STRUCTURAL EQUATION MODELLING OF ANOVULATORY INFERTILITY AMONG WOMEN WITH POLYCYSTIC OVARIAN SYMDROME IN EDO STATE, NIGERIA

BY

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B.sc(Hons.) Statistics(FUNAAB)

Matric No. 189648

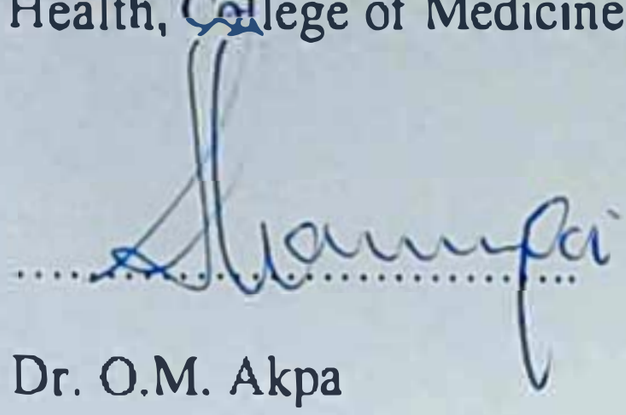
A DISSERTATION SUBMITTED TO THE DEPAERTMENT OF EPIDEMIOLOGY AND MEDICAL STATISTICS, FACULTY OF PUBLIC HEALTH, UNIVERSITY OF IBADAN, NIGERIA

IN PARTIAL FULFILMENT OF THE REQUIRMENT FOR THE AWARD OF AMASTER DEGREE (M.SC) IN BIOSTATISTICS

NOVEMBER, 2016

CERTIFICATION

I Ogunmokun Adekunbi D. certify that this project work was carried out directly under my supervisor and also meets the rules and regulations of the award of degree of M.SC. Biostatistics of the department of Epidemiology and Medical Statistics , Faculty of Public Health, College of Medicine, University of Ibadan.



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DEDICATION

This project is dedicated to the ever faithful God, who through His infinite mercy sustained me through thick and thin of the university.

Also to my loving mother, may you live to reap the fruit of your labour.

ATTESTATION

I understand the nature of plagiarism, and I am aware of the University's policy on this. I certify that this dissertation reports work by me has not been presented to any other University or body.

Signature.....

Date.....

ACKNOWLEDGEMENTS

An individual cannot boast of achieving success through dint of hard work alone but by additional effort from the surrounding people. I therefore want to acknowledge the effort of the following people towards the successful completion of this project.

I want to appreciate the ever faithful God who promised and never failed to fulfil His promises, God you are wonderful.

My sincere gratitude goes to my parents, Mr and Mrs Ogunmokun, for their financial support throughout my years in the university.

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AGFI	Adjusted Goodness-of-fit Index
AIC	Akaike Information Criterion
AMOS	Analysis of Moment Structure
ASRM	American Society for Reproductive Medicine
CAIC	Consistent Akaike Information Criterion
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CGF	Chi-square Goodness-of Fit
EFA	Exploratory Factor Analysis
GFI	Goodness-fit-Index
NFI	Incremental Fit Index
RMSEA	Root Mean Square Error of Approximation
SD	Standard deviation
SEM	Structural Equation Modelling
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ABSTRACT

Infertility is the biological inability of an individual to contribute to conception, or to a female who cannot carry a pregnancy to full term. Infertility is one of the toughest challenges a couple can face which could lead to an irreparable damage. Many researches have been done on infertility among women in Nigeria, but none has explored structural equation model of anovulatory infertility among women with polycystic ovary syndrome in Nigeria. This study aimed to develop a structural equation model of the relationships between anovulatory infertility and some characteristics in women with polycystic ovarian disease.

A total of 366 reproductive women aged 18-44 years responded to the questionnaire at the University of Benin Teaching Hospital (UBTH) and the Women's Health and Action Research Centre (WHARC), Benin, Edo State. Confirmatory factor analysis was performed on the hypothesized factors and structural equation modelling was fitted using AMOS software to know the relationship between women with anovulatory infertility and characteristics in women with polycystic ovarian syndrome. Analyses was performed at 5% significance level.

The minimum sample discrepancy (CMIN) is given as 722.418 and after dividing it by the degrees of freedom, CMIN/DF which is given as 15.05. The RMSEA is 0.205 while the values of the GFI and AGFI are close to one. Furthermore, there exist a relationship between Estradiol and fasting glucose ($r = 0.186, p = 0.001$), follicle stimulating hormone and total testosterone ($r = -0.172, p = 0.002$), Progesterone and total testosterone ($r = -0.182, p = 0.009$), Estradiol and total testosterone ($r = 0.333, p =< 0.001$), Estradiol and fasting glucose ($r = 0.186, p = 0.001$), and some other hormonal, metabolic and bio-physical variables.

Our results showed relationships between Hormonal, Metabolic and Bio-physical variable with polycystic ovarian syndrome. The SEM model had some fit indices significant but a non-significant chi square fit index which may be due to our sample size.

Keywords: Structural equation modelling, Hormonal, Metabolic, Bio-physical.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Infertility or infecundity is described as the biological inability of an individual to contribute to conception, or to a female who cannot carry a pregnancy to full term. According to the World Health Organization (WHO, 2013), infertility can be explained as the inability to become pregnant, maintain a pregnancy, or carry a pregnancy to live birth.

Globally infertility prevalence rates are difficult to determine, because of the presence of both male and female factors that complicate any estimate which may only address the woman. However, one in every four couples had been found to be affected by infertility. (DHS, WHO 2004).

Female infertility varies widely by geographic location around the world. In 2010, there was an estimated 48.5 million infertile couples worldwide, and from the year 1990 to 2010 there was slight changes in levels of infertility in most of the world. The exact prevalence of infertility in developing countries is unknown, due to poor documentation and lack of well-designed studies. However, a study in sub-Saharan Africa showed that infertility is highly prevalent, affecting about 10%–30% of couples. (Menuba et al, 2014)

The prevalence of infertility in Nigeria is put at between 20 to 25 percent among married couples, according to experts. Most infertile couples in southeast Nigeria are offered conventional forms of treatment, Several reports indicate that infertility is the most frequent reason for gynaecological consultation in Nigeria.(Menuba et al,2014).

Infertility can further be broken down into primary and secondary infertility. Basically, infertility refers to the inability to produce offsprings either because of not being able to become pregnant, or carry a child to live birth, this might be a miscarriage or a stillbirth. Secondary infertility refers to the inability to conceive or give birth when there was a previous pregnancy or live birth (WHO,2013). Female infertility can simply classified regarding whether they are genetic or acquired, or strictly by location. Acquired, according to the American Society for Reproductive Medicine (ASRM), factors like, Age, Smoking, Sexually Transmitted Infections, and Being Overweight or Underweight can all affect fertility.

Gene mutation is also a factor which contributes to infertility among women, although gene contributes less to infertility among women, an unknown number of genetic mutations cause a state of subfertility, which in addition to other factors such as environmental ones may manifest as frank infertility.

By location, polycystic ovary syndrome, anovulation, poor ovarian reserve, premature menopause, menopause, hypothalamic-pituitary factor, ovarian factors (chemotherapy with certain agents have a high risk toxicity on the ovaries, and many genetic defects. However, this study will focus on anovulation and polycystic ovary syndrome. To understand anovulation, understanding what occurs during a normal ovulatory cycle is important. In normal physiology, ovulation is dependent on the presence of a functioning hypothalamic-pituitary-ovarian (HPO) axis. (Balen and Rutherford, 2007)

Anovulation is a menstrual disorder whereby the ovaries do not release an ocyte. Therefore, ovulation does not take place. However it is important to note that a woman who does not ovulate at each menstrual cycle is not necessarily going through menopause. Anovulation causes infertility in about a third of couples who attend infertility clinics, and polycystic ovary syndrome (PCOS) accounts for 90% of such cases (Balen, 2007). Almost all women experience anovulatory cycles at some point in their reproductive lives. Yet, attempting to determine the frequency of chronic anovulation in the general population is difficult because of the problem of under-reporting. Estimates of chronic anovulation rates range from 6-15% of women during the reproductive years (Balen, 2007). Anovulation occurs only in women of reproductive age.

Polycystic ovarian syndrome (PCOS) is the commonest cause of anovulatory infertility. The prevalence of PCOS varies depending on which criteria are used to for diagnosis, but the prevelence is as high as 15 percent to 20 percent when the European Society for Human Reproduction and Embryology and American Society for Reproductive Medicine criteria are used. It is a complex endocrine disorder affecting women in reproductive years. It is associated with disorders of reproduction, metabolism and general increased risk of miscarriage. (Odunukwe, 2015).

PCOS is fairly common occurring in approximately one in six infertile Nigerian women. (Abubakar et al,2011.) Polycystic ovary syndrome is the most common gynaecological endocrine disorder in women of reproductive age (Ugwu et al.,2013)

PCOS is defined by specific clinical, biochemical and ultrasonographic criteria. Clinical manifestations include menstrual irregularities, signs of androgen excess and obesity. It is characterized by metabolic and endocrine disorders or malfunctions. Although the clinical manifestation of the syndrome is dependent on the age of the person, ovarian malfunction and hyperandrogenism are common features at any age. (Tsikouras et al., 2015)

According to the ESHRE which is the European Society for Human Reproduction and Embryology, and the American Society for Reproductive Medicine (ASRM) consensus on the diagnostic criteria of PCOS (2003), when two of the following three criteria are present, the syndrome is diagnosed:

i) Anovulation or oligoovulation
ii) Biochemical hyperandrogenemia or hyperandrogenism
iii) Polycystic ovaries observed ultrasonographically (Tsikouras et al.,2015)

1.2 Problem statement

Infertility is perceived as the major cause of divorce in Africa. (Adeniran, 2015). Child birth is a very important part of couples lives and infertility is one of the toughest challenges a couple can face which could lead to an irreparable damage. Women who are still infertile after treatment are three times more likely to divorce or end cohabitation with their partner than those who do. (Trille et al, 2014). Women diagnosed with infertility have also been seen to have a higher risk of sexual dysfunction compared with women without infertily. (Leah et al, 2010)

Again, in infertile women depression is more common and severe than fertile women. Family pressure to get pregnant is a significant contributor to depression (Homaidan,2011). Anovulation is one of the major factors responsible for infertility among women, it accounts for 25-50% of the causes of female infertility (Unuane et al., 2011).

Social stigma due to infertility is seen in many cultures throughout the world in varying forms. Often, when women have problems with conceiving, the blame is put on them, even when approximately 50% of infertility issues come from the man. Its negative impact on the peace of the affected families and the demographic status of the community is becoming conspicuously increasing every day.

1.3 Justification for the study

Infertility and sub fertility affect a significant proportion of humanity. It is a public health issue which has social, cultural and emotional impact on the women and families affected. Women with PCOS have been seen to experience some health challenges, about 50% of women with PCOS will have diabetes or pre-diabetes conditions which may be due to the fact that they are older than 45, may be overweight or obese (Susan Y et al.2016)

Also, women with PCOS are at a greater risk of having high blood pressure.It was also stated that women with PCOS have high levels of LDL (bad) cholesterol and low levels of HDL (good) cholesterol. (United State of Health and Human Services, 2010).

Furthermore, many researches have been conducted on infertility among women in Nigeria, factors causing infertility, its impact, and likely ways out, but none has explored structural equation model of anovulatory infertility among women with polycystic ovary syndrome in Nigeria.Hence, this study is going to estimate the structural equation modelling of anovulatory infertility among women with polycystic ovary syndrome in Nigeria.

1.4 Objectives

1.4.1 Broad Objective

To develop a structural equation model of the relationships between anovulatory infertility and some characteristics in women with polycystic ovarian disease.

1.4.2 Specific Objectives

i) To assess the differences in hormonal, Bio-physical and Metabolic characteristics between the younger and older women with anovulatory infertility.

ii) To investigate the causal relationship between polycystic ovarian syndrome and anovulatory infertility.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Anovulation is a common cause of infertility among women, it is a menstrual disorder whereby the ovaries do not release oocyte, therefore, ovulation does not take place (Geetu, Samar,2013).

Polycystic ovary syndrome is the most common contributor to infertility and also the most common endocrine problem affecting women. Polycystic ovary syndrome accounts up to 90% of anovulatory infertility. Its symptoms, and signs change greatly among those affected and it may also change over time in individual women. (Balen, Anthony,2007).

2.2 Historical development of infertility

Infertility is a condition of the reproductive system that prevents the conception of children. (American Pregnancy Association, 2016). It is the inability of a person, or animal to reproduce by natural means. Infertility has been a major social and medical preoccupation since the beginning of human existence and women have always been the symbol of fertility. (ACFS, 2010).

According to demographers, it is defined as childlessness in a population of reproductive age (15-49) within five years of exposure to pregnancy (DHS). Infertility is a disease of the reproductive system defined by the failure or inability to achieve a clinical pregnancy after 12 months of more or regular unprotected sexual intercourse.(WHO).

Infertility can either be primary or secondary. Primary infertility can be explained as when a woman is unable bear/carry a child, either because of the inability to become pregnant or the inability to carry a pregnancy to a live birth, such would be classified as having primary infertility. Women who have miscarriage or whose pregnancy resulted into still birth without ever having had a live birth would be classified as having primary infertility (WHO,RHR,2014). The prevalence of primary infertility can be calculated as the number of women in an infertile union divided by the number of women in in both fertile and infertile union.(Maya et al.,2012).

Secondary infertility can be explained as when a woman is unable to bear a child, either due to the inability to become pregnant or the inability to carry a pregnancy to a live birth following either a previous pregnancy or an inability to carry a pregnancy to live birth is classified as secondary infertility. (Sexual and Reproductive health). The prevalence of secondary infertility can be calculated as the number of women in an infertile union divided by the combined number of women in infertile and fertile unions. (Maya et al,2012).

2.3 Studies involving anovulatory infertility

According to Sabarre et al.,2013 in a qualitative study of Ottawa University students' awareness, knowledge, and perception of infertility risk factors and assisted reproductive technology, the objective of the study was to check men and women's (young) awareness, knowledge and perceptions of infertility, male and female risk factors and assisted reproductive technologies (ART). In the result, reproductive health knowledge gaps and discombobulation of the physiological life stage of menopause with infertility were visible. It also showed that most patients would go for in-vitro fertilization or international adoption in the case of personal infertility.

Adegbola and Akindele in 2013 studied the pattern and challenges of infertility management in Lagos, Nigeria aimed to determine the pattern of infertility cases amongst infertile couples setting care in Lagos University Teaching Hospital, Lagos, Nigeria. The incidence of infertility was found to be 26.8% of the gynaecological consultations with a mean duration of infertility of 4.3 ±3.4 years. Also, the mean age of the women was 33.8±5.2 years and 66.1% were nulliparous. Secondary infertility accounted for 80% cases.

Andersen,2009 predicted the FSH threshold dose in women with WHO Group II anovulatory infertility failing to ovulate or conceive on clomiphene citrate with the objective to establish independent predictors of follicle-stimulating hormone (FSH) threshold dos in anovulatory women undergoing ovulation induction with FSH preparations. In the univariate analysis, body mass index (BMI), age, failure to ovulate with clomiphene citrate, menstrual cycle history with mean ovarian volume , LH/FSH ratio, testosterone and free androgen index were significant (P<0.05) indicators of FSH threshold dose. In the multivariate analysis, menstrual cycle history, mean ovarian volume and BMI remained significant. (P<0.001). in women with PCOS, the pregnancy rate was less in patients with progesterone level <1.2ng/ml. However, this difference was not statististically significant, differences in pregnancy rate in patients with fallopian tube factor infertility.

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Azizeh et al.,2012 did a research to size up predictive value of progesterone level on in vitro fertilization success in women with infertility due to tubal factors or polycystic ovarian syndrome. They were able to get a total pregnancy rate of 15.8% in patients with tubal factor infertility and 26.3% in women with PCOS. In women with PCOS

Mehmet et al.,(2014), aimed to determine the correlates and the prevalence of infertility in a group of women. The mean age of the participants was 35.45±8.39 years. The prevalence of infertility was higher in those with a history of gynaecological disease or gynecologic surgery and in those with menstrual irregularity (P<0.05; for each). In the study, no difference was found between the level of loneliness and who is responsible for infertility among infertile/fertilewomen (P≥ 0.05). Level of loneliness among the women the women with primary infertility was higher compared to the women with secondary infertility. (P<0.05).

Peter et al., (2005) did a research on the resolution of anovulation infertility using Neuro emotional tecluique: A report of 3 cases. They aimed to review the normal menstrual cycle and also to show a number of case studies on how the stress reducing techniques (NET) successfully aided the fertility of a number of female patients by resolving anovulation/menstrual irregularity. They were able to get that anovulating patients started to ovulate following a series of treatments. Initial Visual Analog (VAS) scale on menstrual abnormalities was rated 10 out of a possible 10 anovulation for all participants.

Ovulatory dysfunction was defined as a history of less than eight cycles in a year, or menstrual cycles less than 26 d or more than 35 d in length; or a d 21-24 (midluteal) P4 level < 4 ng/ml in women with regular menstrual cycle. Regular menstrual cycle was defined as 26 – 34 d in length (Azziz et al., 2004).

Jorge. et al, (2008) did a research on the use of multivitamins, intake of B vitamins and risk of ovulatory infertility. The objective was to examine whether use of multivitamins and intake of specific nutrients in multivitamins is associated with ovulatory infertility. The result of the study showed that there was an inverse association between frequency of multivitamin use and ovulatory infertility. Also, folic acid appeared to explain part of the association between multivitamin supplement use and risk of ovulatory infertility. They were able to find out that the association between soft drinks and ovulatory disorder infertility appears not to be attributable to their caffine or sugar content, and deserves further investigation.

2.4 Studies involving Polycystic Ovary syndrome (PCOS).

2.4.1 Prevalence of PCOS in women

Fahimeh et al (2011) did a research on the prevalence of polycystic ovary syndrome in a community sample of Iranian population which was an Iranian PCOS prevalence study. The objective was to determine prevalence of PCOS in a community based sample using the National Institute of Health (NIH), the Rotterdam consensus (Rott) and the Androgen Excess Society (AES) criteria. They were able to get the mean ± standard deviation (S.D) of age of study population was 34.4±7.6 years. 8.3% of women had only oligo/anovulation and 8.0% had only polycystic ovaries. The prevalence of PCOS was 7.1% (95% CI :5.4-8.8%) using the NIH definition and 14.6% (95% CI, 12.3-16.9%) using the Rott definition). At community level, widespread screening of Rotterdam criteria will increase the estimated prevalence of PCOS over twofold.

A study of the prevalence of polycystic ovary syndrome and its associated complications in Iranian women which was done by Anahita et al. (2015), aimed at investigating the prevalence of PCOS and its associated complications in Iranian women, they were find out the prevalence of PCOS based on National Institute of Child Health and Human disease of the U.S was 6.8%(95%CI: 4.11-8.5) based on Rotterdam was 19.5%(95%CI:2.24-8.14). they concluded that the prevalence of PCOS in Iran is not high.

Jerilyn et al., (2015) aimed to determine the population point prevalence of ovulation in premenopausal, normally menstruating women. The null hypothesis was that such cycles are ovulatory. Women who are with/without ovulation did not differ in factors like age, cycle day, BMI, menarche age, cigarette use, physical activity, % obesity or self-reported health. There were small differences in parity (96.7% versus 94.5%, p=0.04) and major differences in progesterone level. It was concluded that anovulation in a random population occurs in over a third of clinical normal menstrual cycles.

Erin and Rajesh in (2015) did a study on PCOS. The study was aimed at reviewing the present status and formulates an interesting and clinically relevant research direction that is essential to move the field of PCOS forward. They concluded that PCOS is becoming a more prevalent disorder among women of reproductive age with lifelong complications.

2.4.2 Prevalence of PCOS in Adolescents

Tsikoras et al. (2015) did a research on the features of polycystic ovary syndrome in adolescence with the aim to get the therapeutic targets and regimes, not only to prevent the long term complications of the syndrome, but it was also done to enhance the self-esteem of a young girl who matures into womanhood. Results showed that the pathogenesis of the PCOS was hypothesized to be based on interactions between genetic and some environmental factors. The diagnosis was usually difficult in young girls; the syndrome was also related to a greater risk of future infertility, type II diabetes mellitus, the metabolic syndrome and cardiovascular disease.

West et al.,2014, aimed to know if teenage girls with a history of menstrual irregularities and elevated androgen levels in adolescence exhibit an increased risk of polycystic ovary syndrome (PCOS) and/ or infertility later on in adulthood. Result showed that the proportion of symptomatic girls who had conceived at least once child (68.0 versus 67.9%) and had delivered at least one child (25.7versus 28.1%) was similar to the non-symptomatic women and the groups had similar miscarriage rates (11.6 versus 12.1%). Logistic regression analyses indicated that menstrual irregularity at 16years was associated with an increased risk of menstrual irregularity.

2.4.3 Hormonal Factors and PCOS

Sedigheh et al.,2011 aimed at comparing the effects of metformin or orlistat on hormone, lipid profile and ovulation status in obese women with polycystic ovary syndrome. Results showed that there was no significant difference in ovulation between the two treatment groups (30% vs 15%). Treatment with either drug showed a significant reduction in body weight, Body Mass Index(BMI) and waist circumference. The level of reduction in both groups was the same. Participants who were treated with orlistat showed a significant reduction in total testosterone and serum lipid. Women in metformin group showed a significant reduction in serum LH.

Wanakan Singhasena et al.,2014 tried to know follicle–stimulating hormone receptor (FSHR) gene polymorphism in chronic anovulatory women, with or without polycystic ovary syndrome. This was a cross-sectional study focused on getting the distribution of FSHR gene polymorphisms at condons 307 and 680 in Thai women with chronic anovulation. There were three groups; women with PCOS, women without PCOS and fertile women as controls. The

prevalence of FSHR gene polymorphisms at both condons were not statsistically different among the three groups.

Richard et al.,2014 aimed to summarize baseline characteristics from a large multi-centre infertility clinical trial. It was found out that most females had an elevated antral follicle count and enlarged ovarian volume on ultrasound. They wanted to know if aromatase inhibitors including letrozole might result in better pregnancy outcomes. It was found out that women who received letrozole had more cumulative live births than those who received clomiphene. The cumulative ovulation rate was higher with letrozole than with clomiphene. There was no significant between-group differences in pregnancy loss in the letrolzole group and pregnancies in the clomiphene group. Clomiphene was associated with more incidences of hot flushes and letrozole was associated with more incidences of dizziness and fatigue. Rates of other adverse events were similar in the two treatment groups.

2.5 Historical background of structural equation model.

Structural Equation Modelling has an evolutionary history. It has its roots in factor analysis and path analysis. According to Matsueda and Press (2011) and Hoyle (2012) it was Sewall Wright, a young geneticist, who applied path analysis in the field of Genetics for causal explanation, while in the field of sociology reference to path analysis appeared in the works of Blalock (1961). It was generally believed that path analysis should exclusively be used in observational data and causality was linked with experimental data only. Side by side with causality in path analysis, interest in factor analysis was presented with the focus to have economy of description (Harman, 1960).

Matsueda and Press (2011) contended that the year 1970 was a "watershed" for SEM. This year is marked by the Conference on Structural Equation Models and the publication of Structural Equation Models in the Social Sciences. Goldberger and Hauser (1971) and Jöreskog (1970, 1973, 1978) are great main contributors. The formers discussed many issues including identification and estimation in SEM while the latter addressed covariance analysis and introduced a computer program LISREL for empirical applications. This program dominated the field of SEM (Matsueda & Press, 2011).

2.6 Studies involving structural equation model

Ester et al.,2014 did a research to investigate the theoretical frameworks to measure health Related Quality of Life (HRQoL) in children. The variance explained of Health Quality of Life was 15%. Health related Quality of life was affected by the area of education (i.e where kinder gardens were located) and development status. Development status was affected by the area of education, socio economic status and individual behaviour symptoms did not affect the model.

WL Cheah et al.,2009 aimed to examine the causal relationships among the biological, behavioural and environmental factors related to malnutrition in children aged 5years and under. The modified model fitted the data adequately. The result showed that an environmental construct had a significant effect on malnutrition. Neither the biological nor behavioural construct had significant effects. Figure 2.1 depicts the conceptual model of the causal relationship among the factors related to malnutrition in children.

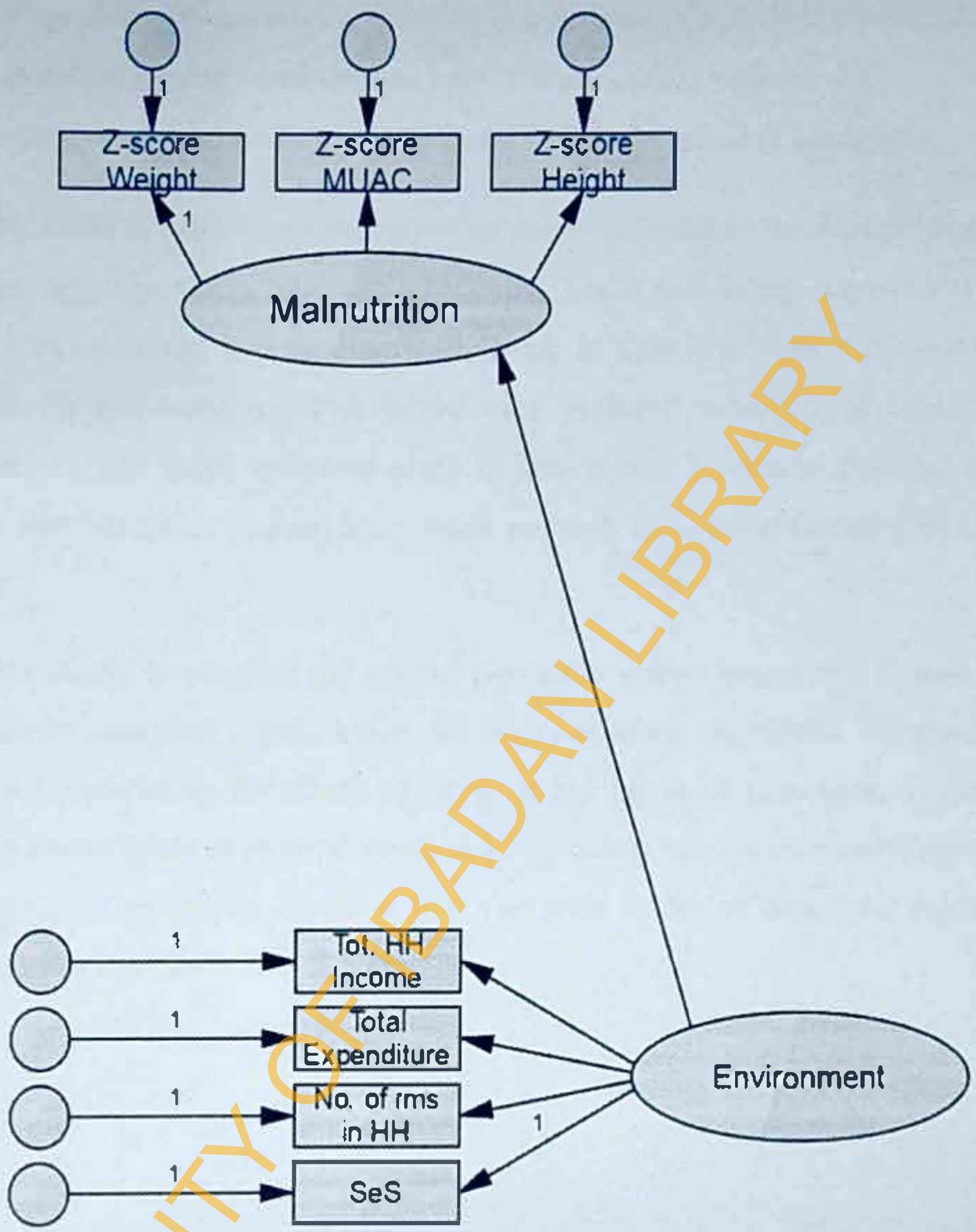


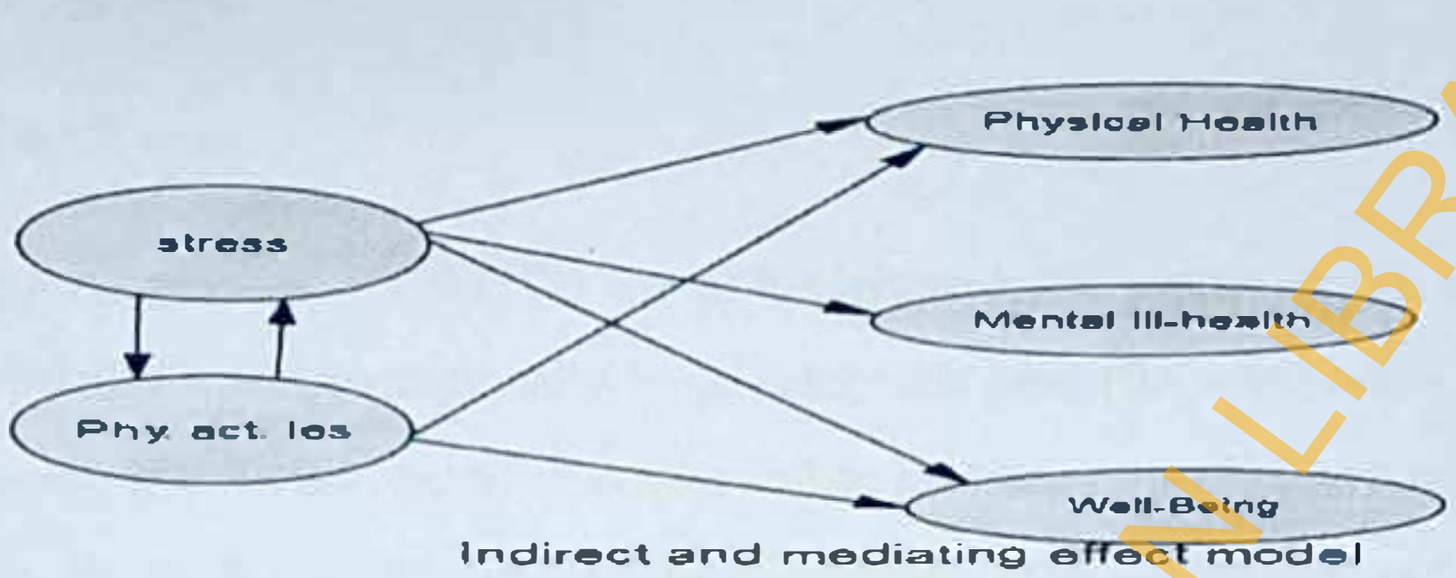
Figure 2.1 CONCEPTUAL MODEL OF THE STUDY.

Dorit (2015) in a study using Structural Equation Model and Multidimensional Scaling to assess female college students' academic adjustment as a function of perceived parenting styles. The two statistical methods used showed a positive association between the authoritarian parenting style and the parents who find it difficult to adjust in academics.

David et al.,2006 aimed to build a structural equation model to highlight the relationships of some factor (age, cognitive ability, physical functioning, health and falling behaviour were used to create a causal model in a predictors 45 falling in older Maryland driving using structural model. Factors associated with falling were explored, a variety of cognitive, physical-performance, and health measured given to participants. The model revealed that being older was associated with declines in cognition and such cognitive reduction predicted increased falling.

Yoshi et al.,2010 aimed to examine the role of physically active leisure in i) directly promoting health ii) maintaining good health for highly stressed individuals iii)reducing stress levels and iv) mediating the effects of stress on the health of Canadians. Overall, physically active leisure levels of physical health and well-being, and lower levels of mental ill-health among Canadian. Figure 2.2 show the conceptual model of direct and indirect model of physically active leisure.

Direct effect model



Indirect and mediating effect model

Figure 2.2 Conceptual Model of the Study

CHAPTER THREE

METHODS

3.1 Study design and setting

The current study is a secondary analysis of data collected in a hospital-based case control study (on fertility) among women of reproductive age at the University of Benin Teaching Hospital (UBTH) and the Women's Health and Action Research Centre (WHARC), Benin City, Edo State.

3.2 Study area

The fertility clinic at UBTH is one of the largest in the tertiary health institutions in Nigeria and attends to a geographically large catchment area (the south-south geopolitical zone in Nigeria). The department of obstetrics and gynaecology is a clinical research department. It is made up of 4 departments viz: materno-fetals Gynae-oncology and URO-Gynaecology, fertility counselling and infertility and endocrinology. Infertility clinic and endocrinology runs a specified consultation and complete infertility work up and including assisted reproductive technology inclusive of intra-uterine insemination (IUI). In-vitro fertilization and embryo transfer, in vitro-cytoplasmic sperm injection and counselling facilities all at affordable rates. Women Health and Action Research centre is a Nigerian non-profit and charitable organization based in Benin City, Edo state to improve reproductive health through scientific research and advocacy. The goal of the organization is to promote accessibility of women and adolescents to basic reproductive health. And also aims to improve the social well-being and reproductive health of adolescents and women across African countries. One of the key objectives of women Health and Action Research Centre is to decrease maternal mortality in the country and to design programs for improving maternal health in Africa as well as advocacy for policies that will promote maternal health (WHARC, 2002).

3.3 Study population

The population of this study is women of reproductive age (18-44) who attended clinics for treatment for the period 2010-2012 at the University of Benin Teaching Hospital and Women's Health and Action Research Centre in Benin City

3.4 Data collection

Secondary data (n = 336) involving women at the reproductive age 18-44years was used in the study. The anovulatory infertile women with polycystic ovary syndrome and women attending fertility clinics having normal ovulation were closely equal in size for the case and control cohorts.

3.5 Subjects and methods

The study was based on a cohort of consecutive women who were attending the fertility clinics in university of Benin Teaching Hospital (UBTH) and Women Health and Action Research Centre (WHARC) in Benin City, do State, Nigeria between 1st of April 2009 and 30th of November 2010. The sampling frame was chosen because it broadly captured a representative of women with fertility challenges. The fertility clinic at UBTH is one of the largest in the tertiary health institutions in Nigeria and attends to a geographically large catchment area (South-south geopolitical zone in Nigeria). The obstetrics and gynaecology (O&G) department of the hospital is well equipped for Assisted Reproductive Technology (ART) such as In-vitro fertilization (IVF).

A total of 366 women aged 18-44 years who responded to the questionnaire and also gave their consent to take part in the research, they were gotten from among the reproductive aged women. The women who were on hormonal therapy or receiving treatment for hypertension were not allowed to participate.

Interviews were conducted by trained nurses in the clinics. The procedure of the study was explained to the subjects and their consent obtained. A medical history was obtained using a pre-pared standard questionnaire (n=1000) focusing on detailed anthropometry, with emphasis on height, weight, body mass index (BMI),blood pressure (BP), menstrual regularity, medications and family history regarding diabetes mellitus in first and second generation and gynaecological history. Blood pressure was measured with subjects in sitting position, and the mean blood pressure (MBP) was estimated (MBP=diastolic+(systolic/3) Diamanti-Kandarakis et al,1999).

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3.6 Missing data and outliers

The variables extracted were inspected for missing information. In this study, missing data were handled using maximum likelihood estimation in AMOS program version 21 when CFA and SEM were conducted.

3.7 Data screening and preliminary analysis

Preliminary analysis was done using the Statistical Package for Social Sciences (SPSS) program version 20 for data cleaning, descriptive statistics and confirmatory factor analysis.

3.8 Normality

Sample sizes sometimes affect study's results where the outcome of a sample size is of little statistical power. The makes test not to realistically identify significant results (Heir et al, 1998). The data were extracted and tested for normality, normality of the data set was examined using skewness and kurtosis, Mahalanodis distance (D) statistics (Schumacker and Lomax, 2010).

3.9 Data analysis plan

The data extracted were analysed for normality to ensure its appropriateness using standard multivariate analysis. Normality of the dataset can be examined through statistical approaches like Skewness and Kurtosis, Mahalandis distance (D) statistics (Schumacker and Lomax,2010). Skewness and kurtosis was used in this study to assess the normality of variables in the dataset.

Structural Equation Modelling (SEM) was used to analyse the data. This is a common method which is used in representing causal relations in data that demonstrate a multivariate structure in behavioural and social sciences. SEM is a wide statistical tool used in hypothesizing relations among latent and observed variables (construct with measured and unmeasured variables).

An initial analysis (Descriptive) was done using the Statistical Package for Social Sciences version 20 (SPSS). The Analysis of Moment Structures (AMOS) software (version21) was used to draw the path diagrams and fit indices.

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3.9.1 Outcome and study variable:

The outcome variable in the dataset was anovulatory infertility. This variable was recorded as a binary variable as follows: 0, if the respondent is ovulated normally; then 1, if the respondent suffered from anovulation. The study variables gotten from extraction are:

3.9.2 Hormonal variables

The hormonal variables are chemical substances that are secreted by an endocrine gland or group of cells (endocrine) that acts to control or regulate specific physiological processes, including growth, metabolism and reproduction. The hormonal variables used in this study are:

i) Follicle stimulating hormone (FSH)
ii) Luteinizing hormone (LH)
iii) Prolactin (PRL)
iv) Progesterone (P4)
v) Estradiol (E2)

3.9.3 Metabolic variables

These are chemical characteristics in the participants which are involved in maintaining the living state of the cells in the body. These variable are:

i) Fasting glucose (FG)
ii) Fasting insulin (FI)
iii) Total cholesterol (TC)
iv) Triglycerides (TG)
v) High density lipoprotein (HDL-C)
vi) Low density lipoprotein (LDL-C)
vii) Uric acid

3.9.4 Bio-physical variables

These are variables that relates to the physical and biological attributes of participants.

Such variables considered in the study were:

i) Age
ii) BMI
iii) Mean Blood Pressure

3.9.5 Recommended ranges of classifying Metabolic and Bio-physical Variables.

The American Association for Clinical Chemistry in 2016 classified Low Density Lipoprotein (LDL) into groups which are listed below:

Table 3.1 Classification of Low Density Lipoprotein (LDL)

Level mg/dl	Level mmol/L	Interpretation
Less than 100mg/dL	2.59mmol/L	Optimal
100-129mg/dL	2.59-3.34mmol/L	Near optimal
130-159mg/dL	3.37-4.72mmol/L	Borderline high
160-189mg/dL	4.15-4.90mmol/L	High
Greater than 189		Very High

The American Heart Association, NIH and NCEP in 2016 provides range of values High Density lipoprotein (HDL), the values are listed below:

Table 3.2 Classification of High Density Lipoprotien

Level mg/dL	Level mmol/L	Interpretation
<50	<1.03	Low HDL Level
50-59	1.03-1.55	Medium HDL level
>60	>1.55	High HDL level

The U.S Department of Veterans Affairs in 2016 adapted from National Cholestrol Education Program (NCEP), National Heart, Lung and Blood Institue , National Institues of Health classified Triglycerides into levels, the levels are listed below:

Table 3.3 Classification of Triglycerides

Level	Measurment
Normal	<150mg/dL
Borderline High	150-199150mg/dL
High	200-299150mg/dL
Very High	Greater or equal to 500

The National heart , Lung and Blood Institute in 2016 classified overweight and obsesity by BMI, waist circumference and Associated Disease Risks. The levels are listed below:

Table 3.4 Classification of Body Mass Index

	BMI (KG/M^2)	**Obesity Class**
Underweight	<18.5	
Normal Weight	18.5-24.9	
Over weight	25.0-29.9	
Obesity	30.0-34.9	i
	35.0-39.9	ii
Extreme Obesity	40.0+	iii

Lastly, age of reproductive women was categorized into two,(younger and older women) according to NDHS:

Table 3.5 Classification of Age.

Age Range (years)	**Group**
<24 years	Younger Women
>25 years	Older women

3.9.6 Structural Equation Modelling (SEM)

Structural Equation Modelling (SEM) refers to a diverse set of mathematical models, computer algorithm and statistical methods that fits networks of constructs to data. SEM has become one of the best techniques used by researchers across different areas and is a MUST for reseachers in the social sciences. (Daire H. et al, 2008).

The procedure recommended by Schumacker and Lomax (2010) is adopted in fitting the final structural model. They are; Model specification, Model identification, Model estimation, Model testing and Model modification.

Structural Equation Model involves two main components; namely, the measurement equation and the structural equation. A mathematical expression of the measurement equation is represented in the matrix form as follows:

3.9.7 Measurement model

The measurement model for the structural equation model is presented below:

$$y_{(p\times 1)} = \Lambda_{y(p\times m)} \times \eta_{(m\times 1)} + \varepsilon_{(p\times 1)}$$

$$x_{(q\times 1)} = \Lambda_{x(q\times n)} \times \xi_{(n\times 1)} + \delta_{(q\times 1)}$$

Where: $y = vectors\ of\ observed\ exogenous\ variables$

η= vectors of exogenous latent constructs

x= vectors of observed endogenous variables

ξ= vectors of endogenous latent constructs

Λ_y= matrix of construct loadings on exogenous latent construct

Λ_x = matrix of construct loadings on endogenous latent construct

ε = vectors of random measurement errors of exogenous variable

δ = vectors of random measurement errors of endogenous variables

p = number of exogenous indicator variables

q= number of endogenous indicator variables.

Given the observed data for describing Anovulatory infertility and (Hormonal, Metabolic and Bio-physical variables) the measurement equations appropriately group together the correlated indicator variables to form the latent variables in η and ξ. This done by assigning fixed parameters and defining unknown parameters Λ_y and Λ_x.

The interrelationship among the latent factors or components is explained through a structural equation model. It is expressed mathematically in matrix form as follows:

3.9.8 Structural model

The structural equation for the structural equation model is presented below:

Where:

η =vectors of exogenous latent constructs

β=*matrix of structural parameters describing the endogenous constructs together*

Γ= *matrix of structural parameters describing the endoge tructs to the exogenous constructs*

ξ=*vectors of endogenous latent constructs*

ς=*vectors of disturbances representing the unexplained variation in the endogenous constructs.*

The parameters of the model were estimated after the model specification was performed. The estimation was done in order to reduce the differences between the hypothesized matrix which is a function of the parameterθ, a vector that includes all unknown parameters $\sum(\theta)$ and sample covariance matrix S.

In addition, slightly non-normal and non-interval data set were handled using maximum likelihood

3.9.8.1 Assessing Model Fit

In Structural Equation Modelling, model fit is determined by peculiar or suitable fit indices. These fit indices are divided into three which are the absolute fit indices, the increment fit indices and the parsimony fit indices. The absolute fit indices sets limits on how well a prior model fits the sample data (McDonald and Ho, 2002). These measures demonstrate which proposed model has the best fit. Absolute fit index provides primary principles of how the well the formulated or proposed theory fits the data. Some fit indices included in this category are explained as follows:

3.9.8.2 The Relative Chi square

The Relative chi-square is a measure for assessing overall model fit and evaluates the magnitude or size of inconsistency between the sample and fitted covariance matrices. It is also a traditional method for which overall modes are assessed. (Hu and Bentler,1992). The relative chi-square is gotten by the value of the chi-square index divided by the degree of freedom CMIN/DF. (Schumacker , Lomax, 2004). The acceptable range of value for the relative chi- square should be less than 2 or 3 (Ullman,2001).

3.9.8.3 Root mean square error of approximation (RMSEA)

The RMSEA is one of the most informative fit indices that show how well the model fits the populations covariance matrix. (Hooper D, Coughlan J, Mullen M, 2008). Values closer to zero indicate better fit which is otherwise known to be badness of fit (Kline 2011). It is calculated using by :

$$\text{RMSEA}=\sqrt{\frac{X^2_M - df_M}{df_M(N-1)}}$$

Where:

X^2=Chi-square value for the model

df_M =degree of freedom of the model

N=sample size

3.9.8.4 The Goodness of Fit indices (GFI)

Furthermore, the GFI is an alternative to the Chi square test. It calculates the percentage of variance accounted for by the estimated population covariance. This Goodness of fit statistic ranges from 0-1. However, as the number of parameters increase,the GFI increases. (Hooper D, 2008). The GFI is expressed as:

$$\text{GFI}= 1 - \frac{F[s,\Sigma(\hat{\partial})]}{F[s,\Sigma(\partial)i]}$$

Where,

S = Sample variance or covariance matrix

$\Sigma(\partial)i$= Population parameter implied variance or covariance matrix

$\Sigma(\hat{\partial})$= Sample-estimate implied variance or covariance matrix

F= Maximum likelihood discrepancy function.

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Where,

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$\Sigma(\partial)i$= Population parameter implied variance or covariance matrix

$\Sigma(\hat{\partial})$= Sample-estimate implied variance or covariance matrix

F= Maximum likelihood discrepancy function,

3.9.8.5 Root Mean Square Residual (RMR) and Standardised Root Mean Residual (SRMR)

The RMR and SRMR are the square root of the difference between the errors of the covariance matrix and the proposed covariance model.(KLINE,2002). A good model fit for RMR is equal to zero(0), while higher values show a worse fit. The SRMR is a measure of the mean absolute correlation matrix, it is easier to interpret because of its standardized nature. Values less than 0.08 show best model fit.(Hu and Bentler 1999).

3.9.8.6 Incremental Fit Indices

The incremental fit indices are otherwise known as comparative or relative fit indices. The IFI do not use the raw form of chi-square but compares the chi-square value to a baseline model (Hooper D. et al, 2008). Example of this indices are:

3.9.8.7 Normed –Fit index (NFI)

The NFI compares the value of the chi square model to the null model's chisquare value in its way of assessing the model. Its acceptable value ranges between 0 and 1. A disadvantage of this model is that it is sensitive to sample size (Kline, 2011)

3.9.8.8 Comparative fit Index (CFI)

This is an improved form of the NFI that performs well when the sample size is small. Its acceptable values ranges from 0 to 1 and values closer to 1 indicate good fit. CFI is one of the most reported fit indices because it is less affected by sample size.

3.9.8.9 Parsimony fit indices

The parsimony fit indices is divided into two which are the Parsimony Goodness of Fit Index (PGFI) and the Parsimonious Normed Fit Index (PNFI). The PGFI operates upon the GFI by adjusting the degree of freedom while the PNFI does the same but it is based on NFI.

CHAPTER FOUR

RESULT

4.1 Descriptive statistics of Hormonal, Metabolic and Bio-physical variables.

Table 4.1 presents the descriptive statistics of Hormonal, Metabolic and Bio-physical variables used in this study. A total of 336 reproductive women participated in the study, with minimum age of 18 and maximum age of 44 years. The mean age and standard deviation of women in this study was 33.12 ±4.704.

The mean and S.D of body mass index for women in this study is 26.95±4.07 with Mean blood Pressure of 117.47 ±12.28. Fasting glucose has a mean and S.D of 79.17 ±13.31 respectively. High Density Lipoprotein (HDL) gave a mean and S.D of 47.20±17.43 and Low Density Lipoprotein (LDL) gave a mean and S.D of 103.77±34.27 respectively.

Table 4.1: Descriptive statistics of Hormonal, Metabolic and Bio-physical variables.

Variable	N	Minimum	Maximum	Mean	S.D
Hormonal Variables					
Follicle Stimulating Hormone (FSH)	336	0.6	36	9.29	4.85
Luteinizing Hormone (LH)	336	0.2	104.9	13.13	11.49
Prolactin (PRL)	336	0.9	56.9	10.52	5.41
Progesterone (P4)	208	0.1	46.7	11.34	8.62
Estradiol (E2)	336	8	446	38.80	38.21
Metabolic Variables					
Fasting glucose (FG)	336	51	189	79.17	13.31
Fasting Insulin	335	1.3	168	69.71	51.53
Total Cholesterol	336	75	334	166.78	34.53
Triglycerides	336	29	290	79.10	28.97
High Density Lipoprotein	336	18	107	47.20	17.43
Low Density Lipoprotein	336	12	269	103.77	34.27
Uric Acid	336	2.1	14.5	5.14	1.442
Bio-Physical Variables					
Age (years)	336	18	44	33.12	4.70
Body Mass Index (BMI)	336	18.5	45.7	26.95	4.07
Mean Blood Pressure (MBP)	336	93	173	117.47	12.28

4.2 Classification of Metabolic and Bio-physical Variables

Table 4.2 shows the classification of Metabolic and Bio-physical variables used in this study. It was observed that about 60% of the women studied had a low High Density Lipoprotein. Also, almost all the women (97.6%) had normal triglyceride and almost half of the participants (48.2%) were overweighed. Further results are presented in Table 4.2.

Table 4.2 Classification of Metabolic and Bio-physical Variables

Variables		Frequency (%)	Mean ±SD
Age			
	Young Women	17(5.1)	1.95±0.22
	Old women	319(94.9)	
LDL			
	Optimal	157(46.7)	1.81±0.94
	Near Optimal	111(33.0)	
	Border line	50(14.9)	
	High	12(3.6)	
	Very High	6(1.8)	
HDL			
	Low HDL	203(60.4)	1.63±0.84
	Medium HDL	54(16.1)	
	High HDL	79(23.5)	
TRI			
	Normal	328(97.6)	1.03±0.20
	Border line	6(1.8)	
	High	2(0.6)	
BMI			
	Normal weight	108(32.1)	2.92±0.81
	Overweight	162(48.2)	
	Obesity	54(16.1)	
	Obesity2	10(3.0)	
	Extreme Obesity	2(0.6)	
Fasting glucose			
	Normal	151(45.1)	1.84±0.97
	High	142(42.4)	
	Abnormal	42(12.5)	

4.3 Assessment of Normality Test Table

As shown in table 4.3, skewness and kurtosis do not seem to a great problem in the data set. Using the standard value ±2.0, Prolactin, Triglyceride,and Luteinizing hormone exhibited significant skewness and Prolactin, Uricacid, Fasting glucose, Luteinizing hormone, Follicle stimulating Hormone exhibited significant kurtosis.

TABLE 4.3 Assessment of Normality Test Table

Variable	Min	Max	skew	Critical ratio	kurtosis	Critical ratio
PRL	.900	56.900	2.381**	17.817	15.432**	57.741
UACID	2.100	14.500	1.498	11.210	5.730**	21.441
LDLC	12.000	269.000	.468	3.501	1.345	5.032
AGE	18.000	44.000	-.570	-4.264	.160	.598
FG	51.000	189.000	1.727	12.924	12.792**	47.865
HDLC	18.000	107.000	.660	4.940	-.093	-.348
TG	29.000	290.000	2.024**	15.148	9.065**	33.917
MBP	93.300	173.300	.867	6.490	1.839	6.879
BMI	18.500	45.700	.682	5.104	1.315	4.922
LH	.200	104.900	3.424**	25.623	18.487**	69.172
FSH	.600	36.000	1.440	10.779	4.008**	14.997
Multivariate	----	-----	-----	--- ----	77.546**	42.026

** "Significant"

4.4 Analysis of Outliers

Table 4.4 presents the results of test of outliers using the Mahalanobis distance statistics. The Mahalanobis distance statistic exhibits or shows the squared distance from the centroid of a data set. Column P1 shows the probability of observation above the squared distance from the Mahalanobis of the data set. Column P2 presents the probability that the biggest squared distance of any observation would be beyond the Mahalanobis distance calculated. Observations with P2 greater than 0.1 were individually examined and if proved right were considered as outliers.

Table 4.4 Observations farthest from the centroid (Mahalanobis distance)

Observation number	Mahalanobis d-squared	p1	p2
76	94.251	.000	.000
257	77.224	.000	.000
118	75.631	.000	.000
198	71.693	.000	.000
171	63.225	.000	.000
168	38.470	.000	.000
163	38.336	.000	.000
146	36.366	.000	.000
89	30.322	.001	.000
232	28.249	.003	.000
280	27.869	.003	.000
30	27.422	.004	.000
229	26.919	.005	.000
267	26.145	.006	.000
311	26.031	.006	.000
224	25.200	.009	.000
124	23.916	.013	.000
2	23.651	.014	.000
42	22.717	.019	.000
323	22.389	.022	.000
1	22.297	.022	.000
282	21.622	.027	.000
44	21.620	.027	.000
111	21.038	.033	.000
122	19.672	.050	.033
113	19.670	.050	.020
202	19.232	.057	.048
273	18.538	.070	.193
92	18.399	.073	.195
134	18.305	.075	.180
276	18.018	.081	.254
49	18.008	.081	.201
192	17.731	.088	.281
51	17.542	.093	.325
178	16.855	.112	.705
331	16.763	.115	.700
335	16.509	.123	.791
336	16.480	.124	.755

Observation number	Mahalanobis d-squared	p1	p2
86	16.455	.125	.715
175	16.412	.127	.684
312	16.046	.139	.842
52	16.045	.139	.799
131	15.995	.141	.780
104	15.989	.142	.733
141	15.977	.142	.687
93	15.863	.146	.709
221	15.635	.155	.802
69	15.588	.157	.784
277	15.531	.159	.773
127	15.492	.161	.751
94	15.152	.176	.891
238	15.143	.176	.864
217	15.106	.178	.848
179	15.099	.178	.815
105	14.870	.189	.893
306	14.832	.190	.881
223	14.832	.190	.850
213	14.768	.193	.849
31	14.725	.195	.838
75	14.609	.201	.865
272	14.382	.213	.930
25	14.380	.213	.909
225	14.363	.214	.892
43	14.291	.217	.897
21	14.224	.221	.901
197	14.141	.225	.910
54	14.040	.231	.926
304	13.982	.234	.926
50	13.701	.250	.976
187	13.612	.255	.981
286	13.506	.262	.986
189	13.449	.265	.986
17	13.175	.282	.997
117	13.173	.282	.996
196	13.093	.287	.997
327	13.014	.292	.997
305	12.963	.296	.997

Observation number	Mahalanobis d-squared	p1	p2
36	12.960	.296	.996
116	12.867	.302	.997
29	12.787	.307	.998
47	12.782	.308	.997
317	12.740	.311	.997
329	12.526	.325	.999
11	12.496	.328	.999
215	12.468	.330	.999
26	12.457	.330	.999
48	12.409	.334	.999
320	12.374	.336	.999
125	12.152	.352	1.000
237	11.964	.366	1.000
180	11.940	.368	1.000
328	11.916	.370	1.000
96	11.861	.374	1.000
162	11.859	.374	1.000
262	11.780	.380	1.000
73	11.681	.388	1.000
255	11.568	.397	1.000
260	11.492	.403	1.000
227	11.484	.404	1.000
87	11.458	.406	1.000

4.5 Sample Correlation: Investigate the causal relationship between polycystic ovarian syndrome and anovulatory infertility.

Table 4.5 shows that some variables have significant relationship as compared to other. The respective p values and Pearson correlation coefficients are shown in table 4.5. The Table shows that there is correlation between Triglycerides and Fasting glucose, Follicle stimulating Hormone and Testosterone, Progesterone and Testosterone, Estradiol and Fasting Glucose, Estradiol and Testosterone, Age and Fasting Glucose, Triglyceride and age, Age and Testosterone, Age and Fasting Glucose, Body Mass Index and Fasting glucose, Body Mass Index and Triglycerides, Body mass Index and Progesterone, Luteinizing Hormone and Follicle Stimulating Hormone, Luteinizing Hormone and Estradiol, Luteinizing Hormone and Age, Luteinizing Hormone and Body Mass Index

Table 4.5 Investigating the causal relationship between polycystic ovarian syndrome and anovulatory infertility.

	Fasting Glucose	Triglycerides	Total Testosterone	Follicle Stimulating Hormone	Progesterone	Estradiol	Age	Body mass Index	Luteinizing hormone
Fasting Glucose	1								
Triglycerides	0.223 <0.001*	1							
Total Testosterone	0.058 0.29	-0.039 0.48	1						
Follicle Stimulating Hormone	-0.026 0.63	-0.046 0.41	-0.172 0.002*	1					
Progesterone	-0.059 0.39	-0.090 0.20	-0.182 0.009*	0.030 0.67	1				
Estradiol	0.186 0.001*	-0.003 0.96	0.330 <0.001*	-0.082 0.135	-0.106 0.13	1			
Age	0.222 <0.001*	0.215 <0.001*	-0.129 0.02*	0.229 <0.001*	-0.063 0.36	0.054 0.321	1		
Body mass Index	0.117 0.03*	0.151 0.006*	-0.17 0.76	-0.045 0.41	-0.157 0.03*	-0.033 0.55	0.389 <0.001*	1	
Luteinizing hormone	0.004 0.935	-0.072 0.191	0.14 0.01*	0.309 <0.001*	-0.108 0.121	0.195 <0.001*	-0.117 0.03*	-0.162 0.003*	1

4. 6 Path Diagram showing the three factor Model contributing to Anovulatory Infertility.

A path diagram is drawn to show the relationship observed variables and their latent constructs in Figure 4.7. The boxes represent the observed variables and the circles represent the latent variables. Double arrow headed lines show the correlation between the two latent constructs of anovulatory infertility, while the single headed arrow lines show the effect of the latent construct on the observed variable. This model shows the three variables for the anovulatory infertility with their respective loadings on them. The variables are Hormonal, Metabolic and Bio-physical variables and they contribute to polycystic syndrome.

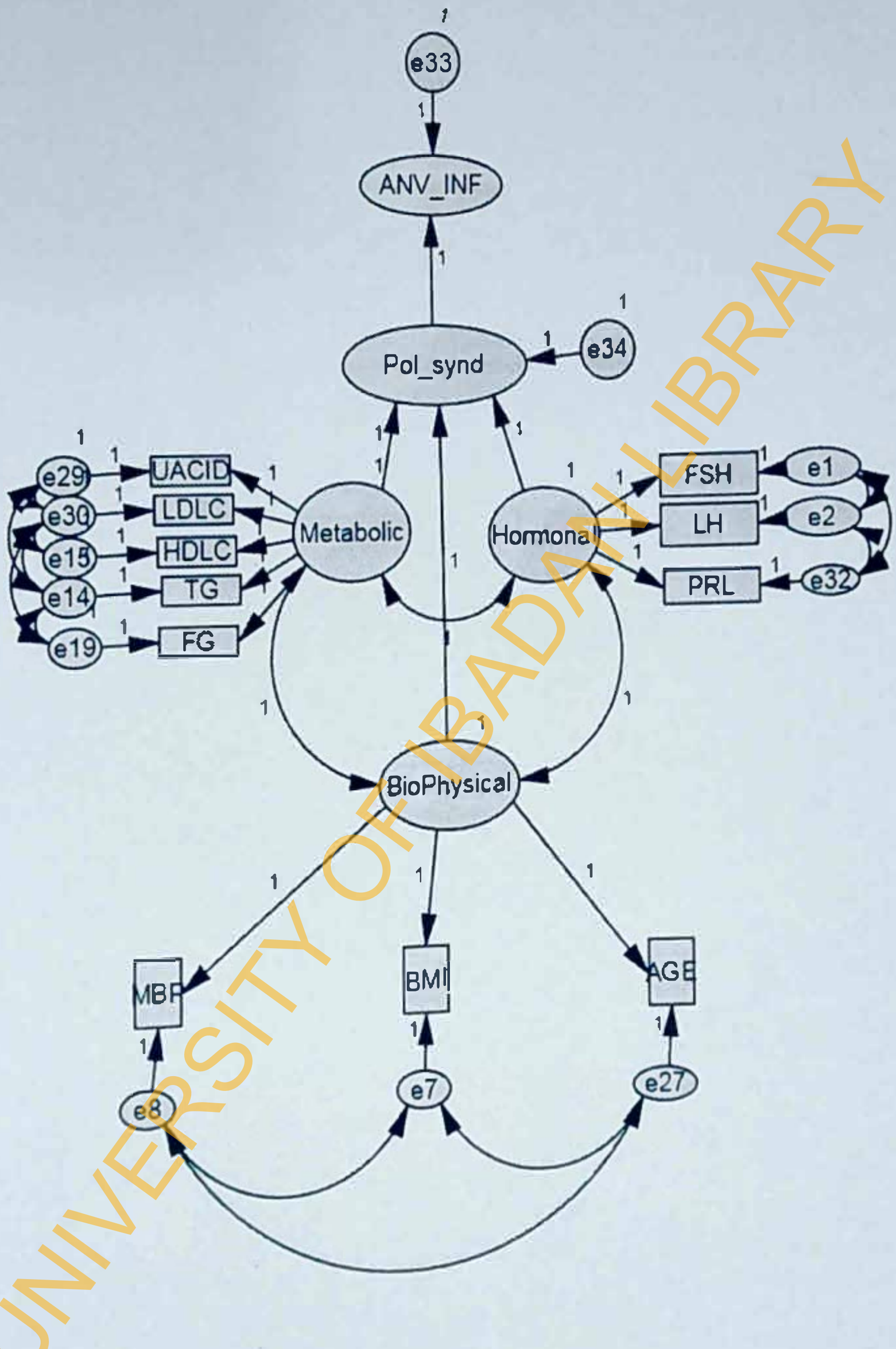

Figure 4.1 Path diagram showing the three variables of Anovulatory Infertility and Polycystic ovary syndrome.

4.7 Standardized Regression Weights

Table 4.7 showed that metabolic, hormonal and bio-physical variables had positive effects on anovulation. Litunizing hormone had the smallest effect (0.1) on hormonal variable while almost all the variables had increased effect on metabolic variable.

Table 4.7 Standardized Regression Weights

	Variable	Estimate
FSH	<------Hormonal	0.234
LH	<------Hormonal	0.100
BMI	<------BioPhysical	0.293
TG	<------Metabolic	0.707
HDLC	<------Metabolic	0.707
FG	<------Metabolic	0.707
AGE	<------BioPhysical	0.272
MBP	<------BioPhysical	0.098
LDLC	<------Metabolic	0.707
UACID	<------Metabolic	0.707
ANV_INF	<----BioPhysical	0.316
ANV_INF	<----Metabolic	0.316
ANV_INF	<----Hormonal	0.316
PRL	<----Hormonal	0.190

4.8 Squared Multiple Correlations of the Observed Variables of Anovulatory Infertility.

Table 4.8 shows the squared multiple correlations of the observed/manifest variable of Anovulatory Infertility. The table shows the percentage of variance explained by each of the predictors.

Table 4.8 Squared Multiple Correlations of the Observed Variables of Anovulatory Infertility.

Manifest/Observed Variables	Estimate
Pol_synd	.900
ANV_INF	.909
PRL	.036
UACID	0.500
LDLC	0.500
AGE	0.062
FG	0.500
HDLC	0.500
TG	0.500
MBP	0.008
BMI	0.07
LH	0.009
FSH	0.05

4.9 COVARIANCES

The covariances among the Metabolic, Hormonal and Bio-physical variables with their respective error term are presented in table 4.8

Table 4.9 Covariances among Metabolic, Hormonal and Bio-physical Variables.

		VARIABLES	Estimate	S.E.	C.R.	PLabel
Hormonal	<-->	Metabolic	1.000			
Hormonal	<-->	BioPhysical	1.000			
BioPhysical	<-->	Metabolic	1.000			
e15	<-->	e30	128.197	25.563	5.015	***par_1
e14	<-->	e30	-114.276	45.609	-2.506	.012par_2
e19	<-->	e30	-63.451	20.905	-3.035	.002par_3
e14	<-->	e19	-55.346	15.836	-3.495	***par_4
e1	<-->	e2	10.812	2.843	3.803	***par_5
e2	<-->	e32	-.868	3.143	-.276	.783par_6
e1	<-->	e32	.853	1.346	.633	.527par_7
e7	<-->	e8	11.548	2.470	4.676	***par_8
e7	<-->	e27	3.409	.898	3.798	***par_9
e8	<-->	e27	10.208	2.705	3.774	***par_10
e30	<-->	e29	-2.941	2.147	-1.370	.171par_11
e14	<-->	e29	4.232	1.286	3.291	***par_12

*** 'Significant'

4.1.0 Model fit summary of anovulatory infertilty.

Table 4.11 shows the indices of the model fit for the model. The minimum sample discrepancy (CMIN) is given as 722.418 and after dividing it by the degrees of freedom, CMIN/DF which is given as 15.05. The RMSEA is 0.205 while the values of the GFI and AGFI are close to one.

Table 4.1.0 Model fit summary of anovulatory infertilty.

Index	Hypothesized model
CMIN	722.418
CMIN/DF	15.05
RMR	192.176
GFI	0.608
AGFI	0.461
PGFI	0.442
CFI	0.000
RMSEA	0.205
PCLOSE	0.000
AIC	758.418
BIC	827.126

4.1.1 Factor loadings of the hypothesized model

Figure 1 shows the estimated path diagram with its standardized coefficients and coefficients between the latent and observed variables.

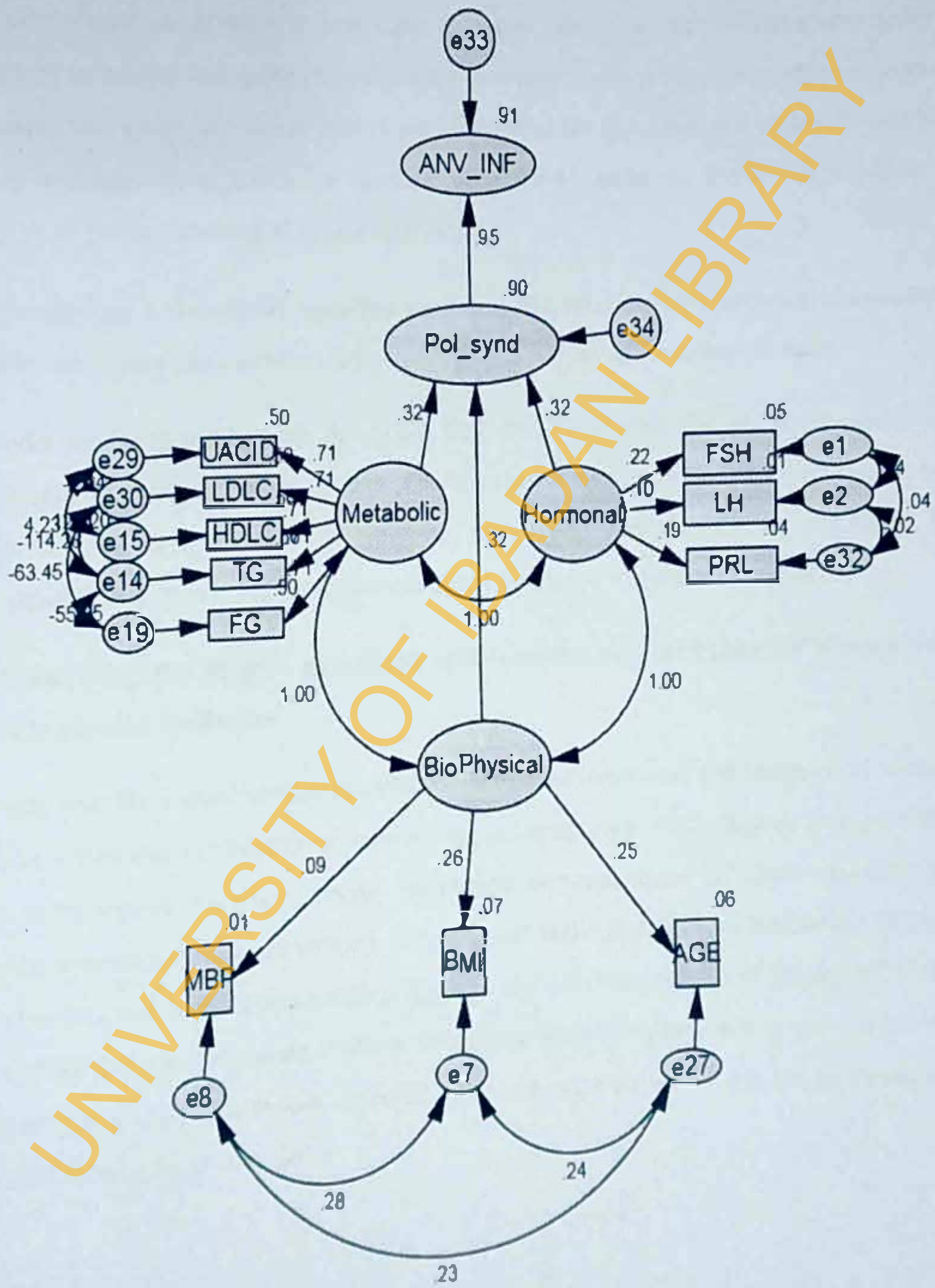

Figure 4.2 Path-diagram showing the factor loadings of the hypothesized model

CHAPTER FIVE

DICUSSION, CONCLUSION AND RECOMMENDATION

5.1 Discussion

This study aimed to develop a Structural Equation Model of the relationships between anovulatory infertility and some characteristics in women with polycystic ovarian syndrome. Information was gotten by trained nurses who measured the hormonal and metabolic and bio-physical variables in reproductive women aged 18-44 years at the Fertility Clinic in University of Benin Teaching Hospital (UBTH).

5.1.1 Developing a structural equation model of the relationships between anovulatory infertility and some characteristics in women with polycystic ovarian disease.

Our model produced results with the AGFI, GFI, PGFI included. The chi square index was also computed but it was not significant. The is an issue that could be caused by sample size Pui-Wa Lei and Qiong Wu (2007). However, to our best of understanding, the model has added significantly to existing literature and could be a basis to further intervention.

5.1.2 Identifying the factors associated with anovulatory infertility in women with polycystic ovarian syndrome

In our analysis, for a unit increase in metabolic variables, hormonal and biophysical variable there was a minimal increase in polycystic ovarian syndrome. According to Dahlgren et al (1994) there was a positively strong correlation between some of these variables and polycystic ovarian syndrome in women. Others found that a high level of luteinizing hormone is found in four out of ten women with polycystic and ovarian syndrome (Patient, 2016). In a study of high density lipoprotein in thirty five obese and twenty two non-obese women with polycystic ovary syndrome it was observed that there were reduced high density lipoprotein cholesterol levels (Rajkhowa, 2011).

5.1.3 Investigating the causal relationship between polycystic ovarian syndrome and anovulatory infertility.

Our study showed that there were some significant relationships between some hormonal and metabolic variables like estradiol and fasting Glucose. Also some hormonal and biophysical variables like body mass index and luteinizing. These results are in line with Yong et al (2002 who found that such relationship existed and Pagan et al (2006) who found that there is a negative correlation between these variables. In addition, Hashemi et al (2016) also discovered that relationships existed between metabolic, hormonal and bio-physical variables in women.

5.2 Conclusion

Our results showed relationships between Hormonal, Metabolic and Bio-physical variable with polycystic ovarian syndrome. The SEM model had some fit indices significant but a non-significant chi square fit index which may be due to our sample size.

5.3 Limitations

The sample size may be too small to detect a causal relationship between anovulatory infertility hormonal, metabolic and bio-physical variables. As stated by Pui-Wa Lei and Qiong Wu (2007) the chi square statistic is very sensitive to sample size.

Furthermore, there may be some biological, environmental or bio-physical variables that our model may not have considered that influenced the relationship between Anovulatory infertility and the other variables.

5.4 Recommendation

I strongly recommend that studies of a more longitudinal and bigger sample size should be encouraged and that when doing SEM, preferences should be made on the adaptability of the data to the model.

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