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# EVALUATION OF MODIFIABLE RISK FACTORS ASSOCIATED WITH TYPE 2 DIABETES MELLITUS IN FEDERAL MEDICAL CENTRE, ASABA, NIGERIA

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**ABSTRACT:** *This study aims to evaluate the prevalence of type 2 diabetes mellitus among the adults from 30 years of age and above and to assess the association between the risk factors and type 2 diabetes. A total of 522 patients diagnosed with diabetes at Federal Medical Centre (FMC) Asaba from August 2022 to February 2023 were collected for the study. We employed the method of logistic multinomial regression to assess the association between the risk factors and the type 2 diabetes mellitus, descriptive statistics to ascertain the prevalence of type 2 diabetes mellitus, and the likelihood ratio test to check which of the risk factors is significant. The female was taken as a reference category. The results showed that the prevalence of type 2 diabetes mellitus was higher in females (284, 54.4%) and also in the age group 45-64 years of age. Risk factors that had a significant association with type 2 diabetes mellitus are age (Chi-square = 10.589, p = 0.005), BMI (chi-square = 1.038, p = 0.092), hypertension (chi-square = 1.370, p = 0.042), alcohol consumption (chi-square = 73.319, p = 0.000), and smoking (chi-square = 142.096, p = 0.000). The results further revealed that with female patients as the reference category, a male patient in the age bracket 45-64 years (p = 0.028, AOR = 0.538, 95% C.I: 0.310 – 0.935), a male that is obese (p = 0.090, AOR = 0.962, 95% C.I: 0.524 – 1.765), male with hypertension (p = 0.044, AOR = 1.362, 95% C.I: 0.810 – 2.292), male that consumes alcohol (p = 0.000, AOR = 0.129, 95% C.I: 0.077 – 0.214), and male that smokes (p = 0.000, AOR = 0.014, 95% C.I: 0.005 – 0.042) had 72.3% fewer odds, 3.8% fewer odds, 36.2 higher odds, 87.1 fewer odds, and 98.6% fewer odds of having type 2 diabetes mellitus compared to a female patient. This study suggests appropriate actions for community awareness of regular blood sugar testing and preventive measures.*

**KEYWORDS:** Diabetes mellitus, associated risk factors, odd ratio



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## INTRODUCTION

Diabetes mellitus (DM) is a chronic disease that occurs as a result of the pancreas' inability to produce insulin or the body's inability to use the insulin it produced. Diabetes mellitus (DM) is one of the major health challenges in the world today. DM is one of the major causes of blindness, kidney failure, heart attacks, stroke and lower limb amputation. Type 2 diabetes mellitus (T2DM) is a chronic disease characterised by high levels of sugar in the blood. However, adults with DM have a 2- to 3-fold high risk of developing heart attacks (Sarwar et al., 2010). In 2019, according to the Global Burden of Disease Collaborative Network (2020), the world recorded 1.5 million deaths caused by DM, of which 48% of these deaths happened before the age of 70 years.

The rising trend of DM in developing countries especially in Nigeria is linked with industrialization, urbanisation and socio-economic development, and some environmental factors such as life and lifestyle coupled with genetic factors (Kokiwar et al., 2007). Many factors are associated with the incidence of T2DM, which are overweight and obese, smoking, quality of diet, alcohol consumption, hypertension, non-regular physical activity, old age, family history of DM, waist to hip ratio (Aynalem & Zeleke, 2018; Kpozehouen et al., 2015; Mawaw et al., 2017; Tesfaye et al., 2016; Zekewos et al., 2018).

The main purpose of this study is to evaluate the modifiable risk factors associated with type 2 diabetes mellitus (T2DM) in Nigeria with Federal Medical Centre (FMC) Asaba as the case study. We used the following modifiable risk factors – body mass index (BMI), alcohol consumption, smoking, hypertension, quality of diet, cholesterol level, family history of diabetes mellitus (DM), regular physical activities, and age of patients.

The specific objectives of this present study are to (1) determine the prevalence of type 2 diabetes mellitus (T2DM) in Nigeria with Asaba as a case study of age 30 years and above; (2) to study the association of the modifiable risk factors with T2DM; (3) to obtain the odd ratios of the risk factors.

## MATERIALS AND METHODS

### Materials

Asaba is the capital city of Delta State which is one of the states in the South-South geopolitical zone of Nigeria. Delta state has a total area of 17,698$km^2$ and a total population of 5,663,400 based on the 2006 census.

The data used in this study are purely secondary data from Federal Medical Centre (FCM) Asaba Delta State. We collected data for 522 patients' records from FMC Asaba for the period August 2022 to February 2023 which were already stored on ages, gender, body mass index (BMI), blood pressure, alcohol consumption, smoking habit, sleep duration, quality of diet, cholesterol level, family history of diabetes, and regular physical activity. We categorised our modifiable risk factors as follows: Gender – (1) Male and (2) Female; Age - (1) <45, (2) 45-64 years and (3) ≥65 years; Body Mass Index (BMI) - (1) Underweight (2) Normal weight (3) Overweight and (4) Obese; Blood pressure – (1) Hypertensive and (2) No hypertensive; Alcohol consumption – (1) No alcohol and (2) Yes (Consume alcohol); Smoking – (1) No (Do


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not smoke) and (2) Yes (Smokes); Sleep duration – (1) <5 hours (2) 5-8 hours and (3) >8 hours; Quality of diet – (1) Low-quality diet (2) Normal quality diet and (3) High-quality diet; Cholesterol – (1) <200mg/dl and (2) ≥200mg/dl; Family history of DM – (1) No and (2) Yes; Regular physical activity – (1) No and (2) Yes.

**Methods**

We employed the methods of descriptive statistics to obtain the prevalence of T2DM, and logistics multinomial regression to ascertain the association of the modifiable risk factors and T2DM, and also to obtain the adjusted odd ratios of the risk factors. In this study, we went ahead and used the Goodness-of-fit test to check whether the logistic multinomial regression model obtained fits the risk factors very well, and we also employed the techniques of the Likelihood ratio test to find out which of the risk factors have a significant association with T2DM.

These modifiable risk factors are our independent variables while gender is taken as the dependent. Equation 1 is the logistic multinomial regression model for the variables applicable in this study.

$$\left[\frac{P(X_{1,i},\cdots,X_{P,i})}{P(X_{1,i},\cdots,X_{P,i})}\right] = \beta_{0,K-1} + \beta_{1,K-1}x_1 + \beta_{2,K-1}x_2 + \cdots + \beta_{P-1,K-1}x_{P-1} = \beta_{K-1}x_i \quad (1)$$

where $Y_i$ is the value of the multinomial response variable (gender) for the $i$th unit, $\beta_0, \beta_1, \cdots, \beta_{P-1}$ are the parameters, $X_{1,i}, \cdots, X_{P,i}$ are the independent variables, and the $K$-th category is the reference category.

## RESULTS AND DISCUSSION

**Summary statistics for the entire risk factors**

Our results in Table 1 show that out of the persons diagnosed with T2DM at FMC Asaba, 238 (45.6%) are males while 284 (54.4%) are females, meanwhile 77 (14.8%) are below 45 years of age, 308 (59.0%) are between 45 to 64 years inclusive, and 137 (26.2%) are 65 years and above. Again, our results show that out of the persons diagnosed with T2DM, 52 (10.0%) are underweight, 162 (31.0%) are both normal weight and overweight and 146 (28.0%) are obese. Furthermore, the results also show that 180 (34.5%) are not hypertensive while 342 (65.5%) are hypertensive; 231 (44.3%) do not consume alcohol while 291 (55.7%) consume alcohol; and 407 (78.0%) persons do not smoke while 115 (22.0%) smoke.

Moreover, our results also show that 287 (55.0%) have less than 5 hours of sleep in a day, 228 (43.7%) have 5 to 8 hours inclusive of sleep in a day, while the remaining 7 (1.3%) have above 8 hours of sleep in a day. In addition to this, 350 (67.0%) have a low-quality diet, 153 (29.3%) have a normal diet, 19 (3.6%) have a high-quality diet; 278 (53.3%) have total cholesterol below 200mg/dl while 244 (46.7%) have total cholesterol 200mg/dl and above.

Consequently, out of the diagnosed persons, 514 (98.5%) do not have a family history of DM while 8 (1.5%) have a family history of DM. In addition, 98 (18.8%) engage in physical activities while 426 (81.2%) do not.


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**Summary statistics for the risk factors classified under male and female**

In Table 2, out of the diagnosed persons, the highest number of males (139, 45.13%) and females (169, 54.87%) are in the age group 45 to 64 years inclusive. In addition, 37 (71.15%) males and 15 (28.85%) females are underweight, 64 (39.51%) males and 98 (60.49%) females are overweight, while 66 (45.21%) males and 80 (54.79%) females are obese.

Again, our results show that 163 (47.66%) males and 179 (52.34%) are hypertensive while 77 (42.78%) males and 103 (57.22%) females are not hypertensive. In addition to this, 172 (59.11%) males and 119 (40.89%) females consume alcohol, while 68 (29.44%) males and 163 (70.56%) females do not consume alcohol; again, 111(96.52%) males and 4 (3.48%) females smoke a cigarette while 129 (31.70%) males and 278 (68.30%) do not smoke.

Furthermore, 103 (45.64%) males and 156 (54.36%) females have less than 5 hours of sleep in a day; 103 (45.18%) males and 125 (54.86%) have 5 to 8 hours of sleep a day, while 6 (85.71%) males and 1 (14.29%) females have more than 8 hours of sleep a day. Furthermore, 158 (45.14%) males and 192 (54.86%) females have low-quality diets, 72 (47.06%) males and 81 (52.94%) females have normal-quality diets, while 10 (52.63%) males and 9 (47.37%) females have a high-quality diet. In addition to this, 127 (45.68%) males and 151 (54.32%) females have total cholesterol below 200mg/dl while 113 (46.31%) males and 131 (53.69%) females have total cholesterol of 200mg/dl and above.

Consequently, 235 (45.72%) males and 279 (54.28%) females do not have a history of DM in their family while 5 (62.50%) males and 3 (37.50) females have a history of DM in their family. In addition to this, 185 (43.63%) males and 239 (56.37%) females do not engage in regular physical activities while 50 (51.02%) males and 48 (48.98%) females engage in regular physical activities.

**Table 1. Summary statistics for the entire risk factors**

| Risk factors | Categories | Observations | Marginal Percentage |
|---|---|---|---|
| Gender | Male | 238 | 45.6% |
| | Female | 284 | 54.4% |
| Age (years) | <45 | 77 | 14.8% |
| | 45-64 | 308 | 59.0% |
| | ≥65 | 137 | 26.2% |
| Body Mass Index (BMI) | Underweight | 52 | 10.0% |
| | Normal | 162 | 31.0% |
| | Overweight | 162 | 31.0% |
| | Obese | 146 | 28.0% |
| Blood pressure | Hypertensive | 342 | 65.5% |
| | No hypertensive | 180 | 34.5% |
| Alcohol consumption | No | 231 | 44.3% |
| | Yes | 291 | 55.7% |
| Smoking | No | 407 | 78.0% |
| | Yes | 115 | 22.0% |
| Sleep duration | <5 hours | 287 | 55.0% |
| | 5-8 hours | 228 | 43.7% |
| | >8 hours | 7 | 1.3% |


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| | | | |
|---|---|---|---|
| Diet quality | Low quality | 350 | 67.0% |
| | Normal quality | 153 | 29.3% |
| | High quality | 19 | 3.6% |
| Cholesterol | <200mg/dl | 278 | 53.3% |
| | ≥200mg/dl | 244 | 46.7% |
| Family history of DM | No | 514 | 98.5% |
| | Yes | 8 | 1.5% |
| Regular physical activity | No | 426 | 81.2% |
| | Yes | 98 | 18.8% |
| Total observations | | 5220 | 100.0% |

**Table 2. Summary statistics for the risk factors classified under male and female**

| Risk factors | | Male | | Female | | Total obs. |
|---|---|---|---|---|---|---|
| | | Obs. | Percentage | Obs. | Percentage | |
| Age (years) | <45 | 38 | 49.35% | 39 | 50.65% | 77 |
| | 45-64 | 139 | 45.13% | 169 | 54.87% | 308 |
| | ≥65 | 61 | 44.53% | 76 | 55.47% | 137 |
| Body Mass Index (BMI) | Underweight | 37 | 71.15% | 15 | 28.85% | 52 |
| | Normal | 75 | 46.30% | 87 | 53.70% | 162 |
| | Overweight | 64 | 39.51% | 98 | 60.49% | 162 |
| | Obese | 66 | 45.21% | 80 | 54.79% | 146 |
| Blood pressure | Hypertensive | 163 | 47.66% | 179 | 52.34% | 342 |
| | Not hypertensive | 77 | 42.78% | 103 | 57.22% | 180 |
| Alcohol consumption | No | 68 | 29.44% | 163 | 70.56% | 231 |
| | Yes | 172 | 59.11% | 119 | 40.89% | 291 |
| Smoking | No | 129 | 31.70% | 278 | 68.30% | 407 |
| | Yes | 111 | 96.52% | 4 | 3.48% | 115 |
| Sleep duration | <5 hours | 131 | 45.64% | 156 | 54.36% | 287 |
| | 5-8 hours | 103 | 45.18% | 125 | 54.82% | 228 |
| | >8 hours | 6 | 85.71% | 1 | 14.29% | 7 |
| Diet quality | Low quality | 158 | 45.14% | 192 | 54.86% | 350 |
| | Normal quality | 72 | 47.06% | 81 | 52.94% | 153 |
| | High quality | 10 | 52.63% | 9 | 47.37% | 19 |
| Cholesterol | <200mg/dl | 127 | 45.68% | 151 | 54.32% | 278 |
| | ≥200mg/dl | 113 | 46.31% | 131 | 53.69% | 244 |
| Family history of DM | No | 235 | 45.72% | 279 | 54.28% | 514 |
| | Yes | 5 | 62.50% | 3 | 37.50% | 8 |
| Regular physical activity | No | 185 | 43.63% | 239 | 56.37% | 424 |
| | Yes | 50 | 51.02% | 48 | 48.98% | 98 |
| Total observations | | 2395 | | 2825 | | 5220 |


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**Goodness of fit test and likelihood ratio tests**

How well the multinomial logistic regression model fits the modifiable risk factors in this study is presented in Table 3, while Table 4 presents the likelihood ratio tests of the modifiable risk factors in the multinomial logistic regression model.

The results in Table 3 show that the Pearson Chi-square of 314.835 and $p = 0.571$, which means not statistically significant, indicates that the multinomial logistic regression model developed fits the modifiable risk factors used in this study well.

Table 4 shows that the age of the patient (Chi-square = 10.589, $p = 0.005$), the alcohol consumption habits (Chi-square = 73.319, $p = 0.000$), and smoking habits (Chi-square = 142.096, $p = 0.000$) are the only statistically significant risk factors in the multinomial logistic regression developed.

## MAIN FINDINGS

Table 5 presents the categorical variables (the modifiable risk factors) and their respective odd ratios and their 95% confidence intervals.

In Table 5, males below 45 years of age ($B = -1.282, p = 0.002, AOR = 0.277, 95\%\ CI\ of\ OR = (0.123,0.625)$) have 72.3% ($(1 - 0.277) \times 100\%$) less risk of DM compared to females, while those between 45 years to 64 years inclusive ($B = -0.620, p = 0.028, AOR = 0.538, 95\%\ CI\ of\ AOR = (0.310,0.935)$) have 46.2% ($(1 - 0.538) \times 100\%$) less risk of DM compare to females.

Males with weight below or exactly 124lbs ($B = 0.266, p = 0.081, AOR = 1.305, 95\%\ CI\ of\ OR = (0.508,3.352)$) have 30.5% ($(1.305 - 1) \times 100\%$) high risk of DM compared to females; while males with weight 125lbs to 168lbs inclusive ($B = 0.213, p = 0.084, OR = 1.237, 95\%\ CI\ of\ AOR = (0.682,2.244)$) have 23.7% ($(1.237 - 1) \times 100\%$) high risk of DM compared to females; and in addition to this, males with weight 169lbs to 202lbs inclusive ($B = -0.039, p = 0.090, AOR = 0.962, 95\%\ CI\ of\ AOR = (0.524, 1.765)$) have 3.8% ($(1 - 0.962) \times 100\%$) less risk of DM compare to the females.

Furthermore, males with hypertension ($B = 0.309, p = 0.044, AOR = 1.362, 95\%\ CI\ of\ OR = (0.810, 2.292)$) have 36.2% ($(1.362 - 1) \times 100\%$) high risk of DM compared to the females, meanwhile, those that do not consume alcohol ($B = -2.050, p = 0.000, AOR = 0.129, 95\%\ CI\ of\ AOR = (0.077, 0.214)$) have 87.1% ($(1 - 0.129) \times 100\%$) less risk of DM compare to females. In addition, males that do not smoke tobacco ($B = -4.270, p = 0.000, AOR = 0.014, 95\%\ CI\ of\ AOR = (0.005,0.042)$) have 98.6% ($(1 - 0.014) \times 100\%$) less risk of DM compare to females.

Again, males that have less than 5 hours of sleep in a day ($B = -1.588, p = 0.164, AOR = 0.204, 95\%\ CI\ of\ AOR = (0.022, 1.913)$) have 79.6% ($(1 - 0.204) \times 100\%$) less risk of DM compare to females, while those that have 5 to 8 hours of sleep in a day ($B = -1.554, p = 0.174, AOR = 0.211, 95\%\ CI\ of\ AOR = (0.022, 1992)$) have 78.9% ($(1 - 0.211) \times 100\%$) less risk of DM compare to females.


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Moreover, males with low quality diet ($B = -0.863, p = 0.179, AOR = 0.422, 95\%\ CI\ of\ AOR = (0.120, 1.484)$) have 57.8% ($(1 - 0.422) \times 100\%$) less risk of DM compare to females, meanwhile those with normal diet ($B = -1.110, p = 0.101, AOR = 0.330, 95\%\ CI\ of\ AOR = (0.087, 1.242)$) have 67% ($(1 - 0.330) \times 100\%$) less risk of DM compare to females.

Consequently, males with cholesterol below 200mg/dl ($B = 0.360, p = 0.140, AOR = 1.433, 95\%\ CI\ of\ AOR = (0.888, 2.312)$) have 43.3% ($(1.433 - 1) \times 100\%$) high risk of DM compare to females, meanwhile, those with no family history of DM ($B = -0.841, p = 0.314, AOR = 0.431, 95\%\ CI\ of\ AOR = (0.084, 2.213)$) have 56.9% ($(1 - 0.431) \times 100\%$) less risk of DM compare to females; in addition to this, those that do not engage in physical activities ($B = 0.127, p = 0.692, AOR = 1.135, 95\%\ CI\ of\ AOR = (0.606, 2.125)$) have 13.5% ($(1.135 - 1) \times 100\%$) high risk of DM compare to females.

## DISCUSSION

The results of our study show that out of the patients diagnosed with T2DM, 234 (45.6%) are males and 284 (54.4%) are females, this implies that T2DM is more predominant in females, which is consistent with studies from other authors in different countries Azimi-Nezhad, 2008; Qin. et al., 2012). The results also show that the prevalence of males and females with T2DM is more predominant in the age group 45-64 years and it was higher for females.

Again, in the present study, body mass index (BMI) was statistically significantly associated with diabetes mellitus. This finding is consistent with other studies by (Amiri, 2017; Aynalem & Zeleke, 2018; Duong et al., 2022; Tesfaye et al, 2016; Megerssa et al. 2013; Ahmad, et al., 2011; Giday et al., 2010). Furthermore, DM is more predominant in females with overweight compared to males, in addition to this, males with overweight have a 3.8% lesser odds of developing T2DM compared to females.

This present study also revealed that hypertension has a statistically significant association with T2DM, this implies that persons with hypertension have a higher risk of having T2DM. Furthermore, T2DM has a higher prevalence in females compared to males. The results also show that male with hypertension has 36.2% higher odds of having T2DM compared to male.

Another factor found in this study that has a significant correlation with T2DM is the consumption of alcohol, this finding is in line with the findings of the following study (Nithesh et al., 2018). However, a high level of alcohol intake increases the risk of developing T2DM, again, the consumption of alcohol was higher in males compared to females, and males that consume alcohol have 87.1% lesser odds of developing T2DM compare to females. More, in this present study, T2DM has a statistically significant association with smoking, and this finding is consistent with the following studies (Aynalem & Zeleke, 2018; Kapoor et al., 2014; Seifu et al, 2015), and the prevalence of male smoker was far higher than female. Furthermore, males that do not smoke have 98.6% odds lesser odds of having T2DM.

Moreover, the prevalence of T2DM is higher in patients having less than 5 hours of sleep, and it is more predominant in females than in males, while the number of patients with more than 8 hours of sleep is higher in males. In addition to this, male patients with less than 5 hours of sleep have 79.6% fewer odds of developing T2DM, and those with 5 to 8 hours of sleep have


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78.9% fewer odds of having T2DM compared to female patients. Furthermore, the prevalence of T2DM is higher in people with low-quality diets, and it is predominant in female patients. However, males with low-quality diets have 57.8% fewer odds of having T2DM.

The results of our study also show that the prevalence of T2DM is higher in patients with cholesterol less than 200mg/dl, and it is predominant in females. Again, the odds of male patients with cholesterol developing T2DM is 43.3% higher compared to females. The odds of male patients with no family history of DM having T2DM is 56.9% lesser compared to females, while the prevalence of T2DM is higher in patients who do not engage in regular physical activity, and in addition, males that do not engage in regular physical activity has 13.5% odds of having T2DM.

**Table 3. Goodness of fit test for the multinomial logistic regression model**

| | **Chi-Square** | $df$ | **P-value** |
|---|---|---|---|
| Pearson | 314.835 | 320 | 0.571 |
| Deviance | 278.944 | 320 | 0.953 |

**Table 4. Likelihood ratio tests for the risk factors in the multinomial logistic regression model**

| Effect | **Model Fitting Criteria** | **Likelihood Ratio Tests** | | |
|---|---|---|---|---|
| | -2 Log Likelihood of Reduced Model | Chi-Square | $df$ | P-value |
| Intercept | 342.999[a] | 0.000 | 0 | . |
| Age | 353.588 | 10.589 | 2 | 0.005*** |
| Body mass index (BMI) | 344.037 | 1.038 | 3 | 0.092* |
| Hypertension | 344.369 | 1.370 | 1 | 0.042** |
| Alcohol | 416.319 | 73.319 | 1 | 0.000*** |
| Smoking | 485.095 | 142.096 | 1 | 0.000*** |
| Sleep | 345.480 | 2.481 | 2 | 0.289 |
| Diet | 345.768 | 2.769 | 2 | 0.250 |
| Cholesterol | 345.195 | 2.195 | 1 | 0.138 |
| Family | 344.035 | 1.036 | 1 | 0.309 |
| Regular physical activity | 343.158 | 0.158 | 1 | 0.691 |

Note: $***p < 0.01$, $**p < 0.05$, $*p < 0.1$ means significant at 1%, 5%, and 10% level of significance respectively


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**Table 5. Parameter estimates for modifiable risk factors in the multinomial logistic regression model**

| | Coeff. (B) | Std. Error | Wald | $df$ | P-value | Odd Ratio (OR) | 95% Confidence Interval for OR | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower Bound | Upper Bound |
| Intercept | 7.551 | 1.683 | 20.120 | 1 | 0.0008*** | | | |
| $<45$ years | -1.282 | 0.414 | 9.581 | 1 | 0.002*** | 0.277 | 0.123 | 0.625 |
| 45-64 years | -0.620 | 0.282 | 4.831 | 1 | 0.028** | 0.538 | 0.310 | 0.935 |
| $\geq 65$ years | $0^b$ | . | . | 0 | . | . | . | . |
| Under weight | 0.266 | 0.481 | 0.305 | 1 | 0.081* | 1.305 | 0.508 | 3.352 |
| Healthy weight | 0.213 | 0.304 | 0.490 | 1 | 0.084* | 1.237 | 0.682 | 2.244 |
| Overweight | -0.039 | 0.310 | 0.016 | 1 | 0.090* | 0.962 | 0.524 | 1.765 |
| Obesity | $0^b$ | . | . | 0 | . | . | . | . |
| Hypertensive | 0.309 | 0.265 | 1.356 | 1 | 0.044** | 1.362 | 0.810 | 2.292 |
| Non hypertensive | $0^b$ | . | . | 0 | . | . | . | . |
| Take Alcohol | -2.050 | 0.260 | 61.970 | 1 | 0.000*** | 0.129 | 0.077 | 0.214 |
| Do not take alcohol | $0^b$ | . | . | 0 | . | . | . | . |
| Smoke | -4.270 | 0.558 | 58.571 | 1 | 0.000*** | 0.014 | 0.005 | 0.042 |
| Do not smoke | $0^b$ | . | . | 0 | . | . | . | . |
| $<5$ hours of sleep | -1.588 | 1.141 | 1.937 | 1 | 0.164 | 0.204 | 0.022 | 1.913 |
| 5-8 hours of sleep | -1.554 | 1.144 | 1.844 | 1 | 0.174 | 0.211 | 0.022 | 1.992 |
| $>8$ hours of sleep | $0^b$ | . | . | 0 | . | . | . | . |
| Low quality diet | -0.863 | 0.642 | 1.809 | 1 | 0.179 | 0.422 | 0.120 | 1.484 |
| Normal diet | -1.110 | 0.677 | 2.689 | 1 | 0.101 | 0.330 | 0.087 | 1.242 |
| High quality diet | $0^b$ | . | . | 0 | . | . | . | . |
| $<200$mg/dl | 0.360 | 0.244 | 2.175 | 1 | 0.140 | 1.433 | 0.888 | 2.312 |
| $\geq 200$mg/dl | $0^b$ | . | . | 0 | . | . | . | . |
| Family history of DM | -0.841 | 0.834 | 1.016 | 1 | 0.314 | 0.431 | 0.084 | 2.213 |
| No family history of DM | $0^b$ | . | . | 0 | . | . | . | . |
| Physical activities | 0.127 | 0.320 | 0.157 | 1 | 0.692 | 1.135 | 0.606 | 2.125 |
| No physical activities | $0^b$ | . | . | 0 | . | . | . | . |

Note: The reference category is Female; $***p < 0.01$, $** p < 0.05$ means significant at 1% and 5% level of significance respectively; $0^b$ means the variable is redundant and has no effect

## CONCLUSION

The aim of this study is to evaluate the risk factors associated with diabetes mellitus (DM) and to obtain the associated odds ratios in males and females diagnosed at FMC Asaba from September 2022 to February 2023. We used age, weight, blood pressure, alcohol consumption, smoking habit, diet quality, total cholesterol level, family history of DM, and physical activity as the modifiable risk factors associated with DM. In this study, we used descriptive statistics to obtain the proportions of the risk factors, and multinomial logistic regression to estimate the effects and the odd ratios of the modifiable risk factors.


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The result of descriptive statistics in Table 1, showed that 234 (45.6%) males and 284 (54.4%) females are diagnosed with DM, while the persons in the age group 45-64 years and in the weight intervals 125-168lbs and 169-202lbs were more affected. Furthermore, the results of Table 2 showed that the proportion of males that take alcohol, smoke, have a family history of DM, and engage in physical activities is more than the females. On the other hand, the proportion of females with hypertension, the highest number of sleep, and total cholesterol levels <of 200mg/dl and ≥200mg/dl are more than the males.

The result of the likelihood ratio test in Table 4 showed that the age of the person, alcohol consumption, and smoking habit are statistically significant risk factors associated with DM in the logistic multinomial regression model. consequently, the results in Table 5 showed that males in the age group – less than 45 years and 45-64 years have a lesser risk of DM compared to females; males with weight ≤124lbs and 125-168lbs have a higher risk of DM while males with weight 169-202lbs have a lesser risk of DM compared to females. Furthermore, the results also revealed that males that do not consume alcohol, do not smoke, have low-quality diets, lesser number of sleeping hours, and have no family history of DM have a lesser risk of DM compared to females. On the other hand, males with total cholesterol less than 200mg/dl have a higher risk of DM compared to females.

Our study will add to the already existing literature on the evaluation of modifiable risk factors associated with DM, it will help researchers on similar work and it will help the government and health policymakers. This study has some limitations, first, the time frame is too small, so we suggest that future studies should focus on larger time frames. Second, our study only focus on comparing modifiable risk factors based on gender, so we suggest that future study should consider the comparison of age groups.

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