CODEN [USA]: IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

http://doi.org/10.5281/zenodo.3511091

Available online at: http://www.iajps.com *Research Article*

THE PREVALENCE AND DETERMINANTS OF RISKY BEHAVIORS AMONG SUBJECTS WITH DIABETES IN PRIMARY HEALTH CARE CENTERS OF THE MINISTRY OF HEALTH JEDDAH 2018

[1]Dr. Mohammed Alghalibi, [2]Dr. Osama Alharbi, [3]Dr. Sulafa Alqutub

[1]MBBS, Family Medicine Resident, Kingdom of Saudi Arabia, Joint Program of Family Medicine, Jeddah, [2]MBBS, Family Medicine Resident. [3]MBBS, ABCM, MPH, consultant of Preventive Medicine

Article Received: August 2019 **Accepted:** September 2019 **Published:** October 2019

Abstract:

Background: *Saudi Arabia has one of the highest prevalence of diabetes mellitus in the world. The continuous increasing prevalence is further aggravated by the increasing prevalence of risk factors contributing to diabetes such as physical inactivity, overweight and obesity throughout the population.*

Aim of Study: *The purpose of this study is determine which risk factors are prevalent among diabetic patients.*

Methodology: *Following a cross-sectional study design, 291 diabetic patients attending primary health care centers in Jeddah were interviewed.*

Results: *Around 86.6% [251 patients] were classified with Type II diabetes, while 12.4% [36 patients] were classified with Type I diabetes. Only 10.6% [30 patients] are presently smoking, while 15.8% [45 patients] stopped smoking. Eighty percent [231 patients] are engaged in low physical activity. Smoking is suggested to be associated with physical activity, with former smokers mostly engaged in high physical activity. Younger age is associated with medium physical activity, while those with high BMI are associated with high physical activity. Those earning between 5000-10000 SAR or being retired appear to have a higher association with low physical activity.*

For risky behaviors, age, physical activity and job status were the strongest factors determining medical administration. BMI is the strongest determinant of healthy lifestyle attitude score, while increasing monthly income has an inverse effect. Overall, BMI, monthly income, and physical activity are the strongest determinants of risky behavior.

Conclusions: *Based on findings of the present study, high BMI, low physical activity and monthly income are significant factors in diabetes. Smoking also contributes in the development of diabetes progression through its effect on physical activity and BMI. Programs promoting increased physical activity and weight management should be added in present health interventions. A preventive approach showing the effects of smoking and high BMI should encourage those not at risk to be more physically active.*

Corresponding author:

Mohammed Alghalibi,

MBBS, Family Medicine Resident, Kingdom of Saudi Arabia, Joint Program of Family Medicine, Jeddah.

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Please cite this article in press Mohammed Alghalibi et al., ***The Prevalence And Determinants Of Risky Behaviors Among Subjects With Diabetes In Primary Health Care Centers Of The Ministry Of Health Jeddah 2018.,*** *Indo Am. J. P. Sci, 2019; 06[10].*

INTRODUCTION:

Background:

Diabetes is a prolonged, metabolic disease defined by high sugar levels, causing neuropathy, retinopathy, and nephropathy. [1] Almost 422 million persons worldwide haves diabetes mellitus; it directly contributed for 1.5 million deaths, while indirectly responsible for 17.5 million deaths yearly [1, 2]. As per the 2014 Surgeon General's report, the risk of DM is increased by 30%–40% for active smokers compared with nonsmokers. The World Health Organization [WHO] considers smoking as a preventable risk factor for diabetes. [1, 2]. It is defined by UNICEF as the act of inhaling smoke, produced by the combustion of an element, through the mouth, usually of tobacco in a cigarette, cigar, or pipe. Smoking yields many health hazards such as nicotine or tar, contributing to respiratory or cardiac diseases [3]. Smoking cessation or avoidance is recommended as an essential public health strategy in response to diabetes.

The WHO considers sedentary lifestyle as the fourth leading factor causing global mortality estimated by 3.2 million deaths worldwide. Physical activity is defined as movement produced by skeletal muscles that requires energy [4], whereas dietary habits pertain to the way or pattern a person of group of people consume food, as well as how many, what kind, and what time it is consumed [5].

Poor diet and exercise are some of the leading risk factors associated with non-communicable diseases [NCDs] such as CVD, cancer and diabetes. It is estimated that 1 out of 4 adult persons is not active enough, and more than 80% of the youth are inactive [6]. Both diabetes and smoking contributed to 34-40 % of cardiovascular disease risk [7-9].

Saudi Arabia has one of the greatest prevalence of DM worldwide. At 14.4% prevalence, those between 30-69 years old are at high mortality risk. A recent report from WHO indicated that 13 780 deaths have been related to high blood glucose. Furthermore, the prevalence of diabetes for both males and females continues to increase from 1980 to 2014. Risk factors such as physical inactivity, overweight and obesity are even more prevalent throughout the population [10-12]. On the other hand, the authors reported in 2013 national survey that the prevalence of smoking 15.3 % [28.8 % for males and 1.9 % for females] [13].

Rationale:

Risky lifestyle choices including [smoking, inadequate physical activities, and dietary habits] are major risk factors increase the risk of developing complications of diabetes, especially micro vascular. We observed that smoking patients, with poor dietary habits and exercises are present with diabetic complications. The knowledge of the prevalence of risky behaviors among diabetics will provide a basis for the clinician to invest time in health promotion education aimed to quit smoking, following proper diet and exercise. Most complications of diabetes mellitus in Saudi Arabia could be due to risky behaviors, but this aspect of management of the patients may be overlooked because of limited research on the prevalence of risky behaviors among diabetics in Saudi Arabia. At present, there are limited studies about diabetes and associated risk factors, one or two were specific for Jeddah [14-18].

Aim:

The study aims is to check which risk factors are prevalent among diabetic patients and to determine prevalence of smoking and its associated factors among diabetics.

Objectives:

- To determine the prevalence of risky behaviors among diabetic patients availing primary health care services in Jeddah last 2018.
- To determine the factors related to the prevalence of risky lifestyle choices among diabetics in Jeddah last 2018.

LITERATURE REVIEW:

General:

Risky lifestyle behaviors and diabetes are important risks to the health of many people and substantially contribute to the global burden of disease in various ways [19].

Type-II diabetes mellitus [DM] represents 90%–95% of diabetes cases, caused by insulin resistance and gradual loss of beta-cell function and mass. DM risk is associated strongly with environmental, nutritional, and lifestyle factors, hence lifestyle modification could decrease the prevalence and mortality of diabetes [1, 7].

Smoking:

The prevalence of daily smoking decreased from 41.2% to 31.1% for males and from 10.6% to 6.2% in females from 1980 to 2012 [19, 20]. However the number of smokers increased from 721 million to 967 million due to global population growth over time. Despite global efforts in controlling tobacco use, smoking remains a leading cause of morbidity and mortality [19-22].

Several studies reported that insulin sensitivity is decreased by smoking, leading to hyperglycemia and dyslipidemia, causing including low HDL cholesterol and postprandial lipid intolerance [23, 24].

Among diabetics, it is obvious that smoking worsens the metabolic control. Smokers need a larger insulin dose to achieve similar metabolic control [24]. Heavy smokers [who at least smoke 20 sticks per day] have 61% greater risk, while light smokers [who at least smoke less than 20 cigarettes daily] have a 29% greater risk, and former smokers only have 23% higher risk [24].

Regarding complications, there are several complications and chronic illness linked to diabetes, such as micro-vascular complications [diabetic nephropathy, neuropathy, and retinopathy], hypertension, dyslipidemia, non-alcoholic fatty liver, CVD, kidney disease and obesity [25, 26]. As well as smoking were linked to several complications including cardiovascular disease, pulmonary disease, different types of cancer, adverse effects on reproductive health and the exacerbation of chronic health conditions [27].

Physical activities & Dietary habits:

Type II diabetic patients have a twice all-cause mortality rate and a higher cardiovascular mortality rate as compared with non-diabetic patients. Inadequate diet and physical inactivity increase cardiovascular risk. Changing multiple behaviors together, such as lifestyle modification, proper diet and regular physical activity, are often recommended, as changing one behavior helps as a enabler to encourage change in another. However, trying to change multiple behaviors together [e.g. modify diet and physical activity at the same time] may seem difficult or overwhelming [28, 29].

Previous studies:

Cho, et al [2009] did a prospective cohort study to determine the relationship between smoking and its additive effects together with insulin resistance and beta cell function towards Type-II diabetes incidence. Ten thousand thirty eight patients were enrolled from both rural and urban regions. At both baseline and follow-up, they were given 75-gram OGTT and full biochemical assessment. Only four thousand forty one men were included in the final analysis due to the low smoking rates among the women participants. During four years, both former and heavy smokers have the highest incidence of diabetes of 12.5% and 11.1% respectively, compared to non-smokers [7.9%]. Former and current smokers have a relative risk of 1.60 [95% CI: 1.07-2.39], 2.06 [1.35-3.16, for <20 cigarettes/day] and 2.41 [1.48-3.93, for > or =20 cigarettes/day] respectively compared with non-smokers.. Smoking was concluded to be an independent risk factor for Type-II diabetes mellitus and showed a synergistic interaction with low insulin secretion and high insulin resistance. They recommended cessation of smoking as a key factor for diabetes prevention and treatment [30].

In 2015, Akhter and colleagues conducted an occupational health study in Japan to determine how smoking status, intensity, and cessation are related towards the risk of Type-II diabetes. Fifty three thousand, nine hundred thirty Japanese employees were employed, aged from fifteen to eighty-three years of age, who were given health check-up and did not have diabetes at the start of the study. The results revealed that over 3.9 years of following up, Type-II diabetes developed in 2441 [4.5%] individuals. The hazard ratios for diabetes were 1 for non-smokers, 1.16 [1.04 to 1.30] for former smokers and 1.34 [1.22 to 1.48] for smokers. Risk of diabetes increased with increased cigarette consumption among smokers [P <0.001]. Subjects with higher BMI [≥ 23 kg/m2] had greater attributable risk. The researchers concluded smoking is associated with high risk of type II diabetes. This elevated could be reversed similar to that of a non-smoker upon ten years of stopping[31].

Another study was conducted in 2015 in Japan, by Hilawwe and colleagues aimed to determine adiponectin, leptin, and C-reactive protein[CRP] concentrations' mediating effects towards the smoking-diabetes association. They followed members of the second Aichi worker's cohort study from 2002 to 2011, comprising 3338 Japanese workers, aged 35-66 years. Risk of diabetes was significantly increased in both smokers [hazard ratio 1.75, 95% CI 1.25-2.46] and former smokers [hazard ratio 1.54, 95% CI 1.07-2.22] as compared to non-smokers. The adiponectin levels have shown that the indirect effects of smoking on diabetes were statistically significant. On the other hand, neither leptin nor CRP levels were able to show the indirect effects of smoking on diabetes [32].

In 2016, Swoboda and colleagues conducted a pragmatic pilot randomized trial to assess a four-month intervention among Type-II diabetic adults with multiple risk factors for cardiovascular disease [CVD]. Adults aged 40 to 75 years with BMI greater than 25, Type-II diabetes and ≥1 additional cardiovascular risk factor were included in the trial. The case group was given individualized cardiovascular risk data. At the start of the study and each weekly phone call, the multiple-goal group chose

to work on their diet and physical activity, the single-goal group set their own goal, and the control group were given information regarding community health resources at baseline and every week. The single-goal group's systolic blood pressure improved and reflected their intake fruits, vegetables, and refined grains [all $P < .05$] from pre to post intervention. The multiple-goal group lessened their energy intake from total, saturated, monounsaturated, and trans-fat, while increased their leisure time walking [all $P < .05$].They concluded that a multiple-objective approach can improve both dietary and physical activity outcomes, while a focused approach can improve one behavioral domain. They recommended further studies to determine the maintenance of the achieved changes [29].

METHODOLOGY:

Study Design:
A cross-sectional study was carried out on August 2018.

Study Area:
The city: Jeddah is the main seaport city in the western Saudi Arabia. It is the largest city in the province of Makkah and the second largest city in Saudi Arabia after Riyadh. Jeddah also serves an important commercial hub in the Kingdom.

Forty seven primary health care centers are distributed over 5 main sectors based on the secondary hospitals [King Abdullah Medical Complex, King Fahad General Hospital, East Jeddah General Hospital, King Abdulaziz Hospital and Althager General Hospital], with each hospital containing 6 to 13 centers.

Study Population:
Diabetes mellitus patients availing primary health care services in Jeddah during 2018, regardless of sex and type of diabetes.

Eligibility Criteria:
Any consenting diabetic patient of legal age, but not critically ill.

Sample Size:
The sample size used for the study was determined using Raosoft website, with a confidence interval of 95% and 5% margin of error, and prevalence of 50%. The initial sample size was computed to be 323 patients, but upon addition of 10% in consideration for non-responders and defaulters, the final sample size was estimated to be 355.

Sampling Technique:
Stratified random sampling was then used so that each of the five main sectors will be represented. From there, the centers from each sector are selected through a random number generator. Once the primary health care centers were identified, the patients were selected using simple random sampling.

Upon approval of the PHCC director, both the researcher and a well-trained assistant distributed questionnaires during duty hours for the selected patients to fill out.

Data Collection Tool:
The self-administered valid questionnaire was derived several questionnaires, including from Global Tobacco Surveillance System Questionnaire [33], from Zurich Life Diabetes [34], from the International Physical Activities questionnaire [35], and from the UK Diabetes and Diet Questionnaire [36].

The questionnaire consisted of three main parts: [1] socio-demographic and personal characteristics including age, gender, educational level, occupation, monthly income; [2] Medical characteristics including DM type, medication, duration, complications, diabetic history, smoking history, and chronic illness; and [3], smoking information including the type of smoking, duration, family history, and consumption.

The questionnaires were collected as once they were filed out by the patients, where the results were then consolidated, tabulated and analyzed.

Study variables:
Dependent variable:
Smoking habits,

Independent variable:
Gender, age, educational level, occupation, monthly income, diabetic family history, smoking history, and chronic illness.

DATA ENTRY AND ANALYSIS:

Descriptive statistics was used to define the characteristics of the study variables through counts, percentages, mean and standard deviations. Three domains are identified and used in the analysis after checking the data related to the study. The following are:

- Overall risky behavior
- Medication administration attitude
    - History of insulin administration
    - History of taking oral hypoglycemic drugs
    - Compliance to medication
    - Frequency of checking blood sugar

- Healthy life style attitude
    - Did you meet a dietitian
    - History of regular exercise
    - History of smoking
    - History of passive smoking

Chi-squared test was used to establish a relationship between categorical variables. An independent t-test and one-way ANOVA, was used respectively to compare two group means and multiple groups with Least Significant Difference [LSD] as a post hoc test. These were done with the assumption of normal distribution. Otherwise, Games-Howell post hoc test for multiple groups were used as a non-normal alternative for the LSD test. To correlate variables which both represented by means a Pearson's correlation coefficient was used. Also a Linear Regression Model are presented in the analysis to estimate the linear equation coefficients involving one or more independent variables, as well as determine the best value of the dependent variable. Lastly, p-value <0.05 was used as rejection criteria for the null hypothesis.

Pilot study:
A preliminary study was made based on the 10% of the computed sample size in order to check the validity of the questionnaire and to determine if any modification was needed. Both the participants and results from the pilot study are excluded from the actual study.

Ethical consideration:
The study was conducted with clearance from the local research committee, PHCC directors and the the Joint Program of Family Medicine in Jeddah. Written consent was obtained from each participating patient.

Limitation:
The study is constrained within a limited time frame. Furthermore, the results of the questionnaires are limited by the respondent's memory and bias.

Budget:
The study has been completely funded by both researchers.

RESULTS:

Based on the results of the 291patients [Table 1], 48% [139 patients] are aged between 45 to 60 years old, 31% [90 patients] are aged 60 years or older and 21% [61 patients are aged 45 or younger. Majority of the patients [69.8%; 201 patients] are male while 30.2% [87] are female. For marital status, 80.1% [225 patients are married], while only 8.9% are single/unmarried [25 patients]. On the other hand, 6% [17 patients] are already divorced, while 5% [14 patients] are widowed.

For educational level, 42.8% [121 patients] have attained college level, while 36.7% [104 patients] have reached high school level. Only 8.1% [23 patients] have only reached intermediate school, and 9.2% [26 patients] have reached elementary school. Lastly, only 3.2% [9 patients] are able to read and write but not reach a formal educational level.

In terms of job status, 36.6% [106 patients] have reported to be employed, while 33.8% [98 patients] have reported to be retired. Only 8.6% [25 patients] were unemployed. Notably, 17.6% [51 patients] reported to be full-time housewives, while 3.4% [10 patients] reported to be studying.

Table 1. Demographics and characteristics of the study group n=291

Demographics		**N**	**Min**	**Max**	**Mean**	**SD**
Age		290	18	86	53.99	12.8
Weight		291	48	155	85.21	15.4
Height		291	151	185	170.24	6.1
BMI		291	20	48	29.17	4.9
Waistline		159	54	122	89.48	11
					n[%]	
Age	<45 years old				61[21.0]	
	45-60 years old				139[48.0]	
	>60 years old				90[31.0]	
	Missing				1	
Gender	Male				201[69.8]	
	Female				87[30.2]	
	Missing				3	
Marital Status	Single				25[8.9]	
	Married				225[80.1]	

	Divorced	17[6.0]
	Widow	14[5.0]
	Missing	10
Educational Level	Reads and writes	9[3.2]
	Elementary school	26[9.2]
	Intermediate school	23[8.1]
	High school	104[36.7]
	College degree	121[42.8]
	Missing	8
Monthly income	Less than 5k	84[28.9]
	5-10k	111[38.1]
	10-15k	50[17.2]
	More than 15k	24[8.2]
	No income	22[7.6]
Job status	Employed	106[36.6]
	Unemployed	25[8.6]
	Retired	98[33.8]
	Student	10[3.4]
	Housewife	51[17.6]
	Missing	1

In terms of medical condition [Table 2], 86.6% [251 patients] were classified to have Type II diabetes, while 12.4% [36 patients] were classified as Type I. Seventy-nine percent [203 patients] reported to have diabetes as part of their family medical history, while only 21% have no prior family history of diabetes. Seventy-eight point one percent [225 patients] reported no complication in their condition while 21.5% [62 patients] reported complications. In checking blood sugar, 36.5% [100 patients] reported to check their blood sugar monthly, while 34.7% [95 patients] reported to do so weekly. Only 17.5% [48 patients reported to check their blood sugar daily. On the other hand, 11.3% [31 patients] reported that they don't check their blood sugar at all. Ninety-five point five [277 patients] have a history of insulin administration while only 4.5% [13 patients] did not. Ninety point three percent [260 patients] have a history of taking oral hypoglycemica drugs while only 9.7% [28 patients] did not. Sixty-nine point four percent [200 patients] reported themselves to be compliant with their medication, while only 29.5% were not.

Table 2. Medical history reported by participants

Variables		n[%]
History of diabetes	Type 1	36[12.4]
	Type 2	251[86.6]
	I don't know	3[1.0]
	Missing	1
History of insulin administration	Yes	277[95.5]
	No	13[4.5]
	Missing	1
History of taking oral hypoglycemic drugs	Yes	260[90.3]
	No	28[9.7]
	Missing	3
Compliance to medication	Yes	200[69.4]
	No	85[29.5]
	I don't know	3[1.0]
	Missing	3
History of diabetes complication	Yes	62[21.5]
	No	225[78.1]
	I don't know	1[0.3]
	Missing	3
Frequency of checking blood sugar	Daily	48[17.5]
	Weekly	95[34.7]
	Monthly	100[36.5]
	I don't check it	31[11.3]
	Missing	
Family history of diabetes	Yes	203[79.0]
	No	54[21.0]
	Missing	

In terms of smoking prevalence among diabetics [Table 3], 73.6% [209 patients] reported that they did not have any history of smoking, while only 10.6% [30 patients reported that they smoke. Only 15.8% [45 patients] reported that they used to smoke.

Among those with smoking history, the average packs consumed daily is 1.03 [1 pack], with the highest consumption reaching 2 packs per day. Among those who some, 83.3% [25 patients] reported to smoke daily, 13.3% [4 patients] reported to smoke less than daily, while 3.3% [1 patient] reported that they did not smoke.

Table 3. Prevalence of smoking among diabetics.

Variables						n[%]
History of smoking	No					209[73.6]
	Yes					30[10.6]
	Ex smoker					45[15.8]
	Missing					3
History of smoking n=32		**N**	**Min**	**Max**	**Mean**	**SD**
No. of pack/day		31	1	2	1.03	0.2
						n[%]
Frequency of smoking	Daily					25[83.3]
	Less than daily					4[13.3]
	I do not smoke					1[3.3]
History of passive smoking	Yes					45[15.7]
	No					151[52.8]
	I don't know					90[31.5]
	Missing					1

History of passive smoking n=45		n[%]
If yes, who	Father	6[14.6]
	Mother	1[2.4]
	Brother	30[73.2]
	Sister	1[2.4]
	Brother and Father	3[7.3]
	Missing	4
How often does a family member smoke	Daily	12[27.3]
	Weekly	8[18.2]
	Monthly	4[9.1]
	Less than monthly	2[4.5]
	I don't know	18[40.9]

For those who have a history of passive smoking [45 patients], 73.2% [30 patients] reported that they are exposed from their brother's smoking, while 14.6% [6 patients] that they are exposed from their father's smoking. Seven point three percent [3 patients] are exposed to smoke from both their father and brother. On the other hand, only 2.4% [1 patient] are exposed to smoke from their mother, and another 2.4% [1 patient] from their sister.

Forty point nine percent [18 patients] reported that they do not know how frequent their family member smokes. On the other hand, 27.3% [12 patients] reported that their family member smokes daily. Eighteen point two percent [8 patients] reported that their family member smokes weekly, while 9.1% [4 patients] reported that their family member smoked monthly. Only 4.5% [2 patients] reported that their family member smoked less than monthly.

For physical activity [Table 4], 80.5% [231 patients] reported to be engaged in low physical activity, while 16% [46 patients] are engaged in high physical activity, and only 3.5% [10 patients are engaged in moderate physical activity. For a given week, the average duration of heavy physical activity within the group is barely one day [0.84], Among the 48 patients engaged in high physical activity, they reported to spend 1.77 hours of heavy activity. On average, the group was reported to have spent barely half of a day [0.47] for normal activities per week. Those who have reported to have a high physical activity reported to spend an average of two hours of normal activities daily. In terms of walking, the group has reported to have spent an average of 1.19 days per week of walking. By contrast, the group reported an average weekly vehicle use of 5.02 days, with an average of 2.04 hours per trip.

Table 4. Prevalence of physical inactivity among the diabetics

Variables	**N**	**Min**	**Max**	**Mean**	**SD**
Heavy activity in the past 7 days	287	0	7	.84	2.0
Duration of heavy activities[Hours]	48	0	6	1.77	1.1
Duration of heavy activities[Mins]	48	0	360	107.50	64.3
Normal activities in the past 7 days [except walking]	287	0	5	.47	1.2
Duration of normal activities [except walking][Hours]	45	0	4	2.04	1.3
Duration of normal activities [except walking][Mins]	45	0	240	122.67	80.9
Walking during the past 7 days	285	0	7	1.19	1.6
Duration of walking[Hours]	117	0.01	4	1.34	1.1
Duration of walking[Mins]	117	1	240	80.56	66.2
Vehicle use during the past 7 days	286	0	7	5.02	2.1
Duration of vehicle use[Hours]	276	1	6	2.04	1.0
Duration of vehicle use[Mins]	276	60	360	122.17	59.0
Duration of sitting during the past 7 days	287	1	15	8.18	3.2
Vigorous MET	284	0	20160	714.93	2094.2
Moderate MET	286	0	4800	218.18	675.5
Transportation MET	284	0	15120	3857.32	2767.1
Walking MET	280	0	3168	314.83	614.8
Total MET	287	0	22668	5049.03	3583.4
				n[%]	

Physical activity	Low	231[80.5]
	Moderate	10[3.5]
	High	46[16.0]

In terms of monthly income, those earning less than 5000 SAR per month have the highest percentage engaged in high physical activity [42.9%], followed by those earning more than 15000 [16.7%]. However, those earning 5000 to 15000 SAR monthly have a similar percentage of those engaged in low physical activity with those not earning at all.

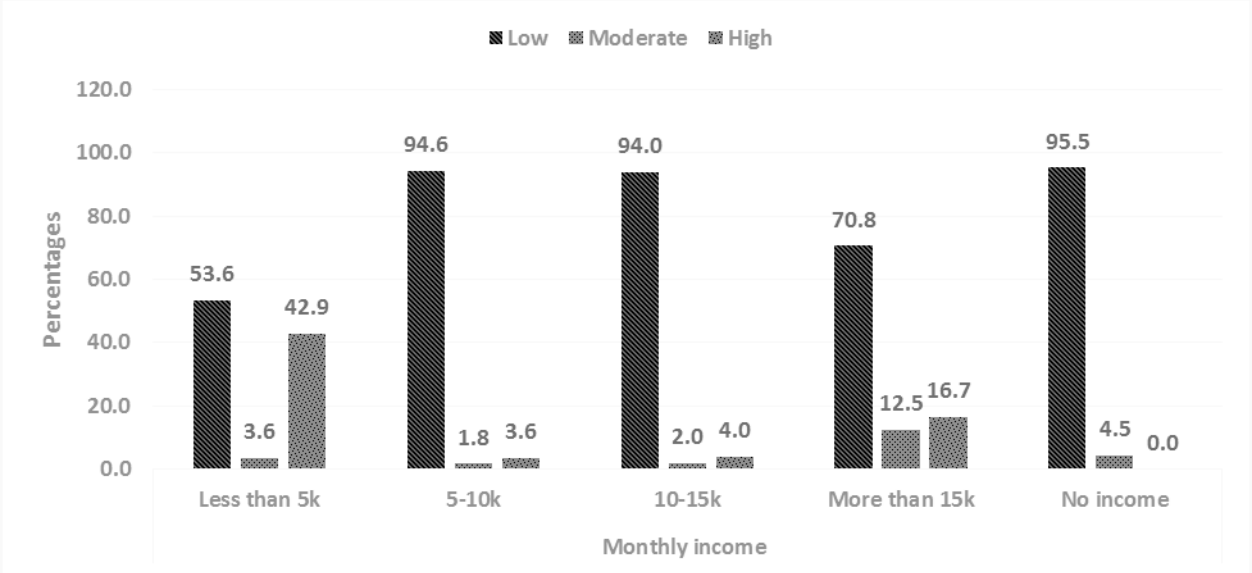

Figure 1 .Physical activity vs Monthly income

In terms of job status, those studying have the highest percentage of engagement in high physical activity [40%], followed by those employed [22.6%], and unemployed [20%]. Retirees and housewives have the highest percentage of those engaged in low physical activity.

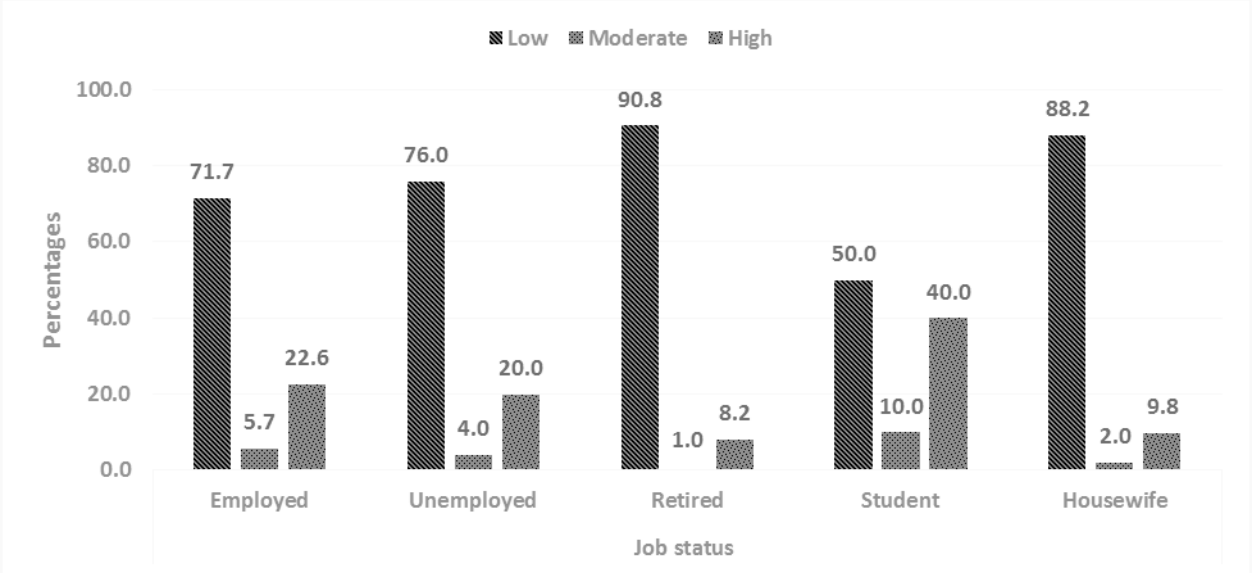

Figure 2. Physical activity vs Job Status

In determining the relationship of smoking history with physical activity [Table 5], it can be said that physical activity and smoking history have a significant association [p<0.001]. However, it should be noted that both groups that smoke and do not smoke have a high proportion of those with low physical activity [91.4% and 86.7%, respectively vs 31.1%], whereas by contrast, those who have stopped smoking have a higher proportion of those with high physical activity [60% vs 5.7% and 13.3%, respectively].

Table 5. Relationship of smoking history with physical inactivity among diabetic patients.

Variables		Total	Physical activity			p-value
			Low	Moderate	High	
History of smoking	No	209	191[91.4]	6[2.9]	12[5.7]	<0.001[a]
	Yes	30	26[86.7]	0[0.0]	4[13.3]	
	Ex-smoker	45	14[31.1]	4[8.9]	27[60.0]	

[a]-significant using Chi-Square Test @<0.05 level.

Comparison of smoking history with physical activity show that those have stopped smoking have the greatest proportion having high physical activity, while most of smokers and non smokers are engaged in low physical activity.

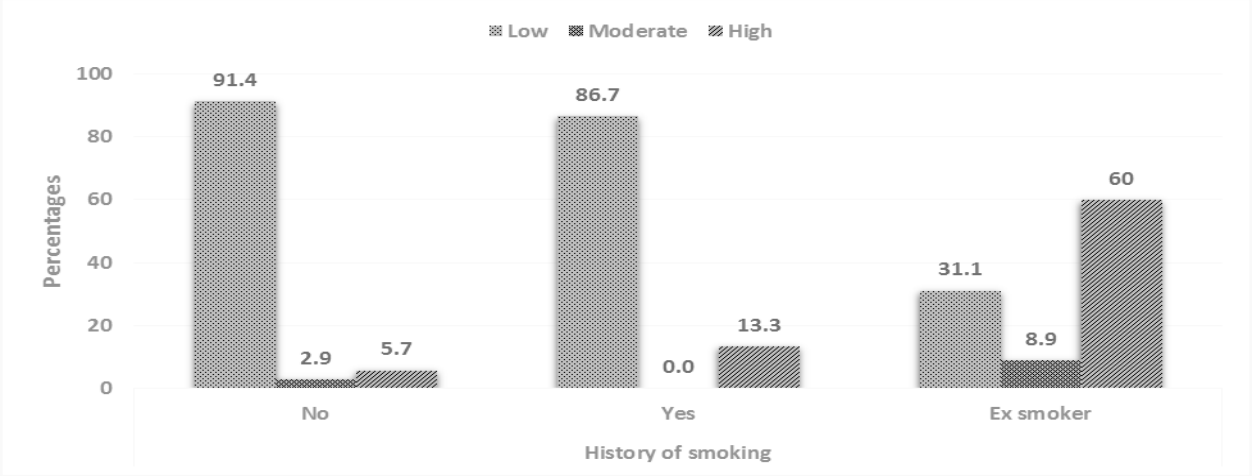

Figure 3. Smoking history with physical inactivity among diabetic patients

In determining the relationship of smoking history with physical activity [Table 5], it can be said that physical activity and smoking history have a significant association [p<0.001]. However, it should be noted that both groups that smoke and do not smoke have a high proportion of those with low physical activity [91.4% and 86.7%, respectively vs 31.1%], where as by contrast, those who have stopped smoking have a higher proportion of those with high physical activity [60% vs 5.7% and 13.3%, respectively]. Between history of smoking and physical activity [Table 6], it can be said that the strongest predictor is having a low physical activity [B = -2.603; P<0.001].

Table 6. Predictors of Smoking History

Dependent variable: History of Smoking[Smoker/Ex-Smoker]		B	Exp[B]	95% C.I.for EXP[B]		p-value
				Lower	Upper	
Step 1[a]	Physical activity					<0.001
	Physical activity[Low]	-2.603	.074	.022	.254	<0.001
	Physical activity[Moderate]	19.293	2.393E+08	0.000		0.999
	Constant	1.910	6.750			<0.001

[a]-Variable[s] entered on step 1: Physical activity.

Other results have shown that 37.9% [110 patients] have a history of chronic disease. Among them, 80.0% [88 patients] reported to have a history of hyper tension, while 20.9% [23 patients] have a history of dyslipidemia.

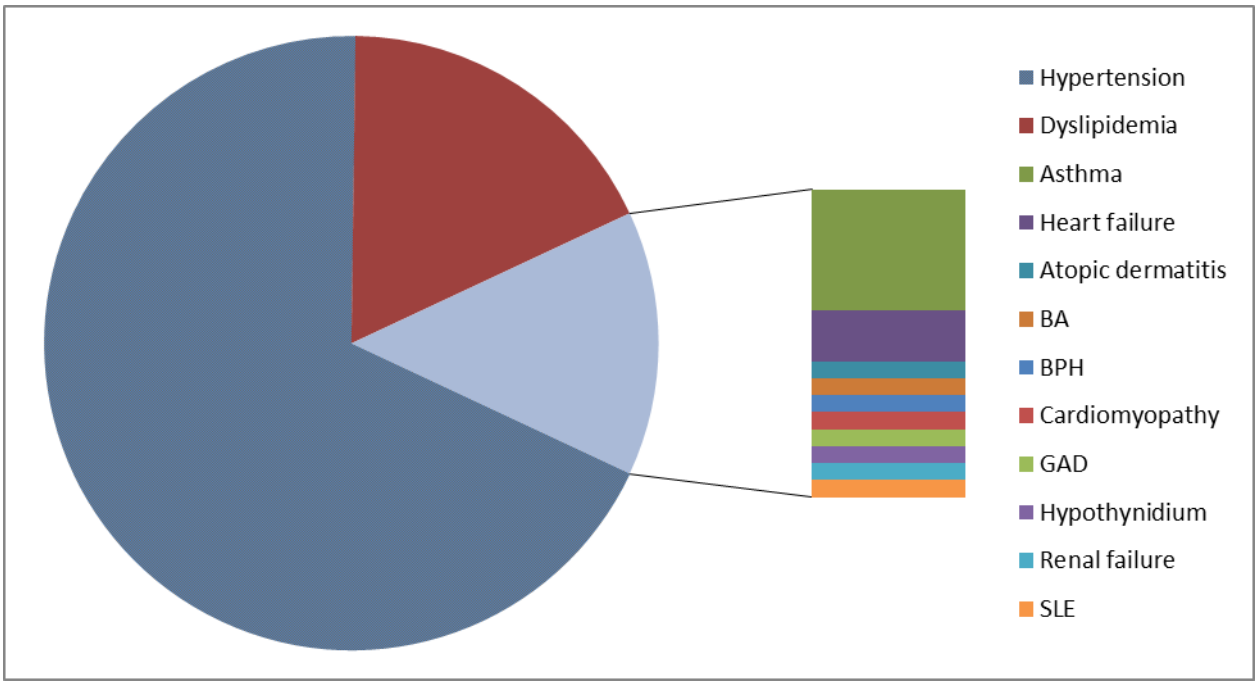

Figure 4. History of chronic disease among the 291 diabetic patients

Six point four percent [7 patients have a history of asthma, while 2.7% [3 patients] reported to have a history of heart failure. Other chronic disease found in their medical history are atopic dermatitis, bronchial asthma, benign prostatic hyperplasia, cardiomyopathy, generalized anxiety disorder, heart failure, hypthynidum, renal failure, and SLE.

Table 7a. Patients' history of chronic disease and medications

Variables		**n[%]**
History of chronic disease	Yes	110[37.9]
	No	180[62.1]
	Missing	1
Chronic disease: n=110[a]		**n[%]**
Hypertension		88[80.0]
Dyslipidemia		23[20.9]
Asthma		7[6.4]
Atopic dermatitis		1[0.9]
BA		1[0.9]
BPH		1[0.9]
Cardiomyopathy		1[0.9]
GAD		1[0.9]
Heart failure		3[2.7]
Hypothynidium		1[0.9]
Renal failure		1[0.9]
SLE		1[0.9]

There is a statistically significant difference between mean age and physical activity [p = 0.002] and between mean BMI and physical activity [p<0.001]. It appears that those with younger ages are associated with moderate physical activity. As for BMI values, it appears that higher BMI values are associated with high physical activity.

Between, patient characteristics and patient activity, age [p = 0.024], monthly income [p < 0.001], and job status [p = 0.008] have a significant association towards physical activity.

Table 8. Relationship of demographics and characteristics with physical activity.

Variables		Total	Physical activity			p-value
			Low	Moderate	High	
Age Mean[SD]		290	55.26[11.9]	47.70[15.4]	48.89[15.1]	0.002[a]
BMI Mean[SD]		291	28.66[4.3]	28.07[5.8]	32.04[6.3]	<0.001[a]
Age n[%]	<45 years old	61	41[67.2]	4[6.6]	16[26.2]	0.024[b]
	45-60 years old	139	113[81.3]	4[2.9]	22[15.8]	
	>60 years old	90	80[88.9]	2[2.2]	8[8.9]	
Gender n[%]	Male	201	159[79.1]	7[3.5]	35[17.4]	0.595
	Female	87	73[83.9]	3[3.4]	11[12.6]	
Marital Status n[%]	Single	25	16[64.0]	2[8.0]	7[28.0]	0.425
	Married	225	184[81.8]	8[3.6]	33[14.7]	
	Divorced	17	14[82.4]	0[0.0]	3[17.6]	
	Widow	14	12[85.7]	0[0.0]	2[14.3]	
Educational Level n[%]	Reads and writes	9	7[77.8]	1[11.1]	1[11.1]	0.380
	Elementary school	26	23[88.5]	0[0.0]	3[11.5]	
	Intermediate school	23	22[95.7]	0[0.0]	1[4.3]	
	High school	104	86[82.7]	4[3.8]	14[13.5]	
	College degree	121	92[76.0]	5[4.1]	24[19.8]	
Monthly income n[%]	Less than 5k	84	45[53.6]	3[3.6]	36[42.9]	<0.001[b]
	5-10k	111	105[94.6]	2[1.8]	4[3.6]	
	10-15k	50	47[94.0]	1[2.0]	2[4.0]	
	More than 15k	24	17[70.8]	3[12.5]	4[16.7]	
	No income	22	21[95.5]	1[4.5]	0[0.0]	
Job status n[%]	Employed	106	76[71.7]	6[5.7]	24[22.6]	0.008[b]
	Unemployed	25	19[76.0]	1[4.0]	5[20.0]	
	Retired	98	89[90.8]	1[1.0]	8[8.2]	
	Student	10	5[50.0]	1[10.0]	4[40.0]	
	Housewife	51	45[88.2]	1[2.0]	5[9.8]	
History of chronic disease n[%]	Yes	110	96[87.3]	3[2.7]	11[10.0]	0.080
	No	180	138[76.7]	7[3.9]	35[19.4]	

[a]-significant using One-Way ANOVA test @<0.05 level.
[b]-significant using Chi-Square test @<0.05 level.

Given that the mean age and BMI are significantly different in Table 1, Games-Howell post-hoc analysis [Table 9] was made to ascertain which specific means are significantly different. Based on the results in Table 3, it can be said that a statistically significant difference between low physical activity and high physical activity across age [6.365; p=0.024] and BMI [3.37564; p=0.003] is present.

Table 9. Post-hoc analysis of age and BMI with physical activity

Dependent Variable: Physical activity	I	J	Mean Difference [I-J]	95% Confidence Interval		p-value
				Lower Bound	Upper Bound	
Age [Games-Howell]	Low	Moderate	7.556	-6.10	21.21	0.321
		High	6.365*	.70	12.03	0.024
	Moderate	Low	-7.556	-21.21	6.10	0.321
		High	-1.191	-15.33	12.95	0.973
	High	Low	-6.365-*	-12.03	-.70	0.024
		Moderate	1.191	-12.95	15.33	0.973
BMI	Low	Moderate	.58732	-4.5381	5.7128	0.946

[Games-Howell]		High	-3.37564-*	-5.7272	-1.0241	0.003
	Moderate	Low	-.58732	-5.7128	4.5381	0.946
		High	-3.96296	-9.3356	1.4097	0.167
	High	Low	3.37564*	1.0241	5.7272	0.003
		Moderate	3.96296	-1.4097	9.3356	0.167

*. The mean difference is significant at the 0.05 level.

Upon closer look between physical activity and the significant variables, the mean age of those engaged in high physical activity is 48.89, whereas their mean is 32.04. On the other hand, those engaged in moderate physical activity have the lowest mean age [47.7 years] and BMI [28.07]. However 28.07 is still considered overweight.

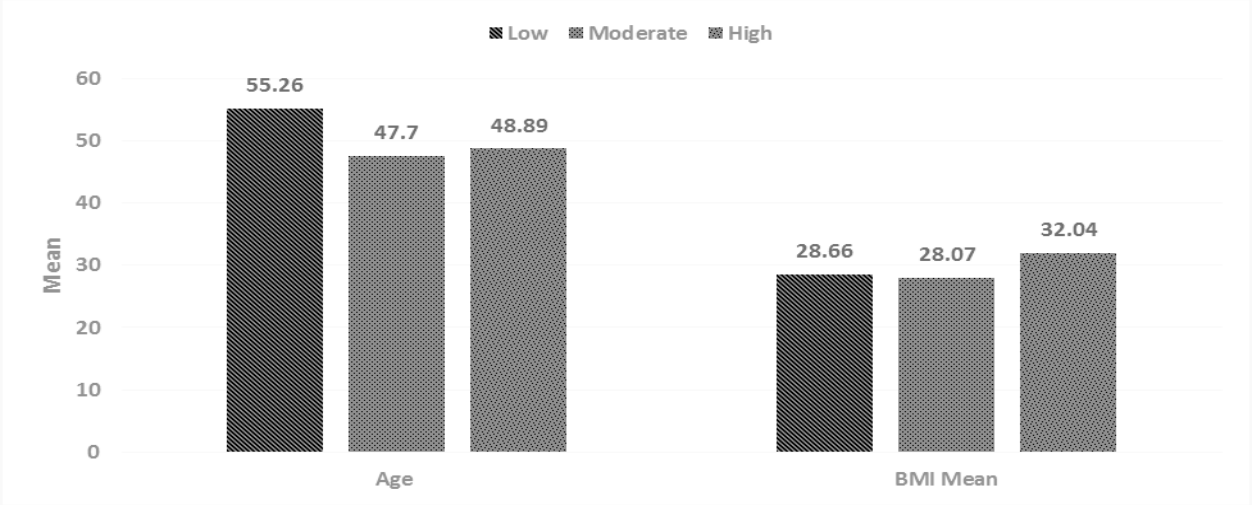

Figure 5. Physical activity vs significant variables [Age and BMI].

Regression analysis was done to determine the strongest indicators of medication administration attitude. The final regression model [Table 2] shows five independent variables [age, BMI, monthly income, job status and physical activity]. The strongest predictors of medication administration attitude score [p<0.001] is age [Beta=-0.294], followed by physical activity [Beta=0.256], and job status [Beta=-0.231].

Table 10. Determinants of medication administration attitude score

Model		Beta	t	95.0% Confidence Interval for B		p-value
				Lower Bound	Upper Bound	
1	[Constant]		.456	-.484	.776	0.649
	Age	-.304	-4.985	-.023	-.010	<0.001
	BMI	.189	3.501	.012	.042	0.001
	Marital Status	.023	.408	-.104	.158	0.683
	Monthly income	-.110	-2.008	-.125	-.001	0.046
	Job status	.231	4.277	.059	.160	<0.001
	Physical activity	.254	4.471	.131	.337	<0.001
2	[Constant]		.551	-.444	.788	0.582
	Age	-.294	-5.277	-.022	-.010	<0.001
	BMI	.187	3.489	.011	.041	0.001
	Monthly income	-.107	-1.976	-.122	.000	0.049
	Job status	.231	4.291	.059	.160	<0.001
	Physical activity	.256	4.512	.133	.338	<0.001

[a]-Dependent Variable: Medication administration attitude score

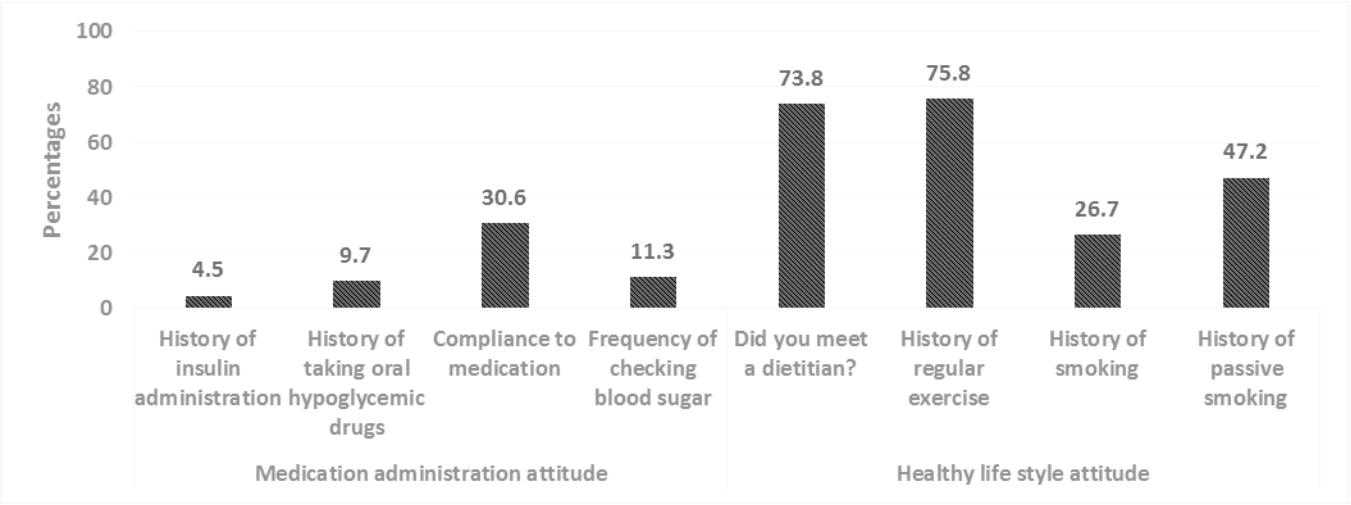

Figure 6. Pattern of medication administration and some of lifestyle behaviors among participants

For healthy lifestyle attitude score [Table 5], BMI has shown to be the strongest predictor [Beta = 0.182], while monthly income has shown to have an inverse association with healthy lifestyle attitude score [Beta = -0.153].

Table 11. Determinants of healthy lifestyle attitude score

Model		**Beta**	**t**	**95.0% Confidence Interval for B**		**p-value**
				Lower Bound	**Upper Bound**	
1	[Constant]		4.292	.801	2.158	<0.001
	BMI	.182	3.182	.013	.056	0.002
	Monthly income	-.153	-2.667	-.208	-.031	0.008

For overall risky behavior score, the strongest predictors in the final regression model is BMI [B = 0.256; p < 0.001], followed by monthly income [B = -0.156; p = 0.008], and physical activity [B = 0.133; p = 0.028].

Table 12. Determinants of overall risky behavior score

Model		Beta	t	95.0% Confidence Interval for B		p-value
				Lower Bound	Upper Bound	
1	[Constant]		1.798	-.093	2.056	0.073
	BMI	.255	4.388	.036	.095	<0.001
	Marital Status	-.012	-.214	-.263	.211	0.830
	Monthly income	-.155	-2.663	-.284	-.043	0.008
	Physical activity	.132	2.198	.023	.424	0.029
2	[Constant]		2.001	.015	1.821	0.046
	BMI	.256	4.448	.037	.095	<0.001
	Monthly income	-.156	-2.684	-.284	-.044	0.008
	Physical activity	.133	2.209	.024	.424	0.028

[a]-Dependent Variable: Overall risky behavior score

For smoking [Table 13], only the mean BMI has a significant association with smoking history. It appears that lower BMI is associated with a lack of smoking history. It also appears that gender [p=0.012], educational level [p=0.037], monthly income [p<0.001], and job status [p=0.001] have a significant association with smoking history.

Table 13.Relationship of patient characteristics with smoking history

Variables		Total	History of smoking			p-value
			No	Yes	Ex-smoker	
Age Mean[SD]		287	54.89[12.8]	51.68[9.8]	50.80[14.0]	0.090
BMI Mean[SD]		288	28.48[4.3]	29.05[4.5]	31.30[6.3]	<0.001[a]
Age n[%]	<45 years old	61	39[63.9]	9[14.8]	13[21.3]	0.069
	45-60 years old	137	97[70.8]	16[11.7]	24[17.5]	
	>60 years old	89	75[84.3]	6[6.7]	8[9.0]	
Gender n[%]	Male	199	135[67.8]	27[13.6]	37[18.6]	0.012[b]
	Female	86	73[84.9]	5[5.8]	8[9.3]	
Marital Status n[%]	Single	25	16[64.0]	3[12.0]	6[24.0]	0.619
	Married	223	163[73.1]	24[10.8]	36[16.1]	
	Divorced	17	13[76.5]	2[11.8]	2[11.8]	
	Widow	13	12[92.3]	1[7.7]	0[0.0]	
Educational Level n[%]	Reads and writes	8	8[100.0]	0[0.0]	0[0.0]	0.037[b]
	Elementary school	26	22[84.6]	0[0.0]	4[15.4]	
	Intermediate school	23	20[87.0]	3[13.0]	0[0.0]	
	High school	104	79[76.0]	11[10.6]	14[13.5]	
	College degree	119	76[63.9]	17[14.3]	26[21.8]	
Monthly income n[%]	Less than 5k	81	44[54.3]	5[6.2]	32[39.5]	<0.001[b]
	5-10k	111	87[78.4]	20[18.0]	4[3.6]	
	10-15k	50	43[86.0]	2[4.0]	5[10.0]	
	More than 15k	24	18[75.0]	2[8.3]	4[16.7]	
	No income	22	19[86.4]	3[13.6]	0[0.0]	
Job status n[%]	Employed	105	63[60.0]	15[14.3]	27[25.7]	<0.001[b]
	Unemployed	24	18[75.0]	2[8.3]	4[16.7]	
	Retired	97	79[81.4]	12[12.4]	6[6.2]	
	Student	10	6[60.0]	0[0.0]	4[40.0]	
	Housewife	51	45[88.2]	2[3.9]	4[7.8]	
History of chronic disease n[%]	Yes	109	87[79.8]	8[7.3]	14[12.8]	0.150
	No	178	124[69.7]	23[12.9]	31[17.4]	

[a]-significant using One-Way ANOVA test @<0.05 level.
[b]-significant using Chi-Square test @<0.05 level.

Post-hoc analysis of BMI status with smoking history show [Table 14] that at @=0.05, there is a significant mean difference between those that formerly smoke and those who do not smoke [3.81863; p=0.001], and those who smoke [3.25633; p=0.026].

Table 14. Post-hoc analysis of patient characteristics with smoking history

Dependent Variable: History of Smoking	I	J	Mean Difference [I-J]	95% Confidence Interval		p-value
				Lower Bound	Upper Bound	
BMI[Games-Howell]	No	Yes	-.56230	-2.6193	1.4947	0.785
		ex-smoker	-3.81863*	-6.1997	-1.4375	0.001
	Yes	No	.56230	-1.4947	2.6193	0.785
		ex-smoker	-3.25633*	-6.1985	-.3141	0.026
	ex-smoker	No	3.81863*	1.4375	6.1997	0.001
		Yes	3.25633*	.3141	6.1985	0.026

*. The mean difference is significant at the 0.05 level.

Based on BMI, former smokers have the highest mean BMI [31.30], while non-smokers have the lowest mean BMI [28.48] as shown in Figure 7. However, it should be noted that the cut-off point between normal BMI and overweight BMI is at 25.00.

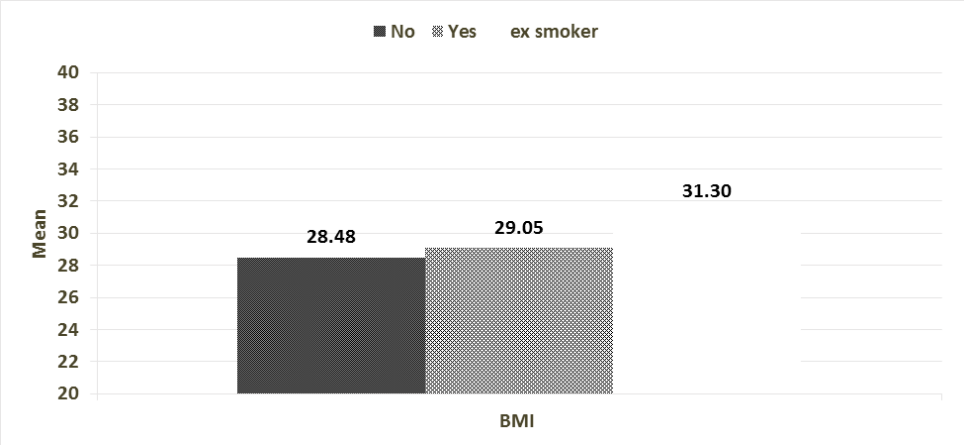

Figure 7. History of smoking vs BMI

In terms of gender, women have a higher percentage of non-smokers compared to men at 84.9% [vs 67.8%]. On the other hand, men have the greater percentage of both current and former smokers at 13.6% and 18.6%, [vs 5.8% and 9.3%] respectively [Figure 9].

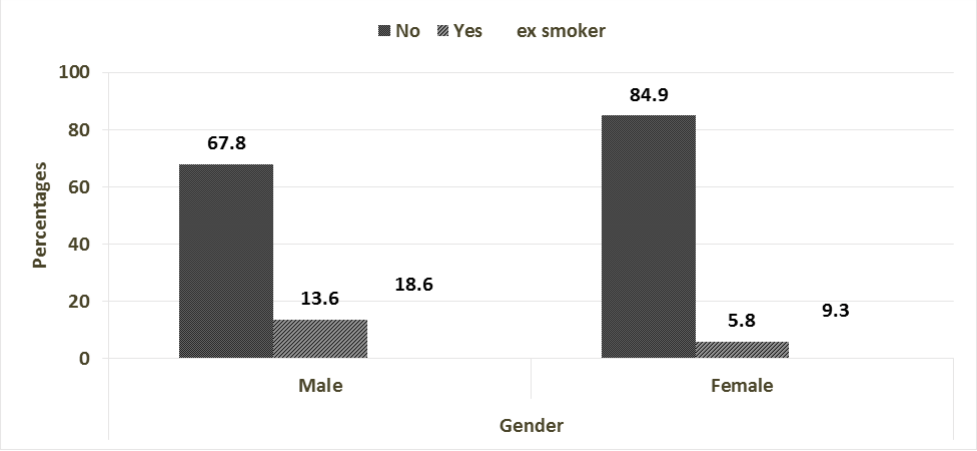

Figure 8. History of smoking vs Gender

For educational level, the highest percentage of current smokers have attained at least college level [14.3%], followed by those who have finished up to intermediate school [13.0%]. Those who finished college also have the highest percentage of former smokers [Figure 10].

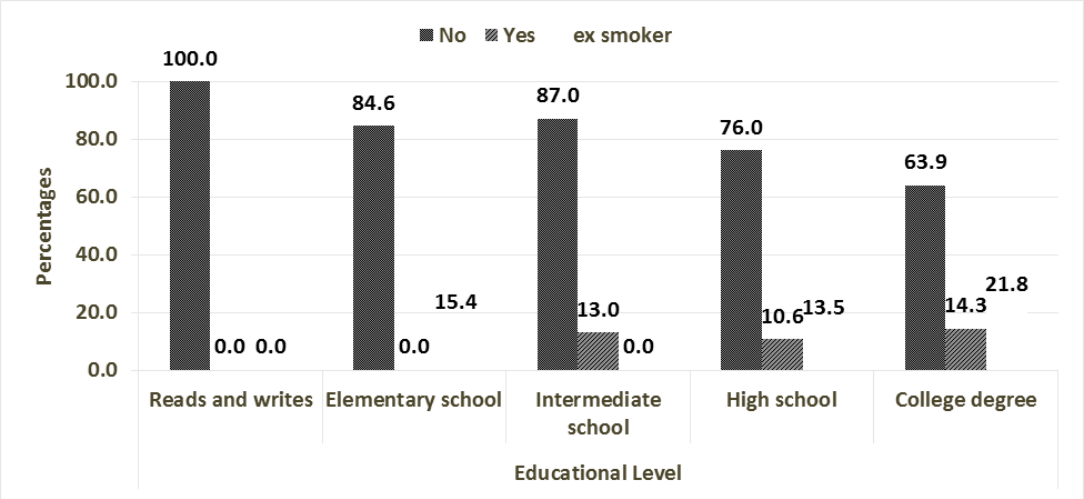

Figure 9. History of smoking vs Educational Level

Between monthly income with smoking history, those without income or those earning between 5-10 thousand SAR per month have the highest percentage of current smokers, with 13.6% and 18.0% respectively. By contrast, those higher or lower than 5000 to 10000 SAR per month have greater percentage of former smokers, with 39.5% for those earning less than 5000 SAR per month, and 16.7% for those earning greater than 15000 SAR per month [Figure 11].

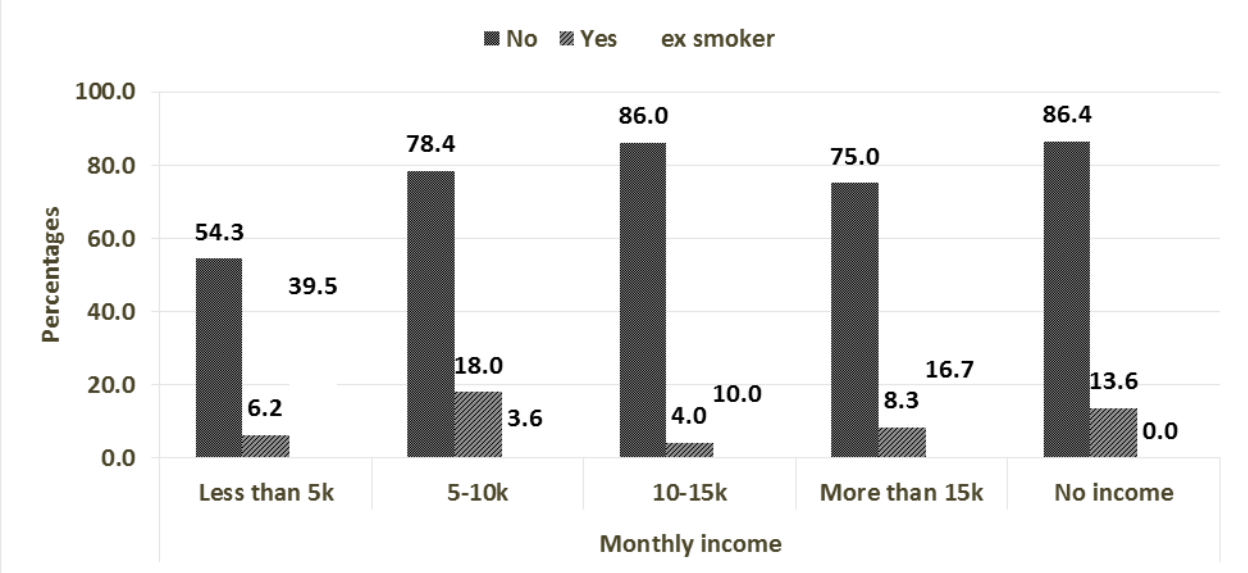

Figure 10. History of smoking vs Monthly Income

Upon comparison of job status with smoking history, students and employees have the greatest percentage of ex-smokers [40% and 25.7%], respectively. On the other hand, most of the current smokers are either employees [14.3%] or retirees [12.4%] [Figure 12].

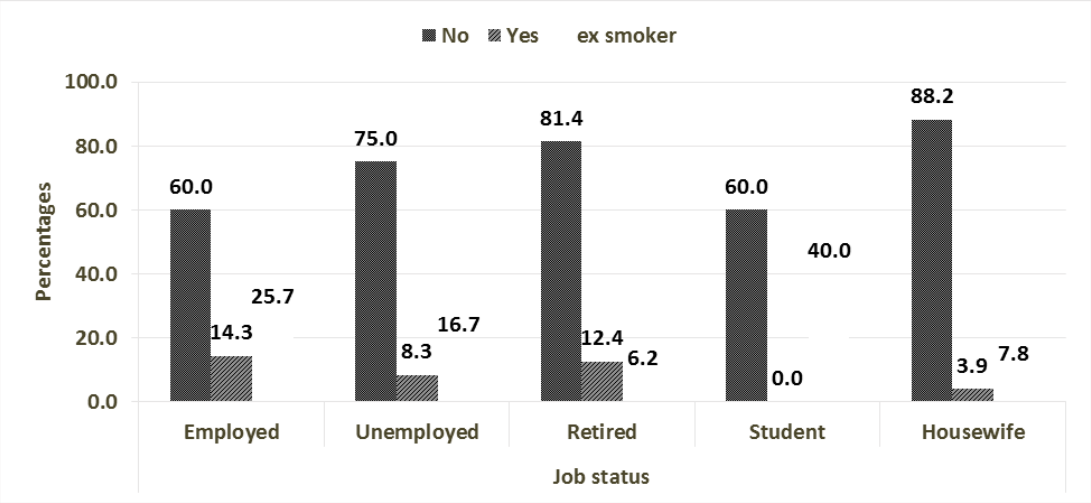

Figure 11. History of smoking vs Job Status

Further analysis of patient characteristics with smoking history indicate that none of these characteristics have a statistically significant effect on smoking history. These factors for these study do not significantly predetermine the smoking history of diabetic patients [Table 15].

Table 15.Regression analysis of patient characteristics with smoking history.

Dependent variable: History of Smoking[Smoker/Ex-Smoker]		**B**	**Exp[B]**	**95% C.I.for EXP[B]**		**p-value**
				Lower	**Upper**	
First Step[a]	Age	-.128	.880	0.65	1.18	0.397
	BMI	.118	1.126	0.87	1.46	0.374
	Age Cat					0.834
	Age Cat[<45 years]	-2.446	.087	0.00	501.75	0.580
	Age Cat[45-60 years]	-.888	.412	0.00	50.75	0.718
	Marital Status					0.403
	Marital Status[Single]	40.926	5.94E+17	0.00		0.999
	Marital Status[Married]	43.556	8.24E+18	0.00		0.999
	Marital Status[Divorced]	39.617	1.60E+17	0.00		0.999
	Educational Level					0.703
	Educational Level[Elementary]	18.932	1.67E+08	0.00		0.999
	Educational Level[Intermediate]	-20.063	.000	0.00		0.999
	Educational Level[High School]	2.077	7.978	0.26	245.74	0.235
	Job Status					0.990
	Job Status[1Employed	-17.694	.000	0.00		0.999
	Job Status[Unemployed]	.511	1.667	0.00		1.000
	Job Status[Retired]	-18.888	.000	0.00		0.999
	Job Status[Student]	.549	1.731	0.00		1.000
	Monthly Income					0.027
	Monthly Income[Less than 5k]	44.459	2.033E+19	0.00		0.999
	Monthly Income[5-10K]	39.776	1.882E+17	0.00		0.999
	Monthly Income[10-15k]	44.198	1.566E+19	0.00		0.999
	Monthly Income[More than 15k]	42.300	2.347E+18	0.00		0.999
	History of chronic disease [Yes]	2.350	10.491	0.44	251.78	0.147
	Constant	-63.708	.000			0.999
Last Step[a]	Marital Status					0.689
	Marital Status[Single]	25.287	9.594E+10	0.00		0.999
	Marital Status[Married]	25.628	1.349E+11	0.00		0.999
	Marital Status[Divorced]	23.569	1.721E+10	0.00		1.000

Educational Level					0.781
Educational Level[Elementary]	21.325	1.825E+09	0.00		0.999
Educational Level[Intermediate]	-23.081	.000	0.00		0.999
Educational Level[High School]	1.071	2.918	0.39	21.95	0.298
Monthly Income					0.002
Monthly Income[Less than 5k]	25.210	8.886E+10	0.00		0.999
Monthly Income[5-10K]	19.980	4.755E+08	0.00		0.999
Monthly Income[10-15k]	23.073	1.048E+10	0.00		0.999
Monthly Income[More than 15k]	22.402	5.361E+09	0.00		0.999
Constant	-47.484	.000			0.999

[a]-Variable[s] entered on step 1: Age, BMI, Age Categorical, Marital Status, Educational Level, Job Status, Monthly Income, History of chronic disease.

DISCUSSION:

The objective of this research is to ascertain which risk factors are prevalent among diabetic patients. Given the results, high BMI and low physical activity are significant risk factors prevalent among diabetic patients. This remains congruent with the report done by the World Health Organization last 2016 regarding the diabetic profile of Saudi Arabia [6]. By contrast however, the percentage of diabetic patients in Jeddah are slightly different, with that of the report [69.1% vs 62.46% for males, 30.2% vs 37.54% for females. In comparison to related studies, the mean age in Jeddah is higher compared to the study conducted in Turaif [10] [53.99 vs 23.27 years]. The male to female ratio between regions is also different, [69.1% to 30.2% and 38.1% to 61.9%, respectively.]

Smoking and low physical activity are lifestyle choices that affect the onset of diabetes and its complications. While 73.6% of the respondents do not smoke, it is still possible for them to be at risk from second-hand smoke as they indirectly inhale the same chemicals inhaled by smokers.. Exposure to smoke increases LDL cholesterol and damage your blood vessels, contributing to the vascular complications of diabetes. As for smokers, the risk for diabetes becomes greater with more smoked cigarettes [30].Those who smoked at least 20 sticks per day or greater, had a risk of 1.55 compared to those that never smoked at all [37, 38]. Smoking is also associated with centraI obesity [39], which in turn compounds the risk in developing diabetes.

Low physical activity is generally prevalent throughout in Saudi Arabia [10], by as much as 58%. The percentage of those engaged in low physical activity is drastically higher [80.5% vs 58%] in this sample group in Jeddah. In high-income countries, sedentary occupations, recreation and mobility could explain the increased levels of physical inactivity [40]. Based on the results, it could be observed that those with income less than 5000 SAR/month have the largest number of those engaged in high physical activity [46 patients]. Low physical activity, or sedentary lifestyle contributes to insulin resistance, which in turn leads to diabetes [41].

CONCLUSION:

Based on findings of the present study, high BMI, low physical activity and monthly income are significant factors in diabetes. Smoking also contributes in the development of diabetes progression through its effect on physical activity and BMI.

Recommendations:

Based on the results, it is strongly recommended that a preventive stance is used as a national response to diabetes. Increased physical activity should also be integrated not only in medical intervention but also in other fields such as infrastructure and culture in order to effectively address high BMI and sedentary lifestyle. Programs promoting increased physical activity and weight management should be added in as part of the country's operational policy for diabetes mellitus. The effects of smoking, high BMI, low physical activity should encourage those not at risk to be more physically active.

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