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## Nutritional Assessment of Type II Diabetic Patients

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**Abstract:** The study identified the association of the nutritional status with dietary pattern of type II diabetic patients. Cross-sectional study was conducted, collecting data from 51 patients at AL-Noor Specialist Hospital in Holy Makkah, Kingdom of Saudi Arabia. An interview questionnaire used to collect demographic and socioeconomic data, anthropometric measurements and laboratory investigations. A bioelectric impedance analysis used to estimate body composition findings. Thirty-one type II patient women and twenty men were assessed, the mean age was  $49.35 \pm 1.020$  years and the mean of BMI was  $31.59 \pm 5.538$  kg/m<sup>2</sup>. A percentage of 57 of the studied patients were low-income level that affected their nutrition outcomes. A percentage of 25 of male group and 25.8% of female group rarely or never eat fruits, meanwhile, 15% of male group and 3.2% of female group rarely or never eat vegetables. A percentage of 50 from male group and 51.6% from female group were usually eating dark meats, meanwhile, 50% of male group and 45.2% of female group sometimes consume regular sweet. It is well improver that nutritional status of the diabetic patients influenced by the socio-economic level, dietary habits and physical activity. Socio-economical support, nutritional education and exercise programs are needed for better nutritional and clinical outcomes for the diabetic patients. From the results we concluded that most of the studied sample was overweight or obese and that might be due to their inadequate nutrition and unhealthy dietary patterns. Low-educational level as well as low-income level can negatively influence the nutritional and health status of the patients, due to the lack of nutritional information and lacking of access to nutritious foods. Blood glucose level, lipid profile and blood pressure are influenced by the dietary habits and types of food consumed. The consumption of inadequate nutrition can increase the risk of chronic diseases beside diabetes mellitus.

**Key words:** Nutritional assessment, type II diabetes, dietary pattern

### INTRODUCTION

New evidence from Saudi Arabia has put DM into the top 10 for the first time and shows the rapid pace of the epidemic in the Middle East and North Africa region. The Western Pacific islands continue to dominate the list where ethnicity combined with changing lifestyles are largely to blame for the high percentages of diabetes (IDF, 2013).

Diabetes mellitus is a disease known since ancient times, cited by both the Greeks and Egyptians in as early as 1500 BC. In its various forms, it affects over 18 million American every year and it is the sixth leading cause of death and a major cause of complications, such as heart disease, kidney disease, blindness and amputations (Width and Reinhard, 2009).

Type II DM may account for 90 to 95% of all diagnosed cases of diabetes. Risk factors of this type include genetic and environmental factors, including a family history of diabetes, older age, obesity, particularly intra-abdominal obesity and physical inactivity. Adiposity and longer duration of obesity are powerful risks factors for type II diabetes, a sedentary lifestyle has also been linked to an increased propensity to develop type II diabetes (Mahan and Escotte-Stump, 2008).

Medical management of type II diabetes includes monitoring of blood glucose and A1c testing and medications; sulfonylureas, non-sulfonylurea

secretagogues, biguanides,  $\alpha$ -glucosidase inhibitors and thiazolidinediones. Nutritional management is as important as the medical management and it includes, lifestyle strategies that improve glycemia, dyslipidemia and blood pressure, nutrition education, energy restriction to promote 5-10% weight loss and blood glucose monitoring to determine adjustments in food or medications (Mahan and Escotte-Stump, 2008).

### MATERIALS AND METHODS

**Design:** Cross-sectional quantitative survey conducted during the academic year 1434-1435 H (2013-2014).

**Settings:** The study was conducted starting from 03-11-34H to 06-04-35H in Al Noor Specialist Hospital in Holy Makkah, Saudi Arabia. The participants were both Saudi and non-Saudi patients. Applied Medical Sciences and Al Noor Hospital Ethics Committees approved the study.

**Subjects:** A sample of 51 participants with type II diabetes mellitus were included in the study, including 20 males and 31 females. The age range of the participants was 23 to  $\leq 70$  years. All participants had been informed about the nature and the purpose of the study.

**Tools:**

**Interview questionnaire:** A pretested, structured interview questionnaire was used in collecting data. It consisted of the following parts:

- 1: Demographic and socioeconomic data: Include data about the general characteristics of the study sample including age, education level, income level, etc
- 2: Nutritional assessment
- 3: Anthropometric Measurements, weight and height, body mass index, body fat percentage, lean body mass, visceral fat
- 4: Laboratory Investigation: Fasting blood sugar, HbA<sub>1c</sub>, blood pressure, total cholesterol, HDL and LDL, albumin and bilirubin, hemoglobin, urea, creatinine, Na and K

**Bioelectric impedance analysis:** Bioelectric Impedance Analysis (BIA) that is faster, easier, less intrusive and includes a precision scale making this a simple one-step process. The Body Fat Monitor looks just like a bathroom scale. A person inputs various personal information such as age, gender and height, then steps onto the scale platform. Electrodes in the foot sensor pads send a low, safe signal through the body weight is calculated automatically along with Body Fat content and Body Mass Index in seconds (Healthgoods, 2014).

**Statistical analysis:** Analysis of all data were performed by using computer program, Statistical Package Social Science (SPSS, v. 19). (SPSS Inc., Chicago, IL, USA). The statistical analysis includes frequencies and mean ± SD.

**RESULTS**

**Body Composition and anthropometric measures:** Body composition and anthropometric measures according gender for type 2 diabetes patients are listed in Table 1 showing the means±SD of age, anthropometric measurements and body composition results of the studied patients according to their gender. It could be observed from Table 1 that the mean age of male group was 48±1.22 years, while the mean age of the female group was 50.23±8.82 years. There was no significant between male and female age. The studied female group have a higher mean of BMI which was 32.84±5.65 kg/m<sup>2</sup> than male group which was 29.71±4.92 kg/m<sup>2</sup>. There was significant decrease for male when compared to female group between the studied groups according to their BMI (p<0.05). As shown in the table, the body fat percentage in the female group had a higher significant of Body fat percentage which was 48.32±6.40% than the male group which was 31.62±6.15%. While the body muscle percentage showed that the mean of male group was higher which

Table 1: Body composition and anthropometric measures according to gender for type II diabetes patients

| Variables                | Gender -----                |                               | Sig.    |
|--------------------------|-----------------------------|-------------------------------|---------|
|                          | Male<br>(n = 20)<br>Mean±SD | Female<br>(n = 31)<br>Mean±SD |         |
| Age (years)              | 48.00±1.22                  | 50.23±8.82                    | 0.453   |
| Weight (kg)              | 84.45±17.12                 | 78.59±17.47                   | 0.244   |
| Height (cm)              | 167.72±7.23                 | 154.65±6.82                   | 0.001** |
| BMI (kg/m <sup>2</sup> ) | 29.71±4.92                  | 32.84±5.65                    | 0.049*  |
| Body fat (%)             | 31.62±6.15                  | 48.32±6.40                    | 0.001** |
| Body muscle (%)          | 30.94±3.74                  | 21.42±2.4                     | 0.001** |
| Visceral fat             | 14.55±4.93                  | 11.00±3.12                    | 0.003** |

\*p<0.05, \*\*p<0.01

was 30.94±3.74% than female group which was 21.42±2.4%. Also, the table showed that visceral fat was higher significant in male group which was 14.55±4.93 nearly female group which was 11±3.12.

**Socio-demographic characteristics of the studied patients:** Table 2 shows socio-demographic Characteristics of the Studied Groups According to Their Gender. This table distribute both male and female groups according to their marital status, educational level, household income, occupation and smoking status.

Regarding the socio-demographic results of the studied groups, the table showed that 90% of male and 67.7% of female are married. Moreover, 30% of male group reported that they are living in families consists of 5 members, while 32.3% of female group were living with families of 6 members. The table showed that less than the half (45%) of the male group reported completed university education, while only 22.6% of the female group had graduated from primary school. Also, there were 60% of the male patients had more than 6000 SR as an total income monthly, while 20% of them had between 3000 and 6000 SR and the rest 20% had less than 3000 SR. For female group, 35.5% had an income less than 3000 SR and a percentage of 32.2 had an income between 3000 and 6000 SR, also, the same percentage had more than 6000 SR monthly. It was found that more than half (65%) of the male group distributed as employed while 87% of the female group are not employed. The table also showed that 30% of male patients are currently smoking versus 3.2% of the female patients.

**Biochemical data results according to the gender:**

Table 3 shows the Mean±SD of the laboratory results of BGL, HbA<sub>1c</sub>, hemoglobin, lipid profile, electrolytes and blood pressure.

It could be cleared that blood glucose level showed nearly similar levels of BG Mean±SD for both groups, which was showed slightly higher 191.77±64.23 mg/dL female group for than male group which was 189±60.64 mg/dL. HbA<sub>1c</sub>, the mean value of female group was

Table 2: Socio-demographic characteristics according gender for type II diabetic patients

| Variables                | Gender           |                    | Sig.    |
|--------------------------|------------------|--------------------|---------|
|                          | Male<br>(n = 20) | Female<br>(n = 31) |         |
| <b>Marital status</b>    |                  |                    |         |
| Married                  | 18 (90%)         | 21 (67.7%)         | 0.242   |
| Single                   | 1 (5%)           | 4 (12.9%)          |         |
| Divorced                 | 1 (5%)           | 2 (6.5%)           |         |
| Widowed                  | 0 (0%)           | 4 (12.9%)          |         |
| <b>Family size</b>       |                  |                    |         |
| ≤3                       | 1 (5%)           | 9(29.1%)           | 0.187   |
| 4-6                      | 10(50%)          | 14(45.2)           |         |
| >6                       | 9(45%)           | 8(25.8)            |         |
| <b>Educational level</b> |                  |                    |         |
| Illiterate               | 0 (0%)           | 6 (19.4%)          | 0.040** |
| Can write/read           | 1 (5%)           | 4 (12.9%)          |         |
| Primary school           | 1 (5%)           | 7 (22.6%)          |         |
| Intermediate school      | 2 (10%)          | 4 (12.9%)          |         |
| Secondary school         | 6 (30%)          | 4 (12.9%)          |         |
| Graduated                | 10 (50%)         | 6 (19.4%)          |         |
| <b>Household income</b>  |                  |                    |         |
| <3000 SR                 | 4 (20%)          | 11 (35.5%)         | 0.148   |
| 3000-6000 SR             | 4 (20%)          | 10 (32.3%)         |         |
| □ 6000 SR                | 12 (60%)         | 10 (32.3%)         |         |
| <b>Smoking</b>           |                  |                    |         |
| Yes                      | 6 (30%)          | 1 (3.2%)           | 0.007*  |
| No                       | 14 (70%)         | (96.8%)            |         |

\*p<0.05, \*\*p<0.01

9.66±1.96% and for male group was 8.85±1.83%. Blood pressure: it has close values for both groups. The female mean of blood pressure is 79.61/133.03±12.44 mmHg versus 81.95/136.65±16.94 mmHg for the male group. Hemoglobin, the mean of the hemoglobin level is higher in male group which was 14.69±1.31 g/dL and lower in the female group which was 12.30±2.40 g/dL. Total cholesterol, the mean for male patients was 198.22±49.43 mg/dL compared to 202.83±44.15 mg/dL for female patients as shown in Table 2. Triglycerides, it was found that the mean was 186.89±135.58 mg/dL for male group versus 157.71±77.86 mg/dL for female. HDL, as shown in Table 2 the mean value of HDL is found to be 49.33±29.17 mg/dL male patients versus 50.29±15.56 mg/dL for female. LDL, showed that 105.02±33.94 mg/dL was the mean for male patients and 121.76±50.51 mg/dL for female patients regarding their LDL level. Sodium level, as shown in the table there was significant difference between the two groups regarding their Na level (p<0.05), where the mean of Na level for male group was 137.40±4.50 mEq/L compared with 140.69±1.96 mEq/L as for female group. Potassium level, the mean of K level was 4.07±0.27 mEq/L for the male patients and 4.09±0.29 mEq/L for female patients. There were significant increase for male patients in Hemoglobin and Creatinine when compared to female, while female group showed significant increase in sodium level when compared to female group.

**Family history of chronic diseases according to the gender:** Family history of chronic diseases such as DM, HTN and CVD for the studied diabetic patients are listed in Table 4.

Regarding to the family history of chronic diseases among the studied male and female groups. It was found that 5 (25%) of male diabetic group reflected none family history of DM compared with 16.1% for female diabetic group, while 37.2% of all patients (40% of male and 35.5% of female) had family history of DM alone. Also, the percentage of 15% for male patients and 19.4% for female group showed family history of DM and combined HTN.

**Personal history of chronic diseases according to the gender:** Personal history of chronic diseases besides DM in the studied patients are listed in Table 5.

Our study found that 40% of the male group and in the same time 38.7% of female group had no personal history of any chronic diseases, while 30% of male group and 38.7% of female group had personal history of HTN.

**Diabetic therapy of the patients according to the gender:** Table 6 show the type of diabetic therapy, any previous pregnancies among the studied female patients and if they were following their physician's directions or not.

According to the table that previous pregnancies among studied female patients reflected that 87.1% of them had been pregnant before. Regarding to the type of diabetic therapy used by the studied patients; it was found that 35% of the male patients were on hypoglycemic pills alone versus 35.5% of the female group. While 20% of the male diabetic patients were on insulin injections alone compared with 32.3% of the female diabetic patients. Also, 15% of the male group are on both hypoglycemic pills and insulin injections compared with 9.7% of the female group as shows in Table 6. This study also found that 90% of the male diabetic group and 77.4% of the female diabetic group are following their physician's directions.

**Nutritional history and dietary pattern of the patients according to the gender:** Table 7 show nutritional history and dietary pattern of the studied diabetic patients according to their gender showing all dietary habits of the studied patients, starting from their breakfast, to their fruits and vegetable, meats and milk servings consumed by the patients. It also showing the patient's physical activity level and their willingness to make healthy changes for a better life.

It could be observed that dietary history and eating habits of the patients, it was found that 30% of the male group are usually skipping breakfast compared with 32.3% of the female group and 45% of the male patients are rarely skipping their breakfast compared to 35.5% of the female patients. One fourth of the male group are often eating meals from restaurant compared with a percentage of 38.7% of the female and 60% of the male

Table 3: Biochemical data results according to the gender

| Variables            | Gender             |                    | Sig.    |
|----------------------|--------------------|--------------------|---------|
|                      | Male (Mean±SD)     | Female (Mean±SD)   |         |
| BG level (mg/dL)     | 189±60.64          | 191.77±64.23       | 0.878   |
| HbA1c (%)            | 8.85±1.83          | 9.66±1.96          | 0.181   |
| BP (mm Hg)           | 81.95/136.65±16.94 | 79.61/133.03±12.44 | 0.425   |
| Hemoglobin (g/dL)    | 14.69±1.31         | 12.30±2.40         | 0.024*  |
| TC (mg/dL)           | 198.22±49.43       | 202.83±44.15       | 0.808   |
| Triglyceride (mg/dL) | 186.89±135.58      | 157.71±77.86       | 0.489   |
| HDL (mg/dL)          | 49.33±29.17        | 50.29±15.56        | 0.913   |
| LDL (mg/dL)          | 105.02±33.94       | 121.76±50.51       | 0.406   |
| Albumin (g/dL)       | 4.13±0.36          | 3.88±0.41          | 0.141   |
| Bilirubin (mg/dL)    | 0.54±0.17          | 0.42±0.22          | 0.142   |
| Urea (mg/dL)         | 27±4.77            | 25.79±8.83         | 0.710   |
| Creatinine (mg/dL)   | 0.96±0.142         | 0.65±0.126         | 0.001** |
| SL (mEq/L)           | 137.40±4.50        | 140.69±1.96        | 0.016*  |
| PL (mEq/L)           | 4.07±0.27          | 4.09±0.29          | 0.874   |

\*p<0.05, \*\*p<0.01. BG: Blood glucose, BP: Blood Pressure, TC: Total cholesterol, PL: Potassium level, SL: Sodium level

Table 4: Family History of chronic diseases according to the gender

| Variables   | Gender      |               | Sig.  |
|---|-------------|---------------|-------|
|   | Male No (%) | Female No (%) |       |
| <b>Family history of chronic diseases</b>                 |             |               |       |
| None  | 5 (25%)     | 5 (16.1%)     | 0.485 |
| DM  | 8 (40%)     | 11 (35.5%)    |       |
| HTN   | 1 (5%)      | 1 (3.2%)      |       |
| DM, CVD and HTN   | 0 (0%)      | 5 (16.1%)     |       |
| DM and HTN  | 3 (15%)     | 6 (19.4%)     |       |
| DM and renal disease                                      | 0 (0%)      | 1 (3.2%)      |       |
| DM, CVD and renal disease                                 | 1 (5%)      | 1 (3.2%)      |       |
| DM, HTN and asthma  | 0 (0%)      | 1 (3.2%)      |       |
| DM, CVD, HTN and renal disease                            | 1 (5%)      | 0 (0%)        |       |
| DM, HTN, psychiatric disorder, asthma and vision disorder | 1 (5%)      | 0 (0%)        |       |

\*p<0.05, \*\*p<0.01

Table 5: Medical History of chronic diseases according to the gender

| Variables                                   | Gender      |               | Sig.  |
|---|-------------|---------------|-------|
|   | Male No (%) | Female No (%) |       |
| <b>Personal history of chronic diseases</b> |             |               |       |
| None  | 8 (40%)     | 12 (38.7%)    | 0.547 |
| CVD   | 1 (5%)      | 1 (3.2%)      |       |
| HTN   | 6 (30%)     | 12 (38.7%)    |       |
| CVD, HTN and renal disease                  | 0 (0%)      | 1 (3.2%)      |       |
| CVD and HTN                                 | 1 (5%)      | 3 (9.7%)      |       |
| HTN and renal disease                       | 1 (5%)      | 0 (0%)        |       |
| Prostate cancer                             | 1 (5%)      | 0 (0%)        |       |
| Colonic disorder                            | 1 (5%)      | 0 (0%)        |       |
| Asthma                                      | 1 (5%)      | 0 (0%)        |       |
| CVD, HTN and rheumatism                     | 0 (0%)      | 1 (3.2%)      |       |
| CVD, HTN and asthma                         | 0 (0%)      | 1 (3.2%)      |       |

\*p<0.05, \*\*p<0.01

rarely/never eating 7% meals from restaurant compared with 61.3% of the female. our study found that 40% of the male patients sometimes consuming whole grains products compared to 54.8% for female patients, while only 3.9% of female patients are rarely consuming whole grains products.

The Table 7 shows that almost one fourth of each female group (25.8%) and male group (25%) are rarely eating 2-3 fruits servings per day. On the other hand, there is 62.7% of the patients (11 are male and 21 are

Table 6: Diabetic therapy of the patients according to the gender

| Variables                                   | Gender      |               | Sig.  |
|---|-------------|---------------|-------|
|   | Male No (%) | Female No (%) |       |
| <b>Previous pregnancies</b>                 |             |               |       |
| Yes   | 0 (0)       | 27 (87.1)     | 0.001 |
| No  | 20 (100)    | 4 (12.9)      |       |
| <b>Type of diabetic therapy</b>             |             |               |       |
| Diet  | 1 (5)       | 0 (0)         | 0.684 |
| Hypoglycemic pills                          | 7 (35)      | 11 (35.5)     |       |
| Insulin injections                          | 4 (20)      | 10 (32.3)     |       |
| Hypoglycemic pills and insulin injections   | 3 (15)      | 3 (9.7)       |       |
| Diet, herbs and insulin injections          | 0 (0)       | 1 (3.2)       |       |
| Diet, herbs and hypoglycemic pills          | 0 (0)       | 1 (3.2)       |       |
| Diet and insulin                            | 3 (15)      | 2 (6.5)       |       |
| Diet, herbs, hypoglycemic pills and insulin | 0 (0)       | 1 (3.2)       |       |
| Hypoglycemic pills and herbs                | 0 (0)       | 1 (3.2)       |       |
| Hypoglycemic pills and diet                 | 1 (5)       | 1 (3.2)       |       |
| Hypoglycemic pills, insulin and herbs       | 1 (5)       | 0 (0)         |       |
| <b>Following physician directions</b>       |             |               |       |
| Yes   | 18 (90)     | 24 (77.4)     | 0.250 |
| No  | 2 (10)      | 7 (22.6)      |       |

\*p<0.05, \*\*p<0.01

female) are consuming 3-4 servings of vegetables in the day.

This study has found that 51.6% of the female group are usually consuming 2-3 servings of dairy products per day, while 60% of the male group are sometimes consuming dairy products.

The total of 24 patients (47% of the patients) 12 of them are male and 12 of them are female, are often eating or drinking 2% or whole milk, while 16 patients (31% of the patients) are rarely having 2% or whole milk.

There is 35% of male group are sometimes using regular cheese, versus 38.7% from the female group.

**Frequency consumption of proteins and fats consumption of the studied diabetic patients:**

Frequency consumption of proteins and fats consumption of the studied diabetic patients are listed in Table 8.

Table 7: Nutritional history and dietary pattern of the studied diabetic patients

| Variables   | Gender         |                  | Sig.  |
|---|----------------|------------------|-------|
|   | Male<br>No (%) | Female<br>No (%) |       |
| <b>Skipping breakfast</b>   |                |                  |       |
| Usually/often   | 6 (30)         | 10 (32.3%)       | 0.772 |
| Sometimes   | 5 (25)         | 10 (32.3%)       |       |
| Rarely/never  | 9 (45)         | 11 (35.5%)       |       |
| <b>Eating ≥4 meals from restaurants a week</b>                      |                |                  |       |
| Usually/often   | 3 (15)         | 0 (0)            | 0.069 |
| Sometimes   | 5 (25)         | 12 (38.7)        |       |
| Rarely/never  | 12 (60)        | 19 (61.3)        |       |
| <b>Eating &lt;3 servings of whole grain products a day</b>          |                |                  |       |
| Usually/often   | 12 (60)        | 12 (38.7)        | 0.222 |
| Sometimes   | 8 (40)         | 17 (54.8)        |       |
| Rarely/never  | 0 (0)          | 2 (6.5)          |       |
| <b>Eating &lt;2-3 servings of fruit a day</b>                       |                |                  |       |
| Usually/often   | 5 (25)         | 7 (22.6)         | 0.980 |
| Sometimes   | 10 (50)        | 16 (51.6)        |       |
| Rarely/never  | 5 (25)         | 8 (25.8)         |       |
| <b>Eating &lt;3-4 servings of vegetables a day</b>                  |                |                  |       |
| Usually/often   | 11 (55)        | 21 (67.7)        | 0.285 |
| Sometimes   | 6 (30)         | 9 (29)           |       |
| Rarely/never  | 3 (15)         | 1 (3.2)          |       |
| <b>Eating or drinking &lt;2-3 servings of milk products a day</b>   |                |                  |       |
| Usually/often   | 7 (35)         | 16 (51.6)        | 0.208 |
| Sometimes   | 12 (60)        | 11 (35.5)        |       |
| Rarely/never  | 1 (5)          | 4 (12.9)         |       |
| <b>Using 2% or whole milk instead of skim or 1% milk</b>            |                |                  |       |
| Usually/often   | 12 (60)        | 12 (38.7)        | 0.324 |
| Sometimes   | 3 (15)         | 8 (25.8)         |       |
| Rarely/never  | 5 (25)         | 11 (35.5)        |       |
| <b>Using regular cheese instead of low fat or part skim cheeses</b> |                |                  |       |
| Usually/often   | 5 (25)         | 7 (22.6)         | 0.971 |
| Sometimes   | 7 (35)         | 12 (38.7)        |       |
| Rarely/never  | 6 (30)         | 8 (25.8)         |       |
| Rarely eat cheese   | 2 (10)         | 4 (12.9)         |       |

\*p<0.05, \*\*p<0.01

It could be concluded that 50% of male group have chosen usually eating beef, or dark meat chicken more than 2 times a week, at the same time a slightly more than the half of the female group (51.6%) have chosen the same. A percentage of 65% from male group, versus 54% from female group are rarely choosing high fat red meats instead of lean red meats. While 65% of male group and 58.1% of the female group are rarely or never use regular processed meats. It was found that 50% of male group were rarely eating fried foods, compared with 45.2% from female group. Also, 55% of male patients were rarely eating snack foods versus 38.7% of female patients. There was high percentage of 80% from male group and 64.5% from female group were rarely adding butter or oil to bread or vegetables. The same table showed that 50% of male group and slightly less (45.2%) from female group are sometimes consuming regular sweets instead of low fat or fat-free sweets. While a percentage of 71 from male group and 65% from female group were rarely drinking 16 ounces or more of non-diet soda daily. Meanwhile, 55% among male patients and 41.9% among female patients were rarely adding extra salt to their foods.

Table 8: Frequency consumption of proteins and fats consumption of the studied diabetic patients and their dietary habits

| Variables  | Gender   |            | Sig.  |
|--|----------|------------|-------|
|  | Male     | Female     |       |
| <b>Eating beef, or dark meat chicken &gt; 2 times a week</b>   |          |            |       |
| Usually/often  | 10 (50%) | 16 (51.6%) | 0.963 |
| Sometimes  | 9 (45%)  | 13 (41.9%) |       |
| Rarely/never   | 1 (5%)   | 2 (6.5%)   |       |
| <b>Choosing higher fat red meats instead of lean red meats</b>   |          |            |       |
| Usually/often  | 3 (15%)  | 8 (25.8%)  | 0.466 |
| Sometimes  | 4 (20%)  | 4 (12.9%)  |       |
| Rarely/never   | 13 (65%) | 17 (54.8%) |       |
| Rarely eat meat  | 0 (0%)   | 2 (6.5%)   |       |
| <b>Using regular processed meats instead of low-fat processed meats</b>  |          |            |       |
| Usually/often  | 1 (5%)   | 0 (0%)     | 0.348 |
| Rarely/never   | 6 (30%)  | 13 (41.9%) |       |
| Rarely eat processed meat  | 13 (65%) | 18 (58.1%) |       |
| <b>Eating fried foods</b>  |          |            |       |
| Usually/often  | 1 (5%)   | 4 (12.9%)  | 0.622 |
| Sometimes  | 9 (45%)  | 14 (45.2%) |       |
| Rarely/never   | 10 (50%) | 13 (41.9%) |       |
| <b>Eating regular chips, crackers, popcorn nuts instead of pretzels, low-fat chips, low-fat crackers, air-popped popcorn</b> |          |            |       |
| Usually/often  | 0 (0%)   | 2 (6.5%)   | 0.443 |
| Sometimes  | 2 (10%)  | 6 (19.4%)  |       |
| Rarely/never   | 7 (35%)  | 11 (35.5%) |       |
| Rarely eat snacks  | 11 (55%) | 12 (38.7%) |       |
| <b>Adding butter, margarine, or oil to bread, potatoes, rice, or vegetables at the table</b>                                 |          |            |       |
| Usually/often  | 0 (0%)   | 3 (9.7%)   | 0.283 |
| Sometimes  | 4 (20%)  | 8 (25.8%)  |       |
| Rarely/never   | 16 (80%) | 20 (64.5%) |       |
| <b>Eating regular sweets instead of low fat or fat-free sweets</b>   |          |            |       |
| Usually/often  | 1 (5%)   | 3 (9.7%)   | 0.937 |
| Sometimes  | 10 (50%) | 14 (45.2%) |       |
| Rarely/never   | 6 (30%)  | 9 (29%)    |       |
| Rarely eat sweets  | 3 (15%)  | 5 (16.1%)  |       |
| <b>Drinking ≥16 ounces of non-diet soda, fruit drink a day</b>   |          |            |       |
| Usually/often  | 2 (10%)  | 1 (3.2%)   | 0.602 |
| Sometimes  | 5 (25%)  | 8 (25.8%)  |       |
| Rarely/never   | 13 (65%) | 22 (71%)   |       |
| <b>Adding salt to foods during cooking or at the table</b>   |          |            |       |
| Usually/often  | 2 (10%)  | 6 (19.4%)  | 0.462 |
| Sometimes  | 7 (35%)  | 13 (41.9%) |       |
| Rarely/never   | 11 (55%) | 12 (38.7%) |       |
| <b>Doing &lt;30 total minutes of physical activity ≥3 days a week</b>  |          |            |       |
| Usually/often  | 6 (30%)  | 8 (25.8%)  | 0.816 |
| Sometimes  | 6 (30%)  | 12 (38.7%) |       |
| Rarely/never   | 8 (40%)  | 11 (35.5%) |       |
| <b>Following a special diet</b>  |          |            |       |
| Yes  | 12 (60%) | 10 (32.3%) | 0.051 |
| No   | 8 (40%)  | 21 (67.7%) |       |

\*p<0.05, \*\*p<0.01 <sup>(1)</sup>1 = Not at all willing, 5 = Very willing

It could be observed that 35.2% of all the patients (30% of male and 38.7% of female) were sometimes performing some physical activity 3 days or more weekly, while 37.2% of all the patients (40% of male and 38.7% of female) were rarely or never performing any kind of physical activity. There was high percentage of 60 among male group and 67.7% among female group were following no any special diets. Therefore, it was found that 65% of the male group and 51.6% of female group were willing to make changes in their dietary habits in order to eat healthier.

## DISCUSSION

This study was conducted to determine the nutritional status among type II diabetic patients in holy Makkah.

Regarding the socio-economic data of the studied diabetic patients, the study conducted that 40% of male group and 37.8% of female group had an income of <6000 SR monthly, it was also conducted that 19.4% of female group were illiterate while only 5% of the male group were post graduated (Table 3). Tol *et al.* (2012) reported in a study that the frequency of type II diabetes complications demonstrated significant relation with sex, age, educational level, type of occupation, duration of diabetes and social class and the majority of patients with complications (54.2%) belonged to low income group.

According to family history of chronic diseases in the studied patients, this study indicated that 40% of male group and 35.5% of female group had family history of DM alone (Table 4). It had been reported in a study by Jeong *et al.* (2010) that in type II DM patients with a family history of diabetes, the disease tended to develop earlier. Metabolic syndrome and cardiovascular risk factors are more prevalent in familial type II DM than they were in non-familial type II DM. In this study we also found that 21.6% of the studied patients had a family history of diabetes and cardiovascular diseases combined. We also found that 37.2% of the patients had a family history of diabetes and hypertension combined, a study conducted by Jeong *et al.* (2010) who found that 38.4% of the diabetic studied members had family history of diabetes and out of the participants, 39.1% had family history of hypertension.

Regarding to the personal medical history, in this study we found that 60.9% of the total studied diabetic patients had one or more chronic diseases other than diabetes. A study conducted by Lujiks *et al.* (2012) indicated that 84.6% of the diabetic patients had one or more chronic comorbid disease of any type, cardiovascular diseases were the most common.

Type II diabetes and obesity were like conjuncted-twins and causes poor glycemic control and 1 complications (Ercan and Kiziltan, 2013). Our study found that the prevalence of overweight (BMI 25-29.9 kg/m<sup>2</sup>) was 25.5% while the prevalence of obesity (BMI ≥30 kg/m<sup>2</sup>) was 62.7% among the studied diabetic patients according to the BMI classifications.

According to the body composition results of the diabetic patients, it was found that both male and female patients had higher percentage of body fat when compared to healthy people as listed in (Table 1). These results were in agreement with Atanas *et al.* (2011) who found that the % BF, giving the relative percentage of fat connective tissue in human body, was statistically significantly higher in diabetic patients than in healthy controls. It was also found that female group had higher body fat percentage than in male group, these results confirmed

with Hong *et al.* (2011) who conducted that the muscle mass decreases and obesity increases with aging in Korean men, whereas both fat mass and obesity increases with aging in Korean women. This study also illustrated that both male and female groups have lower percentage of body muscle than healthy people, meanwhile, these results did not agree with Atanas *et al.* (2011) who conducted that the muscle mass were found to be higher in diabetics than in healthy controls but the difference did not reach statistical significant.

Based on the biochemical data, the results of our study showed an agonist correlation between triglycerides and systolic blood pressure. In contrast with the result of Teng *et al.* (2011) who conducted that there is no correlation between triglyceride and SBP, but the effect of triglyceride on DBP were additive. This study also found an agonist correlation between SBP and age of the studied group. Mungreiphy *et al.* (2011) indicated that there was a positive and significant correlation among BMI, age, SBP and DBP. This study conducted a negative correlation between triglyceride and sodium level, in contrast to the study of Parker (2013) who illustrated reducing sodium posed little risk for increasing triglyceride or cholesterol levels. It was also found that HDL levels of both studied groups are lower than the healthy ranges, while there was a higher level of triglycerides for both male and female groups (Table 2), these findings agreed with Drexel *et al.* (2005) who conducted that low HDL cholesterol and high triglycerides pattern is associated with the degree of hyperglycemia.

According to the dietary habits of the studied patients, our data showed that 30% of male group and 32.3% of the female group were usually skipping their breakfast meal (Table 7). Meanwhile, our study confirmed by Reutrakul *et al.* (2013) who reported that breakfast skipping contribute to poor glycemic control, as indicated by higher levels of HbA1c, recommended that studies should be needed to confirm these findings and determine whether behavioral interventions targeting breakfast eating or sleeping time may improve glycemic control in patients with type II diabetes. Our study also conducted that 25% of male group and 38.7% of female group were sometimes eating more than or equal four meals outsider home from restaurants weekly (Table 7). A study by Pereira *et al.* (2005) who reported that fast foods consumption has a strong positive association with weight gain and insulin resistance, reporting that fast foods contain large amounts of partially hydrogenated oils which cause insulin resistance and increase risk of obesity; also containing large amounts of highly refined starchy food in addition of sugar added and carbohydrates that have been characterized to be higher in glycemic index.

In this study we found that 40% of male group and 54.8% of female group were sometimes consuming

three servings of whole grain products a day (Table 7). As soon as Chandalia *et al.* (2000) reported that high intake of dietary fiber, particularly of the soluble type exceed the level recommended by the ADA, improves glycemic control, decreasing hyperinsulinemia and lowers plasma lipid concentrations in patients with type II diabetes.

Consumption of vegetables and fruits may reduce HbA1c, therefore choosing the appropriate diet with high fruits and vegetables may help to develop antioxidant defense and reduce the HbA1c in diabetic patients as described by Tabesh *et al.* (2013). Daily total vegetables intake of 200 g or more and green vegetables intake of 70 g or more correlated with improving HbA1c and TG levels in type II diabetic patients through achieving a well-balanced diet as performed by Takahashi *et al.* (2012). Fruits, despite the fructose containing, may lower the glycemic index, as well as their consumption had been associated with a reduction in HbA1c levels and can positively influence HDL cholesterol, blood pressure and risk of coronary heart disease in general as mentioned by Aguero *et al.* (2012). Regarding the dietary pattern data, our study conducted that 25% of male group and 25.8% of female group rarely or never eat 2-3 servings of fruits per day, meanwhile, only 15% of the male group and 3.2% of the female group rarely or never eat 3-4 servings of vegetables per day (Table 7). The study of Ridout *et al.* (2013) reported that high dairy consumption (4 servings of low fat) may improve insulin resistance without negatively impacting bodyweight or lipid status under free-living conditions. In this respect, our study also found that 35% of male group and 51.6% of female group were usually consuming milk and milk products while 60% of male group and 38.7% of female group were using whole or 2% instead of low fat or skim milk (Table 7).

Limuro *et al.* (2012) concluded that greasy type as a dietary pattern with an increased amount of sugar, fat and meat led to poor life prognosis for elderly Japanese type II diabetic patients. The healthy type of dietary pattern rich in vegetables and fish, which is similar to the Mediterranean diet and dietary approach to stop Hypertension diet, was suggested to improve life prognosis.

The sedentary lifestyle, also, rapid changes in socio-economic status and food habits in Arab Gulf countries, had led to a great change in health and nutritional status of people (Musaiger and Al-Neyadi, 2003). Exercise and training that consist of aerobic exercise, resistance training or both combined is associated with HbA1c reduction in patients with type II diabetes as described by Umpierre *et al.* (2011). In our study, illustrated that 40% of the diabetic male group and 35.5% of the diabetic female group rarely or never do physical exercises 3 times a week (Table 8).

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