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Model Comparison and Factors Associated with Quality of Life of Type 2 Diabetic Patients: Gender Differentials

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Authors' contributions

This work was carried out in collaboration between all authors. Author KSO conceived the title, involved in statistical analysis and wrote the first draft of the manuscript. Author OOO participated in conception and wrote part of the discussion. Authors OOO and OO designed the study, wrote the protocol, data collection and revising the manuscript critically for important intellectual content. All authors read and approved the final manuscript.

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) disease has become public health concern, because of its increasing rate worldwide especially in developing countries. Previous studies have used statistical methods like multiple regression and correlation to show factors associated with Quality of life (QoL) assessed by SF-36 despite the scoring nature of the items. This study aimed at identifying best model and factors associated with gender differentials in QoL among T2DM.
Methods: This cross-sectional study recruited T2DM from Diabetes Care Centre of a teaching hospital, South-western, Nigeria. The models considered were Poisson Model with log link function and square-root link function. The model selection criteria used was Akaike Information Criterion

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(AIC). The model with the smaller AIC was considered to be better.
Results: The AIC values for Poisson model with log and square-root link functions for Physical Component Summary (PCS) were 1713 and 1708.3, Mental Component Summary (MCS): 1482.2 and 1480.7, QoL: 2359.7 and 235.8 respectively. Age and diastolic blood pressure had significant negative association with PCS, MCS and QoL in both gender ($p<0.05$), while occupation and education had significant positive association with PCS, MCS and QoL more in male than female. BMI of normal weight had significant reduction in PCS and QoL of female, whereas this had significant increase in the MCS of male.
Conclusion: Poisson model with square-root link function was of better fit to model QoL in T2DM. The significant positive effect of occupation and education on QoL and its domains was more in male than female.

Keywords: Quality of life; Poisson model; Akaike information criterion; residual deviance.

1. INTRODUCTION

The increasing rate of diabetes mellitus disease worldwide cannot be over-emphasized, and this has being a public health concern. It is also one of the health challenges especially in developing country like Nigeria. One of the highly prevalent diseases worldwide is type 2 diabetes mellitus (T2DM) [1,2]. In 2011, the estimation by the International Diabetes Federation (IDF) was that over 360 million people had diabetes, which will be more than 550 million by 2030 [1,2]. Varied instruments and techniques had been used to assess HRQoL among T2DM. Generic instruments such as SF-12, SF-36 and WHOQOL-BREF were used to assess a wide range of domains applicable to a variety of states, conditions and diseases including T2DM [3-8]. They are usually not specific to any particular disease state. Disease specific instruments (such as Bradley Well-Being Questionnaire, Quality of Life Index-Diabetes Version and Health Utilities Index Mark 3) on the other hand focus on domains most relevant to T2DM and on the characteristics of patients in whom the condition is most prevalent [3,4,9].

There are reports that the increasing prevalence rate in diabetes is a result of significant change in life style and environment, which eventually affect health related quality of life (HRQoL) [9-12]. The duration of diabetes, its complications, age of the patient and other related diseases like cardiovascular diseases may likely lead to reduction in the scores of HRQoL domains [1,5]. In addition, some other studies have identified different factors associated with HRQoL in type 2 diabetes patients such as high body mass index, advancing age, depression, female gender, low educational level, social status, duration of the disease, and diabetic complication which significantly reduced HRQoL [2,13-22]. Physical functioning of HRQoL was worse in obese patients than found in normal weight and overweight [23], while hemodialysis and intensive glucose had no significant effect on HRQoL [17,24]. Other factors such as marital status, stress, anxiety, retinopathy, neuropathy and mental fatigue were associated with quality of life [19-20,25-26]. Also, primary health care received by the patients, smoking and use of insulin significantly reduced quality of life [7,22,27]. Considering the models used in different studies, multiple regression analysis, Pearson and Spearman rank correlation coefficient, Logistic regression were mostly used [6,8,13,14,16,19,20,25,28]. Looking at the coefficient of determination (R^2) of some of the models used, one found that the independent variables were unable to explain the total variation in response variable up to 50%, which is not good enough.

The previous studies have shown that gender is significantly associated with HRQoL with female gender being affected more than the male. So, there is a need to identify factors associated with HRQoL in each gender group. There is also limited information on gender differentials of correlates of Physical Component Summary, Mental Component Summary and quality of life of type 2 diabetic patients. Therefore, this study was carried out to bridge the gaps. The examination of determinants of quality of life of type 2 diabetic patients by gender is paramount, for this will provide information on the intervention for their well being by gender. This study was aimed to: identify the better estimator of Poisson model with different link functions of Generalized Linear Model, examine determinants of quality of life differentials in gender among type 2 diabetic patients in South-western Nigeria.

2. METHODS AND DATA

2.1 Data

The study was carried out in a University Teaching hospital in the South- western Nigeria. It was a cross-sectional design. The data used for this study were from 119 type 2 diabetic patients recruited consecutively out of the 183 patients attending the Dame Adebutu Diabetes Care Centre of Olabisi Onabanjo University Teaching Hospital (OOUTH) during the study period. These were clinically stable and with informed consent. IDF criteria used for diagnosis of T2DM [2]. The aged, acutely ill and with obvious impairment/disability were excluded. The Ethical approval of Ethics Committee of OOUTH was obtained.

The measurements made were Health-related quality of life (HRQoL) from Short Form-36 (SF-36) Health Survey Questionnaire. SF-36 was chosen because it is a generic measure of HRQoL so as to make comparison with other ill-health conditions possible. The scale has repeatedly shown high reliability and validity in multiple studies in many languages including Nigerian version [29,30]. Physical composite summary (PCS) and mental composite summary (MCS) of HRQoL were the outcome variables. The items are scores which are discrete in nature but categorized and scored separately from 0 to 100 [2]. To achieve the quality control of the survey, we recruited and trained research assistants to collect the data with one of the authors (OOO). The SF-36 questionnaires were reviewed for proper recording. See comprehensive measurement methodology in [2].

2.2 Statistical Analysis/Model Selection

2.2.1 Variables

The outcome variables for this study were QoL and its domains (PCS and MCS). The discrete portion of the dependent variables were used for this study The independent variables were Age, Education, Marital status, Accommodation, Occupation, Religion, Smoking, Alcohol, Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Body Mass Index (BMI) and Residence.

2.2.2 Models

Poisson model with different link functions such as Log and square-root were used. The Akaike Information Criteria (AIC) and Residual deviance were used to select the better model. The smaller the AIC value, the better the model. AIC and Chi-square test were used on all the variables to select the ones that would be in the final analysis for PCS, MCS and QoL separately.

The Poisson distribution is a discrete probability. Response or outcome variable *Y* is a count.

The probability of *k* occurrences can be expressed as [31],

$$f(k;\lambda)=\frac{e^{-\lambda}\lambda^{k}}{k!} \quad for\ k=0,1,2,... \tag{1}$$

2.2.2.1 Generalized Linear Model (GLM) for Counts

$$g(\mu)=\beta_0+\beta_1x_1+\beta_2x_2+...+\beta_px_p \tag{2}$$

$$=x_i^T\beta \tag{3}$$

2.2.2.1.1 GLM has three components namely

1. Random component: Response *Y* has a Poisson distribution that is

   $y = Poisson(\mu_i)\ i=1,2,...,N$, where $E(Y)=\mu$ is the expected count of y_i.

2. Systematic component*:* These are sets of explanatory variables X = (X_1, X_2, … X_k)
3. Link function:

The log link function is generally used for the Poisson distribution. Assume the Response measurements for a count variable $y_1,\ldots,y_n$ are independent and

$$y_i \sim Poi(\mu_i), \quad \text{where} \quad \mu_i = e^{\beta_1 x_{i1}+...+\beta_p x_{ip}}$$

The natural logarithm of the above equation is used to define the link function:

$$\log(\mu_i)=\beta_1x_{i1}+...+\beta_px_{ip} \tag{4}$$

Where $x=(x_1,...,x_k)'$ is a vector of explanatory variables or independent variables as are listed in the study. Where β_o is the

intercept parameter, and β is the vector of slope parameter.

Square-root link function was also considered as

$$\mu^{1/2} = \beta_0 + \beta_1 x_1 + ... + \beta_p x_p \quad (5)$$

$$\mu = [\beta_0 + \beta_1 x_1 + ... + \beta_p x_p]^2 \quad (6)$$

$$= [X'\beta]^2 \quad (7)$$

3. RESULTS

3.1 Variables Selection and Models of Best Fit

Table 1a shows the variables selected for analysis under Physical and Mental Composite Summaries. The variables were selected at significant level of p< 0.10. In Physical Composite summary, 8 variables were selected for analysis, while 7 were selected in Mental Composite summary as shown by the asterisk. Eight variables were also selected for analysis in Quality of life (Table 1b). Poisson model comparison with different link functions for Physical, Mental and Quality of life are given in Tables 2, 3 and 4 respectively. The AICs and Residual deviances with smaller values for square-root link functions suggest it to be of best fit in all the quality of life composites variables.

3.2 Square-root Link Function and Associated Variables

The variables significantly associated with Physical Composite Summary (PCS) were as follow: Age group 30-49, 50-69 years, accommodation (flat), Diastolic Blood Pressure (DBP) and Body Mass Index (BMI) which had negative significant association with PCS; while Education (OND or higher, SSCE and proficiency certificate) and Occupation (professional) had positive significant association with PCS, (p< 0.05) as in Table 2. The Age, Religion (being a Muslim or Christian) and DBP had negative significant association with Mental Composite Summary (MCS), whereas Education, Smoking and BMI had positive significant association with MCS, (p< 0.05) as seen in Table 3. Considering the Quality of Life, Age group 30-49, 50-69 years, accommodation (flat), Religion (being a Muslim or Christian) ,DBP and BMI had negative significant association with QoL (p< 0.05). Education (OND or higher, SSCE and proficiency certificate) and Occupation (professional) had positive significant association with QoL, (p< 0.05) in Table 4.

3.3 Incidence Rate Ratios (IRR) of Poisson Model for Gender differentials

3.3.1 Physical composite summary

Table 5 shows the Incidence Rates Ratios for Ph**y**sical Composite Summary of male and female patients. In male patients: Age group 30-49 years, Education with OND or higher, Marital status of being a widow and DBP were significantly associated with Physical Composite Summary (p<0.001) , a flat accommodation ,and unemployed/retired were significantly associated with PCS at p< 0.05, while being a professional was significantly associated with PCS at p< 0.01. In female counterpart, all the age groups (except ages 50-69 years) and having OND or higher had significant association with PCS at p<0.001 while age-group 50-69 years was significantly associated with PCS at p< 0.01. Also, unemployed/retired and BMI (normal weight) had significant association with PCS in female patients (p<0.05).

Patients of 19-29 years and 30-49 years of age have PCS of 58% and 52% less than those who are above 70 years old in female, while those with 50-69 years have 2.028 times the incident rate of the ones above 70 years of age. Among the males, patients of age group 30-49 years have 77% less PCS than the patients in age group of above 70 years. Patients with OND or higher educational level have incident rate of 4.58 and 1.97 times the incident rate of illiterate and primary education in males and females respectively. Widows have incident rate of 8.78 times the incident rate of the divorced in male gender compared with incident rate of female gender of 0.80 which was not significant (p>0.05). Those that live in flat have PCS of 49% less than those who live in BQ and detached house among male (p<0.05) while there was no difference in the PCS of those in flat and BQ in female. The effect of being a professional, and unemployed/ retired on PCS have incident rates of 4.776 and 3.691which were significant at p< 0.01 and 0.05 respectively in male patients. The effect of a patient being unemployed/ retired is to reduce the expected number of PCS by some 75% in female which is significant at p<0.05. In male gender, the percentage change in the

incident rate of PCS is a decrease of 5% for every unit increase in DBP (p<0.001), while there was a decrease of 1% which was not significant (p>0.05) in female. The effect of a female patient having a BMI of normal weight is to reduce the expected number of PCS by some 43%, significant at p<0.05 compared with 10% decrease in male counterpart which was not statistically significant (p>0.05).

Table 1a. Variable selection with Akaike Information Criterion (AIC) methods for physical and mental composites summary

Variable	Degree of freedom	AIC	LRT	Pr(Chi)
Physical Composite Summary (PCS)				
Age	3	1728.5	15.722	0.0012928 **
Education	2	1788.8	73.991	< 2.2e-16 ***
Marital status	3	1720.7	7.895	0.0482268 *
Accommodation	2	1734.0	19.236	6.652e-05 ***
Occupation	4	1731.2	20.413	0.0004139 ***
Religion	3	1719.6	6.844	0.0770347’
Smoking	1	1717.4	0.639	0.423983
Alcohol	1	1716.8	0.005	0.945447
Systolic blood pressure	1	1716.8	0.072	0.788491
Diastolic blood pressure	1	1726.4	9.639	0.0019052 **
Body mass index	2	1729.9	15.119	0.0005212 ***
Residence	1	1718.8	2.029	0.154273
Mental composite summary (MCS)				
Age	3	1511.9	29.925	1.431e-06 ***
Education	2	1553.4	69.421	8.421e-16 ***
Marital status	3	1484.0	2.052	0.561744
Accommodation	2	1489.0	5.056	0.0798026’
Occupation	4	1489.4	9.457	0.0506479’
Religion	3	1497.3	15.349	0.0015415 **
Smoking	1	1490.9	4.94	0.0262381 *
Alcohol	1	1486.0	0.03	0.86325
Systolic blood pressure	1	1486.9	0.962	0.326665
Diastolic blood pressure	1	1489.7	3.715	0.0539224’
Body mass index	2	1501.0	17.025	0.0002009 ***
Residence	1	1487.7	1.747	0.186258

*‘Significant at 10%; *Significant at 5%; **Significant at 1%; ***Significant at 0.1%*

Table 1b. Variable selection with Akaike Information Criterion (AIC) methods for quality of life

Variable	Degree of freedom	AIC	LRT	Pr(Chi)
Quality of Life (QoL)				
Age	3	2402.8	43.122	2.318e-09 ***
Education	2	2504.6	142.935	< 2.2e-16 ***
Marital status	3	2367.9	8.172	0.042588 *
Accommodation	2	2383.2	21.539	2.103e-05 ***
Occupation	4	2384.2	26.525	2.479e-05 ***
Religion	3	2380.9	21.249	9.344e-05 ***
Smoking	1	2365.0	1.332	0.248442
Alcohol	1	2363.7	0.004	0.946733
Systolic blood pressure	1	2364.0	0.279	0.597513
Diastolic blood pressure	1	2376.2	12.518	0.000403 ***
Body mass index	2	2391.8	30.072	2.951e-07 ***
Residence	1	2363.7	0	0.983032

**Significant at 5%; **Significant at 1%; ***Significant at 0.1%*

Table 2. Model comparison for physical composite summary

Variable	Estimate(β)	
PCS	**Log_link**	**Square root_link**
Intercept	4.490***	9.731***
Age : 19-29yrs	0.087	0.455
Age : 30-49yrs	-0.197***	-0.822***
Age : 50-69yrs	-0.062*	-0.258*
Education : OND or higher	0.332***	1.300***
Education : SSCE & proficiency certificate	0.173***	0.635***
Marital status : married	0.107	0.190
Marital status : single	-0.077	-0.647
Marital status : widow	0.049	-0.082
Accommodation : flat	-0.126**	-0.543***
Accommodation : room + room &palour	-0.022	-0.143
Occupation : artisan/trading	0.142	0.484
Occupation : professional	0.250*	0.885*
Occupation : teaching	0.205	0.698
Occupation : unemployed/retired	0.077	0.227
Religion : Christianity	-0.248*	-0.990
Religion : Islam	-0.252*	-1.046
Religion : traditional	0.002	0.029
DBP	-0.005***	-0.018***
BMI : normal weight	-0.122*	-0.536**
BMI : overweight/obese	-0.001	-0.032
Akaike Information Criterion (AIC)	**1713.90**	**1708.30**
Residual deviance	**979.18**	**973.65**

**Significant at 5%; **Significant at 1%; ***Significant at 0.1%*

Table 3. Model comparison for mental composite summary

Variable	Estimate(β)	
MCS	**Log_link**	**Square root_link**
(Intercept)	4.658***	10.290***
Age : 19-29yrs	-0.343*	-1.303*
Age : 30-49yrs	-0.226***	-0.899***
Age : 50-69yrs	-0.071*	-0.284*
Education : OND or higher	0.293***	1.219***
Education : SSCE & proficiency certificate	0.141***	0.548***
Accommodation : flat	-0.063	-0.268
Accommodation : room + room&palour	-0.009	-0.044
Occupation : artisan/trading	0.046	0.102
Occupation : professional	0.091	0.253
Occupation : teaching	0.039	0.065
Occupation : unemployed/retired	-0.020	-0.164
Religion : Christianity	-0.283*	-1.258*
Religion : Islam	-0.280*	-1.242*
Religion : traditional	0.087	0.361
Smoking : yes	0.278**	1.242*
DBP	-0.004***	-0.016***
BMI : normal weight	-0.001	-0.070
BMI : overweight/obese	0.120*	0.457*
Akaike Information Criterion (AIC)	**1482.20**	**1480.70**
Residual deviance	**734.15**	**732.62**

**Significant at 5%; **Significant at 1%; ***Significant at 0.1%*

Table 4. Model comparison for quality of life

Variable	Estimate(β)	
Quality of life	**Log_link**	**square root_link**
Intercept	5.257 ***	14.135 ***
Age: 19-29yrs	-0.053	-0.133
Age : 30-49yrs	-0.212 ***	-1.222 ***
Age : 50-69yrs	-0.062 **	-0.359 **
Education: OND or higher	0.318 ***	1.816 ***
Education : SSCE & proficiency certificate	0.156 ***	0.835 ***
Marital status : married	0.053	0.099
Marital status : single	-0.109	-0.945
Marital status: widow	0.014	-0.168
Accommodation : flat	-0.094 ***	-0.594 ***
Accommodation :room + room&palour	-0.017	-0.157
Occupation : artisan/trading	0.095	0.433
Occupation : professional	0.164 *	0.786 *
Occupation : teaching	0.109	0.487
Occupation : unemployed/retired	0.035	0.094
Religion : Christianity	-0.265**	-1.567**
Religion : Islam	-0.265**	-1.591**
Religion : Traditional	0.041	0.264
DBP	-0.004***	-0.024***
BMI : normal weight	-0.059	-0.418*
BMI : overweight/obese	0.065	0.327
Akaike Information Criterion (AIC)	**2359.70**	**2351.80**
Residual deviance	**1532.60**	**1524.70**

**Significant at 5%; **Significant at 1%; ***Significant at 0.1%*

Table 5. Incidence Rate Ratios (IRR) of poisson (square root link) model for physical composite summary

Variable	Exp (B)	
Physical Composite Summary (PCS)	**Male**	**Female**
(Intercept)	54629.0***	9597.5***
Age : 19-29yrs	0.875	0.422***
Age : 30-49yrs	0.231***	0.480***
Age : 50-69yrs	0.902	2.028**
Education: OND or higher	4.580***	1.966***
Education : SSCE & proficiency certificate	1.328	1.128
Marital status : single	1.059	0.389
Marital status : widow	8.781***	0.801
Accommodation : flat	0.514*	1.000
Accommodation : room + room&palour	1.222	1.278
Occupation : artisan/trading	2.621	0.490
Occupation : professional	4.776**	1.656
Occupation : teaching	4.231	0.840
Occupation : unemployed/retired	3.691*	0.253*
Religion : Christianity	0.378	-
Religion : Islam	0.653	0.861
Religion: Traditional	0.785	-
DBP	0.952***	0.993
BMI : normal weight	0.898	0.575*
BMI : overweight/obese	1.433	1.049

**Significant at 5%; **Significant at 1%; ***Significant at 0.1%*

3.3.2 Mental composite summary

The Incidence Rates Ratios (IRR) of gender differentials for Mental Composite Summary (MCS) is presented in Table 6. Patients whose age is within 19 -29 years have MCS some 81% less than patients with age >70 years in male (significant at p<0.01), while in female it was

73% less (significant at p<0.05). Both genders within age 30-49 years have MCS some 83 and 59% less than those with age >70 years which are significant at p<0.001. Patients of ages 50-69 years in female have MCS some 25% less than those with age above 70 years (p<0.05) whereas in male it has 18% less than those with above 70 years (p>0.05). Patients whose highest level of education is OND or higher have incident rate of 4.306 and 3.385 times the incident rate of the illiterates/primary education in male and female respectively, both are significant at p<0.001. Patients whose highest level of education is SSCE and proficiency certificate have MCS some 92 and 73% more than patients who are illiterates or with primary education in male and female respectively; Significant at 0.01 and 0.001 respectively. Furthermore, all the categories of occupation were significantly associated with MCS in male gender only (p<0.001), with the following incident rates: 12.776(artisan/trading), 13.362(professional), 14.800(teaching), and 12.415(unemployed/ retired). Christian patients have MCS 77% and 72% less than patients from other type of religion (not Islam and Traditional) in male and female respectively (p<0.05). Being a Muslim female had significant association with MCS (p<0.05), 72% less than patients from other religion. The incident rates for smokers are 3.447 and 3.461 times the incident rates of the non-smokers in male and female gender respectively, significant at p<0.05. The percentage change in the incident rate of MCS is a decrease of 5% and 1% for every unit increase in DBP for male and female patients respectively; significant at p<0.001 in male patient alone. The effect of a patient being a normal weight in BMI is to reduce the expected number of MCS by 7% in female patient, but not significant (p>0.05), while the incident rate for having a normal weight is 2.195 in a male patient, significant at p<0.05. Also, being over - weight/obese had significant association with MCS: p<0.01 in male and p<0.05 in female; with incident rates of 2.781 and 1.579 for male and female gender respectively.

3.4 Quality of Life

Incidence Rates Ratios (IRR) of Poisson (square root link) model for QoL is displayed inTable7. Patients whose age group is 30-49 years have QoL score 88% and 71% less than those who are in age greater than 70years in male and female gender respectively (p<0.001). Those in age group 50-69 years and female have QoL score 62% less than those who are in age greater than 70years and significantly associated with QoL at p< 0.001, while in male it has 18% less than those in age group above 70 years and not significantly associated with QoL score (p>0.05). The incident rates for patients whose highest level of education is OND or higher are 9.692 and 2.780 times the incident rate of the illiterates and with primary education in male and female gender respectively; both are significant at p<0.001. Those with SSCE and proficiency certificate have the incident rates of the male and female patients as 1.887 and 2.349 times the incident rate of the illiterates and primary education respectively, significant at p<0.05 in male and p<0.001 in female. Being a widow is significantly associated with QoL score in male (p<0.001) with incident rate of 15.854 times the incident rate of the divorced; it is insignificant in female patients. Living in flat is significantly associated with QoL in male (p<0.05) with 42% less than patients in BQ /detached house. In addition, all the occupation categories in male gender patients had significant association with QoL score (p<0.001); the incident rates are 11.470 (artisan/trading), 19.464 (Professional), 14.981(teaching) and 15.978(unemployed/ retired). In female, being an artisan/trading, and unemployed/ retired are significantly associated with QoL score (p<0.001) with incident rates 0.136 and 0.060 respectively, whereas patients whose occupation is teaching is significantly associated with QoL (p<0.05) with incident rate of 0.221. Being a Christian in male has QoL score some 85% less than patients in other religion, significant at p<0.01. Moreover, the percentage change in the incident rate of QoL score is a decrease of 6% for every unit increase in DBP for male, significant at p<0.001. In the case of female, 1% decrease occurred, significant at 0.05. Patients with normal weight (BMI) in female have incident rate of 0.557 (p<0.05) compared with male whose BMI is overweight/obese, significant at p<0.01 with incident rate of 2.897.

4. DISCUSSION

This study aim was to identify the appropriate Poisson link function for determining associated factors of Health Related Quality of Life (HRQoL) in type 2 diabetic patients. The smaller Akaike Information Criterion (AIC) and Residual deviance allowed us to select the model with the square root link function as the better model in all cases. This was not the case in previous studies, especially in Nigeria. The SF-36 instrument used to assess quality of life in this study was scoring

on discrete count which may probably account for small R^2 yielded by multiple regression employed by previous studies which examined associating factors of T2DM [2,25,28]. Based on discrete count nature of SF-36 instrument, Poisson analysis was considered appropriate to examine the associating factors of T2DM.

Table 6. Incidence Rates Ratios (IRR) of poisson (square root link) model for mental composite summary

Variable	Exp (B)	
Mental Composite Summary (MCS)	**Male**	**Female**
Intercept	5119.5 ***	29440.9 ***
Age :19-29yrs	0.192 **	0.272 *
Age : 30-49yrs	0.174 ***	0.407 ***
Age : 50-69yrs	0.819	0.753 *
Education : OND or higher	4.306 ***	3.385 ***
Education : SSCE & proficiency certificate	1.924 **	1.730 ***
Accommodation: flat	0.625	0.765
Accommodation : room + room&palour	1.089	0.957
Occupation : artisan/trading	12.776 ***	1.107
Occupation : professional	13.362 ***	1.288
Occupation : teaching	14.800 ***	1.067
Occupation : unemployed/retired	12.415 ***	0.849
Religion : Christianity	0.233 *	0.284 *
Religion : Islam	0.391	0.289 *
Religion : Traditional	0.658	1.435
Smoking : yes	3.447 *	3.461 *
DBP	0.967 ***	0.984 ***
BMI : normal weight	2.195 *	0.933
BMI : overweight/obese	2.781 **	1.579 *

**Significant at 5%; **Significant at 1%; ***Significant at 0.1%*

Table 7. Incidence Rate Ratios (IRR) of poisson (square root link) model for quality of life

Variable	Exp (B)	
Quality of Life	**Male**	**Female**
Intercept	970237.7 ***	1378210.0 ***
Age : 19-29yrs	0.406	-
Age : 30-49yrs	0.122 ***	0.290 ***
Age : 50-69yrs	0.821	0.382 ***
Education : OND or higher	9.692 ***	2.780 ***
Education : SSCE & proficiency certificate	1.887 *	2.349 ***
Marital status : married	-	1.136
Marital status : single	0.919	0.301
Marital status : widow	15.854 ***	0.781
Accommodation : flat	0.578 *	0.940
Accommodation : room + room&palour	1.613	1.165
Occupation : artisan/trading	11.470 ***	0.136 ***
Occupation : professional	19.464 ***	0.571
Occupation : teaching	14.981 ***	0.221 *
Occupation : unemployed/retired	15.978 ***	0.060 ***
Religion : Christianity	0.155 **	-
Religion : Islam	0.328	1.005
Religion : Traditional	0.615	-
DBP	0.941 ***	0.990 *
BMI : normal weight	1.385	0.557 *
BMI : overweight/obese	2.897 **	1.380

**Significant at 5%; **Significant at 1%; ***Significant at 0.1%*

Among the link function of Poisson (Log link, Identity link, square link and square root link), Log link function is mostly used in previous studies [23,32]. We choose to compare the mostly used Log link with square root link and the smaller Akaike Information Criterion (AIC) and Residual deviance allowed us to select the model with the square root link function as the better model in all cases. This suggests that using SF-36 to asses HRQoL of T2DM in Nigeria, square root link function of Poisson will be better in examining associating factors of T2DM.

It was observed that females in the age group 50-69 years have QoL score (62%) less than those in age greater than 70years which significantly associated with QoL at $p< 0.001$, while in male, having 18% less than those in age group above 70 years is not significantly associated with QoL score ($p>0.05$). This indicates that age was a significant factor associated with T2DM in both gender but females reported reduced quality of life at an earlier age (50-69 years) compared with males at age 70 years. This observation persists in other domains of HRQoL (MCS and PCS). The implication of this is that women with T2DM should be monitored in their middle ages for reduced QoL while measures to address such reduced QoL should be readily available.

The incident rates for patients whose level of education is OND or higher are about 10 and 3 times the incident rate of the illiterates/primary education in male and female gender respectively; both being significant at $p<0.001$. Although, higher education is associated with better QoL; this result indicates that OND and higher education level have a more pronounced effect among men with T2DM than women. This was consistent with previous studies [20,33]. The better QoL of T2DM subjects with higher education compared with those with no formal education may be explained by the level to which T2DM subjects are well informed.

All the occupation categories in male gender patients had significant association with QoL score ($p<0.001$); the incident rates are 11.470 (artisan/trading), 19.464 (Professional), 14.981(teaching) and 15.978(unemployed/ retired) while in female, being an artisan/trading, and unemployed/ retired are significantly associated with QoL score ($p<0.001$) with incident rates 0.136 and 0.060 respectively. This observation remains the same in the different domains of QoL with slight difference. This suggests that occupation is a strong factor among men with T2DM. Generally, in Nigeria, men are bread winners and anything that alters this role may lead to reduced QoL.

Marital status is a significant factor associated with T2DM in men. Being a widow is significantly associated with QoL score in male ($p<0.001$) with incident rate of 15.854 times the incident rate of the divorced; it is insignificant in female patients. Probably men are able to cope with emotional loss or bereavement and consequence isolation that follows than women. This may explain why the observation is likely so among men with T2DM.

5. CONCLUSION

Poisson model with square-root link function was of better fit to model Quality of Life in type 2 diabetic patients. Age and DBP had significant negative association with quality of life and its domains (PCS and MCS) in both gender. The significant positive effect of occupation and education on QoL and its domains was more in male than female.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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