities) and QB5 (Dependence on medication) variables appear to be the best indicators of Domain 3. Their standardized regression weights are -0.58 and 0.57 respectively. Additionally, Domain 3 explained about 34% of the variance in QB22 and 32% of the variance in QB5. QB20 (How well are you able to move around?) is the poorest among the level of dependence indicators of Domain 3 with an R^2 of 0.10 and a standardized regression weight of -0.31.

In Domain 4, it is evident that all the four items related to social relationship loaded well. QB25 (Satisfaction with personal relationships) and QB26 (Satisfaction with sexuality) variables appear to be the best indicators of Domain 4. Their standardized regression weights are 0.61 and 0.54 respectively. Additionally, Domain 4 explained about 37% of the variance in QB25 and 29% of the variance in QB26. QB17 (Extent of acceptability by people) is the poorest among the social relationship indicators of Domain 4 with an R^2 of 0.12 and a standardized regression weight of 0.35.

In Domain 5, it is evident that seven out of the eight items related to the environment loaded moderately. QB30 (Satisfaction with transportation) and QB29 (Satisfaction with access to health services) variables appear to be the best indicators of Domain 5. Their standardized regression weights are 0.57 and 0.55 respectively. Additionally, Domain 5 explained about 32% of the variance in QB30 and 31% of the variance in QB29. QB16 (Have you enough money to meet your needs?) is the poorest among the environmental indicators of Domain 5 with an R^2 of 0.04 and a standardized regression weight of 0.20.

In Domain 6, it is evident that three out of four items related to the spirituality loaded well. QB9 (Fear of the future) and QB10 (Worry about death) variables appear to be the best indicators of Domain 6. Their standardized regression weights are -0.90 and -0.76 respectively. Additionally, Domain 6 explained about 81% of the variance in QB9 and 58% in QB10. QB7 (To what extent do you think your life is meaningful?) is the poorest among the spirituality indicators of Domain 6 with an R^2 of 0.00 meaning that Domain 6 explains practically no variance in it and a standardized regression weight of 0.05.

The model also gave information on the structural part as follows: the indicators on the endogenous variable SWLS gave sufficient information except for QC5 (If I could live my life over, I would change almost nothing) which had an average impact on SWLS. The estimated structural equation indicated that physical domain (ξ_1) had the most substantial causal effect on SWLS (η) was more than psychological domain (ξ_2) which was in turn higher than the causal effects of social relationship domain (ξ_4) and spirituality domain (ξ_6), while as level of independence (ξ_3), and environmental domain (ξ_5) increases, quality of life declines. Also, the estimated residual variance was small (0.16).

11: SEM Parameter estimates, standard error estimates (S.E), and Z-value for Model 11

Indicator Variable		**Latent Variable**	**Estimate**	**S.E.**	**Z-value**	**P-value**	**R^2**
QoL	<---	Domain3	-0.312	0.173	-1.712	0.087	
QoL	<---	Domain4	1.619				
QoL	<---	Domain2	1.865	1.096	2.563	0.01	
QoL	<---	Domain1	-2.260	0.620	-3.428	<0.001	
SWLS	<---	QoL	0.714	0.104	6.865	<0.001	
QB4	<---	Domain1	0.603	0.104	10.975	<0.001	0.364
QB10	<---	Domain1	0.757	0.126	9.992	<0.001	0.574
QB15	<---	Domain1	0.550	0.094	9.548	<0.001	0.302
QB16	<---	Domain1	0.678	0.117	10.054	<0.001	0.460
QB17	<---	Domain1	0.537	0.093	8.605	<0.001	0.289
QB5	<---	Domain2	0.502				0.252
QB6	<---	Domain2	0.688	0.225	9.399	<0.001	0.474
QB7	<---	Domain2	0.670	0.168	10.002	<0.001	0.449
QB11	<---	Domain2	0.716	0.264	9.126	<0.001	0.512
QB19	<---	Domain2	0.772	0.236	9.354	<0.001	0.596
QB26	<---	Domain2	0.538	0.222	7.675	<0.001	0.290
QB20	<---	Domain3	0.630				0.397
QB21	<---	Domain3	0.683	0.124	10.819	<0.001	0.467
QB22	<---	Domain3	0.741	0.110	12.260	<0.001	0.550
QB9	<---	Domain4	0.565	0.047	11.579	<0.001	0.319
QB12	<---	Domain4	0.525	0.055	11.557	<0.001	0.275
QB13	<---	Domain4	0.543	0.049	12.550	<0.001	0.295
QB14	<---	Domain4	0.358	0.053	6.228	<0.001	0.128
QB23	<---	Domain4	0.572	0.051	12.381	<0.001	0.327
QB24	<---	Domain4	0.254	0.055	5.524	<0.001	0.065
QB1	<---	QoL	0.591				0.350
QB3	<---	Domain1	0.543				0.294
QB18	<---	Domain1	0.768	0.135	10.343	<0.001	0.590

QB8	<---	Domain4	0.786				0.618
QB25	<---	Domain4	0.694	0.056	15.641	<0.001	0.482
QC1	<---	SWLS	0.453				0.206
QC2	<---	SWLS	0.703	0.240	8.295	<0.001	0.494
QC3	<---	SWLS	0.798	0.298	8.539	<0.001	0.637
QC4	<---	SWLS	0.274	0.160	5.236	<0.001	0.075
QC5	<---	SWLS	0.321	0.176	5.615	<0.001	0.103

Note: Level of significance is 1%
S.E= Standard Error

Fitted Structural Equation Model (SEM) for Model 11

The estimated path diagram with the standardized path coefficients, as well as the coefficients between the exogenous latent constructs for the theoretical 6-component WHOQOL-HIV (BREF), 5–component SWLS and 1-component endogenous overall QoL question (Model 11) are presented in Figure 16. The standardized error term of each indicator variable were also reported. The latent constructs were also moderately and highly correlated rating (between -0.81 and 0.93). The model recorded a very high relationship between domains 1 and 3 and a weak relationship between domains 4 and 6. Fig. 16 also showed that most of the indicators contributed significantly to their corresponding domains using 0.5 as a standard as follows: In Domain 1, it is evident that the four items related to physical appearance loaded well. QB4 (Bothered by physical problems) and QB3 (Physical pain) variables appear to be the best indicators of Domain 1. Their standardized regression weights are 0.73 and 0.66 respectively. Additionally, Domain 1 explained about 53% of the variance in QB4 and 44% of the variance in QB3. QB21 is the poorest among the physical indicators of Domain 1 with an R^2 of 0.23 and a standardized regression weight of -0.48.

In Domain 2, it is evident that four out of five items related to psychology loaded well. QB24 (How satisfied are you with yourself?) and QB31 (Negative feelings) variables appear to be the best indicators of Domain 2. Their standardized regression weights are 0.65 and -0.48 respectively. Additionally, Domain 2 explained about 42% of the variance in QB24 and 24% of the variance in QB31. QB11 (How well are you able to concentrate?) is the poorest among the psychology indicators of Domain 2 with an R^2 of 0.05 and a standardized regression weight of 0.22.

In Domain 3, it is evident that all the four items related to level of dependence loaded well. QB22 (Satisfaction with ability to perform daily activities) and QB23 (Satisfaction with work capacity) variables appear to be the best indicators of Domain 3. Their standardized regression weights are -0.61 and -0.59 respectively. Additionally, Domain 3 explained about

37% of the variance in QB22 and 34% of the variance in QB23. QB20 (How well are you able to move around?) is the poorest among the level of dependence indicators of Domain 3 with an R^2 of 0.16 and a standardized regression weight of -0.40.

In Domain 4, it is evident that all the four items related to social relationship loaded well. QB25 (Satisfaction with personal relationships) and QB26 (Satisfaction with sexuality) variables appear to be the best indicators of Domain 4. Their standardized regression weights are 0.61 and 0.54 respectively. Additionally, Domain 4 explained about 37% of the variance in QB25 and 29% of the variance in QB26. QB17 (Extent of acceptability by people) is the poorest among the social relationship indicators of Domain 4 with an R^2 of 0.13 and a standardized regression weight of 0.36.

In Domain 5, it is evident that seven out of the eight items related to the environment loaded moderately. QB29 (Satisfaction with access to health services) and QB30 (Satisfaction with transportation) variables appear to be the best indicators of Domain 5. Their standardized regression weights are 0.58 and 0.55 respectively. Additionally, Domain 5 explained about 33% of the variance in QB29 and 30% of the variance in QB30. QB16 (Have you enough money to meet your needs?) is the poorest among the environmental indicators of Domain 5 with an R^2 of 0.03 and a standardized regression weight of 0.18.

In Domain 6, it is evident that three out of four items related to the spirituality loaded well. QB9 (Fear of the future) and QB10 (Worry about death) variables appear to be the best indicators of Domain 6. Their standardized regression weights are -0.89 and -0.77 respectively. Additionally, Domain 6 explained about 80% of the variance in QB9 and 59% in QB10. QB7 (To what extent do you think your life is meaningful?) is the poorest among the spirituality indicators of Domain 6 with an R^2 of 0.01 meaning that Domain 6 explains practically little or no variance in it and a standardized regression weight of 0.08.

The model also gave information on the structural part as follows: the indicator variable QB1 had impact on QoL which is also the endogenous variable, while all indicators except QC5 (If I could live my life over, I would change almost nothing) had averagely high impact on SWLS. Where β coefficient is 0.54 indicating high impact of SWLS on the QOL of an infected person. The estimated structural equation indicated that physical domain (ξ_1) had the most substantial causal effect on QoL (η) which was higher than psychological domain (ξ_2) which was in turn higher than the causal effect of spirituality domain (ξ_6), while as level

of independence (ξ_3), environmental domain (ξ_5) and social relationship domain (ξ_4)increases, quality of life declines. Also, the estimated residual variance was small (0.29).

12: Parameter estimates, standard error estimates (S.E), and Z-value for Model 12

Indicator Variable		Latent Variable	Estimate	S.E.	Z-value	P-value	R^2
QoL	<---	Domain3	-0.855	0.739	-2.543	0.011	
QoL	<---	Domain4	0.842				
QoL	<---	Domain2	4.713	6.342	3.591	<0.001	
QoL	<---	Domain1	-4.496	19.586	-1.974	0.048	
SWLS	<---	QoL	0.152	0.019	2.002	0.045	
QB4	<---	Domain1	0.504	2.039	2.207	0.027	0.254
QB10	<---	Domain1	0.745	3.044	2.103	0.035	0.555
QB15	<---	Domain1	0.429	1.617	2.114	0.034	0.184
QB16	<---	Domain1	0.602	2.546	2.121	0.034	0.362
QB17	<---	Domain1	0.376	1.381	2.070	0.038	0.141
QB5	<---	Domain2	0.299				0.089
QB6	<---	Domain2	0.547	0.534	5.116	<0.001	0.299
QB7	<---	Domain2	0.596	0.475	5.451	<0.001	0.355
QB11	<---	Domain2	0.652	0.744	5.115	<0.001	0.425
QB19	<---	Domain2	0.718	0.699	5.165	<0.001	0.515
QB26	<---	Domain2	0.393	0.505	4.336	<0.001	0.155
QB20	<---	Domain3	0.522				0.272
QB21	<---	Domain3	0.714	0.225	7.858	<0.001	0.510
QB22	<---	Domain3	0.626	0.157	8.527	<0.001	0.392
QB9	<---	Domain4	0.216	0.050	3.878	<0.001	0.046
QB12	<---	Domain4	0.448	0.063	9.115	<0.001	0.201
QB13	<---	Domain4	0.369	0.053	8.016	<0.001	0.136
QB14	<---	Domain4	0.296	0.060	4.864	<0.001	0.088
QB23	<---	Domain4	0.347	0.056	6.625	<0.001	0.121
QB24	<---	Domain4	-0.025	0.062	-0.521	0.602	0.001
QB1	<---	QoL	1.000				1.000
QB3	<---	Domain1	0.119				0.014
QB18	<---	Domain1	0.662	2.608	2.106	0.035	0.439
QB8	<---	Domain4	0.749				0.560
QB25	<---	Domain4	0.560	0.061	11.297	<0.001	0.313
QC1	<---	SWLS	0.215				0.046
QC2	<---	SWLS	0.633	1.150	3.255	0.001	0.401
QC3	<---	SWLS	0.667	1.244	3.318	<0.001	0.445
QC4	<---	SWLS	0.143	0.494	2.042	0.041	0.021
QC5	<---	SWLS	0.286	0.711	2.876	0.004	0.082
QB2	<---	QoL	0.382	0.036	9.124	<0.001	0.146

Note: Level of significance is 1%
S.E= Standard Error

Fitted Structural Equation Model (SEM) for Model 12

The estimated path diagram with the standardized path coefficients, as well as the coefficients between the latent constructs for the theoretical 6-component exogenous WHOQOL-HIV (BREF), 5-component exogenous SWLS and 2-component endogenous overall QOL questions (Model 6) are presented in Figure 17. The standardized error terms of each indicator variables were also reported. The latent constructs were also moderately and highly correlated rating (between -0.85 and 0.94). The model recorded a very high relationship between domains 1 and 3 and a weak relationship between domains 4 and 6. It further showed that most of the indicators contributed significantly to their corresponding domains using 0.5 as a standard as follows: In Domain 1, it is evident that the four items related to physical appearance loaded well. QB4 (Bothered by physical problems) and QB3 (Physical pain) variables appear to be the best indicators of Domain 1. Their standardized regression weights are 0.69 and 0.66 respectively. Additionally, Domain 1 explained about 47% of the variance in QB4 and 43% of the variance in QB3. QB21 is the poorest among the physical indicators of Domain 1 with an R^2 of 0.29 and a standardized regression weight of -0.54.

In Domain 2, it is evident that four out of five items related to psychology loaded well. QB24 (How satisfied are you with yourself?) and QB31 (Negative feelings) variables appear to be the best indicators of Domain 2. Their standardized regression weights are 0.71 and -0.43 respectively. Additionally, Domain 2 explained about 50% of the variance in QB24 and 19% of the variance in QB31. QB11 (How well are you able to concentrate?) is the poorest among the psychology indicators of Domain 2 with an R^2 of 0.02 and a standardized regression weight of 0.14.

In Domain 3, it is evident that all the four items related to level of dependence loaded well. QB23 (Satisfaction with work capacity) and QB22 (Satisfaction with ability to perform daily activities) variables appear to be the best indicators of Domain 3. Their standardized regression weights are -0.64 and -0.62 respectively. Additionally, Domain 3 explained about 41% of the variance in QB23 and 39% of the variance in QB22. QB20 (How well are you able to move around?) is the poorest among the level of dependence indicators of Domain 3 with an R^2 of 0.18 and a standardized regression weight of -0.42.

In Domain 4, it is evident that all the four items related to social relationship loaded well. QB25 (Satisfaction with personal relationships) and QB26 (Satisfaction with sexuality) variables appear to be the best indicators of Domain 4. Their standardized regression weights are 0.61 and 0.55 respectively. Additionally, Domain 4 explained about 37% of the variance

in QB25 and 30% of the variance in QB26. QB17 (Extent of acceptability by people) is the poorest among the social relationship indicators of Domain 4 with an R^2 of 0.12 and a standardized regression weight of 0.35.

In Domain 5, it is evident that seven out of the eight items related to the environment loaded moderately. QB29 (Satisfaction with access to health services) and QB30 (Satisfaction with transportation) variables appear to be the best indicators of Domain 5. Their standardized regression weights are 0.58 and 0.55 respectively. Additionally, Domain 5 explained about 33% of the variance in QB29 and 31% of the variance in QB30. QB16 (Have you enough money to meet your needs?) is the poorest among the environmental indicators of Domain 5 with an R^2 of 0.04 and a standardized regression weight of 0.21.

In Domain 6, it is evident that three out of four items related to the spirituality loaded well. QB9 (Fear of the future) and QB10 (Worry about death) variables appear to be the best indicators of Domain 6. Their standardized regression weights are -0.88 and -0.76 respectively. Additionally, Domain 6 explained about 78% of the variance in QB9 and 58% in QB10. QB7 (To what extent do you think your life is meaningful?) is the poorest among the spirituality indicators of Domain 6 with an R^2 of 0.00 meaning that Domain 6 explains practically no variance in it and a standardized regression weight of 0.05.

The model also gave information on the structural part as follows: the two indicator variables QB1 and QB2 had very high impact on QoL, while, QC1 (In most ways my life is close to my ideal) and QC5 (If I could live my life over, I would change almost nothing) had little or no impact on SWLS. Where β coefficient is 0.42 indicating an averagely high impact of SWLS on the QOL of an infected person. The estimated structural equation indicated that physical domain (ξ_1) had the most substantial causal effect on QoL (η) which was more than psychological domain (ξ_2) which was in turn higher than the causal effect of spirituality domain (ξ_6), while as level of independence (ξ_3), environmental domain (ξ_5) and social relationship domain (ξ_4)increases, quality of life declines. Also, the estimated residual variance of SWLS on QoL was small (0.17)**.**

13: SEM Parameter Estimates for NModel 5

Indicator Variable		Latent Construct	Estimate	S.E.	Z-Value	P-Value	R^2
QoL	<---	ND1	0.627	0.230	3.127	0.002	
QoL	<---	ND2	0.043	0.181	0.212	0.832	
QoL	<---	ND3	0.120	0.066	1.422	0.155	
QoL	<---	ND4	-0.073	0.044	-.966	0.334	
QoL	<---	ND5	-0.180	0.263	-.727	0.467	
QoL	<---	ND6	0.396	0.091	3.795	<0.001	
QoL	<---	ND7	-0.227	0.214	-1.213	0.225	
QoL	<---	ND8	-0.084	0.133	-.506	0.613	
QoL	<---	ND9	0.344	0.117	2.763	0.006	
SWLS	<---	QoL	0.491	0.164	6.552	<0.001	0.241
qc1	<---	SWLS	0.519	0.069	9.942	<0.001	0.269
qb8	<---	ND4	0.496	0.064	9.528	<0.001	0.246
qb1	<---	QoL	0.745				0.555
qc2	<---	SWLS	0.834				0.696
qc3	<---	SWLS	0.788	0.064	13.739	<0.001	0.620
qc4	<---	SWLS	0.431	0.078	8.300	<0.001	0.185
qc5	<---	SWLS	0.301	0.085	5.816	<0.001	0.091
qb24	<---	ND1	0.790	0.106	11.611	<0.001	0.625
qb23	<---	ND1	0.727	0.101	10.741	<0.001	0.529
qb22	<---	ND1	0.642	0.077	12.193	<0.001	0.412
qb21	<---	ND1	0.587				0.344
qb11	<---	ND2	0.428	0.081	8.038	<0.001	0.247
qb12	<---	ND2	0.761	0.070	12.473	<0.001	0.580
qb14	<---	ND2	0.731				0.535
qb15	<---	ND2	0.604	0.074	11.638	<0.001	0.365
qb5	<---	ND3	0.573				0.328
qb4	<---	ND3	0.806	0.135	9.934	<0.001	0.649
qb3	<---	ND3	0.681	0.111	9.710	<0.001	0.464
qb9	<---	ND4	0.884	0.096	12.575	<0.001	0.782
qb10	<---	ND4	0.772				0.596
qb29	<---	ND5	0.648	0.094	10.361	<0.001	0.420
qb28	<---	ND5	0.604	0.089	9.681	<0.001	0.365
qb25	<---	ND5	0.681				0.464
qb6	<---	ND6	0.690				0.477
qb7	<---	ND6	0.682				0.465
qb18	<---	ND7	0.514				0.265
qb17	<---	ND7	0.381	0.123	5.764	<0.001	0.145
qb13	<---	ND7	0.669	0.130	7.531	<0.001	0.447
qb16	<---	ND9	0.549				0.324
qb30	<---	ND9	0.630				0.396

Indicator Variable		Latent Construct	Estimate	S.E.	Z-Value	P-Value	R^2
qb26	<---	ND8	0.636				0.404
qb27	<---	ND8	0.670				0.449
qb20	<---	ND1	0.625	0.082	9.948	<0.001	0.391
qb11	<---	qc1	0.203	0.025	4.865	<0.001	
qb16	<---	qb8	0.211	0.042	4.577	<0.001	

Note: Level of significance is 1%
S.E= Standard Error

Fitted Structural Equation Model (SEM) for NModel 5

The estimated path diagram with the standardized path coefficients, as well as the coefficients between the exogenous latent constructs for the hypothesized 9-component WHOQOL-HIV (BREF), 5–component SWLS and 1-component endogenous overall QoL question with its modifications (NModel 5) are presented in Figure 19. The standardized error term of each indicator variable were reported because the solution was admissible. The correlation of about half of the latent constructs were weak, with the weakest correlation between ND 4 and 6, while the strongest correlation was between ND 1 and 5. Figure 19 also shows that most of the indicators contributed significantly to their corresponding domains using 0.4 as a standard as follows: In ND 1, it is evident that the five items related to activities loaded averagely well. QB24 (self-esteem) and QB23 (work capacity) variables appear to be the best indicators of ND 1. Their standardized regression weights are 0.79 and 0.72 respectively. Additionally, ND 1 explained about 63% of the variance in QB24 and 53% of the variance in QB23. QB21 (sleep & rest) is the poorest among the activities indicators with an R^2 of 0.34 and a standardized regression weight of 0.58.

In ND 2, it is evident that three out of four items related to their physical look loaded well. QB12 (physical safety & security) and QB14 (energy & fatigue) variables appear to be the best indicators of ND 2 with standardized regression weights of 0.76 and 0.73 respectively. Additionally, ND 2 explained about 58% of the variance in QB12 and about 53% of the variance in QB14. QB11 (thinking, learning & concentration) is the poorest among the physical indicators with an R^2 of 0.25 and a standardized regression weight of 0.43.

In ND 3, it is evident that the three items related to symptoms loaded averagely well. QB4 (symptoms of PLWA) and QB3 (pain & discomfort) variables appear to be best indicators of ND 3. Their standardized regression weights are 0.80 and 0.68 respectively. Additionally, ND 3 explained about 65% of the variance in QB4 and 46% of the variance in QB3. QB5

(dependence on medication or treatment) is the poorest among the symptoms indicators with an R^2 of 0.33 and a standardized regression weight of 0.57.

In ND 4, it is evident that two out of the three items related to concern loaded well. QB9 (concern about the future) and QB10 (death & dying) variables appear to be the best indicators of ND 4. Their standardized regression weights are 0.88 and 0.77 respectively. Additionally, ND 4 explained about 78% of the variance in QB9 and 59% of the variance in QB10. QB8 (forgiveness & blame) is the poorest among the indicators with an R^2 of 0.25 and a standardized regression weight of 0.49.

In ND 5, it is evident that the three items related to the personal domain loaded averagely. QB25 (personal relation) variable appeared to be the best indicator of ND 5. The standardized regression weight is 0.68. Additionally, ND 5 explained about 46% of the variance in QB25.

In ND 6, the two items related to believe loaded averagely well. QB6 (life enjoyment) and QB7 (life is meaningful) variables with their standardized regression weights 0.69 and 0.68 respectively. Additionally, ND 6 explained about 48% of the variance in QB6 and 46% of the variance in QB7.

In ND 7, it is evident that two of the three items related to the social domain loaded averagely. QB13 (physical environment-pollution) and QB18 (opportunities for acquiring new information & skill) variables appear to be the best indicators of ND 7. Their standardized regression weights are 0.67 and 0.51 respectively. Additionally, ND 7 explained about 45% of the variance in QB13 and 26% of the variance in QB18. QB17 (social inclusion) is the poorest among the indicators with an R^2 of 0.14 and a standardized regression weight of 0.38.

In ND 8, the two items related to the relationship loaded averagely well. QB27 (social support) and QB26 (sexual activities) with their standardized regression weights 0.67 and 0.64 respectively. Additionally, ND 8 explained about 45% of the variance in QB27 and 40% of the variance in QB26.

In ND 9, the two items related to finance loaded averagely. QB30 (transport) and QB16 (financial resources) with their standardized regression weights 0.63 and 0.55 respectively.

Additionally, ND 9 explained about 39% of the variance in QB30 and 32% of the variance in QB16.

The model also gave information on the structural part as follows: the indicator variable QB1 had a high impact on QoL which is also the endogenous variable, while all indicators except QC5 (If I could live my life over, I would change almost nothing) had a low impact on SWLS. Where β coefficient is 0.49 indicating an averagely high impact of SWLS on the QOL of an infected person. The estimated structural equation indicated that activities domain (ξ_1) had the most substantial causal effect on QoL (η) which was more than believe domain (ξ_6) which was in turn higher than the causal effects of finance domain (ξ_9). Furthermore, as physical domain(ξ_2), level of concerns(ξ_4), personal domain (ξ_5), social domain (ξ_7) and relationship domain (ξ_8) increases, quality of life declines. Also, the estimated residual variance was small (0.24).

14: SEM Estimates for NModel 6

Indicator Variable		**Latent Construct**	**Estimate**	**S.E.**	**C.R.**	**P**	**R^2**
QoL	<---	ND1	0.640	0.233	3.605	<0.001	
QoL	<---	ND2	0.095	0.192	0.492	0.623	
QoL	<---	ND3	0.093	0.048	1.321	0.187	
QoL	<---	ND4	-0.049	0.042	-0.740	0.459	
QoL	<---	ND5	-0.203	0.263	-0.931	0.352	
QoL	<---	ND6	0.284	0.092	3.037	0.002	
QoL	<---	ND7	-0.249	0.217	-1.434	0.152	
QoL	<---	ND8	-0.085	0.133	-0.569	0.569	
QoL	<---	ND9	0.331	0.124	2.835	0.005	
SWLS	<---	QoL	0.463	0.116	7.714	<0.001	0.215
qc1	<---	SWLS	0.519	0.070	9.905	<0.001	0.269
qb9	<---	ND4	0.894	0.108	11.061	<0.001	0.799
qb1	<---	QoL	0.817				0.668
qc2	<---	SWLS	0.818				0.669
qc3	<---	SWLS	0.808	0.067	13.720	<0.001	0.652
qc4	<---	SWLS	0.416	0.078	8.052	<0.001	0.173
qc5	<---	SWLS	0.295	0.087	5.704	<0.001	0.087
qb24	<---	ND1	0.799	0.108	11.776	<0.001	0.638
qb23	<---	ND1	0.717	0.103	10.673	<0.001	0.514

Indicator Variable		Latent Construct	Estimate	S.E.	C.R.	P	R^2
qb22	<---	ND1	0.641	0.079	12.277	<0.001	0.411
qb21	<---	ND1	0.573				0.329
qb20	<---	ND1	0.640	0.085	10.224	<0.001	0.410
qb11	<---	ND2	0.424	0.082	7.960	<0.001	0.241
qb12	<---	ND2	0.762	0.071	12.462	<0.001	0.581
qb14	<---	ND2	0.717				0.537
qb15	<---	ND2	0.611	0.077	11.714	<0.001	0.374
qb5	<---	ND3	0.554	0.079	9.523	<0.001	0.307
qb4	<---	ND3	0.791				0.625
qb3	<---	ND3	0.712	0.083	10.637	<0.001	0.508
qb8	<---	ND4	0.428	0.061	8.147	<0.001	0.183
qb10	<---	ND4	0.773				0.598
qb29	<---	ND5	0.654	0.097	10.254	<0.001	0.427
qb28	<---	ND5	0.611	0.092	9.588	<0.001	0.373
qb25	<---	ND5	0.675				0.455
qb6	<---	ND6	0.677				0.458
qb7	<---	ND6	0.676				0.456
qb18	<---	ND7	0.521				0.272
qb17	<---	ND7	0.386	0.119	5.870	<0.001	0.149
qb13	<---	ND7	0.664	0.124	7.700	<0.001	0.441
qb16	<---	ND9	0.553				0.306
qb30	<---	ND9	0.619				0.382
qb26	<---	ND8	0.634				0.402
qb27	<---	ND8	0.669				0.447
qb2	<---	QoL	0.727				0.528
qb14	<---	qb9	-0.092	0.028	-2.193	0.028	
qb11	<---	qc1	0.203	0.025	4.830	<0.001	

Note: Level of significance is 1%
S.E= Standard Error

Fitted Structural Equation Model (SEM) for NModel6

The estimated path diagram with the standardized path coefficients, as well as the coefficients between the latent construct for the hypothesized 9-component exogenous WHOQOL-HIV (BREF), 5-component exogenous SWLS and 2-component endogenous overall QOL questions (NModel 6) with its modifications are presented in Figure 20. The standardized error terms of each indicator variables were also reported because the solution was admissible. The correlation of most of the latent constructs were weak, with the weakest correlation between ND 3 and 6, while the strongest correlation was between ND 2 and 7. Fig. 20 also shows that most of the indicators contributed significantly to their corresponding

domains using 0.4 as a standard as follows: In ND 1, it is evident that the five items related to activities loaded well. QB24 (self-esteem) and QB23 (work capacity) variables appear to be the best indicators of ND 1. Their standardized regression weights are 0.80 and 0.72 respectively. Additionally, ND 1 explained about 64% of the variance in QB24 and 51% of the variance in QB23. QB21 (sleep & rest) is the poorest among the activities indicators with an R^2 of 0.33 and a standardized regression weight of 0.57.

In ND 2, it is evident that three out of four items related to their physical look loaded well. QB12 (physical safety & security) and QB14 (energy & fatigue) variables appear to be the best indicators of ND 2 with standardized regression weights of 0.76 and 0.72 respectively. Additionally, ND 2 explained about 58% of the variance in QB12 and about 54% of the variance in QB14. QB11 (thinking, learning, memory) is the poorest among the physical indicators with an R^2 of 0.24 and a standardized regression weight of 0.42.

In ND 3, it is evident that the three items related to symptoms loaded well. QB4 (symptoms of PLWA) and QB3 (pain & discomfort) variables appear to be best indicators of ND 3. Their standardized regression weights are 0.79 and 0.71 respectively. Additionally, ND 3 explained about 63% of the variance in QB4 and 48% of the variance in QB3. QB5 (dependence on medication or treatment) is the poorest among the symptoms indicators with an R^2 of 0.31 and a standardized regression weight of 0.55.

In ND 4, it is evident that two out of the three items related to concern domain loaded well. QB9 (concern about the future) and QB10 (death & dying) variables appear to be the best indicators of ND 4. Their standardized regression weights are 0.89 and 0.77 respectively. Additionally, ND 4 explained about 80% of the variance in QB9 and 60% of the variance in QB10. QB8 (forgiveness & blame) is the poorest among the indicators with an R^2 of 0.18 and a standardized regression weight of 0.43.

In ND 5, it is evident that the three items related to the personal domain loaded averagely well. QB25 (personal relation) variable appeared to be the best indicator of ND 5. The standardized regression weight is 0.67. Additionally, ND 5 explained about 46% of the variance in QB25.

In ND 6, the two items related to believe loaded averagely well. QB6 (life enjoyment) and QB7 (life is meaningful) variables with their standardized regression weight of 0.68 each, it also explained about 46% of the variance in each of the variables.

In ND 7, it is evident that two of the three items related to the social domain loaded averagely. QB13 (physical environment-pollution) and QB18 (opportunities for acquiring new information & skill) variables appear to be the best indicators of ND 7. Their standardized regression weights are 0.66 and 0.52 respectively. Additionally, ND 7 explained about 44% of the variance in QB13 and 27% of the variance in QB18. QB17 (social inclusion) is the poorest among the indicators with an R^2 of 0.15 and a standardized regression weight of 0.39.

In ND 8, the two items related to the relationship loaded averagely well. QB27 (social support) and QB26 (sexual activities) with their standardized regression weights 0.67 and 0.63 respectively. Additionally, ND 8 explained about 45% of the variance in QB27 and 40% of the variance in QB26.

In ND 9, the two items related to finance loaded averagely. QB30 (transport) and QB16 (financial resources) with their standardized regression weights 0.62 and 0.55 respectively. Additionally, ND 9 explained about 38% of the variance in QB30 and 31% of the variance in QB16.

The model also gave information on the structural part as follows: the indicator variables QB1 and QB2 had high impact on QoL which are also the endogenous variables, while all indicators except QC5 (If I could live my life over, I would change almost nothing) had averagely high impact on SWLS. Where β coefficient is 0.46 indicating an averagely high impact of SWLS on the QOL of an infected person. The estimated structural equation indicated that activities domain (ξ_1) had the most substantial causal effect on QoL (η) which was more than finance domain (ξ_9) which was in turn higher than the causal effects of believe domain (ξ_6), where concern domain (ξ_4) had little causal effect on QoL. Also, the estimated residual variance of SWLS on QoL was small (0.21).

15-: Summary of Fit Indices for New Model 1

Model	χ^2	*df*	χ^2/df	*GFI*	*AGFI*	*RMSEA*	*AIC*	*BIC*	*CAIC*
NModel 1a	822.737	340	2.420	0.899	0.871	0.050	1012.73	1424.56	1697.776
NModel 1b	686.057	285	2.407	0.910	0.880	0.050	872.057	1275.217	1368.217

Note: x^2 =Chi-square statistics; df=degree of freedom; GFI=Goodness-of-Fit index; AGFI= Adjusted Goodness-of-Fit index; RMSEA=Root Mean Square error of approximation; AIC=Akaike's information criterion; BIC=Bayesian information criterion; CAIC=Consistent AIC

16. Table 4.28: CFA Parameter Estimates for regrouped WHOQoL-HIV (BREF) (NModel 1)

Indicator Variable		Latent Construct	Estimate	S.E.	Z-Value	P-Value
qb8	<---	ND4	0.470	0.059	9.161	<0.001
qb10	<---	ND4	0.798			
qb20	<---	ND1	0.583	0.075	9.825	<0.001
qb21	<---	ND1	0.602			
qb22	<---	ND1	0.637	0.072	12.259	<0.001
qb23	<---	ND1	0.724	0.097	10.993	<0.001
qb24	<---	ND1	0.795	0.102	11.781	<0.001
qb11	<---	ND2	0.470	0.080	8.583	<0.001
qb12	<---	ND2	0.740	0.065	12.485	<0.001
qb14	<---	ND2	0.742			
qb15	<---	ND2	0.603	0.073	11.795	<0.001
qb31	<---	ND2	0.036	0.083	0.671	0.502
qb3	<---	ND3	0.644	0.066	10.933	<0.001
qb4	<---	ND3	0.825			
qb5	<---	ND3	0.564	0.073	9.884	<0.001
qb9	<---	ND4	0.861	0.089	12.793	<0.001
qb25	<---	ND5	0.665			
qb28	<---	ND5	0.590	0.090	9.667	<0.001
qb29	<---	ND5	0.635	0.091	10.597	<0.001
qb6	<---	ND6	0.658			
qb7	<---	ND6	0.643			
qb13	<---	ND7	0.671	0.138	7.370	<0.001
qb17	<---	ND7	0.381	0.132	5.743	<0.001
qb18	<---	ND7	0.479			
qb19	<---	ND7	0.351	0.130	5.557	<0.001
qb26	<---	ND8	0.650			
qb27	<---	ND8	0.668			
qb16	<---	ND9	0.532			
qb30	<---	ND9	0.615			

Indicator Variable		Latent Construct	Estimate	S.E.	Z-Value	P-Value
qb16	<---	qb8	0.200	0.043	4.384	<0.001
qb31	<---	qb10	0.373	0.037	7.896	<0.001

Note: Level of significance is 1%
S.E= Standard Error
Source: Results from computer output

17. Table 4.29: CFA Covariance among latent constructs of New Model 1

	DOMAIN								
	ND1	**ND2**	**ND3**	**ND4**	**ND5**	**ND6**	**ND7**	**ND8**	**ND9**
ND1	1	0.174*	-0.009	-0.038	0.158*	0.091*	0.073*	0.134*	0.113*
ND2		1	-0.109*	-0.087*	0.172*	0.147*	0.159*	0.181*	0.141*
ND3			1	0.385*	-0.036	0.010	-0.042	-0.060	-0.086*
ND4				1	-0.051	0.017	-0.061	-0.070	-0.099*
ND5					1	0.086*	0.103*	0.171*	0.152*
ND6						1	0.078*	0.146*	0.066*
ND7							1	0.069*	0.099*
ND8								1	0.128
ND9									1

***** Significant at 0.01 level of significance

18. Table 4.31: SEM Covariance among latent variables for NModel 5

	DOMAIN								
	ND1	**ND2**	**ND3**	**ND4**	**ND5**	**ND6**	**ND7**	**ND8**	**ND9**
ND1	1	0.159*	-0.032*	-0.048*	0.151*	0.096*	0.074*	0.128*	0.110*
ND2		1	-0.062*	-0.073*	0.167*	0.146*	0.163*	0.191*	0.143*
ND3			1	0.252*	-0.018	-0.014	-0.035*	-0.072*	-0.052*
ND4				1	-0.047*	0.011	-0.056*	-0.093*	-0.084*
ND5					1	0.090*	0.107*	0.173*	0.143*
ND6						1	0.088*	0.150*	0.067*
ND7							1	0.075*	0.095*
ND8								1	0.135*
ND9									1

***** Significant at 0.01 and 0.05 level of significance

19. Table 4.33: SEM Covariance among latent constructs for NModel 6

	DOMAIN								
	ND1	**ND2**	**ND3**	**ND4**	**ND5**	**ND6**	**ND7**	**ND8**	**ND9**
ND1	1	0.153*	-0.036	-0.055*	0.141*	0.095*	0.075*	0.125*	0.102*
ND2		1	-0.068*	-0.053	0.160*	0.145*	0.165*	0.189*	0.140*
ND3			1	0.284*	-0.015	-0.018	-0.045	-0.083*	-0.058
ND4				1	-0.032	0.009	-0.048*	-0.076*	-0.041
ND5					1	0.085*	0.107*	0.168*	0.139*
ND6						1	0.088*	0.149*	0.067*
ND7							1	0.076*	0.095*
ND8								1	0.131*

***** Significant at 0.01 level of significance

20. Distribution of Variables into Components/Domains under six (6) Rotations

	Components					
	1	2	3	4	5	6
Thinking, learning, memory & concentration	.446					
Physical safety & security	.617					
Physical environment-pollution	.435					
Energy & Fatigue	.661					
Body image & appearance	.595					
Financial resources	.326					
Social inclusion	.280					
Participation in recreation/leisure activities	.387					
Mobility	.600					
Sleep & rest	.509					
Activities of daily living	.602					
Work capacity	.570					
Self esteem	.678					
Personal relationships	.525					
Sexual activity	.364					
Social support	.457					
Home environment	.487					
Health & social care: accessibility & quantity	.573					
Pain & discomfort		.603				
Symptoms of PLWA		.724				
Dependence on medication or treatment		.528				
Forgiveness & blame		.536				
Concerns about the future		.689				
Death & dying		.596				
Life is meaningful			.488			
Opportunities for acquiring new information & skill			.439			
Transport				.560		
Negative feelings				.506		
Life enjoyment						.481