UNIVERSITY FOR DEVELOPMENT STUDIES

# DIFFERENCES IN SOME DIABETIC INDICATORS AMONG PATIENTS WITH SEXUAL DYSFUNCTION

IMURANA IBRAHIM



2019

**UNIVERSITY FOR DEVELOPMENT STUDIES**

# DIFFERENCE IN SOME DIABETIC INDICATORS AMONG PATIENTS WITH SEXUAL DYSFUNCTION



**IBRAHIM IMURANA (B.Sc. APPLIED STATISTICS)**

**UDS/MAS/0005/17**

**THESIS SUBMITTED TO THE DEPARTMENT OF STATISTICS, FACULTY OF MATHEMATICAL SCIENCES, UNIVERSITY FOR DEVELOPMENT STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHILOSOPHY DEGREE IN APPLIED STATISTICS**

**NOVEMBER, 2019**

## DECLARATION

I hereby declare that this thesis is the result of my own original work and that no portion of it has been presented for another degree in this University or elsewhere. Related works by other people which served as relevant information for this study have been duly referenced.

Ibrahim Imurana …… …….

(Candidate) Signature Date

I hereby declare that the preparation and presentation of this thesis was supervised in accordance with the guidelines on supervision of thesis laid down by the University for Development Studies.

Abukari Alhassan (PhD) …… …….

(Supervisor) Signature Date

## ACKNOWLEDGEMENTS

I would like to express my appreciation and gratitude to my supervisor, Dr. Abukari Alhassan, whose supervision of this work gave me insight into various aspects of research, especially identification of appropriate distributions and sensitivity analysis.

I would like to also express my profound gratitude and thanks to Dr. Sulemana Nasiru, who never got tired of my series of questions I posted to him. His guidance and teaching will forever be appreciated.

I am very thankful to my wife, Salifu Yatasu, who gave me moral and financial support throughout this study. I sincerely show much gratitude to my mother, Fatima Soale Braimah, whose patience and care brought me this far.

Finally, I would like to thank all of the people who helped me in different stages of this work, especially Madam Veronica Akalibiik, who helped me type portions of this work, and my family and friends who provided support during this study period.

## DEDICATION

I dedicate this piece of work to my parents, especially my father, Soale Braimah, who did not live long to see me come this far, and my lovely wife, Madam Yatasu Salifu.




## ABSTRACT

Erectile dysfunction is defined as the continuous inability of a man to attain a satisfactory erection for a successful sexual intercourse. Female sexual dysfunction is also defined as the inability of a woman to enjoy a complete sexual activity. A two-way between groups MANOVA was performed to investigate whether there is a significant difference between male and female, and married and single. Five dependent variables were used: age, creatinine levels, duration of diabetes, glucose levels and pulse rates. The independent variables were sex and marital status. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity, with no serious violations noted. There was a significant difference between males and females on the dependent variables: F (5, 223) = 34.00, P = 0.00; Wilk's lambda = 0.55. When the results for the dependent variables were considered separately using the logit and the probit regression models, only age and creatinine levels reached statistical significance. An inspection of the mean scores indicated that males recorded slightly higher scores in the dependent variables than females and the single recorded slightly higher values than the married. There was also a significant difference between married and single on the dependent variables; F (5, 223) = 25.74, P = 0.00; Wilk's lambda = 0.63. The interaction effect was not statistically significant; F (5, 223) = 17.55, P = 0.06 and Wilk's lambda = 0.72. Probit and logit models were used to classify and predict observations. It was revealed that logit model has a higher predictive and classification power than the probit model, though they both produced very similar results. Bootstrapping was performed to check the sensitivity of the models. It was revealed that the bootstrapped estimates converged to the actual estimates.

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES





## LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| ED | : | Erectile Dysfunction |
| SD | : | Sexual Dysfunction |
| FSD | : | Female Sexual Dysfunction |
| HSDD | : | Hypoactive Sexual Desire Disorders |
| FSAD | : | Female Sexual Arousal Disorders |
| SPD | : | Sexual Pain Disorders |
| FOD | : | Female Orgasmic Disorders |
| IIEF | : | International Index of Erectile Function |
| FSFI | : | Female Sexual Function Index |
| DSFI | : | Derogatis Sexual Function Inventry |



# CHAPTER ONE

# INTRODUCTION

## 1.0 Background of the Study

Dysfunction of the sexual reproductive system is any sexual abnormality that a person suffers which interrupts normal sexual life. (Masters and Johnson, 1978). Sexual dysfunction is a feeling of discomfort and often disrupts an individual's social life (DMS-IV, 1994). Sexual dysfunction may also be defined as unsuccessful sexual activity with a sexual partner (Masters and Johnson, 1978).

Since sexual function is an ingredient of healthy lifestyle, any form of dysfunction of the sexual system affect the quality of life of an individual. Sexual dysfunction does not refer to a side effect of ongoing medication or interruption in sexual activity which happens for a short period of time but an occurring problem that affects the individual and has the ability to affect other aspects of his or her life. When one cannot keep a good erection for successful sexual activity it may also be an alarm bell for other health conditions that may need treatment and which, mostly may be alarm bell factor for heart related problems (Masters and Johnson, 1978).

In a broader perspective, sexual dysfunction has been defined according to the type of disorder and the conditions or circumstances that promote the disorder. Montgomery (2008) classified disorders of the sexual function into four main areas, which include; "sexual desire disorders, arousal disorders, orgasm disorders and pain disorders". These disorders basically influence the reduction in libido or reduction in desire for sexual fantasies.

Sexual dysfunction among men has long been known as a common experience. Knowledge of normal erectile function and the possible associated causes of erectile dysfunction, through research, are gaining clarity, and some treatments are increasingly being identified. The experience was initially referred to by National Institute of Health (NIH, 1993), as impotence, with little explanation. Erectile dysfunction is increasingly becoming the object of public concern of late due to the prevalence of the condition and the evolution of remarkable oral therapies such as "sildenafil", "tadalafil", "Vardenafil", among others. There is dominance in the sexual function literature by Masters and Johnson (1978). In fact, their work is said to be the foundation on which most recent developments in sexual function are based. They defined the sexual response in their study to include four stages: excitement, plateau, orgasm, and resolution. During excitement and plateau, blood is pumped throughout the body in response to sexual stimuli, particularly to the genitals. In males, the penis attains rigidity (becomes erect) as penile smooth muscles relax, allowing an increased amount of blood to move through the penis and other genital areas. The nipples, abdomen, and rectum also become increasingly sensitive to touch. Orgasm involves muscle contraction throughout the body, particularly at the pelvic level. Male ejaculation mostly occurs simultaneously with orgasm and this signals movement of prostate and pelvic muscles around the base of the penis to release semen. After orgasm, penile smooth muscles contract forcing the blood to drain from the penis causing flaccidity, also known as detumescence. Sexual dysfunction may be associated with "diabetes", hypertension, dyslipedemia, "depression and cardiovascular disease" (Masters and Johnson, 1978).

In an attempt to define the normal time for a good sexual activity, sex therapists have categorized average time for normal erection before ejaculation, upon certain considerations. According to Penn State (2008), the average therapists' response on how long erection should last fell under four definitions; erection that lasts between 3 and 7 minutes is considered 'adequate', erection that lasts between 7 and 13 minutes is considered 'desirable', erection that lasts between 1 and 3 minutes is considered 'too short', and erection that lasts between 10 and 30 minutes is considered 'too long'. Erectile dysfunction data is generated based on certain standards such as those set by "International Index for Erectile Function (IIEF)". The "IIEF is an instrument that is commonly used to evaluate the male sexual function". It is a multi-dimensional questionnaire that gives the respondent the opportunity to self-assess his sexual function. The IIEF was designed based on a clinical trial program for ED treatment drug (sildenafil). It is now accepted as a standard document for the assessment of clinical trial data on ED. The questionnaire was psychometrically tested to be reliable and valid. For consistency, the questionnaire was tested through studies in the US, Europe and Asia, and concluded to be consistent (Rosen *et al.*, 2000). The IIEF questionnaire was developed and validated in 1997, after piloting the final scale of 15 items recommended by a panel of international expects. "The questionnaire was divided into five main domains of the sexual function; six items constituted the erectile, two items each constituted the orgasmic function, sexual desire and the overall sexual satisfaction, and three items constituted the intercourse satisfaction".

Female Sexual Dysfunction (FSD), unlike the males, is not easy to reconcile due to disparities in perception about sex by women. FSD is a complex combination of

disorders, which comprises the body, the mind, as well as other social elements. Hypoactive sexual desire disorder (HSDD), according to Clayton *et al*. (2018), is a term which refers to the continuous lack of sexual fantasies, which includes unpreparedness of the mind and body. McCabe and McCabe (1991) also defined female sexual arousal disorders (FASD) as an increasing inability to attain and maintain successful sexual activity. This may be as a result of inadequate lubrication or lack of sexual excitement. According to them, indicators of sexual arousal consist of vasocongestion in the pelvis, which translates to insufficient lubrication of the vagina and the dilation of the genitals. Sexual pain disorders (SPDs) are another category of dysfunction in females, defined by Mayo Clinic (2019), which is characterized by pain during sexual intercourse (dyspareunia). It may be characterized by the recurrent muscle spasm in the pelvic floor muscles that interrupt penis penetration (vaginismus) and pains associated with nonvaginal penetration. FSD is also defined by WHO (2014), under international classification of diseases, as "a woman's inability to experience sexual intercourse as she would wish".

According to Planned Parenthood (Sex and Sexuality), FSD has to do with the reduction in sexual desire and libido. According to sex therapists, FSD is closely associated with the reduction in female sexual hormones, estrogen, especially in menopausal women. Information about the sexual function of individuals can be obtained through female sexual function index (FSFI). FSD are highly prevalent in recent years with rates ranging from 25% to 65% of women in the "generally defined population" (Laumann *et al*, 1999). The diagnosis of FSD has often being done based on the system of "American psychiatric association known as diagnostic and statistical

manual of mental disorders" (DMS). This system is best at providing appropriate "classification for psychiatric disorders but lacks the classification power for sexual disorders with organic or mixed etiology" (Basson *et al*, 2000; DMS-IV 1994). The DMS-IV system captured the FSD under four categories; "hypoactive sexual desire disorder (HSDD), female orgasmic disorder (FOD), dyspareunia (painful sexual intercourse), and female sexual arousal disorder (FSAD)". Basson (2000) expanded the scope of the DMS-IV due to the broad scope of the "female sexual response cycle". He therefore defined the female sexual arousal which encompasses "subjective mental excitement, increased sensitivity of the genital as well as nongenital areas, lubrication and other sensitive areas of the female sexual system". Laan *et al*. (1995) also added that the physical perception of the genital also affects the subjective arousal and therefore advocated for multidimensional approach to measure female sexual function (FSF). Many of the FSF questionnaires do not meet the current definitions under the psychometric and multidimensionality measurement due to the fact that questionnaires are designed to elicit information about a specific sexual function. Derogatis (1979) reported a more multidimensional measure known as Derogatis sexual function inventory (DSFI), which covers sexual attitudes, experience and satisfaction. Rosen *et al*. (2000) developed a currently used questionnaire known as the "female sexual function index (FSFI), which also lacks longitudinal data validity" (Francis *et al*., 2002).

Anorgasmia is an example of orgasm disorders, which describes the persistent delays or absence of orgasm. Menopause may be an associated link to anorgasmia. Exposure of the body to some medications, such as antidepressants has the tendency to delay or

even eliminate orgasm. Another sexual disorder, especially with women is sexual pain disorder (dyspareunia). The woman experiences severe pain during sexual intercourse, which is believed to be caused by vaginal dryness in women (lack of sufficient vaginal lubrication), changes in hormonal concentrations due to menopause, pregnancy, or by breast-feeding. This association has been reported by Eden and Wylie (2009). Priapism in men, is a disorder which is characterized by prolong and painful erection that occurs without sexual activity. It is said to be a condition caused by the inability of the penis to draw blood out of its vessels. The adverse effect of untreated priapism is permanent erectile failure as a result of damaged nerves around the penis. Abusers of medications, especially those relying on aphrodisiacs for sexual fantasies are at a higher risk of Priapism.

In some instances, sexual dysfunction is seen as a risk factor of high blood pressure, hyperglycemia, dyslipidemia, and diabetes, as reported by Vrentzos *et al*. (2007). As far as this study is concerned, emphasis is on diabetic patients experiencing sexual dysfunction. According to Mayo clinic (2019), "diabetes or diabetes mellitus refers to a group of diseases that affect how the body uses blood sugar (Glucose). Chronic conditions of diabetes are type 1 and type 2 diabetes. Prediabetes is reversible. Type 1 diabetes is a chronic condition in which the pancreas produces little or no insulin to regulate blood sugar. Type 2 diabetes is a chronic condition that affects the way the body synthesizes glucose. Gestational diabetes occurs in pregnant women, and occurs when the body does not react properly to insulin. Some of the symptoms of diabetes, especially type 1 diabetes, include increased thirst, frequent urination, extreme hunger, unexplained weight loss, fatigue, slow-healing sores, blurred vision, frequent

infections, etc. Though type 1 and type 2 diabetes can occur at any age, type 2 diabetes is common in people above 40 years. The risk factors of diabetes include age, family history, weight, race, inactivity, abnormal cholesterol, triglyceride levels and high blood pressure. Drugs such as glucophage and glumetza may reduce the risk of type 2 diabetes". Diabetes can be tested for by either using the method of fasting (drawing blood sample after about twelve hours without food or water), or random (drawing blood sample at any given time). If your "fasting blood glucose test value falls within 100 to 125 mg/dL (5.6 to 6.9) mmol/L, it means you have a type of prediabetes. This increases your risk of developing type 2 diabetes. A level of 126mg/dL (7mmol/L) and higher mostly means that you have type 2 diabetes. Also, if your random blood sugar test value falls around 200mg/dL (11.1mmol/L) or higher, it means you have diabetes. Below 5.6mmol/L is normal blood glucose" (Mayo Clinic, 2019). "Creatinine is a waste product from the normal breakdown of muscle tissue, filtered through the kidneys and excreted as urine. The level of creatinine is a test for kidney function. The normal levels of creatinine in blood for men and women are 0.6 to 1.2mg/dL and 0.5 to 1.1mg/dL. Creatinine level of 5mg/dL or more is a sign of severe kidney impairment" (Mayo Clinic, 2019). "A normal resting heart rate for adults ranges from 60 to 100 beats per minute (BPM). This implies more efficient heart function and better cardiovascular fitness". Abnormality sets in if your pulse is consistently above 100BPM (Bahar, 2018).

Body mass index (BMI) may also be related to the sexual function of individuals. It is a "value calculated from the mass (weight) and height of an individual. The BMI refers to the ratio of the body mass and the square of the body height, universally expressed

as kg/m$^2$. The BMI is an attempt to quantify the amount of tissue mass (muscle, fat and bone) in an individual", to be able to classify that an individual is underweight, normal weight, or overweight. According to Blackburn and Jacobs (2014), "under 18.5 kg/m$^2$ is considered underweight, 18.5 kg/m$^2$ to 25 kg/m$^2$ is normal weight, and 25 kg/m$^2$ to 30 kg/m$^2$ is overweight (obese)". According to Mayo Clinic (2019), "under 18.5kg/m$^2$ is considered as underweight, and may be attributed to malnutrition, eating disorder, or other health problems. BMI equal to and beyond 25 kg/m$^2$ is considered overweight and over 30 kg/m$^2$ is considered obese, signaling high risk of developing heart disease, high blood pressure, stroke, diabetes, and other health issues". Cholesterol level varies by age, weight and gender. Cholesterol is measured in 3 categories; "total cholesterol, low density lipoprotein (bad cholesterol) and high density lipoprotein (good cholesterol). Total cholesterol level less than 200mg/dl are considered desirable for adults, between 200 and 239 mg/dl is considered borderline high, and above 240mg/dl is considered high. LDL should be less than 100mg/dl. Levels of 100 to 129mg/dl is acceptable for people without health issues, but considered a serious concern for people with history of heart disease and its related risk factors. LDL level between 130 and 159mg/dl is considered borderline high, 160 to 189mg/dl is high, and above 190mg/dl is considered very high. HDL should be reasonably high. Below 40mg/dl is considered a risk factor for heart disease. Between 41 and 59mg/dl is considered borderline low. Normal levels should be 60mg/dl or more" (Mayo Clinic, 2019).

This study considered a cross-section of diabetes patients who were diagnosed at the Tamale teaching hospital in Ghana. Since patients visited the facility for medical

services their consent was guaranteed because the data about their conditions is the basis for treatment, as well as the basis for improved future treatment. The study population consisted of 230 diabetic patients of equal proportion of males and females, enrolled between 2016 and 2018. The inclusion criteria for this study were type 2 diabetic mellitus patients who aged 30 years and beyond. All the patients were also interviewed face-to-face using standardized questionnaires such as IIEF, FSFI and "sexual quality of life (SQL)", to detect sexual dysfunction and "sexual quality" of patients.

### 1.2 Problem Statement

Diabetes has become a monotonic increasing canker in the world. Studies have revealed positive correlation between diabetes and sexual dysfunction (Kolodny *et al*., 1974). Lack of enough statistical data on the differences in sexual dysfunction among men and women as well as married and single undermines proper understanding of the concept, which may affect the effort to finding lasting solutions to sexual dysfunction. The relationship between differences in sexual dysfunction in some diabetic indicators is therefore an area of concern. My motivation therefore, is to investigate whether there is significant difference in sexual dysfunction among a cross-section of diabetic patients who reported at Tamale Teaching Hospital.

### 1.3 Research Questions

1. What are the main effects of sex and marital status on age, creatinine, duration of diabetes, glucose and pulse rates of respondents?
2. What is the interaction effect between sex and marital status?

3. What is the relationship between Sexual quality and marital satisfaction?

## 1.4 Objectives of the Study

### 1.4.1 General Objective

The research seeks to identify whether there is significant difference in sexual dysfunction among diabetic patients.

### 1.4.2 Specific Objectives

The research seeks to;

1. Investigate whether there is a significant difference between males and females as well as between married and single on some sexual function indices.
2. Investigate whether there is a relationship between sexual quality and their marital life.
3. Determine the reliability of the models.
4. Determine the best model for the data.



## 1.5 Significance of the Study

The study adds to the body of knowledge on sexual dysfunction since it reveals how some demographic factors such as sex and marital status influence the performance of some metabolic factors such as creatinine, glucose and pulse rates of people.

## 1.6 Limitations of the Study

Variables such as sex and marital status of respondents may not be suitable for discriminant analysis since they cannot be tested for normality. Since the data is not longitudinal, it may be difficult to tell what period in the life of the individual the dysfunction was noticed, including the surrounding circumstances associated to the period. Also, since sexual dysfunction is associated to stigma, respondents may likely not be willing to give exact information about their sexual lives.

## 1.7 Organization of the Study

In chapter one, information on the subject matter was explored and reconciled. In chapter 2, relevant literature on similar studies was reviewed. In chapter 3, the models and the methods employed in the analysis of the study were illustrated. Data was analyzed after testing the assumptions associated with the models, and results were presented in chapter 4. Finally, results were discussed, recommendations made and the study concluded in chapter 5.



# CHAPTER TWO

# REVIEW OF LITERATURE

## 2.0 Introduction

This chapter reviewed related studies on the genesis of both male and female sexual dysfunction, prevalence and risk factors of male and female sexual dysfunction, theories of sexual dysfunction, empirical study of sexual dysfunction, sexual dysfunction and diabetes and sexual quality of life

## 2.1 Genesis of Male Sexual Dysfunction

Impotence in sexual dysfunction literature is used to describe the inability of a man to get a continuous erection adequate enough to complete sexual intercourse. In the work of J. Shah (2002), reference was made to the definition of impotence by Wilhelm Stekel (1940), to be "a disorder associated with modern civilization". Impotence is referenced to "impotencia", a latin word which connotes to 'powerlessness'. The term was earlier used by Thomas Hoccleve in 1420 to denote want. The term impotence was later used to mean "loss of sexual power". The oldest reference to impotence is dated back to the eighth century BC in india, in the Samhita of Sushruta, on the account of the possible description and the causes of the condition. As part of the study into impotence the ancient Hindus also associated the condition to the position of the mind, such as having sexual intercourse with a sexless woman (Shah, 2002). People later believed that impotence was caused by the activities of witchcraft. Impotence was also considered to be a divine curse by the Greek with reference to a story where King Amassis of Greek got married to Ladice, a Greek woman and failed every attempt to

have sex with her, even though he was always successful with his other numerous wives. Ladice was condemned to death since the king's impotence with her was considered a curse. Ladice was purported to have prayed to "Aphrodite, the goddess of sexual love and beauty", for which the curse was said to have been lifted to save her life and marriage. Also, according to the Old Testament (Genesis 20:3), impotence was prescribed for King Abimelech of Gerar as a punishment from God for keeping Abraham's wife, Sarah. It is believed that god revealed to Abimelech while he was asleep in the night the course of his woe, as stated in the Bible: *"behold, thou art but a dead man, for the woman whom thou has taken for she is a man's wife"*. Impotence was a major cause for divorce around the 16$^{th}$ century, especially among the upper classes, as was stipulated in the ecclesiastical law. Though impotence was not legally forbidden, men in the condition were not allowed to marry, and often ridiculed, as presented by Pierre Darmon, on the description of the manner in which impotent men were treated. Towards the 19$^{th}$ century, impotence was referred to as a disorder of men due to lack of self-control and sexual misconduct such as masturbation, excessive sex and spermatorrhoea (Shah, 2002). Some of the many interesting ancient remedies recommended for impotence, included the following;

- "A mixture of sesame powder, Masha pulse, rice of S'ali and Saindhava salt were pasted with juice of the sugar cane. It was then mixed with hog's lard and cooked with clarified butter. This formula was said to enable a man to visit a hundred women".

- "The Egyptian Papyrus Ebers, prescribed treatment for impotence. In it, heart of baby crocodile and wood oil were mixed and smeared on the man's penis to restore his potency".
- "Eating goat testes, which were boiled in milk and adding sesame seeds and lard of porpoise, or by mixing the testes with salt, powdered pepper fish and clarified butter, was believed to have the power of restoring a man's sexual potency".
- "Licking the mixture of honey or sugar, Powder and juice of Amalaka, and clarified butter was reported to give an 80-year-old man the same sexual vigor as with a youth".

Many more of the ancient remedies to impotence exist in the publication 'erectile dysfunction through the ages', by Shah (2002). Treatments for minor cases of impotence later included quinine, opium and digitalis. With difficult cases, physicians resorted to minor operations and insertion of bougie into the penis to restore sexual potency. Years later Eckhard (1963) showed that erections could be induced electronically using "canine models after stimulating the nervi erigentes" to dilate the cavernous tissues so as to improve arterial inflow. Surgical solutions for impotence started in 1873 in Italy, by Francesco Parona, when he sclerosed the veins of the penis of a man in his thirties using hypertonic saline, to remove varicosities that were taking much blood from the penis. The patient was reported to have had a successful intercourse five days after the treatment (Shah, 2002). Cheng-Hsing (2015) also proposed alternative insight in venous anatomy; ligation of dorsal veins. Venous occlusion (Voth *et al*., 1992) was the common mechanism for erection by the early 20$^{th}$ century. Some pharmaceutical companies in recent years have contributed to the

treatment and management of sexual dysfunction through the development and distribution of drugs such as Viagra, Cialis, Tardalafil, etc, that boost sexual function of patients (Klasco, 2018).

### 2.2 Genesis of Female Sexual Dysfunction

Women's sexual desire and pleasure were initially not appreciated by men. They were considered to offer sexual entertainment for men as and when the men desired, and that child birth was an additional responsibility. These beliefs left a good number of women sexually abandoned, causing anxiety, sleeplessness, irritability, nervousness, and other sexual frustrating burdens. These conditions were later reconciled to be called "hysteria", a translation in Greet for 'uterus', and documented in the 13$^{th}$ century. As a result of lack of attention, women resorted to relieve their sexual frustrations with dildos. Women whose hysteria could not be relieved by their husband's lust, including the widows, the singles and the unhappily married were encouraged by doctors to do horseback riding. This was expected to boost orgasm through clitoral stimulation. However, the horseback riding provided most women little relief since it could not provide enough clitoral stimulation. By the 17$^{th}$ century, Doctors and midwives adopted a new relief technique, which was the massage and the application of vegetable oil to the genitals of women. This was called physician-assisted paroxysm. Unfortunately, physician-assisted paroxysm came with challenges. Doctors and physicians could not provide the necessary manpower till orgasm was reached. Through technological advancement, physicians substituted the mechanical massage with water-driven and steam driven dildos. However, the water and steam-driven gadgets had some challenges. The gadgets were considered nonsimple,

sometimes not reliable, and sometimes dangerous. Electrical vibrators substituted the water and steam-driven dildos in the 19th century with an improvement in clitorial stimulation, at a safer, more reliable and convenient manner. Later, battery-powered vibrators were manufactured for easy access. The vibrator ("personal massagers") encouraged pornography, and by 1891, pornographic filming was produced involving the vibrators, and this made the vibrators socially unacceptable. Media advertisements on vibrators therefore disappeared, resulting in poor patronage, until Hitachi introduced the magic wand, which is still mostly patronize in the world (Castleman, 2013).

### 2.3 Prevalence and Risk Factors of Male Sexual Dysfunction

The occurring inability to have continuous erection sufficient to permit satisfactory sexual performance has being a global concern in recent years. Some studies have been conducted to determine the prevalence and risk factors of erectile dysfunction. A community survey conducted by "Massachusetts Male Aging Study (MMAS)" revealed that 52% of the male population between 40 and 70 years old had erectile dysfunction. The prevalence of ED in the world was estimated to increase dramatically by 2025 (Moosa, 2009). The "National Health and Social life survey" with 1749 women and 1410 men between 18 and 59 years reported a prevalence rate of 34.8% for men, which is related to age, health and emotional status of respondents. The study also reported that sexual dysfunction among both sexes is related to unimproved health and some factors associated to the overall well-being of people (Laumann *et al*., 1999). Using MMAS calculations, 152 million men were reported to have had ED in 1995, with a projection prevalence of 322 million ED cases by 2025. High prevalence is

reported to be observed in developing continents (Ayta *et al*., 1999). The prevalence and incidence rates of Androgen deficiency in a sampled data from a cohort of middle-aged and older men stood at 12.3%, which increased significantly with age. Approximately 481000 new cases are expected per year in men between the ages of 40 and 69 years (Andre *et al*., 2004). In a sample of 8000 men between 30 and 80 years reported a prevalence rate of 19.2% with a steep age-related increase, with hypertension, diabetes, pelvic surgery and lower urinary problems as risk factors of ED. A 2-year longitudinal study of 847 men reported a crude incidence rate of ED of 25.9% cases per 1000 men. According to the study the annual incidence rate increased with each decade of age, with 12.4% cases per 1000 men for men between 40 and 49 years, 29.8% cases per 1000 men for men between 50 and 59 years, and 46.4% cases per 1000 men for men between 60 and 69 years. The age adjusted risk of ED was reported to be higher in men with low educational level, diabetes, heart disease and hypertension (Catherine *et al*., 2000). The prevalence rates of erectile dysfunction in a general population ranges from 2% in men below 40 years to 86% in men 80years and above (Prins *et al*., 2002). Since sexual dysfunction is associated with stigma, it is difficult for the patients to declare status of ED (Sookdeb, 2007). In a random sample from New England population conducted from 1987 to 1989, 52% of the men between the ages of 40 and 70 years had some degree of impotence (Feldman *et al*., 1994). Diokno *et al*. (1990) conducted a household survey of 1000 men, above 60 years to explore the medical, epidemiological and social aspects of aging in relation to impotence. The survey established the difficulty in attaining prevalence rates of sexual dysfunction due to unavailability of information. Out of the about 1000 men who

ended the survey, only 283 (28.3%) answered the question on erectile dysfunction and 40.3% of the 283 reported erectile difficulties. Their study had a similar prevalence rate to that of Virag *et al*. (1985) and Diokno, *et al*. (1990). A survey on epidemiological data on erectile dysfunction was published by Kubin *et al*. (2003). They reported that about 20% of men in a population have some ED. These disparities in the prevalence rates could be associated to varying definitions of ED, age distributions, corresponding medical conditions and differences in methodology. Cigarette smoking is reported to almost double the incidence of ED, in MMAS follow-up study, diabetes had a tripling risk, and heart disease had a quadrupling risk of ED (Feldman *et al*., 1994). Erectile dysfunction was also found to be correlated with depression (Johannes *et al*., 2000).

**2.4 Prevalence and Risk Factors of Female Sexual Dysfunction**

Lack of adequate data on female sexual dysfunction makes it difficult to report on the true prevalence of FSD. However, some studies have reported similar prevalence and risk factors of FSD. A cross-sectional survey of 400 married women between 18-50 revealed FSD prevalence rate of 46.2%, which increased with age. This was based on "Female Sexual Function Index (FSFI) questionnaire". 22% prevalence was recorded for women below 20 years, and 75.7% for women between 40 and 50 years. According to the study, 45.3% of the women suffered from desire disorders, 37.5% suffered from arousal disorders, 42.5% suffered from pain disorders, 41.2% suffered from lubrication problems, 42% suffered from orgasm disorders, and 44.5% suffered from satisfaction problems. The study reported that smoking, location and contraceptive methods were insignificant (Molouk *et al*., 2013). A similar survey of 149 married

women in a medical clinic reported a prevalence rate of 73.2%, using FSFI total scores. The study observed that 77.2% had desire disorders, 91.3% had arousal disorders, 96.6% had lubrication problems, 86.6% had orgasm disorders, 64.4% had pain disorders, and 81.2% had satisfaction problems. According to the study, age and lower level of education are risk factors of FSD. The study also attributed physical illness, relationship problems and cultural beliefs to FSD (Singh *et al*., 2009). A sample of 518 women between 18 and 55 years was studied using FSFI evaluation. It was reported that the prevalence rate of FSD was 48.3%, which was age-dependent. 41% prevalence was recorded for women between 18 and 30 years, 53.1% prevalence was recorded for women between 31 and 45 years, and 67.9% for women between 46 and 55 years. The study observed that 48.3% had desire disorders, 35.9% had arousal disorders, 40.9% had lubrication problems, 42.7% had orgasm disorders, 45% had satisfaction problems, and 42.9% had pain disorders. Age, smoking, menopause, diet and marital status were identified as the risk factors of FSD (Ergun *et al*., 2006). An internet-based survey of 504 women between the ages of 18 and 52 years reported that 43.1% of the women below 40 years had FSD, 44% of them had desire disorders, 49% had arousal disorders, 37% had lubrication problems, 32% had orgasm disorders, 37% had satisfaction problems, and 34.6% had pain disorders. The study reported that the risk factors associated with FSD included age, low frequency of sex, depression and history of sexual abuse (Sanghoo *et al*., 2008). Another cross-sectional study of 163 married women between 18 and 65, years in a primary care clinic revealed that 25.8% of the patients had FSD, and that the number increased with age. The study also revealed that 39.3% of the women had desire disorders, 25.8% had arousal disorders,

21.5% had lubrication problems, 16.6% had orgasm disorders, 21.5% had satisfaction problems, and 16.65% had pain disorders. Age of the husband, duration of marriage, health status, menopause and low sexual frequency were some of the observed risk factors of FSD (Izan *et al*., 2010). Another cross-sectional study was conducted, and 490 premenopausal women were subjected to Arabic version of FSFI. According to the survey, age, duration of marriage and number of pregnancies correlated negatively with ArFSFI total scores. However, high body mass index and unemployed women were associated with FSD (Ahmed *et al*., 2018). A survey of 2626 Iranian women aged between 20 and 60 years who responded to self-administered FSFI questionnaire reported that 31.5% had FSD, and the prevalence is age significant. According to the study, a prevalence of 26% was recorded for women between 20 and 39 years, and 39% for women above 50 years. On the types of disorders, 37% of the women recorded orgasm disorders, 35% recorded desire disorders, 30% recorded arousal disorders, and 26.7% recorded pain disorders. Educational level, smoking history, previous pelvic surgery and type of contraceptive methods were weak risk factors of FSD. However, psychological problems, marital status, low physical activity, menopause, chronic disease, and spousal erectile dysfunction were risk factors of FSD (Safarinejad, 2006). In another similar study in Dongcheng and Shinyi districts of Beijing, a sample of 6000 adult women reported a prevalence rate of 63.3%, using the Chinese version of FSFI. Out of this, 30.3% of the women did not advertise their problems for solution. According the study, age, spouse's erectile problems, poor marital affection, location, chronic pelvic pain, chronic disease, previous pelvic surgery, vaginal delivery, lower education and menopause were risk factors of FSD (Lou *et al*., 2017).

## 2.5 Theories Associated with Sexual Dysfunction

In the area of clinical research involving sexuality, genuine references are made to the works of "Masters and Johnson (1970) Human Sexual Inadequacy". Years of hard work changed the world of clinical studies on sexual dysfunction and other related problems, with 790 cases. This was however, a build-up of their earlier work in Human Sexual Response in 1966. Before the works of Masters and Johnson, references were made to Freud's theory on sexual dysfunction. According to him, issues associated with sexual performance were only identifiable signs with unknown causes which were diagnosed psychopathologically. The migration from psychopathology to a broader approach to sexual problems was to Masters and Johnson's credit. In their study, treatment was directed at couples, since they saw that sex was a joint act, unlike the individual-centered approach by Freud. Masters and Johnson reconciled that sexual communication was a serious ingredient to addressing sexual problems; instead most people spend time trying to address specific individual problems. Their work was to develop two-week intensive program to explore appropriate and efficient methods of developing good sexual communication between couples. Couples were engaged in sexual discussions by therapists in attempts to identify sexual experiences that hindered a good sexual relationship. Based on the model specific challenges among the couples were identified and given appropriate and specific solutions by the therapists. For men without partners, Masters and Johnson used female surrogates, an idea that never stood the test of time due to some legal and moral issues associated with it. Masters and Johnson had a broader definition of sexual dysfunction by broadening the scope with appropriate models which was 81.1% successful.

## 2.6 Empirical Study of Sexual Dysfunction

A study on the Comparison of Sexual dysfunction in Women with Infertility and Without Infertility discovered that there is a significant difference between desire, arousal, satisfaction, and total sexual dysfunction. However, lubrication, orgasm and pain during sexual intercourse were not significant. The study was composed of 149 fertile and 147 infertile women who visited an infertility clinic between 2013 and 2014, in Iran. The study concluded that some of the sexual dysfunction indices are higher in all infertile women than in fertile women (Fariba *et al*., 2014). Ugwu *et al*. (2016) also conducted a research into "Predictors of Erectile dysfunction in Men with Type 2 diabetes mellitus". In their study, they found that extended years of diabetes was an independent risk factor for erectile dysfunction. Other risk factors for ED are hypertension and lack of testosterone. The study also revealed that peripheral arterial diseases (PAD) in persons with DM increased the risk of ED exponentially. It was also reported that 44.4% of all the subjects who had ED suffered from PAD. The study also revealed that subject's with ED had lower testosterone. The study observed that neither total cholesterol concentration nor any of the lipoprotein fractions (HDL, LDL, and TG) was significantly associated with ED. It was cross-sectional survey involving 160 males aged between 30 and 70 years who had been diagnose with type 2 DM according to the 1999 WHO's criteria, in Obafemi Awolowo University Teaching Hospital, Ile-Ife, Nigeria. An academic research for the award of Master of Science in medical and Clinical Psychology, Uniformed Services University of Health Sciences (USUHS), was conducted on Heart Rate Variability (HRV) in Male Sexual Arousal and Erectile Dysfunction. In this study, it was discovered that men with erectile dysfunction had

higher pre-film hf-HRV than functional men. However, there was no significant difference in "Autonomic Nervous System (ANS) and Parasympathetic Nervous System (PNS)" between the two groups. He also found that anxiety did not moderate changes in HRV. He noticed that functional men who were attached Holter monitors demonstrated less average and maximum tumescence changes as compare functional men who were not attached Holter monitors. However, men with ED who were attached Holter monitors demonstrated no difference in average and maximum tumescence as compare to men with ED who were not attached holter monitors. In all, 65 subjects were considered for the study, comprising 38 functional men and 27 men with AD (Clark, 2006). Rahman (2009) presented an Academic Dissertation on Prevalence, Incidences and Risk Factors of Erectile Dysfunction. He found that the overall prevalence of ED was 76.5%, which increased steeply with age. According to his work, the prevalence of sexual dysfunction was 22 cases in 1000 men for ages between 50 and 55 years to 84 cases in 1000 men for ages between 70 and 75 years. The study reported that 207,000 of the population had ED and 21,500 new cases of ED every year as a result of diabetes. Heart related diseases were poorly related to ED. The amount of coffee and alcohol consumed did not have a clear effect on erectile function. Smoking doubled the risk of complete ED in men without comorbidity. The study concluded that age, lifestyle indicators, diabetes, hypertension and heart related diseases were closely related to ED. The study formed part of "Tampere Aging Male Urological Study (TAMUS)", with a population of 3152 men at the Tampere University Hospital, Department of Urology. A study was conducted to review journal-published research works on sexual dysfunction disorders in South Africa. The

objective of the research was to identify the scientific research conducted in South Africa on sexual dysfunction disorders. According to the study, high prevalence of ejaculatory and erectile dysfunctions was recorded in all the published articles. Also, lack of sexual interest and inability to attain orgasm were commonly reported dysfunctions for women. The study revealed that diabetes mellitus, cardiovascular disease, urinary disease, and psychological disorders were the commonly reported comorbid conditions that correlated with sexual dysfunction in men and women. The study concluded that there is growing awareness of the importance of sexual health (Campbell *et al*., 2014). A cohort study of 3700 men in two Swiss military centers between the ages of 18 and 25 years was conducted to measure the prevalence of premature ejaculation (PE) and erectile dysfunction (ED). The study reported that 43.9% of the young men had PE and 51% had ED at the baseline study. After 15 months, a follow-up study reported 9.9% new cases of PE and 14.4% new cases of ED. The study concluded that PE and ED are significant sexual problems among young men, which some of them do not disclose (Akre *et al*., 2014). A survey of 595 women with type 2 diabetes was conducted to measure the prevalence and correlates of FSD, using FSFI. According to the study, the mean age of the women was 57.9 years and a standard deviation of 6.9 years. The mean hemoglobin (HbA1c) level was 8.3 and a standard deviation of 1.3, and the mean duration of diabetes was 5.2 and a standard deviation of 1.5. The overall prevalence rate was 53.4%, and that for menopausal diabetic women and active diabetic women are 63.9% and 41.0%, respectively. There was no correlation between hemoglobin level, duration of diabetes, smoking status, hypertension, and FSD. However, metabolic syndrome and

atherogenic dyslipidemia were identified as risk factors of FSD. The study also reported that depression and marital status were independent predictors of FSD (Esposito *et al*., 2010). Doruk *et al*. (2009) conducted a study to determine the effects of diabetes mellitus on female sexual function and the possible risk factors associated with sexual dysfunction. The study enrolled 127 married women, consisting of 21 women with type1 diabetes, 50 with type 2 and the rest were diabetic free women. The study reported SD prevalence of 71% with type 1 diabetic women, 42% with type 2 women and 37% with the diabetic free women. It was discovered that, the diabetic women experienced more problems with sexual desire, arousal, lubrication, orgasm, pain during intercourse and total sexual satisfaction as compared to non-diabetic women. Though the predictor of sexual dysfunction included increased age, poor education, unemployment and menopause, no risk factor of diabetic induced sexual dysfunction was recorded. The diabetic women responded to the FSFI questionnaire to obtain the score for the study. The mean ages of the women were 41±9.5 (type 1), 43±7.8 (type 2) and 39±10.9 years (diabetic free). The mean duration of diabetes was also found to be 7.00±7.13 years (type 1) and 4.6±4.17 (type 2). The total sexual function scores in type 1 diabetic women was reported to be lower than the scores in type 2 women. The study concluded that diabetic women with type 1 diabetes mellitus had a higher prevalence of ED than those with type 2. A study was conducted on 72 young diabetic (type 2) women to assess their sexual function. The mean age of the women was 38.8 years, with 77% of them reporting lack of libido, 62.5% reporting reduced clitoral sensation, 37.5% had issues with vaginal dryness, 41.6% reported

discomfort in the vagina, and those with orgasmic disorders constituted 49%. The study concluded that sexual dysfunction affects their quality of life of diabetic women.

### 2.7 Sexual Dysfunction and Diabetes

Among the complications of diabetes is sexual dysfunction. In a study by Jeobu *et el*. (2012), it was estimated that more than 75% of diabetic men will experience erectile dysfunction in their lives. The ED is reported to have a positive correlation with the age distribution in the general population and that diabetic patient's experience severe ED than the non-diabetic men. According to the research study on diabetes in the United States, it was estimated that over 53% of men with diabetes suffer from ED (Selvin, 2007). It was reported that the prevalence rates of ED in diabetic men in a general population ranges from 20 to 71% (Cho *et al*., 2005; Siu *et al*., 2001; Klein *et al*.,2003 ). The reported prevalence of ED in most studies is with type 1 and type 2 diabetes mellitus. According to Junor *et al*. (2005) diabetes mellitus is reported to be the second most chronic disease affecting the American population. Lack of adequate data on diabetes in the world is a hindrance to the development of policies, solutions and possible projections. Therefore most of the studies on diabetes often rely on assumptions and projections based on early studies. The reliability of results and conclusions is often challenged with some short falls such as inability to consider ethnic, demographic and socio-economic integrations (Jeobu *et al*., 2012). According to Jeobu *et al*. (2012), the overall prevalence of ED increased with age and 58% prevalence was recorded for participants between the ages of 40 and 49 years, 36% for participants between the ages of 50 and 59 years, 75% for ages between 60 and 69 years, and 91% for ages between 70 and 79 years. Patients whose duration of diabetes

was below 6 years recorded 20.3% prevalence of ED, patients between 6 and 10 years duration recorded a prevalence of 25.4% and those above 10 years duration recorded 54.2% prevalence of ED. There was a positive correlation between profession and educational level of participants, and prevalence of ED. Though smoking was associated with increased prevalence of ED, consumption of alcohol was not. The prevalence of ED was higher (76.3%) among men with diabetes who recorded hypertension as compared to diabetic men without hypertension. Cardiovascular related problems, prostate problems, BMI, depression and high cholesterol level were not associated with ED. There was positive correlation between duration of diabetes and ED. The degree of erectile dysfunction was categorized into three, mild, moderate and severe with 33% where the state of the condition increased with age; from mild, moderate, and severe. Most of the studies on diabetes associated age with ED in a general population Fadele *et al*. (1998). In another study in the United States, the prevalence of ED among diabetic men ranges between 35 and 90% ( Nicolosi *et al*., 2003). Over 50% of diabetic men suffer from ED (Selvin *et al*., 2007). ED is very old human health problem with little information about its prevalence as well as the variability of its prevalence across geographical, racial, socio-economic, ethnic and cultural considerations (Driel *et al*, 1994). The prevalence of ED may be difficult to adequately determine due to certain limitation regarding the unwillingness to disclose the condition, giving unreliable information due to stigma and lack of adequate data especially in developing countries. There is a correlation between smoking and ED, with cigarette smoking being considered as an independent risk factor for vasculogenic impotence (Virag *et al*., 1985; Condra *et al*., 1986; Juenemann *et al*., 1987; Shabsigh

*et al*., 1991). The prevalence of complete impotence due to smoking was 11% and 0.3% for non-smokers (Feldman *et al.*, 1994). Also, Mannino *et al*. (1994) reported ED prevalence of 2.2% for non-smokers and 3.3% for current smokers in a general population. Long term complications in diabetic patients could result into multiple health problems and even death (Rahman *et al*., 2007). Diabetes is seen to be a risk factor of sexual dysfunction (Enzlin *et al*. 2003). Diabetes in women is associated with menstrual disorders, STIs, reduction in sexual hormones and pregnancy complications (Williams and Pickup, 1999). The prevalence of sexual dysfunction among diabetic women was estimated to be 47% (Newmam and Bertelson, 1986) and 50% (Guay, 2007) in diabetic men. Enzlin *et al*. (2003) also reported that the prevalence of ED in women with type 1 diabetes was 27%, and that women with complicated diabetes had serious issues with lubrication. Diabetes mellitus has been considered as one of the common chronic diseases in the world, tripling the risk factor of sexual dysfunction in both diabetic men and women. The association between diabetes and sexual dysfunction is often not fully explained since hyperglycaemia, which is a main reference of complications in diabetic patients is associated with hypertension, obesity, metabolic syndrome, dyslipidemia, cigarette smoking etc. which are independent predictors of sexual dysfunction. (Maria *et al*., 2014). The adoption of healthy lifestyle may improve insulin regulation, endothelia function and oxidation, which are ingredients of diabetes control. Also, when the well-being of an individual is improved, it may improve the sexual function (Maria *et al*., 2014). The prevalence of diabetes mellitus is increasing in an alarming rate. It was estimated that over 371milion people had diabetes in 2012, with a projection of 322 million by 2025 and 552 million

by 2030 (Maria *et al*., 2014). In the United States for instance, diabetes is recorded to be the sixth leading cause of death in women and fifth in men, with similar trend in other developed countries as well as developing countries (Maria *et al*., 2014). Of the deaths recorded for diabetes, it is reported that 50% of them are caused by cardiovascular disease (CVD), while between 10 and 20% of the deaths are caused by renal failure. Increased age has the tendency to double the risk of ED in diabetic men (Maria *et al*., 2014). Patients with diabetes stand the risk of losing their sight, foot or even the leg through amputation as a result of damaged nerves and blood vessels due to complication. (Stratton *et al*., 2000). It was reported that the probability of diabetic men experiencing erectile dysfunction is three times that of non-diabetic men (Johannes, *et al*., 2000). Even though, it was reported that it takes 10-15 years (Corona, *et al*., 2013) for ED to occur in diabetic men, it depends on the conditions associated with the diabetes. ED occurs in diabetic men less than 10 years of battling with the conditions. Diabetes medications such as B-blocker, thiazide, diuretics, spironolactone, and other antidepressants, have been associated with ED. Also, excessive intake of alcohol by diabetic men has effects on their erectile function (Foresta *et al*., 2009). The causative mechanism of ED in diabetic men is a combined effect of both organic and psychological factors, translating into diabetes vasculopathy which prevents free flow of blood into the penile vessels. Several other risk factors of cardiovascular disease in diabetic men may also be responsible for reduced blood flow into the penis (Esposito *et al*., 2010). Insulin resistance and visceral adiposity are associated with type 2 diabetes with combinational effect of decreasing the production of nitric oxide (NO), affecting muscle performance, especially in obesed diabetic men,

leading to ED (Esposito *et al*., 2010). Changes in an individual lifestyles such as routine physical activity (exercises), reduction in consumption of caloric foods, as well as other diets that promote weight lost due to less fats and fibre, was reported to significantly improve erectile function in a general population (Esposito *et al*, 2010). Some common risk factors that are associated with FSD include increased age, diabetes mellitus, cardiovascular disease, hypertension, disease of the genital, psychological disorders, poor social life, poverty, low education, lack of physical activity, among others (Basson *et al*, 2000). Both type 1 and type 2 diabetes have been identified to reduce the FSFI score more in non-diabetic women. For instance, a study conducted by Maria *et al*. (2014) revealed that the risks of FSD in type 1 and type 2 diabetic women were 2.27 and 2.49, respectively, with a general risk of 2.02 for any diabetes. The study also reveals that depression in type 1 diabetes was a common predictor of sexual dysfunction in women. The sexual function of women with type 2 diabetes is badly affected by older age, duration of diabetes, menopause, physiological challenges and micro vascular complications. In a study consisting of 613 diabetic women and 524 non-diabetic women, it was reported that degraded sexual function was influenced by increased age, depression, obesity, cardiovascular disease and diabetic complications (Maria *et al*., 2014). The reduction in androgen levels, extrogen levels and the sex hormone-binding globulin in diabetic women is a good predictor of FSD (Feldhaus-Dahir, 2009). Complications of diabetes in women has adverse effects on their self-image, quality of life, health and other social relationships, thereby affecting their sexual performance (Ogbera *et al*., 2009). There are currently no right-forward treatment of FSD in diabetic women, therefore management of diabetes and

lifestyle improvement is the best hope for now (Maria *et al*., 2014). In another study consisting of 595 type 2 diabetic women, it was reported that there was a positive correlation between Mediterranean diet and FSFI score (Esposito *et al*., 2005).

### 2.8 Measuring Sexual Quality of Life

Sex is an important function of the human being and plays an important role in the reproductive life of an individual (Chedraui *et al*., 2012). Different factors affect the quality of life of an individual. The sexual quality of life is an integral component of physical, emotional and psychological factors (Tsai *et al*., 2011). When Sexual quality is deteriorated, it affects the general well-being and for that matter the overall quality of life (Symonds *et al*., 2005). It is necessary to measure the sexual quality so as to be able to determine the sexual condition of an individual. There are basically two types of questionnaires that assess the sexual quality of life of an individual. It became necessary to assess the sexual quality of life for both men and women due to high prevalence rates of erectile dysfunction and female sexual dysfunction. Therefore the female sexual quality of life (SQOL-F) questionnaire is an instrument that self-reports the specifics on the individual's self-esteem, emotional and social issues. Higher values generated by the questionnaire from the respondents suggest that there is a better sexual function (Symonds *et al*., 2005). The male sexual quality of life (SQOL-M) questionnaire is similar to the SQOL-F in structure and construct. The questionnaires were tested to be consistent, reliable and valid (Ferguson *et al*., 1993). Some studies have shown that, there is a relationship between sexual dysfunction and a bad quality of life in individuals with various forms of sexual disorders (Watts, 1982). In a study conducted by Anderson *et al*. (2012), it was reported that there was

a significant difference between the sexual quality of life scores for women who have undergone female genital mutilation (FGM) and those who have not. According to the study FGM was associated with low sexual quality of life scores since the practice has adverse effects on the female sexual function. Sexual quality of life can be affected even by short term disorders of the sexual function since the disorders have the potential to cause frustration, depression, anxiety, sexual relationship problems and other aspects of life (Watts, 1982). It is believed that sexual dysfunction can affect all age groups and that the older one grows after adulthood the higher the tendency of having decreased libido, sexual sensitivity, desire and pleasure (Slag *et al*., 1983; Glefand, 2000). Mulligan *et al*. (1991) reported that though older men have increased interest in sex, they have reduced sexual function. It is also possible for older men to have full sexual function (Gelfand, 2000; Kingsberg, 2000).

There are several methods that are used to measure sexual function but those that are not well tested to be reliable and efficient are not usually used in clinical studies. Some of the common methods used to assess directly the male sexual function include the "nocturnal penile tumescence (NPT) device, intracavernosal injection with prostaglandinel, penile brachial pressure indices, Doppler studies", among others (Giorgi *et al*., 1992). Some common methods used to assess female sexual function include; "genital blood peak systolic velocity, vagina pH, intravaginal compliance and genital vibratory perception threshold". These methods offer direct insight into the sexual function. The indirect measures of the sexual function include; "assessing levels of estrogen, testosterone, LH and prolactin" (Giorgi *et al*., 1992). Questionnaires offer another method of assessing the sexual function of individuals. They give the

individuals the opportunity to self-report aspects of their sexual function (Conte, 1986). The combination of different methods of assessing sexual function is ideal since it gives the opportunity to report entirely all the aspects of the sexual function. Questionnaires that were developed around 1950s and 1970s years basically measured sexual satisfaction based on some specific sexual activities using activity centered checklist (Derogatis *et al*., 1979). Improvements in the sexual function questionnaires started after 1970 when a broader definition of sexual function was given to include sexual function and satisfaction across gender and sexual preferences (Sanders *et al*., 2005). Most of the sexual function questionnaires include items like "satisfaction, frequency, interest, desire, worry, arousal, current behavioral, libido, orgasm, genital problems, and feministic and musculinistic feelings". The scales were categorized into six domains; "the interest or desire domain included interest, desire and libido; the quality or satisfaction domain includes satisfaction with quality of erection, ejaculation or orgasm and pain or discomfort during sex; the excitement or arousal domain included physical evidence of erections, including morning erections, excitement without erections and sufficient vaginal lubrication for sexual intercourse; the ability to maintain erection in order to achieve an orgasm constituted the performance domain; the attitude or behavioral domain constituted attitudes and behaviors of individuals towards their sexual partners such as avoidance, irregularity in sexual frequency and sexual embarrassment; and the relationship domain was made up of the impact of sexual function on the relationship of partners" (Sanders *et al*., 2005). A questionnaire is designed depending on the type of population or sample it is intended to assess. The strength or efficiency of any questionnaire depends on its ability to

reflect the issues that are applicable to the group for which it was designed. Therefore almost all the common questionnaires used in clinical studies and for self-assessment purposes have limitations (Sanders *et al*., 2005).

The Derogatis interview for sexual function is a self-report instrument that was developed to assess sexual function across preferences, genders and multiple groups or populations. It was tested to be reliable, valid and consistent through years of clinical trials. The major identifiable setback of this questionnaire is the fact that it is commonly employed by companies under sponsorship to evaluate their products using clinical drug trials. This makes data from the instrument unacccessible to the public for comparison analysis (Derogatis *et al*., 1979). UCLA Prostate Cancer Index is another useful questionnaire that was developed to quantify sexual dysfunction. It was developed based on the demands of the patients through focus groups and surveys to identify priorities regarding prostate health and sexual dysfunction. It was also tested to be reliable, consistent and valid (Litwin *et al*., 1998).

The Brief Index of Sexual Function for women is simple sexual specific questionnaire that can assess a wide range of domains such as desire, arousal, orgasm and satisfaction. Though not commonly used in major studies regarding female sexual function, it is reliable and valid (Rosen *et al*., 1997). The Watts Scale is another questionnaire that was designed to evaluate the sexual function of heterosexual and homosexual men and women undergoing hypertension therapy. It is a 17-itemed questionnaire that has wide usage. It is valid and reliable with low consistency (Watts, 1982).

The Sabbatsberg Sexual Rating Scale is a questionnaire designed to measure female sexual dysfunction in women with gynecological conditions. It has remarkable consistency, responsiveness and validity (Garratt *et al*., 1995; 1999). The environment and the attitude of individuals influence the prevalence of diabetes mellitus in a population. Since diabetes is closely related to sexual function in both men and women, it affects the sexual quality of life of diabetic patients. Even diabetes alone without any association to sexual function is a demeanor of life quality. Lack of physical activity and too much caloric consumption can increase the risk of developing type 2 diabetes, irrespective of the age and sex of an individual (Maria *et al*., 2014). Some questionnaire have been developed and validated to evaluate the effect of diabetes on the patients' quality of life, including the quality of the sexual function.

In dealing with chronic diseases such as chronic diabetes, it is necessary and important that the partners offer support in the management of the disease (Cogne *et al*., 1994; Primomo *et al*., 1990). It was reported that marital satisfaction was correlated to proper communication and problem solving (Cox *et al*., 1991; Fisher *et al*., 2004). Some studies have reported that there is a good marital adjustment in the management of diseases among couples with diabetes and this reduces stress and improves their lives (Trief *et al*., 2001; Dempster *et al*., 2011). It is appropriate that individuals with sexual problems recognised and advertised their problems for solution, failure to do this may affect the quality of life as well as the quality of relationship between couples (Lindau *et al*., 2010). Some studies have reported better sexual function and marital satisfaction as a factor of better dyadic adjustment (Lawrance et al., 1995; Young *et al*., 2000). It was also reported that high prevalence recorded indiabetic women was associated with

poor marital relations, lower marital satisfaction, poor sexual quality of life and higher depressive tendencies (Elyasi *et al*., 2015; Enzlin *et al*., 2003). Diabetic men also report low sexual desire and marital satisfaction (Pedersen et al., 2015). Another way to improve sexual function is to increase sexual education since this can demystify the ancient and akaike mentality regarding sexual beliefs and Myths (Kukulo *et al*., 2009). Some researchers are of the view that sexual satisfaction can be encouraged based on socio-demographic and psychological factors, intimate relationships and sexual response factors, family relationships factors and factors relating to cultural beliefs (Sânchez-Fuentes *et al*., 2014). Dyadic adjustment is evaluated by the dyadic adjustment scale (DAS), which is a 14 item questionnaire developed with cohesion satisfaction and consensus subscales. Higher scores of the questionnaire is an indication of better adjustment (Pereira *et al*., 2015; Nobre *et al*., 2003). Beliefs associated with sexual function are assessed using sexual dysfunctional beliefs questionnaire (SDBQ). This questionnaire has both the men and female versions that evaluate specific sexual beliefs on sexual dysfunction. It is a lengthy questionnaire, of about 60 items with 6 subscales consisting of sexual conservatism beliefs, sexual desire as a sin, aging, body image, affection and mentality for the women and sexual conservatism, female sexual power, beliefs of excessive sexual strength, beliefs about female sexual satisfaction and sexual attitudinal beliefs (Nober *et al*., 2003). Sexual satisfaction can also be evaluated using the index of sexual satisfaction (ISS), a questionnaire with 25 items that evaluate the degree and magnitude of sexual components in relationship between partners (Hudson, 1992; Pechorro *et al*., 2009).

For the purpose of this study, IIEF, FSFI and SQoL questionnaires were used to obtain sexual function scores for the analysis.



# CHAPTER THREE

# METHODOLOGY

## 3.0: Introduction

This chapter consists of the methods and procedure that were involved in carrying out the research. It comprises revision of models and theories associated with the statistical tools used for the analysis of the collected data, testing of assumptions, and analysis

of the data using Multivariate Analysis of variance (MANOVA), Logistic and Probit Regression Analysis.

### 3.1: Data screening and Coding

Multivariate Analysis of Variance (MANOVA) requires that the data collected are normally distributed, free from outliers. Data points that were extremely high and extremely low were replaced with new data points. Additionally, sampled data points with missing information were equally replaced. Since the models do not accept string values, some data points such as sex and marital status of respondents were coded to make the data suitable for analysis. The other variables considered for this study were age, creatinine levels, duration of diabetes, glucose levels and pulse rates. For the purpose of this study, seven variables were selected for investigation.



### 3.2: Exploratory Analysis

As part of descriptive statistics, the mean, standard deviation, minimum and maximum values of the variables were obtained. Also, age distribution statistics as well as correlation between sexual quality and marriage satisfaction of respondents were obtained

### 3.3 Further Analysis

Assumptions of MANOVA, logistic and probit regression were tested for recommendation of suitability of the data. Analysis was aided by the use of Stata (version 13) and SPSS (version 22). Finally, bootstrapping for Stata and SPSS were used to test for reliability of the results by comparing the parameter estimates for the models and that of their bootstrap estimates.

### 3.4.0 Theories and Models

### 3.4.1 Multivariate Analysis of Variance (MANOVA).

Multivariate analysis of variance (MANOVA) is a procedure for comparing multivariate means. It is employed when there are two or more dependent variables. MANOVA helps the researcher to answer the following questions:

i. Do changes in the independent variable(s) have significant effect on the dependent variable?
ii. What are the relationships among the dependent variables?
iii. What are the relationships among the independent variables?

MANOVA is a generalized form of univariate analysis of variance (ANOVA), where sums of squares in the ANOVA are diagonal elements of the covariance matrix of MANOVA.

The assumptions of MANOVA include the following;

1. There should be more cases in each cell than you have dependent variable. A sample size of at least 20 cases in each cell should ensure robustness.
2. The data should be both univariate and multivariate normal.
3. The data should be free from outliers (using scatter plots).
4. The relationship between pairs of the dependent variables should be linear.
5. The dependent variables should be moderately correlated. Very low and very high correlation may affect the results.
6. The variables should be independent and random.

7. The covariance matrix should be equal. This assumption tends to be too strict when the sample is large.

I am dealing with two sets of experimental conditions, as level of 'sex' (factor 1) and level of 'marital status' (factor 2), respectively.

Let g = number of levels of factor 1

b = number of levels of factor 2

n = independent observations at each gb combinations of levels

l = level of factor 1

k = level of factor 2

$x_{lkr}$= $r^{th}$ observation at level l of factor 1 and level k of factor 2

The model for the two-way MANAOVA is given by

$$x_{lkr} = \mu + \tau_l + \beta_k + \lambda_{lk} + \varepsilon_{lkr} \quad \text{.....(3.1)}$$

l=1,2,…,g

k=1,2,…,b

r=1,2,…, n

Where $\sum_{l=1}^{g} \tau_l = \sum_{k=1}^{b} \beta_k = \sum_{l=1}^{g} \gamma_{lk} = \sum_{k=1}^{b} \gamma_{lk} = 0$ .....(3.2)

The vectors are all of order p*1 and $e_{lkr}$ are assumed to be independent and $N_p(o, \varepsilon)$ random vector. $x_{lkr}$ can be decomposed as;

$$x_{lkr} = \bar{x} + \left(\bar{x}_{l.} - \bar{x}\right) + \left(\bar{x}_{.k} - \bar{x}\right) + \left(\bar{x}_{lk} - \bar{x}_{l.} - \bar{x}_{.k} + \bar{x}\right) + \left(x_{lkr} - \bar{x}_{lk}\right) \text{.....(3.3)}$$

The breakups of the sum of squares and cross-products and degrees of freedom are given as

$$\sum_{l=1}^{g}\sum_{k=1}^{b}\sum_{r=1}^{n}\left(x_{lkr} - \bar{x}\right)\left(x_{lkr} - \bar{x}\right)' = \sum_{l=1}^{g} bn\left(x_{l.} - \bar{x}\right)\left(x_{l.} - \bar{x}\right)' + \sum_{k=1}^{b} gn\left(x_{.k} - \bar{x}\right)\left(x_{.k} - \bar{x}\right)'$$
$$+\sum_{l=1}^{g}\sum_{k=1}^{b} n\left(x_{lk} - x_{l.} - x_{.k} + \bar{x}\right)\left(x_{lk} - x_{l.} - x_{.k} + \bar{x}\right)' +$$
$$\sum_{l=1}^{g}\sum_{k=1}^{b}\sum_{r=1}^{n}\left(x_{lkr} - \bar{x}_{lk}\right)\left(x_{lkr} - \bar{x}_{lk}\right)' \text{.....(3.4)}$$

$$SS_{cor} = SS_{fac1} + SS_{fac2} + SS_{\text{int}} + SS_{res} \text{.....(3.5)}$$

Corresponding to the degrees of freedom;

$$gbn - 1 = (g-1) + (b-1) + (g-1)(b-1) + gb(n-1) \text{.....(3.6)}$$

Where:

$\bar{x}$ = the grand mean observation vector

$\bar{x}_{l.}$ = mean observation vector at $l^{th}$ level of factor 1

$\bar{x}_{.k}$ = mean observation vector at k$^{th}$ level of factor 2

$\bar{x}_{lk}$ = mean observation vector at l$^{th}$ level of factor 1 and k$^{th}$ level of factor 2

The ratios of the mean squares $SS_{fac1}/(g-1)$, $SS_{fac2}/(b-1)$ and $SS_{int}/(g-1)(b-1)$ to the mean square, $SS_{res}/gb(n-1)$ is used to test for the effect of factor 1, factor 2 and factor 1- factor 2 interactions. Wilk's lambda, $\Lambda^*$, is a likelihood ratio test for testing effects of the factors and their interactions, based on the corresponding hypothesis.

Wilk's lambda, $\lambda^*$, is given by;

$$\lambda^* = \frac{|SS_{res}|}{|SS_{option} + |SS_{res}|} \quad \text{.....(3.7)}$$

$H_o$ is rejected at a given $\alpha$ level if $F \geq F^*_{v1,v2(\alpha)}$, where;

$$F = \left(\frac{1-\lambda^*}{\lambda^*}\right)\left(\frac{[gb(n-1)-p+1]/2}{[|(g-1)(b-1)-p|+1]/2}\right) = \left(\frac{1-\lambda^*}{\lambda^*}\right)\left(\frac{V_2}{V_1}\right)$$

### 3.4.3 Logistic Regression Model

The logistic function is the inverse cumulative distribution function (quantile function) of the logistic distribution. It creates a map of the probability values from [0, 1] to [-∞, +∞].

If $P$ is a probability, then $\frac{P}{1-P}$ is the corresponding odds. Therefore, logit of the probability is the logarithm of the odds, given by;

$$Logit(\mathrm{P}) = \log\left(\frac{P}{1-P}\right) = \log(\mathrm{P}) - \log(1-\mathrm{P}) \text{.....(3.9)}$$

The logistic function of any number, $\alpha$, is the inverse-logit of that number;

$$Logit^{-1}(\alpha) = Logistic(\alpha) = \frac{1}{1+e^{-\alpha}} = \frac{e^{\alpha}}{1+e^{\alpha}} \text{.....(3.10)}$$

Both probit and logit map the range (0, 1) to (-∞, +∞) and then run linear regression on the transformed values. **Probit** is abbreviated from '**Prob**ability un**it**', using cumulative normal distribution function to perform the mapping. Similarly, **logit** is derived from '**log**istic un**it**', using cumulative logistic distribution function to perform the mapping.

While logistic model presents estimates in terms of odds ratio $\left(\frac{odds(\mathrm{x}+1)}{odds(\mathrm{x})}\right)$, logit presents estimates as coefficients. Logit fits logit model for binary response by maximum likelihood. It models the probability of a positive outcome based on a set of regressors. The logit model is given by;

$$P(y = 1/x_j) = \frac{e^{x_j\beta}}{1+e^{x_j\beta}} \text{.....(3.11)}$$

The likehood function of logit is given by;

$$\ln L = \sum_{J \in S} w_j \ln F(\mathrm{x}_j\,\beta) + \sum_{J \ni S} w_j \ln(1 - F(\mathrm{x}_j\,\beta)) \text{.....(3.12)}$$

Where; $S$ is the set of observations, $j$ and $w_j$ is the optional weights. $\ln L$ is maximized.

Some underlying assumptions associated with logit model include;

1. The dependent variables should be dichotomous in nature.
2. There should be no outliers in the data.
3. There should be no high correlations between the predictors.
4. There should be linear relationships between the predictors.

### 3.4.4 Probit Regression Model

The probit model is a classification model that is used to model dichotomous or binary outcomes. Probit model transforms the inverse standard normal distribution and models it as a linear combination of the predictors. The procedure of transformation is that the probit model transforms the expectation of the binary dependent variable, then the probit of the expectation is modelled as a linear combination of the covariates, $X$.

Consider the generalized linear model (GLM);

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ..... + \beta_k x_k + \varepsilon .....(3.13)$$

Probit model is a special type of GLM, where the bivariate outcome, $Y$, has a Bernoulli distribution with parameter, $P$, the probability of being 'male' or 'married' ($P \in (0,1)$). Recall that $E(Y) = P$ then by using the probit link function;

$$probit[\mathrm{E(Y)}] = \phi^{-1}(P) = \phi^{-1}\,\mathrm{P(Y=1)} .....(3.14)$$

The predicted probability may be determined using the inverse probit or the standard normal cumulative distribution function transformation;

$$P[Y_i = 1] = \phi(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + ..... + \beta_k x_k) = \phi(\mathrm{x}_i\ \beta).....(3.15)$$

Where;

$\beta$ is a vector of unknown parameters which may be estimated using the method of maximum likelihood, and $\phi$ is a normal standard cumulative distribution function, given by;

$$\phi(\mathrm{x}\beta) = \int_{-\infty}^{x\beta} \phi(\mathrm{v})\,\mathrm{dv} = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x\beta} e^{-v^2/2}\,dv \ .....(3.16)$$

The distribution of $\phi$ determines whether the model is logit or probit. When the cumulative distribution function of $\phi$ is a logistic distribution, then the model is said to be logit or logistic regression. Conversely, if the distribution of $\phi$ is a standard normal distribution, then we refer to it as probit regression model. Both logit and probit take any number and rescale it to lie between 0 and 1. Therefore, irrespective of the value of $\beta_0 + \beta_1 x_1 + \beta_2 x_2 + ..... + \beta_k x_k$ the function can transform it to produce the predicted probability.

Maximum likelihood estimation (MLE) is a method of estimating the parameters of a statistical model, based on some observations

The likelihood function of probit is given by;

$$\ln L = \sum_{J \in S} w_j \ln F(\mathrm{x}_j \beta) + \sum_{J \ni S} w_j \ln(1 - F(\mathrm{x}_j \beta)) \ldots\ldots\ldots\ldots\ldots (3.17)$$

Some underlying assumptions associated with logit model include;

1. The data should be normally distributed.
2. The dependent variables should be dichotomous in nature.
3. There should be no outliers in the data.
4. There should be no high correlations between the predictors.
5. There should be linear relationships between the predictors.

### 3.5 Correlation Coefficient

Pearson product moment correlation (PPMC) is a commonly used parametric statistical tool that is used to investigate the linear relationship between two sets of data. It measures how strong the sets of data are related. The absolute value of the correlation coefficient ($\rho$) is a measure of the strength of the relationship. A correlation coefficient of 1 means that for every increase in one variable, there is a fixed proportional increase in the other. On the other hand, a correlation coefficient of -1 means that for every increase in one variable, there is a fixed proportional decrease in the other. A correlation coefficient of 0 means that there is neither positive nor negative correlation (no relationship) between the sets of data.

The estimate of Pearson product moment correlation coefficient ($\rho$) is given by;

$$\rho = \frac{\sum_{i=1}^{n} w_i (\mathrm{x}_i - \bar{x})(\mathrm{y}_i - \bar{y})}{\sqrt{\sum_{i=1}^{n} w_i (\mathrm{x}_i - \bar{x})^2} \sqrt{\sum_{i=1}^{n} w_i (\mathrm{y}_i - \bar{y})^2}} \ldots\ldots\ldots\ldots\ldots (3.18)$$

Where $w_{i\ i}$ are the weights if specified, otherwise $w_i = 1$, $\bar{x} = \sum_{i=1}^{n} w_i x_i / w_i$ and

$\bar{y} = \sum_{i=1}^{n} w_i y_i / w_i$

The unadjusted significance level is given by;

$$P = 2 * ttail\left( (n-2), |\rho| \frac{\sqrt{n-2}}{\sqrt{1-\rho^2}} \right) \ldots\ldots\ldots\ldots\ldots\ldots (3.19)$$

Pearson correlation coefficient is based on the assumption that the dataset is multivariate normally distributed. It is also based on the assumption that the variables are linearly related.

### 3.6 Presentation of Results

The results of the analysis of the data was presented in two stages, the exploratory stage, where the general characteristics of the data such as the means, standard errors, minimum and maximum values of the dependent variables were ascertained and presented in tables and figures. The second stage was the results of appropriate assumptions as well as results from MANOVA, Logistic and probit Analyses. The values of some statistics were compared under different conditions to determine the best model. Results from the comparison of probit and logit models have been presented in a single table to determine the statistical tool that produced the best model for the data. Some tables and figures that have not been presented in the analysis have been presented in the appendices.

# CHAPTER FOUR

# RESULTS ANALYSIS AND DISCUSSION

## 4.0 Introduction

This chapter presents the analyzed results from the data and discussion. The preliminary analysis consists of the descriptive statistics and the further analysis comprises the two-way MANOVA, probit and logit regression analyses.



## 4.1 Preliminary Analysis

This section presents the preliminary analysis of the study. A total of 230 respondents were used in this study. Out of the total number of respondents, 115 (50%) were males and the rest were females. Also, 50% of the respondents were married and the rest were single. Table 4.1 displays summary statistics for age, glucose, pulse, duration of diabetes (DoD) and creatinine. From Table 4.1, it can be seen that the average age was approximately 60 years. The minimum and maximum ages were 30 and 89 years, respectively. The mean glucose was 8.21ml/dl. The minimum glucose level was 7ml/dl and the maximum was 9ml/dl. The average pulse was 82.62 bpm and the minimum and maximum pulse rates were 80 and 85 bpm, respectively. The mean, minimum and maximum DoD values were 4.2 years, 1 and 7 years, respectively. Also, the average, minimum and maximum creatinine values were 1.6ml/dl, 1.3ml/dl and 1.9ml/dl, respectively. Again, the average scores of sexual quality and marital satisfaction of respondents were 31.6 and 2.1, respectively.

**Table 4.1 Summary Statistics**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Age | 230 | 59.96957 | 10.59678 | 30 | 89 |
| Glucose | 230 | 8.213913 | 0.8331439 | 7 | 9 |
| Pulse | 230 | 82.62174 | 1.690057 | 80 | 85 |
| DoD | 230 | 4.156522 | 1.46631 | 1 | 7 |
| Creatinine | 230 | 1.605217 | 0.122452 | 1.3 | 1.9 |
| SQoL | 230 | 31.57391 | 0.9895601 | 30 | 33 |
| Msatisf | 230 | 2.069565 | .5943216 | 1 | 3 |

From Table 4.2, it can be seen that 3.5% of the respondents fall between 30-39years, 12.6% fall between 40-49years, 34.3% fall between 50-59years, 30.9% fall between 60-69years, 18.3% fall between 70-79years, and 0.4% fall between 80-89years. Diabetes can therefore be said to be highly prevalent in adults between 40-79 years old (96.1%).



**Table 4.2 Age Distribution of Diabetic Patients**

| Age | Tally | Percent |
|---|---|---|
| 30-39 | 8 | 3.5 |
| 40-49 | 29 | 12.6 |
| 50-59 | 79 | 34.3 |
| 60-69 | 71 | 30.9 |
| 70-79 | 42 | 18.3 |
| 80-89 | 1 | 0.4 |

The relationship between sexual quality and marital satisfaction was assessed using correlations. From Table 4.3, it can be seen that there is positive correlation between respondents' sexual quality and their marital satisfaction. The impact or effect of sexual quality on the marital satisfaction of respondents was significant (P value < 0.05); respondents with low scores of sexual function indices have marital issues. This also means that improvement in the sexual function scores triggers sexual satisfaction of the partner, thereby improving marital satisfaction.

**Table 4.3 Correlation between Sexual Quality and Marital Satisfaction of Respondents**

| | SQoL | Msatisf | P-Value |
|---|---|---|---|
| SQoL | 1.00 | 0.8674 | 0.0000 |
| Msatisf | 0.8674 | 1.00 | |

### 4.2 Multivariate Analysis of Variance (MANOVA)

As a requirement for performing MANOVA certain parametric assumptions, such as normality, linearity, equality of error variances, equality of covariance matrices, outliers and multicollinearity, should be satisfied.

Normality of the data was tested using Shapiro-Wilk (univariate) and mahalanobis distance (multivariate). From the results in Table 4.4, it can be seen that the individual variables were normally distributed as the P-values are greater than the 0.05 significance level.

**Table 4.4 Testing for Univariate Normality**

| Variable | Obs | Wilk's | Variance | Z | Prob>z |
|---|---|---|---|---|---|
| Age | 230 | 0.99235 | 1.290 | 0.589 | 0.27782 |
| Creatine | 230 | 0.99585 | 0.700 | -0.827 | 0.79590 |
| DoD | 230 | 0.99720 | 0.503 | -1.593 | 0.94443 |
| Glucose | 230 | 0.99272 | 1.226 | 0.473 | 0.31813 |
| F.Satisfact | 230 | 0.99946 | 0.092 | -5.536 | 1.00000 |
| Pulse | 230 | 0.99713 | 0.484 | -1.682 | 0.95372 |
| SQol | 230 | 0.99881 | 0.200 | -3.731 | 0.99990 |



In order to assess whether the variables were multivariate normally distributed, the Mahalanobis distance, Cook's distance and the centered leverage values were used. The results displayed in Table 4.5 revealed that the variables were multivariate normally distributed. For instance, the Mahalanobis value of 12.989 is less than the chi-square value of 20.52, indicating that the variables are multivariate normally distributed. Also, the Cook's distance (0.00) is less than 0.50, affirming the multivariate normality of the variables. Again, the centered leverage value is close to 0 than 1 (Tabachnick and Fidell, 2001), which further confirms that the variables are multivariate normally distributed.

**Table 4.5 Testing Multivariate Normality**

| Item | Min | Max | Mean | Std. Dev |
|---|---|---|---|---|
| Residual | -0.810 | 0.909 | 0.000 | 0.467 |
| Std. Residual | -1.735 | 1.946 | 0.000 | 1.000 |
| Student Residual | -1.735 | 1.946 | 0.000 | 1.000 |
| Mahalanobis Dist. | 0.444 | 12.989 | 5.000 | 2.527 |
| Cooks Dist. | 0.000 | 0.000 | 0.000 | 0.000 |
| Centered Levered Values | 0.000 | 0.000 | 0.000 | 0.000 |



Linearity assumption was assessed using scatterplot of pairs of the continuous variables. From Figure 4.1, it was observed that there was linear relationship between pairs of the predictor variables.

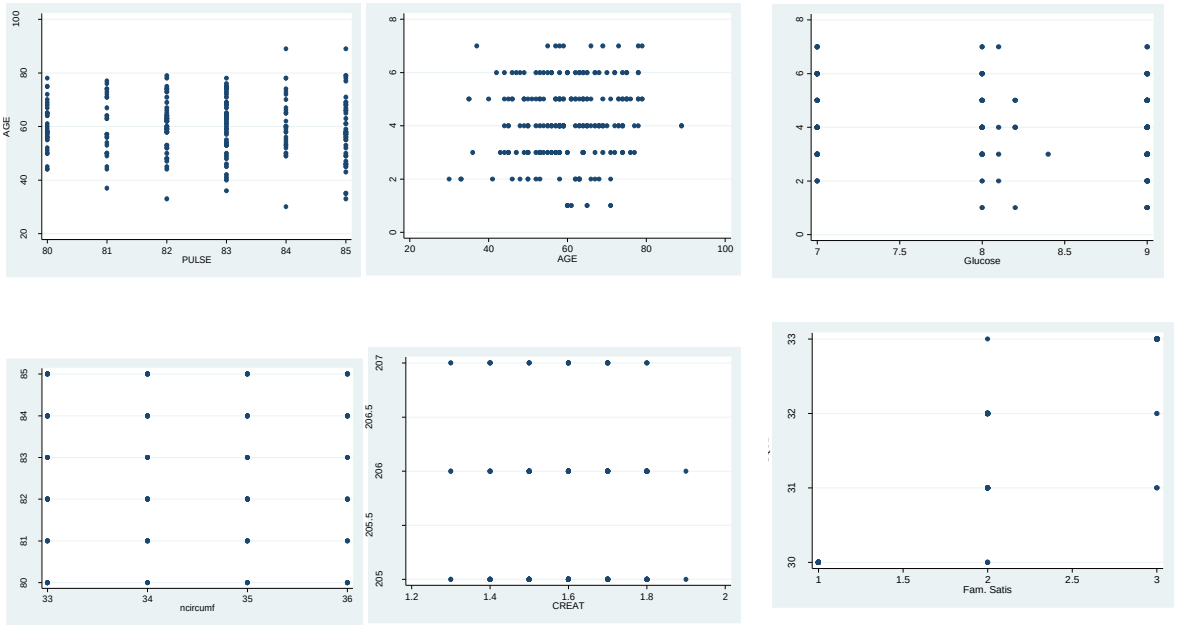


**Fig. 4.1 Linearity testing**

Homogeneity of error variances was assessed using Levene's test. From Table 4.6, it can be observed that only age and creatinine level violate the assumption of equality of error variance. However, violation of this assumption will not affect the results since the sample is large (above 150; Tabachnick and Fidell, 2001) and that the study is using equal sample sizes.

**Table 4.6 Testing for Homogeneity of Error Variances**

| | F | Df1 | Df2 | Sig |
|---|---|---|---|---|
| Age | 5.739 | 3 | 226 | 0.001 |
| Creat | 2.995 | 3 | 226 | 0.033 |
| DoD | 0.642 | 3 | 226 | 0.588 |
| Glucose | 0.312 | 3 | 226 | 0.817 |
| Pulse | 1.447 | 3 | 226 | 0.230 |



Multicollinearity was assessed by regressing the predictors on sex. From Table 4.7, it can be observed that each variable Variance Inflation Factor (**VIF)** value lie within 1 and 10. Also, the tolerance value of each variable is greater than 0.1 (Tabachnick and Fidell, 2001). Hence, the independent variables are not correlated.

**Table 4.7 Testing for Multicollinearity**

| Variable | VIF | Tolerance (1/VIF) |
|---|---|---|
| Age | 1.03 | 0.970937 |
| Creatinine | 1.02 | 0.977485 |
| DoD | 1.08 | 0.928509 |
| Glucose | 1.05 | 0.955405 |
| Pulse | 1.01 | 0.992539 |
| Mean VIF | 1.04 | |

The Box's M test of equality of covariance matrices revealed that the covariance matrices across the groups are equal (P value > 0.05). Table 4.7 displays the Box's test statistic and the P-value of 0.084 given the degrees of freedom, Df1and df2.

**Table 4.7 Testing for Equality of Covariance Matrices**

| | |
|---|---|
| Box's M | 61.000 |
| F | 1.302 |
| Df1 | 45 |
| Df2 | 126360.226 |
| Sig | 0.084 |



Upon the satisfaction of the underlying parametric assumptions, two-way MANOVA was carried out with 'Sex' and 'Marital Status' on the linear combinations of Age, Creatinine, Duration of Diabetes, Glucose and Pulse. From the multivariate test in Table 4.9, it can be seen that Wilk's lambda as well as Pillai's trace, Hotelling trace and Roy's largest root affirmed significance in sex and marital status. Conversely, the interaction effect is not significant.it can also be seen that the observed powers of the tests are above 0.7, indicating that the hypothetical decision is right. The proportion of variation explained by the model for sex, marital status and interaction are 0.135, 0.052 and 0.046 respectively.

**Table 4.9 Multivariate Analysis of Variance**

| Effect | Statistic | Value | F | Sig. | Partial.Eta Sq. | Observed Power |
|---|---|---|---|---|---|---|
| Intercept | Pillai's Trace | 1.000 | 124170.1 | 0.000 | 1.000 | 1.000 |
| | Wilk's Lambda | 0.000 | 124170.1 | 0.000 | 1.000 | 1.000 |
| | Hotelling's Trace | 2796.625 | 124170.1 | 0.000 | 1.000 | 1.000 |
| | Roy's L. Root | 2796.625 | 124170.1 | 0.000 | 1.000 | 1.000 |
| Sex | Pillai's Trace | 0.135 | 6.934 | 0.000 | 0.135 | 0.998 |
| | Wilk's Lambda | 0.865 | 6.934 | 0.000 | 0.135 | 0.998 |
| | Hotelling's Trace | 0.156 | 6.934 | 0.000 | 0.135 | 0.998 |
| | Roy's L. Root | 0.156 | 6.934 | 0.000 | 0.135 | 0.998 |
| M. Status | Pillai's Trace | 0.052 | 2.454 | 0.034 | 0.052 | 0.767 |
| | Wilk's Lambda | 0.948 | 2.454 | 0.034 | 0.052 | 0.767 |
| | Hotelling's Trace | 0.055 | 2.454 | 0.034 | 0.052 | 0.767 |
| | Roy's L. Root | 0.055 | 2.454 | 0.034 | 0.052 | 0.767 |
| Sex* M. Status | Pillai's Trace | 0.046 | 2.161 | 0.059 | 0.046 | 0.704 |
| | Wilk's Lambda | 0.954 | 2.161 | 0.059 | 0.046 | 0.704 |
| | Hotelling's Trace | 0.049 | 2.161 | 0.059 | 0.046 | 0.704 |
| | Roy's L. Root | 0.049 | 2.161 | 0.059 | 0.046 | 0.704 |



As part of post estimation to confirm the estimates from MANOVA, Wald's test was used to test whether the groups differ or not. Results from the analysis suggested that

the group means are not equal, as shown in Table 4.10. The post-estimated result is a confirmation to the results of the MANOVA since sex and marital status of respondents were observed to be significantly different (P Value < 0.05).

**Table 4.10 Testing for Equality of Group Means**

| Model | F | P > F |
|---|---|---|
| Sex | F (5, 227) = 6.87 | 0.000 |
| M.Status | F (10, 227) = 4.68 | 0.000 |

Hotelling $T^2$ test on individual groups revealed that there is significant difference between males and females on the linear combination of Age, Creatinine, Duration of Diabetes, Glucose and Pulse, with a value of 33.48 and P-value of 0.000. On the other hand, there is no significant difference between married and single. This was suggested by $T^2$ value of 11.28 and P-value of 0.0536, as shown in Table 4.11.

**Table 4.11 Testing for Equality of Group Means**

| Source | $T^2$ | $F_c$ | $F^*$ | P>F |
|---|---|---|---|---|
| Sex | 33.48 | 6.58 | F(5, 224)= 6.58 | 0.0000 |
| MStatus | 11.28 | 2.22 | F(5, 224)=2.22 | 0.0536 |

From the parameter estimates in Table 4.12, it can be seen that respondents differ statistically in only age and creatinine levels.

**Table 4.12 Parameter Estimation**

| Dept. Var. | Parameter | Bound | Std. Err. | t | P | Partial Eta Sq. | C.I | Power |
|---|---|---|---|---|---|---|---|---|
| Age | Intercept | 60.05 | 1.30 | 46.29 | 0.000 | 0.905 | 57.50-62.61 | 1.00 |
| | Single | 6.17 | 1.83 | 3.38 | 0.001 | 0.048 | 2.57-9.77 | 0.920 |
| | Female/ Single | -6.06 | 2.58 | -2.34 | 0.022 | 0.024 | -11.15- -0.97 | 0.646 |
| Creatinine | Intercept | 1.60 | 0.02 | 101.06 | 0.000 | 0.978 | 1.57-1.63 | 1.00 |
| | Single | 0.06 | 0.02 | 2.56 | 0.011 | 0.028 | 0.01-0.10 | 0.721 |

According to the model diagnostics in Table 4.13, it can be seen that the two-way MANOVA model is good for fitting the data since there are no error variations (Partial Eta Square) in all the dependent variables, and that estimates provided by the model are valid inferences.



**Table 4.13 Model Fitness**

| Dept. Var | Source | SS | df | MS | Partial Eta Sq. | Noncent. Para. |
|---|---|---|---|---|---|---|
| Age | Lack of fit | 0.000 | 0 | 0 | 0.000 | 0.000 |
| | Pure Error | 21681.636 | 226 | 95.936 | | |
| Creatinine | Lack of fit | 0.000 | 0 | 0 | 0.000 | 0.000 |
| | Pure Error | 3.222 | 226 | 0.014 | | |
| DoD | Lack of fit | 0.000 | 0 | 0 | 0.000 | 0.000 |
| | Pure Error | 489.728 | 226 | 2.167 | | |
| Glucose | Lack of fit | 0.000 | 0 | 0 | 0.000 | 0.000 |
| | Pure Error | 156.817 | 226 | 0.694 | | |
| Pulse | Lack of fit | 0.000 | 0 | 0 | 0.000 | 0.000 |
| | Pure Error | 651.472 | 226 | 2.883 | | |

Bootstrapped estimates were obtained from 1000 replications for some MANOVA parameters and the results were similar to that of the actual MANOVA parameter estimates with zero bias, as in Table 4.14.

**Table 4.14 Comparison of Estimates**

| Dpt. Var. | Type | Para. | S. Err. | t | P | P.E Sq. | C.I | Power |
|---|---|---|---|---|---|---|---|---|
| Age | Manova | Intercept | 1.30 | 46.29 | 0.000 | 0.905 | 57.50-62.61 | 1.000 |
| | **Bootstr.** | Intercept | 1.30 | 46.29 | 0.000 | 0.905 | 57.50-62.61 | 1.000 |
| | Manova | Single | 1.83 | 3.38 | 0.001 | 0.048 | 2.57-9.77 | 0.920 |
| | **Bootstr.** | Single | 1.83 | 3.38 | 0.001 | 0.048 | 2.57-9.77 | 0.920 |
| | Manova | Female/ Single | 2.58 | -2.34 | 0.022 | 0.024 | -11.15- -0.97 | 0.646 |
| | **Bootstr.** | Female/ Single | 2.58 | -2.34 | 0.022 | 0.024 | -11.15- -0.97 | 0.646 |
| Creatinine | Manova | Intercept | 0.02 | 101.06 | 0.000 | 0.978 | 1.57-1.63 | 1.000 |
| | **Bootstr.** | Intercept | 0.02 | 101.06 | 0.000 | 0.978 | 1.57-1.63 | 1.000 |
| | Manova | Single | 0.02 | 2.56 | 0.011 | 0.028 | 0.01-0.10 | 0.721 |
| | **Bootstr.** | Single | 0.02 | 2.56 | 0.011 | 0.028 | 0.01-0.10 | 0.721 |



### 4.3 Probit Regression Analysis

Probit regression analysis was carried out as a follow-up model to classify respondents based on their sex and marital status. From Table 4.15, it can be seen that the model converged with a log-likelihood value of -144.061 for sex. From the results of the analysis without predictor variables, it can be seen that the overall percentage of

correctly classifying the respondents is 50.0. This means that the model predicted that all the respondents are men. The amount of variation in sex accounted for by the model is 9.6%; Pseudo R-squared = 0.096.

**Table 4.15 Baseline Classification for Sex**

| Observe | | Predicted | | |
|---|---|---|---|---|
| | | Sex | | Percentage |
| | | Female | Male | Correct |
| Sex | Female | 0 | 115 | 0.0 |
| | Male | 0 | 115 | 100.0 |
| Overall % | | | | 50.0 |

From the Omnibus test of model coefficients in Table 4.16, it can be observed that the model with the set of predictor variables is better ($P < 0.05$) than the one without predictor variables.

**Table 4.16 Model Performance for Sex**

| Chi-Square | Df | Sig. |
|---|---|---|
| 30.73 | 5 | 0.000 |

Model fitness was assessed using Hosmer and Lemeshow Test. From Table 4.17, it can be seen that the Hosmer-Lemeshow goodness of fit is insignificant with the test statistic of 230.41 and P-value of 0.269, indicating that the model is fit.

**Table 4.17 Hosmer-Lemeshow Model Fitness for Sex**

| Chi-Square | df | Sig. |
|---|---|---|
| 230.41 | 218 | 0.269 |



It can also be seen from Table 4.18 that age, duration of diabetes, glucose level and pulse rate contribute significantly to the model ($P < 0.05$). The difference that exists between males and females is in terms of age and creatinine levels of respondents. A unit change in age, creatinine level and glucose level, increases the probability of being classified as a man. However, a unit change in duration of diabetes and pulse rate increases the probability of being classified as a woman.

**Table 4.18 Testing for Significance in Predictors with Sex**

| Sex | Coeff | Std. Err | z | P>\|z\| | 95% CI | |
|---|---|---|---|---|---|---|
| Age | 0.039 | 0.009 | 4.61 | 0.000 | 0.023 | 0.056 |
| Creatinine | 1.605 | 0.722 | 2.22 | 0.026 | 0.190 | 3.021 |
| DoD | -0.087 | 0.062 | -1.40 | 0.160 | -0.209 | 0.035 |
| Glucose | 0.020 | 0.106 | 0.19 | 0.850 | -0.188 | 0.228 |
| Pulse | -0.018 | 0.051 | -0.36 | 0.722 | -0.119 | 0.082 |
| Constant | -3.228 | 4.477 | -0.72 | 0.471 | -12.00 | 5.546 |

From the classification analysis in Table 4.19, it can be seen that the model has overall correctly predicted 68.3% of the respondents. This is an improvement over the 50.0% prediction in the earlier case. It can also be seen that 67.8% (specificity) of the women have been correctly classified while 68.7% (sensitivity) of the men have been correctly classified. The positive predictive value was 68.1%; the value the model accurately predicted as men from the respondents. Also, the negative predictive value was 68.4%.



**Table 4.19 Prediction Classification for Sex**

| Observe | | Predicted | | |
|---|---|---|---|---|
| | | Sex | | Percentage |
| | | Female | Male | Correct |
| Sex | Female | 78 | 37 | 67.8 |
| | Male | 36 | 79 | 68.7 |
| Overall % | | | | 68.3 |

The log-likelihood for marital status in Table 4.20 is observed to be -153.863. Wald's chi-square test value of 11.12 and a P-value of 0.049, suggested that the model is fit to model the data since it can perform better than a model without predictors. The amount of variation in marital status accounted for by the model is 3.5%; pseudo R-squared is 0.035.

**Table 4.20 Model Performance for Marital Status**

| Chi-Square | Df | Sig |
|---|---|---|
| 11.12 | 5 | 0.049 |

Model fitness was assessed using Hosmer and Lemeshow test. From Table 4.21, it can be seen that the Hosmer-Lemeshow goodness of fit is not significant with test statistic of 225.84 P-value of 0.344, affirming goodness of fit.

**Table 4.21 Hosmer-Lemeshow Model Fitness for Marital Status**

| Chi-Square | df | Sig. |
|---|---|---|
| 225.84 | 218 | 0.344 |

Apart from creatinine level, the rest of the variables in Table 4.22 are statistically significant since their P- values are less than 0.05. It can be seen that for 1 unit change in each of the variables, there is an increased probability of being classified as single. Married and single differ in only age and creatinine level.

**Table 4.22 Testing for Significance in Predictors for Marital Status**

| Mstatus | Coeff | Std. Err | z | P>\|z\| | 95% CI | |
|---|---|---|---|---|---|---|
| Age | -0.017 | 0.008 | -2.11 | 0.035 | -0.033 | -0.001 |
| Creatinine | -1.567 | 0.706 | -2.22 | 0.026 | -2.951 | -0.183 |
| DoD | -0.028 | 0.059 | -0.47 | 0.638 | -0.144 | 0.088 |
| Glucose | -0.021 | 0.103 | -0.21 | 0.836 | -0.223 | 0.181 |
| Pulse | -0.038 | 0.050 | -0.75 | 0.454 | -0.136 | 0.061 |
| Constant | 6.933 | 4.436 | 1.56 | 0.118 | -1.762 | 15.63 |

From the classification analysis in Table 4.23, it can be seen that the model has overall correctly predicted 57.4% of the respondents. This is an improvement over the 50.0% prediction in the earlier case. It can also be seen that 57.4% (specificity) of the women have been correctly classified while 57.4% (sensitivity) of the men have been correctly classified. The positive predictive value was 57.4%; the value the model accurately predicted as married from the respondents. Also, the negative predictive value was 57.4%. This means that the single and the married did not differ in how diabetes induced sexual dysfunction.



**Table 4.23 Prediction Classification for Marital Status**

| Observe | | Predicted | | |
|---|---|---|---|---|
| | | Sex | | Percentage |
| | | Female | Male | Correct |
| Sex | Female | 66 | 49 | 57.4 |
| | Male | 49 | 66 | 57.4 |
| Overall % | | | | 57.4 |

Figure 4.2 shows the graphs of areas under receiver operating characteristic (ROC) curves for sex and marital status of respondents. The proportion of the observations that were correctly predicted by the model to be positive (true positive rate) was plotted against the proportion of the observations that were incorrectly predicted to be positive (false positive rate). It can be seen from Figure 4.2 that the ROC curve for the sex is closer to 1 (sensitivity), affirming that the model is performing better. Again, the ROC

curve for marital status is not so close to 1 as compared to the model for sex of respondents, suggesting that the sex model has a higher classification or predictive ability than that of marital status (Cook and Rajbhandari, 2018).

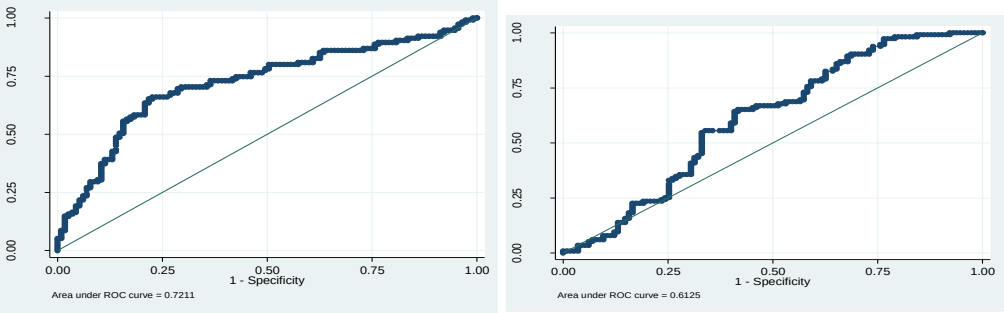


**Figure 4.2 Areas under ROC Curve for Sex and Marital Status**

Figure 4.3 is the ROC curve classification criteria for sex and marital status under probit model. It can be seen that the ROC probability cutoff is 0.5; for sex, any observation that is less than the cutoff (0.125 – 0.500) is classified as a woman, and above the cutoff (0.5000 – 0.8125) is classified as a man; for marital status, any observation that is less than the cutoff (0.300 – 0.500) is classified as single, and above the cutoff (0.50 – 0.75) is classified as married.

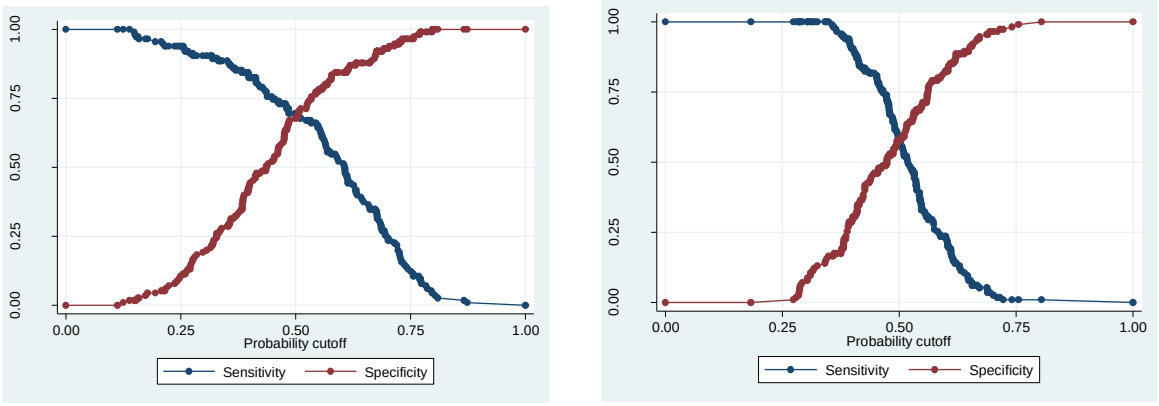


**Figure 4.3 ROC Probability Cutoff for Sex and Marital Status**

### 4.4 Logistic Regression Analysis

Logistic regression analysis was carried out as an alternative follow-up model to classify respondents based on their sex and marital status. The logistic model produced very similar results to the probit model. The model converged with a log-likelihood value of -143.824 for sex. From the results of the analysis without predictor variables in Table 4.24, it can be seen that the overall percentage of correctly classifying the respondents is 50.0. This means that the model predicted that all the respondents are men.

**Table 4.24 Baseline Classification for Sex**

| Observe | | Predicted | | |
|---|---|---|---|---|
| | | Sex | | Percentage |
| | | Female | Male | Correct |
| Sex | Female | 0 | 115 | 0.0 |
| | Male | 0 | 115 | 100.0 |
| Overall % | | | | 50.0 |



From the Omnibus test of model coefficients in the Table 4.25, it can be observed that the model with the set of predictor variables is better ($P < 0.05$) than the one without predictor variables.

**Table 4.26 Model Performance for Sex**

| | Chi-Square | df | Sig. |
|---|---|---|---|
| Step | 31.20 | 5 | 0.000 |
| Block | 31.20 | 5 | 0.000 |
| Model | 31.20 | 5 | 0.000 |



Model fitness was assessed using Hosmer and Lemeshow test. From Table 4.26, it can be seen that the Hosmer-Lemeshow goodness of fit is not significant with a statistic of 231.93 and P-value of 0.247, indicating model fitness.

**Table 4.26 Hosmer-Lemeshow Model Fitness for Sex**

| Step | Chi-Square | Df | Sig |
|---|---|---|---|
| 1 | 231.95 | 218 | 0.247 |

From Table 4.27, it can be observed that the amount of variation in sex explained by the model is between 12.7% and 16.9%; the Cox and Snell R = 0.127 and Nagelkerke R Square = 0.169, suggesting that the logit model is good to model the data. The loglikelihood of the model is 287.166.

**Table 4.27 Explained Variations in Sex**

| Step | -2Log Likelihood | Cox and Snell R Square | Nagelkerke R Square |
|---|---|---|---|
| 1 | 287.166 | 0.127 | 0.169 |

From the classification analysis in Table 4.28, it can be seen that the model has overall correctly predicted 69.1% of the respondents. This is an improvement over the 50.0% prediction in the earlier case. It can also be seen that 69.6% (specificity) of the women have been correctly classified while 68.7% (sensitivity) of the men have been correctly classified. The positive predictive value was 69.3%; the value the model accurately predict as men from the respondents. Also, the negative predictive value was 69.0%.



**Table 4.28 Prediction Classification for Sex**

| Observe | | Predicted | | |
|---|---|---|---|---|
| | | Sex | | Percentage |
| | | Female | Male | Correct |
| Sex | Female | 80 | 35 | 69.6 |
| | Male | 36 | 79 | 68.7 |
| Overall % | | | | 69.1 |

From Table 4.29, it can be observed that age, duration of diabetes, glucose level and pulse rate are significant to the model since their P values are less than 0.05. It can also be observed that a unit increase in age, creatinine level and glucose level increases the probability of being a man whilst a unit increase in duration of diabetes and pulse rate increases the probability of being a woman. Also, Men and women differ in age and creatinine level ($z < 0.05$).

**Table 4.29 Testing for Significance in Predictors with Sex**

| | B | S.E | Z | Sig. | Lower | Upper |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Age | 0.067 | 0.015 | 4.47 | 0.000 | 0.037 | 0.096 |
| Creatinine | 2.633 | 1.183 | 2.22 | 0.026 | 0.313 | 4.952 |
| DoD | -0.140 | 0.102 | -1.38 | 0.168 | -0.340 | 0.060 |
| Glucose | 0.027 | 0.175 | 0.16 | 0.876 | -0.315 | 0.370 |
| Pulse | -0.031 | 0.084 | -0.37 | 0.712 | -0.196 | 0.134 |
| constant | -5.294 | 7.445 | -0.71 | 0.477 | -19.89 | 9..297 |

The model also converged with a log-likelihood value of -153.870 for marital status. From the results of the analysis without predictor variables in Table 4.30, it can be seen that the overall percentage of correctly classifying the respondents is 50.0. This means that the model predicted that all the respondents are men.

**Table 4.30 Baseline Classification for Marital Status**

| Observe | | Predicted | | |
|---|---|---|---|---|
| | | Sex | | Percentage |
| | | Female | Male | Correct |
| Sex | Female | 0 | 115 | 0.0 |
| | Male | 0 | 115 | 100.0 |
| Overall % | | | | 50.0 |

From the Omnibus test of model coefficients in Table 4.31, it can be observed that the model with the set of predictor variables is better ($P < 0.05$) than the one without predictor variables.

**Table 4.31 Model Performance**

| | Chi-Square | df | Sig. |
|---|---|---|---|
| Step | 11.110 | 5 | 0.049 |
| Block | 11.110 | 5 | 0.049 |
| Model | 11.110 | 5 | 0.049 |



Model fitness was assessed using Hosmer and Lemeshow Test. From Table 4.32, it can be seen that the Hosmer-Lemeshow goodness of fit is insignificant, affirming that the model is fit.

**Table 4.32 Hosmer-Lemeshow Model Fitness for Marital Status**

| Step | Chi-Square | df | Sig |
|---|---|---|---|
| 1 | 225.860 | 218 | 0.343 |

From Table 4.33, it can be observed that the amount of variation in sex explained by the model is between 4.9% and 6.3%; loglikelihood = 308.993, Cox and Snell R = 0.049 and Nagelkerke R Square = 0.063.

**Table 4.33 Explained Variations in Marital Status**

| Step | -2Log Likelihood | Cox and Snell R Square | Nagelkerke R. Square |
|---|---|---|---|
| 1 | 308.993 | 0.047 | 0.063 |

From the classification analysis in Table 4.34, it can be seen that the model has overall correctly classified 57.8% of the respondents. This is an improvement over the 50.0% prediction in the earlier case. It can also be seen that 57.4% (specificity) of the single

have been correctly classified while 58.3% (sensitivity) of the married have been correctly classified. The positive predictive value was 57.8%; the value the model accurately predicted as married from the respondents. Also, the negative predictive value was 57.9%.



**Table 4.34 Prediction Classification for Marital Status**

| Observe | | Predicted | | |
|---|---|---|---|---|
| | | Sex | | Percentage |
| | | Single | Married | Correct |
| Sex | Single | 66 | 49 | 57.4 |
| | Married | 48 | 67 | 58.3 |
| Overall % | | | | 57.8 |

From Table 4.35, it can be observed that age, duration of diabetes, glucose level and pulse rate are significant to the model since their P values are less than 0.05. It can also be observed that a unit increase in age, creatinine level, duration of diabetes, glucose level and pulse rate increases the probability of being a single person. The single and married differ in only age and creatinine.

**Table 4.35 Testing of Significance in Predictors with Marital Status**

| | B | S.E | Z | Sig. | Lower | Upper |
|---|---|---|---|---|---|---|
| Age | -0.028 | 0.013 | -2.09 | 0.036 | -0.054 | -0.002 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Creatinine | -2.509 | 1.141 | -2.20 | 0.028 | -4.747 | -0.271 |
| DoD | -0.045 | 0.095 | -0.47 | 0.635 | -0.233 | 0.141 |
| Glucose | -0.036 | 0.167 | -0.22 | 0.829 | -0.363 | 0.291 |
| Pulse | -0.060 | 0.081 | -0.74 | 0.460 | -0.217 | 0.098 |
| constant | 11.099 | 7.156 | 1.55 | 0.121 | -2.925 | 25.124 |



Figure 4.4 also shows the graphs of areas under ROC curves for sex and marital status of respondents. The proportion of the observations that were correctly predicted by the model to be positive (true positive rate) was plotted against the proportion of the observations that were incorrectly predicted to be positive (false positive rate). It can be seen from Figure 4.4 that the ROC curve for the sex is closer to 1 (sensitivity) and recording 72.24% ability to classify or predict the data, affirming that the model is performing better. Again, the ROC curve for marital status recorded 61.92% ability to classify or predict the data. Since the ROC curve is not so close to 1 as compared to the model for sex of respondents, the sex model is said to be doing better than that of marital status (Cook and Rajbhandari, 2018).

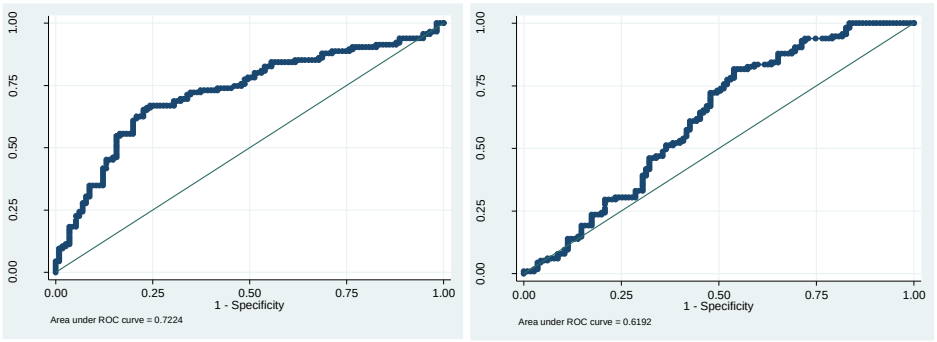


**Figure 4.4 Areas under ROC Curve for Sex and Marital Status**

Figure 4.5 is the ROC curve classification criteria for sex and marital status under the logistic model. It can be seen that the ROC probability cutoff is 0.5; for sex, any observation that is less than the cutoff (0.125 – 0.500) is classified as a woman, and above the cutoff (0.5000 – 0.8125) is classified as a man; for marital status, any observation that is less than the cutoff (0.300 – 0.500) is classified as single, and above the cutoff (0.50 – 0.75) is classified as married.

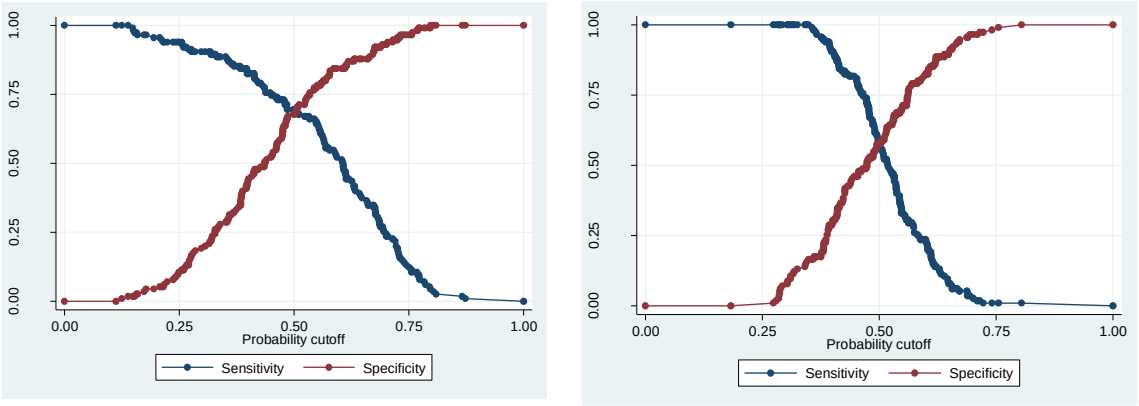


**Figure 4.4 ROC Probability Cutoff for Sex and Marital Status**

### 4.5 Model Comparison

On the basis of Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) the probit and the logistic models were compared. It can be seen from Table 4.37 that the logistic model has a higher classification or predictive power than the probit model. Also, the logistic model has a smaller AIC and BIC values than the probit model, indicating that the logistic model is better.

**Table 4.37 Model Comparison**

| Model | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Probit** | Obs | LL(null) | LL(Model) | df | AIC | BIC | ROC Curve |
| Sex | 230 | -159.424 | -144.061 | 6 | 300.123 | 320.751 | 0.7211 |
| Mstatus | 230 | -159.424 | -153.863 | 6 | 319.723 | 340.354 | 0.6124 |
| **Logit** | | | | | | | |
| Sex | 230 | -159.424 | -143.824 | 6 | 299.649 | 320.277 | 0.7224 |
| Mstatus | 230 | -159.424 | -153.870 | 6 | 319.739 | 340.368 | 0.6191 |



### 4.6 Bootstrapping

Bootstrap estimates of the standard error (SE) for sex and marital status of respondents were compared. From Table 4.38, it can be seen that bootstrap estimates for probit and logit models converged to the actual estimates (P>0.50) since the biases for both sex and marital status are infinitesimal, indicating that the model estimates are valid inferences.

**Table 4.38 Bootstrapped Estimates for the Models.**

| Model | Obs | Coeff | S.E | Z | P>\|z\| | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| Probit | 230 | 1 | 0.501 | 2.00 | 0.05 | 0.018 | 1.982 |
| Logit | 230 | 1 | 0.501 | 2.00 | 0.05 | 0.018 | 1.982 |



### 4.5 Discussions

The mean age of the respondents was 59.9 years, which ranged from 30-89 years. Several studies on sexual dysfunction reported ages ranging between 18-70 years (Molouk *et al*., 2013; Edward *et al*., 1999; Esposito, 2010). The disparity in the ages might be as a result of the diabetes factor of the study. The mean glucose level was 8.21ml/dl, ranging from 7ml/dl-9ml/dl, falling within the diabetic range of between 5.6-6.9 (mayo Clinic, 2019). The average pulse rate was 82.6bpm, and ranged from 80-85bpm. Since normal pulse rate is below 100bpm (Mayo Clinic, 2019), it can be said that diabetes does not independently influence the pulse rate. The mean duration of diabetes was 4.2 years, with a minimum and maximum of 1 and 7 years, respectively. Some studies have reported higher duration of diabetes (Hermans *et al*., 2009). The mean creatinine level was 1.6ml/dl, which ranged from 1.3-1.9ml/dl. The values reported in this study fell out of the normal creatinine level, affirming diabetes, according to the diabetes literature (Mayo clinic, 2019).

Sexual dysfunction among diabetic patients was age related, and that patients between 50-79 years of age mostly experience severe sexual dysfunction. Sexual dysfunction also affects marriage satisfaction. The ability of an individual to sexually satisfy the

partner improves their marital satisfaction. While men and women differ according to age and creatinine levels, they do not differ in their marital status. This study reported that men and women do not differ in the effects of duration of diabetes, glucose levels and pulse rates, on their sexual function. The logistic model classified the data better than the probit model though they both produced very similar results, affirming the information from other studies (Tabachnick and Fidell, 2001). From the test of between-subjects effects, it can be seen that respondents differ in only age and creatinine level, since the P values are less than 0.01.

The proportion of the variance in age explained by sex was 0.100 (10%), which is considered high but that in creatinine level was 0.032 (3.2%), which is considered low (Cohen, 1988). The power of the test for age and creatinine level under sex and marital status is (0.999, 0.779) and (0.678, 0.669), respectively (Tabachnick and Fidell, 2001). For age, the mean score for males is lower (58.32) than the females (61.52). Also, for creatinine, the mean score for males is lower (1.586) than in females (1.624). Although, statistically significant, the actual difference in the two mean scores was 3.2 scale points for age and 0.038 for creatinine.



The probit regression models are as follows;

For sex,

$$P(y = 1/x\_j) = -3.23 + 0.04age1.61creat - 0.09DoD + 0.02glucose - 0.02pulse$$

For marital status,

$$P(y = 1/x\_j) = 6.93 + 0.02age + 1.57creat - 0.03DoD + 0.02glucose - 0.04pulse$$

The logit regression models are asfollows;

For sex,

$$P(y = 1/x\_j) = -5.29 + 0.07age + 2.63creat - 0.14DoD + 0.03glucose - 0.03pulse$$

For marital status,

$$P(y = 1/x\_j) = 11.10 - 0.03age - 2.51creat - 0.05DoD - 0.04glucose - 0.06pulse$$



# CHAPTER FIVE

# SUMMARY, CONCLUSION AND RECOMMENDATIONS

## 5.0 Introduction

This chapter consists of the overview of the analysis, conclusion and some possible recommendations.

## 5.1 Summary of Results

The study was conducted to investigate whether there is a significant difference between diabetic men and women, and between married and single who had sexual dysfunction, in terms of age, creatinine levels, duration of diabetes, glucose and pulse rates. The study consisted of 115 men and 115 women, and the same selection for married and single. Erectile dysfunction was defined as the continuous inability of a man to attain a satisfactory erection for a successful sexual intercourse. Female sexual dysfunction was also defined as the inability of a woman to enjoy a complete sexual activity. It was reported from the analysis of the data that diabetic-induced sexual dysfunction is age related, and that diabetic patients between the ages of 40 and 79 years had severe sexual dysfunction. The mean duration of diabetes was found to be 4.2 years. The study also revealed that sexual dysfunction affected the satisfaction and happiness of the marriage.

A two-way between groups multivariate analysis of variance was performed to investigate whether there is a significant difference between male and female, and married and single. Five dependent variables were used: age, creatinine levels, duration of diabetes, glucose levels and pulse rates. The independent variables were



sex and marital status. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity, with no serious violations noted. There was a statistically significant difference between males and females on the dependent variables: F (5, 223) = 34.00, P = 0.00; Wilk's lambda = 0.55. When the results for the dependent variables were considered separately using the logit and the probit regression models, only age and creatinine levels reached statistical significance. An inspection of the mean scores indicated that males recorded slightly higher scores in the dependent variables than the females and the single recorded slightly higher values than the married, as presented in appendix B. There was also a significant difference between married and single on the dependent variables; F (5, 223) = 25.74, P = 0.00; Wilk's lambda = 0.63. But when individual groups were tested using Hotelling $T^2$, it was revealed that only sex was statistically significantly different; F (5, 224) = 6.58, P = 0.00 for sex and F (5, 224) = 2.22, P = 0.0536 for marital status. The interaction effect was not statistically significant; F (5, 223) = 17.55, P = 0.06 and Wilk's lambda = 0.72. Probit and logit models were used to classify and predict observations. It was revealed that logit model has a higher predictive and classification power than the probit model, though they both produced very similar results. Bootstrapping was performed to check the sensitivity of the models. It was revealed that the bootstrapped estimates converged to the actual estimates.

## 5.2 Conclusion

Diabetic men and women, as well as single and married, differ in terms of their age and creatinine levels. There is a highly positive correlation between sexual dysfunction and satisfactory relationship between couples. Diabetic patients within 50-69 years have a high tendency of experiencing sexual dysfunction. Sex model performed better than the marital status model. Finally, it can be concluded that logit regression model classified the data better than the probit model, though both produce similar results.

## 5.3 Recommendations

In view of the results of the analysis and the conclusion, the following recommendations are made;

1. People should improve on their lifestyles to avoid diabetes and sexual dysfunction.
2. Further research is needed on the differences between diabetic men and women.
3. The media should intensify education on good lifestyles that improve health and better sexual function.



## REFERENCE

Adekanmbi, D. B. (2017). Comparison of probit and logit models for binary response variable with applications to birth data in South-Western Nigeria. *American Journal of Mathematics and Statistics*, **7**(5): 199-208.

Akre, C., Berchtold, A., Gmel, G., and Suris, J. C. (2014). The evolution of sexual dysfunction in young men aged 18-25 years. *Journal of Adolescent Health*, **55**(6): 736-743.

American Psychiatric Assosiation: Diagnostic and Statistical Manual of mental Disorders. Fourth Ed. (1994).

Anderson, S. H., Rymer, J., Joyce, D. W., Momoh, C., and Gayle, C. M. (2012). Sexual quality of life in women who have undergone female genital mutilation: a case-control study. *BJOG,* **119**(13): 1606-1611.

Arafa, A. E., Elbahrawe, R. S., Shawky, S. M., Mostafa, A. M., Ahmed, S. S., El-Houfey, A. A., and Abbas, A. M. (2018). Risk factors associated with female sexual dysfunction among married women in Upper Egypt: a cross-sectional study. *International Journal of Community Medicine and Public Health*, **5**(2): 449-453.

Araujo, A. B., Durante, R., Feldman, H. A., Goldstein, I. and McKinlay, J. B. (1998). The relationship between depressive symptoms and male erectile dysfunction: cross-sectional results from the Massachussetts Male Aging Study. *Psychosomatic Medicine,* **60**(4): 458-465.

Araujo, A. B., O'Donnell, A. B., Brambilla, D. J., Simpson, W. B., Longcope, C., Matsumoto, A. M., and McKinlay, J. B. (2004). Prevalence and incidence of androgen deficiency in middle-aged men: estimates from the Massachusetts Male Aging Study. *Journal of Clinical Endocrinology and Metabolism*, **89**(12): 5920-5926.

Ashby, J., and Goldmeier, D. (2010). Postorgasm illness syndrome: A spectrum of illnesses. *The Journal of Sexual Medicine*, **7**(5): 1976-1981.

Ayta, I. A., McKinlay, J. B., and Krane, R. J. (1999). The likely worldwide increase in erectile dysfunction between 1995 and 2025. *Biomedical Journal of Urology International*, **84**(1): 50-56.

Basson, R., Berman, J., Burnett, A., Derogatis, L., Ferguson, D., and Fourcroy, J. (2000). Report of the international consensus development conference on female sexual dysfunction: definitions and classifications. *Journal of Urology*, **163**(3): 888-893.

Blackburn, H., and Jacobs, D. Jr. (2014). "Commentary: Origins and evolution of body mass index (BMI): continuing saga". *International Journal of Epidemiology*, **43**(3): 665-669.

Bonnie, R., and Saks, M. D. (2008). Common issues in female sexual dysfunction. *Psychiatric Times*, **25**(5): 1-2.

Brindley, G. S., and Gillan, P. (1982). Men and women who do not have orgasm. *The Britsh Journal of Psychiatry*, **140**(4): 351-356.

Campbell, M. M., and Stein, D. J. (2014). Sexual dysfunction: a systematic review of South African research. *South African Medical Journal*, **104**(6): 440-444.

Castleman, M. A. (2013). "Hysteria" and the strange history of vibrators. *Psychology Today*.

Chedraui, P., Perez-Lopez, F. R., Sanchez, H., Aguirre, W., Martinez, N., Miranda, O., Plaza, M. S., Schwager, G., Narvaez, J., Quintero, J. C., and Zambrano, B. (2012). Assessment of sexual function of mid-aged Ecuadorian women with the 6-item female sexual function index. *Maturitas*, **71**(4): 407–412.

Cho, N. H., Ahn, C. W., Park, J. Y., Ahn, T. Y., Lee, H. W., Park, T. S., Kim, I. J., Pomerantz, K., Park, C., Kimm, K. C., and Choi, D. S. (2005). Prevalence of erectile dysfunction in Korean men with type 2 diabetes mellitus, *Diabetes Medicine*, **23**(2): 198-203.

Clark, R. D. (2007). Heart rate variability in male sexual arousal and erectile dysfunction. Department of medical and clinical psychology, uniformed services University of health sciences.

Clayton, A. H., Kingsberg, S. A., and Goldstein, I. (2018). Evaluation and management of hypoactive sexual desire disorder. *Sexual Medicine*, **6**(2): 59-74.

Condra, M., Morales, A., Owen, J. A., Surridge, D. H., and Fenemore, J. (1986). Prevalence and significance of tobacco smoking in impotence. *Urology*, **27**(6): 495-498.

Conte, H. R. (1986). Development and use of self-report techniques for assessing sexual functioning: a review and critique. *Archive of Sexual Behavior*, **12**(6): 555–576.

Cook, J. A., and Rajbhandari, A. (2018). Heckroc: ROC curves for selected samples. *Stata Journal*, **18**(1): 174-183.

Corona, G., Giorda, C. B., Cucinotta, D., Guida, P., Nada, E., and the SUBITO-DE study group. (2013). The SUBITO-DE Study: Sexual dysfunction in newly diagnosed type 2 diabetes in male patients. *Journal of Endocrinological Investigation*, **36**(10): 864–868.

Corona, G., Giorda, C. B., Cucinotta, D., Guida, P., and Nada, E. (2013). Sexual dysfunction in newly diagnosed type 2 diabetes in male patients. *Journal of Endocrinology Investigations*, **36**(10): 864–868.

Cox, D. J., Gonder-Frederick, L., and Saunders, J. T. (1991). *Diabetes: Clinical Issues and Management*. In: Sweet J, Rosensky R, Tovian. 2nd (Ed). Handbook of clinical psychology in medical settings: Plenum Press, pp. 473-496.

"Creatinine". *Mayo Clinic*. Retrieved 9th March 2019. "Diabetes- diagnosis and treatment". *Mayo Clinic*. Retrieved on the 9th March 2019.

Dempster, M., McCarthy, T., and Davies, M. (2011). Psychological adjustment to type 2 diabetes and relationship quality. *Diabetes Medicine*, **28**(4): 487-492.

Derogatis, L. R., and Mellisaratos, N. (1979). Derogatis sexual functioning inventory (DSFI): A multidimensional measure of sexual functioning. *Journal of Sex and Marital Therapy*, **5**(3): 244-281.

Diokno, A. C., Brown, M. B., and Herzog, A. R. (1990). Sexual function in the elderly. *Archives of Internal Medicine*, **150**(1): 197-200.

Doruk, H. Akbay, E. Cayan, S. Bozlu, M., and Acar, D. (2009). Effects of diabetes mellitus on female sexual function and risk factors. *Archives of Andrology*, **51**(1): 11-16.

Eckhard, C. (1963). *Untersuchungen über die Erecktion des Hundes In*: Beitrage zur Anatomie und Physiologie. Vol. Band III Giessen.

Eden, K. J., and Wylie, K. R. (2009). Quality of sexual life and menopause. *Women's Health (London)*, **5**(4): 385-396.

Elyasi, F., Kashi, Z., Tasfieh, B., Bahar, A., and Khademloo, M. (2015). Sexual dysfunction in women with type 2 diabetes mellitus. *Iranian Journal of Medical Sciences*, **40**(3): 206-213.

Enigue, P. (2016). Probit or logit: ladies and gentlemen, pick your weapon. *The Stata blog*.

Enzlin, P., Mathieu, C., Van Den Bruel, A., Vanderschueren, D., and Demyttenaere, K. (2003). Diabetes and female sexual functioning: A state of the art. *Diabetes Spectrum*, **16**(4): 256-259.

Enzlin, P., Mathieu, C., Van Den Bruel, A., Vanderschueren, D., and Demyttenaere, K. (2003). Prevalence and predictors of sexual dysfunction in patients with type 1 diabetes. *Diabetes Care*, **26**(2): 409–414.

Ergun, O., and Simten, M. (2006). Prevalence and risk factors for female sexual dysfunction In Turkish women. *The Journal of Urology*, **175**(2): 654-658.

Ergun, O., and Simten. M. (2006). Prevalence and risk factors for female sexual dysfunction in Turkish women. *The Journal of Urology*, **175**(2): 654-658.

Erol, B., Tefekli, A., Ozbey, I., Salman, F., Dincag, N., Kadioglu, A., and Tellaloglu, S. (2011). Sexual dysfunction in type 2 diabetic females: a comparative study. *Journal of Sex and Marital Therapy*, **28**(1): 55-62.

Esposito, K., Ciotola, M., Marfella, R., Di Tommaso, D., Cobellis, L., Giugliano, D., and Eugen, H. (2005). Probit and Logit models: Differences in the multivariate realm. *ResearchGate*.

Esposito, K. (2010). Determinants of female sexual dysfunction in type 2 diabetes. *International Journal of Impotence Research*, **22**(3): 179-184.

Esposito, K. (2010). Determinants of female sexual dysfunction in type 2 diabetes. *International Journal of Impotence Research*, **22**(3): 179-184.

Fariba, M. G., Rozita, J., Amirreza, A., Mansoureh, T., Mohammed, A. S., and Mehdi, M. (2016). Comparison of sexual dysfunction in women with fertility and without fertility referred to Al-Zahra hospital in 2013-2014. *ResearchGate*.

Feldhaus-Dahir, M. (2009). Female sexual dysfunction: Barriers to treatment. *Urology Nursing*, **29**(2): 81-86.

Feldman, H. A., Goldstein, I., Hatzichristou, D. G., Krane, R. J., and Mckinlay, J. B. (1994). Impotence and its medical and psychological correlates: Results of the Massachusetts male aging study. *The Journal of Urology*, **151**(1): 54-61.

Fisher, L., Chesla, C., Chun, K. M., Skaff, M. M., and Mullan, J. T. (2004). Patient-appraised couple emotion management and disease management among Chinese- American patients with type 2 diabetes. *Journal of Family Psychology*, **18**(2): 302-310.

Foresta, C., Caretta, N., Corona, G., Fabbri, A., Francavilla, S., Jannini, E., Maggi, M., Bettocchi, C., and Lenzi, A. (2009). Clinical and metabolic evaluation of subjects with erectile dysfunction: A review with proposal flowchart. *International Journal of Andrology*, **32**(3): 198-211.

Garratt, A. M., Torgerson, D. J., Wyness, J., Marion, H. H., and David, M. R. (1995). Measuring sexual–functioning in premenopausal women. *BJOG*, **102**(4): 311–316.

Gelfand, M. M. (2000). Sexuality among older women. *Journal on Women's Health Gender Based*, **9**(1): 15–20.

Gholipour, B. (2018). What is a normal heart rate? *Live Science.*

Giorgi, P. M., Canale, D., Turchi, P., Lencioni, R., Macchia, E. (1992). Recent diagnostic and therapeutic aspects in male Sexual impotence. *Recenti Program Medicine*, **83**(11): 614–620.

Guay, A. T. (2007). Erectile dysfunction=Endothelial dysfunction. *Endocrinology Metabolic Clinic of North America*, **36**(2): 453–463.

Hall, S. A., Shackleton, R., Rosen, R. C., and Araujo, A. B. (2010). Sexual activity, erectile dysfunction, and incident cardiovascular events. *The American Journal of Cardiology*, **105**(2): 192-197.

Hsieh, C. H., Hsieh, J. T., Chang, S. J., Chiang, I. N., and Yang, S. S. D. (2015). Penile venous surgery for treating erectile dysfunction: Past, present and future perspectives with regard to new insights in venous anatomy. *Urological science*, **27**(2): 60-65.

Hudson, W. W. (1992). *Index of Sexual Satisfaction*. Walmyr assessment scales scoring manual. F. L., USA: Walmyr Publishing.

International Classification of Diseases (2014). World Health Organization. Retrieve on the 12th of June, 2019.

Ishak, I. H., Low, W. Y., and Othman, S. (2010). Prevalence, risk factors and predictors of female sexual dysfunction in a primary care setting. *The International Journal of Sexual Medicine*, **7**(9): 3080-3087.

Johannes, C. B., Araujo, A. B., Feldman, H. A., Derby, C. A., Kleinman, K. P., and McKinlay, J. B. (2000). Incidence of erectile dysfunction in men 40 to 69 years old: Longitudinal results from the Massachusetts male aging study. *Journal of Urolology*, **163**(2): 460–463.

Johnson, R. A., and Wichern, D. W. (1982). *Applied multivariate Statistical Analysis.* Fith Edition. London, Prentice Hall: Pearson Education Inc.

Juenemann, K. P., Lue, T. F., Luo, J. A., Benowitz, N. L., Abozeid, M., and Tanagho, E. A. (1987). The Effect of cigarette smoking on penile erectile. *Journal of Urology*, **138**(2): 438-441.

Junor, J. J. (2005). An address by Hon. John J. Junor, Minister of health at National fund media breakfast October 27, 2005. Retrieved on May, 2011.

Kinsberg, S. A. (2000). The psychological impact of aging on sexuality and relationships. *Journal of Women's Health and Gender Based Medicine*, **9**(1): 33–38.

Klasco, R. (2018). Which drug for erectile dysfunction is better: viagra or cialis? *The New York Times*.

Klein, R., Klein, B. E. K., and Moss, S. E. (2003). Ten-years incidence of self- reported erectile dysfunction in people with long-term type 1 diabetes. *Journal of Diabetes and Its Complications,* **19**(1): 35-41.

Kolodny, R. C., Kahn, C. B., Goldstein, H. H., and Barnett, D. M. (1974). Sexual dysfunction in diabetic men. *Diabetes*, **23**(4): 306-309.

Kubin, M., Wagner, G., and Fugl-Meyer, A. R. (2003). Epidemiology of erectile dysfunction. *International Journal of Impotence Research*, **15**(1): 63-71.

Kukulo, K., Gürsoy, E., and Sözer, G. A. (2009). Turkish University students' beliefs in sexual myths. *Sexual Disability*, **27**(1): 49-59.

Laan, E., Walter, E., and Andrea, E. (1995). Assessment of female sexual arousal: response specificity and construct validity. *Psychophysiology,* **32**(5): 476-485.

Laumann, E., Paik, A., and Rosen, R. C. (1999). Sexual dysfunction in the United States*: The Journal of the American Medical Association*, **281**(6): 537-544.

Lawrance, K., and Byers, E. S. (1995). Sexual satisfaction in heterosexual long-term relationships: The interpersonal exchange model of Sexual Satisfaction. *Personal Relationship*, **2**(4): 267-285.

Lindau, S. T., Tang. H., Gomero, A., Vable, A., Huang, E. S., Drum, M. L., Qato, D. M., and Chin, M. H. (2010). Sexuality among middle-aged and older adults with diagnosed and undiagnosed diabetes: A National population-based study. *Diabetes Care*, **33**(10): 2202-2210.

Litwin, M. S., Nied, R. J., and Dhanani, N. (1998). Health-related quality of life in men with erectile dysfunction. *Journal of Gender International Medicine*, **13**(3): 159–166.

Lou, W. J., Chen, B., Zhu, L., Han, S. M. Xu, T., Lang, J. H., and Zhang, L. (2017). Prevalence and factors associated with female sexual dysfunction in Beijing, China. *Chinese Medical Journal*, **130**(12): 1389-1394.

Mannino, D. M., Klevens, R. M., and Flanders, W. D. (1994). Cigarette smoking, an independence risk factor for impotence. *American Journal of Epidemiology*, **140**(11): 1003-1008.

Maria, I. M., Giuseppe, B., and Espotito, K. (2014). Diabetes and sexual dysfunction: current perspectives. *Diabetes, Metabolic Syndrome and Obesity*, **7** : 95-105.

Masters, W. H., and Johnson, V. E. (1966). *Human Sexual Response*. Toronto: Newyork. Bantam books ISBN 978-0-553-20429-2.

Masters, W. H., and Johnson, V. E. (1978). *Human Sexual Inadequacy*. Second Edition. London, Churchill: ISBN 978-0700001934.

McCabe, M. P., and McCabe, M. P. (1991). The Development and maintenance of sexual dysfunction: An explanation based on cognitive theory. *Sexual and Marital Therapy*. **6**(3): 245-260.

Molouk, J., Ali, K., Javaher, K., and Suhrabi, Z. (2013). Prevalence and risk factors of female sexual dysfunction. *Journal of Clinical and Diagnostic Research*, **7**(12): 2877-2880.

Montgomery, K. A. (2008). Sexual desire disorders. *Psychiatry (Edgmont)*, **5**(6): 50-55.

Moosa, Y. L. (2009). Investigating the prevalence of erectile dysfunction in a primary healthcare clinic in Kwazulu-Natal centre. Nelson R. Mandela School of medicine, University of KwaZulu-Natal. Durban, South Africa

Mulligan, J., and Moss, C. R. (1991). Sexuality and aging in male veterans: A cross-sectional study of interest, ability and activity. *Journal of Archive on Sexual Behavior,* **20**(1): 17–25.

Nicolosi, A., Glasser, D. B., Moreira, E. D., and Villa, M. (2003). Erectile dysfunction epidemiology, cross National study group: prevalence of erectile dysfunction and associated factors among men without concomitant diseases: a population Study. *International Journal of Impotence Research,* **15**(4): 253-257.

Ogbera, A. O., and Chukwuma, E. (2009). Diabetes mellitus in Nigeria: The past, present and future. *World Journal of Diabetes,* **5**(6): 905-911.

Pechorro, P., Diniz, A., and Vieira, R. (2009). Satisfação sexual feminina: Relação com funcionamento sexual comportamento sexuais [women's sexual satisfaction: Relation to sexual function and sexual behavior]. *Análise Psicológica,* **1**: 99-108.

Pedersen, M. B., Giraldi, A., Kristensen, E., Lauritzen, T., Sandbæk, A., and Morten, C. (2015). Prevalence of sexual desire and satisfaction among patients with screen-detected diabetes and impact of intensive multifactorial treatment: Results from the Addition-Denmark study. *Scandinavian Journal of Primary Health Care*, **33**(1): 3-10.

Penn State. (2008). Good sexual intercourse lasts minutes, not hours, therapists say. *ScienceDaily*.

Peter, J., Cliff, R., Barrington, L. M., and Levi, W. (2012). Prevalence of erectile dysfunction in diabetic men attending clinics in Kingston, Jamaica. *ResearchGate.*

Primomo, J., Yates, B. C., and Woods, N. F. (1990). Social support for women during chronic illness: The relationship among sources and types to adjustment. *Research of Nurse Health*. **13**(3): 153-161.

Prins, J., Blanker, M. H., Bohnen, A. M., Thomas, S., and Bosch, J. L. (2002). Prevalence of erectile dysfunction: A systematic review of population-based studies. *International Journal of Impotence Research,* **14**(6):422-432.

Rahman, S. (2009). *Prevalence, Incidence and Risk Factors of Erectile dysfunction*. Germany: VDM Verlag Dr. Muller. ISBN 10:3639114876.

Rahman, S., Rahman, T., Ismail, A. A., and Rashid, A. R. (2007). Diabetes-associated macrovasculopathy: Pathophysiology and pathogenesis. *Diabetes Obstetrics Metabolism*, **9**(6): 767–780.

Rosen, R. C., Brown, C., Heiman, J., Leiblum, S., Meston, C., Shabsigh, R., Ferguson, D., and D'Agostino, R. Jr. (2000). The female sexual function index (FSFI): A multidimensional self- report instrument for the assessment of female sexual function. *Journal of Sex and Marital Therapy*, **26**(2): 191-208.

Rosen, R. C., Riley, A., Wagner, G., Osterloh, I. H., Kirkpatrick, J., and Mishra, A. (1997). The international index of erectile function (IIEF): a multidimensional scale for assessment of erectile dysfunction. *Urology*, **49**(6): 822-830.

Safarinejad, M. R. (2006). Female sexual dysfunction in a population-based study in Iran: Prevalence and associated risk factors. *International Journal of Impotence Research*, **18**(4): 382-395.

Sanders, R. A., Cofrancesco, J., and Wu, A. W. (2005). Questionnaire to measure sexual quality of life. *Quality of Life Research.*

Song, H. S., Jeon, H., Kim, S. W., Paick, J. S., and Son, H. (2008). Prevalence and risk factors of female sexual dysfunction in young Korean women: An internet based survey. *Journal of Sexual Medicine*, **5**(7): 1694-16701.

Selvin, E., Burnett, A. L., Platz, and E. A. (2007). Prevalence and risk factors for erectile dysfunction in the U.S. *American Journal of Medicine*, **120**(2): 151-157.

Shabsigh, R., Fishman, I. J., Schum, C., and Dunn, J. K. (1991). Cigarette smoking and other vascular risk factors in vasculogenic impotence. *Urology*, **38**(3): 227-231.

Shah, J. (2002). Erectile dysfunction through the ages. *Biomedical Journal of Urology International*, **90**(4): 433-441.

Singh, J. C., Tharyan, P., Kekre, N. S., Singh, G., and Gopalakrishnan, G. (2009). Prevalence and risk factors of female sexual dysfunction in women attending a medical clinic in South India. *Journal of Postgraduate Medicine*, **55**(2): 113-120.

Siu, S. C., Lo, S. K., Wong, K. W., Ip, K. M., and Wong, Y. S. (2001). Prevalence and risk factors for erectile dysfunction in Hong Kong diabetic patients. *Diabetes Medicine*, **18**: 732-738.

Slag, M. F., Morley, J. E., Elson, M. K., Trence, D. L., Nelson, C. J., Nelson, A. E., kinlaw, W. B., and Bever, H. S. (1983). Impotence in medical clinic outpatients. *Journal of American Medical Association*, **249**: 1736–1740.

Sookdeb, S. (2007). An investigation of factors that determine when men with erectile disorder present for treatment. *Nurse Researcher*, **14**(4): 76-88.

Stekel, W. (1940). *Impotence in the Male*; The Psychic disorders of the sexual function in the male. Vol.2. New York. Liveright Publishing Corporation.

Stratton, I. M., Adler, A. I., Neil, H. A., David, R., Methews, S. E., Manley, C. A., Cull, D. H., Robert, C. T., and Rury, R. H. (2000). Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *BioMedical Journal*, **321**(7258): 405–412.

Symonds, T., Boolell, M., and Quirk, F. (2005). Development of a questionnaire on sexual quality of life in women. *Journal of Sex and Marital Therapy*, **31**: 385–397.

Tabachnick, B. G., and Fidell, L. S. (2001). *Using Multivariate Statistics* (4th Edition). New York: HarperCollins.

Ugwu, T., Ezeani, I., Onung, S., Kolawole, B., and Ikem, R. (2016). Predictors of erectile dysfunction in men with type 2 diabetes mellitus referred to a tertiary healthcare centre. *Advances in Endocrinology*.

Trief, P. M., Himes, C. L., Orendorff, R., and Weinstock, R. S. (2001). The marital relationship and psychosocial adaptation and glycemic control of individuals with diabetes. *Diabetes Care*, **24**: 1384-1389.

Tsai, T. F., Yeh, C. H., and Hwang, T. I. S. (2011). Female sexual dysfunction: Physiology, epidemiology, classification, evaluation and treatment. *Urological Science*, 22: 7–13.

United States*: The Journal of the American Medical Association*, **281(**6): 537-544.

Van Driel, M. F., Van de Wiel, H. B., and Mensink, H. J. (1994). Some Mythologic, Religious and Cultural Aspects of Impotence before the Present Modern Era. *International Journal of Impotence Research.* **6**:163-169.

Virag, R., Bouilly, P., and Frydman, D. (1985). Is impotence an arterial disorder? A study of arterial risk factors in 440 impotent men. *Lancet*, **26**: 181-184.

Voth, D., Scwarz, M., Hahn, K., Dei-Anang, K., Al Butmeh, S., and Wolf, H. (1992). Prevention of deep vein thrombosis in neurosurgical patients: A prospective double-blind comparison of two prophylactic regimen. *Neurosurg Revelation,* **15**(4): 289-294.

Vrentzos, G. E., Paraskevas, K. I., and Mikhailidis, D. P. (2007). Dyslipidemia is a risk factor of erectile dysfunction. *Current Medicinal Chemistry,* **14**(16): 1765-1770.

Watts, R. J. (1982). Sexual functioning, health beliefs, and compliance with high blood pressure medications. *Nurse Researcher,* **31**(5): 278–282.

Williams, G., and Pickup, J. C. (1999). *Sexual Problems in Diabetes*: Handbook of diabetes. M.D. Gareth. 2nd edition. Balckwell Science: Oxford. 166-170.

Young, M., Denny, G., Young, T., and Luquis, R. (2000). Sexual satisfaction among married women age 50 and older. *Psychological Research*, **86**: 1107-1122.

# APPENDICES

## Appendix A: Ho'elling $T^2$ test for Sex and Marital Status

```
. hotelling AGE CREAT DODyrs Glucose PULSE, by(SEX) notable

2-group Hotelling's T-squared = 33.477227
F test statistic: ((230-5-1)/(230-2)(5)) x 33.477227 = 6.5779814

H0: Vectors of means are equal for the two groups
            F(5,224) =    6.5780
      Prob > F(5,224) =    0.0000

. hotelling AGE CREAT DODyrs Glucose PULSE, by(MSTATUS) notable

2-group Hotelling's T-squared = 11.282694
F test statistic: ((230-5-1)/(230-2)(5)) x 11.282694 = 2.2169503

H0: Vectors of means are equal for the two groups
            F(5,224) =    2.2170
      Prob > F(5,224) =    0.0536
```



**Appendix B: Mean Scores by sex and Marital Status**

| SEX | AGE | CREAT | Glucose | DODyrs | PULSE |
|---|---|---|---|---|---|
| 0 | 56.67826 | 1.583478 | 8.20087 | 4.252174 | 82.66957 |
| 1 | 63.16522 | 1.626957 | 8.226957 | 4.06087 | 82.57391 |
| Total | 59.92174 | 1.605217 | 8.213913 | 4.156522 | 82.62174 |

| MSTATUS | AGE | CREAT | Glucose | DODyrs | PULSE |
|---|---|---|---|---|---|
| 0 | 61.52174 | 1.624348 | 8.214783 | 4.2 | 82.69565 |
| 1 | 58.32174 | 1.586087 | 8.213043 | 4.113043 | 82.54783 |
| Total | 59.92174 | 1.605217 | 8.213913 | 4.156522 | 82.62174 |