Review

# Identification of risk factors of diabetes mellitus in bank employees of selected banks in Ndola town

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## ARTICLE INFO

## ABSTRACT

*Background:* Diabetes mellitus, a lifelong disease is achieving pandemic proportions. The prevalence of diabetes is on the rise and is expected to be worlds 7th leading cause of death by 2030. Studies have associated a number of risk factors like obesity, lack of physical activity, sedentarism, diet, and stress to diabetes mellitus. The job of bank employees is both sedentary in nature and involves high levels of stress. These people spend almost all their working hours seated as they carry out their work. With this background, the primary objective study of this project is to identify risk factors of diabetes mellitus among bank employees of selected banks in Ndola town. This study also aims to find the prevalence of diabetes among bank employees in the selected nine banks.
*Methods:* A cross-section study was conducted on 121 bank employees from nine (9) selected banks of Ndola town center. Information about their biosocial characteristics, their weight, height, blood pressure, fasting plasma glucose was measured and recorded and a questionnaire on physical activity of participants was administered. Data was analyzed by SPSS 20.0 for Windows. Univariate, bivariate and multivariate analysis were conducted to ascertain any correlation between the dependent variables and independent variables.
*Results:* Prevalence of diabetes mellitus was found to be 15%. The risk of developing Diabetes mellitus was high in obese participants (OR 5.1 [cl95%] $p = 0.000$). And in physical inactive participants it was also high (OR 7.6 [cl95%] $p = 0.046$).
*Conclusion:* and recommendations: Diabetes mellitus shows significant correlation with physical inactivity, body mass index, blood pressure, age and sex. Findings in this study support the need for programs to promote employee health, to help prevent and monitor the enormity and temporal trends of these factor as well as asses the actions that are directed toward this population group.

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## 1. Background

Diabetes mellitus is a disease of ancient times; it was described as 'madhumeha' meaning honey urine in the 5th century by Susruta (one of earliest surgeons of recorded history-600B.C.) in Indian Vedic literature [1] (see Figs. 1 and 2).

World health organization define diabetes mellitus as a chronic metabolic disease characterized by elevated levels of blood glucose, which leads over time to serious damage to the heart, blood vessels, eyes, kidneys, and nerves [2].

It is estimated that 1.5 million deaths are directly attributed to diabetes mellitus worldwide and that it will be the 7th leading cause of death by 2030 [2,3]. Global Prevalence of diabetes mellitus in adults greater than 19 years of age was estimated to be 2.8% (171 million) in 2000 and the percentage is expected to project to 4.4% (366 million) by 2030 (Wild et al., 2004).

In the past diabetes mellitus was considered a plaque of the western world together with other non-communicable diseases, these diseases were believed to be diseases of the wealthy people. Diabetes was very uncommon in Africa till in the 1950s when prevalence was estimated to be less than 1.4%. But by 1994 about 3 million Africans were affected. The number then projected to 7.1 million in the year 2000. This showed an increase in diabetes prevalence with a >50% rise in less than 15 years [4]. Studies done on diabetes in Africa have indicated the high percentages of

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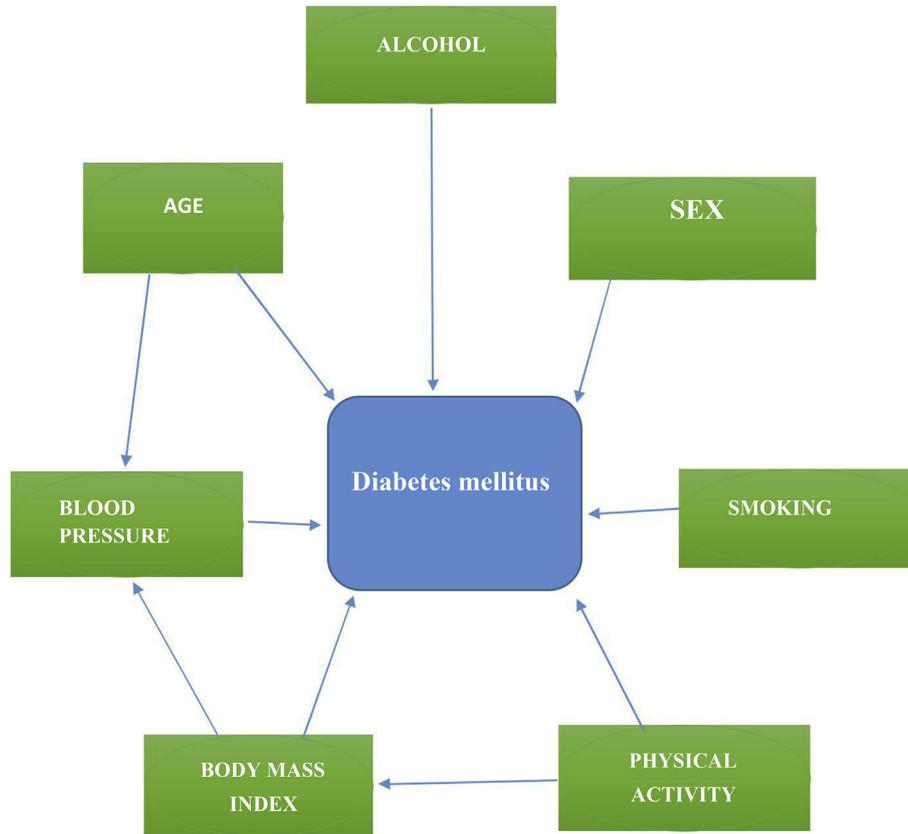
**Fig. 1.** Conceptual framework.



**Fig. 2.** Prevalence of DM.

mortality and undiagnosed diabetes mellitus. Prevalence of undiagnosed diabetes remains high about 50.7% and is worse in low-income countries compared to middle-income countries 75.1% and 46.0% respectively [5]. Increased mortality and increased undiagnosed diabetes can be due to a number of reasons, major ones include; inadequate health care infrastructures and disproportionate distribution of facilities, also lack of education to both non-diabetic and diabetic people on diabetics and its risk factors [6].

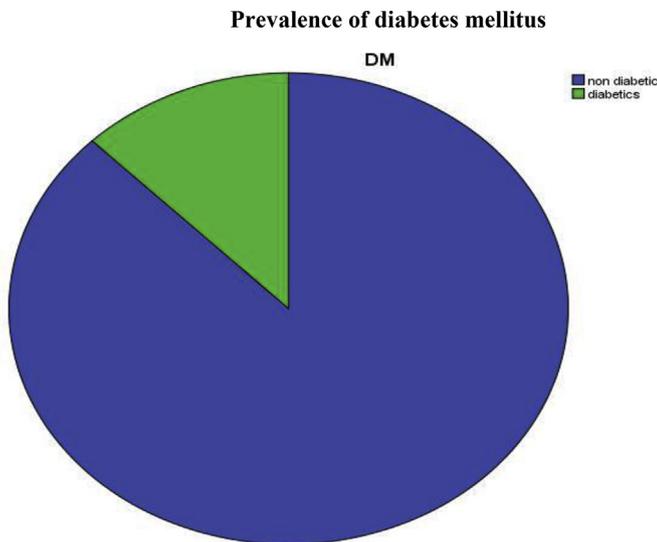According to Sedentary Behavior Research Network [7] amount of physical activity has been decreasing among people in workplaces resulting in the rise of the sedentary job. They further define sedentary work as any kind of job that requires most of the working time to be spent in sitting with minimal or occasional walking or standing. A number of studies have been done to prove the strong association of sedentarism with the development of obesity, cardiovascular diseases and diabetes mellitus [8,9]. However, most of these studies have been done in developed countries this study will be done in a developing country, Zambia.

Previous studies have indicated that experienced tension and adjustment on the job are followed by turnover, absenteeism or sickness [10], this tension and adjustment stress all employees and have potential to affect all professions and workers regardless of their category [11]. However, financial sector employees are more prone to stress [12].

The job of most bank employees is both sedentary in nature and involves high levels of stress. These people spend almost all their working hours seated as they carry out their work. Most studies have found out that sedentary lifestyle and increased mental stress are risk factors of diabetes [13]. A Large number of bank employees have metabolic syndrome, this has been related to individuals who have college degrees and is explained by high rates of obesity and overweight in these subjects [14].

Studies on non-communicable diseases, especially among occupation groups, is least explored in our country and more of such studies are needed. An example is of Sedentarism in a workplace, which accelerates the risk of diabetes mellitus, is rarely reported. Several studies have indicated that breaking long sitting hours with bouts of light or moderate intensity walking yields reduction of waist circumference, BMI, plasma glucose and triglyceride levels [15].

## 2. Problem statement

There is a high burden of diabetes mellitus among bank employees. This could be because this kind of job predisposes the bank employees to sedentarism, mental stress, obesity, or Physical inactivity which could be due to lack of time, ignorance, or workload [14].

This project tries to identify the risk factors of diabetes among bank employees of Ndola town, and also to come up with strategy for reducing these modified risk factors of diabetes.

## 3. Literature review

Diabetes mellitus is a group of metabolic disorders marked by high levels of glucose in the blood due to how insulin is produced, how insulin works or both. Insulin plays a vital role in the synthesis of glycogen, proteins, and fats. Thus, in other words, diabetes mellitus is a medical condition that indicates that there is improper metabolism of carbohydrates, fats, and proteins caused by insulin secretion, insulin activation or both [16]. There are several pathogenic processes that are involved in the development of diabetes mellitus. These pathogeneses include; autoimmune destruction of beta cells of pancreas leading to the deficiency in insulin, abnormalities that result in resistance to insulin action or mutations in insulin gene producing ineffective insulin. Metabolic abnormalities in carbohydrate, fats, and proteins in diabetes are due to action deficiency of insulin on the target tissue [17].

Symptoms of diabetes mellitus include; polyuria, polydipsia, weight loss, polyphagia and sometimes blurred vision. Uncontrolled high blood sugar levels can cause acute life-threatening consequences of ketoacidosis or hyperosmolar syndrome while long-term complications include: Retinopathy with potential vision loss, nephropathy leading to renal failure, peripheral neuropathy with increased risk of foot ulcers and stroke, genitourinary and cardiovascular symptoms and sexual dysfunction. Increased incidences of atherosclerotic cardiovascular, peripheral arterial and cerebrovascular diseases have been seen in patients with diabetes mellitus. (Diabetes Care, 2003).

Pre-diabetes is elevated blood sugar level that does not reach the criterion accepted for diagnosis of diabetes mellitus. People who are pre-diabetic have an increased risk of developing type 2 diabetes, heart diseases and stroke. However, it is not everyone with pre-diabetes that will develop to diabetes. According to W.H.O 2006, recommended diagnostic criteria used in the diagnoses of diabetes are:

- Random blood glucose concentration of 200 mg/dl (11 mmol/dl) or higher with classical symptoms discussed above
- Fasting glucose concentration of 126 mg/dl (7 mmol/dl) or higher on more than one occasion
- An abnormal oral glucose tolerance test in which glucose concentration is 200 mg/dl (11 mmol/dl) or higher two (2) hours after taking a standard carbohydrate load (75 g of glucose).

There are three forms of diabetes mellitus. All the three forms share hyperglycemia as a common factor.

Type 1 diabetes also known as insulin-dependent diabetes or juvenile onset diabetes. Accounts for 5—10% of those with diabetes [2]. It is characterized by the deficiency of insulin secretion caused by autoimmune destruction of pancreatic cells which are responsible for insulin secretion, these cells are called beta cells of islets of Langerhans, and Patients depends on the intake of insulin for survival [17].

Type 2 diabetes, non-insulin dependent diabetes accounts for 80%—90% [2]. This type is largely as a result of excess body weight and lack of physical activity, this disease is usually diagnosed several years after onset, usually when complications manifest. The pathology is due to lack of sensitivity of receptors to insulin [17]. Patients have increased risk of developing macro-vascular and micro-vascular complications. The risk of developing this type of diabetes increases with age, obesity and lack of physical activity. Concordance of this type in identical twins is 100% indicating that there is a strong association with genetic predisposition though its genetics involvement is complex and not clearly defined [17]; diabetes care 2003). Weight reduction via changing diet is major treatment with administration of oral anti-diabetic drugs in case of severe hyperglycemia.

Gestational diabetes is increased blood sugar during second or third trimester of pregnancy. This condition requires treatment to reduce problems for the mother and infant. Some Mothers (5%—10%) after pregnancy tend to develop type 2 diabetes while their children are at risk of developing obesity and type 2 diabetes. (National Diabetes statistics report 2014).

A study was done among bank employees of Meerut district in India and prevalence of diabetes was found to be 20%. Also a study on metabolic syndrome among bank employees in Vitoria/ES Brazil indicated a prevalence of 17.2% and these studies were associated with age >45 years, waist circumference (of male >102 cm and female >88 cm were classified as obese), body mass index (BMI of >29kg/m2 were classified as obese), type of diet and hypertension [13,14].

Prevalence of diabetes is significantly more among people who are above 45 years old and maximum prevalence is found in the age group of 56—60 years [13,18,19]. Epidemiological studies have also shown greater male preponderance globally among diabetics [18,20].

[21] reported a significant association of diabetes prevalence with BMI, waist circumference and hypertension.

Regarding tobacco smoking and alcohol consumptionParashar et al [13], found that smoking and alcohol use were not significantly associated with diabetes prevalence. Contrary a similar study done by Carlsson et al[22] among middle-aged Swedish men, found that heavy alcohol consumption significantly increases the risk of type 2 diabetes. This study will try to find out if there are any correlates between alcohol and smoking and diabetes.

## 4. Objectives

### 4.1. General objectives

- To establish the magnitude of diabetes mellitus in bank employees and its precipitation factors.

### 4.2. Specific objective

- To determine the prevalence of diabetes mellitus among bank employees of selected banks in Ndola city.
- To determine the risk factors for diabetes mellitus among bank employees of selected nine banks.
- To come up with public health and intervention strategy for reduction and prevention of diabetes mellitus in sedentary workers.

## 5. Hypotheses

- diabetes mellitus has high association with sedentary lifestyle and physical inactivity
- diabetes mellitus incidence rates are high in age group greater than 45 years old

- Diabetes mellitus incidence rates are high in males than females.

## 6. Study justification

Although a number of studies have been done on "bank employees and diabetes" across the globe, few have been done in developing countries concerning the same, E.g. Zambia, [13,23]. In developing countries there is increased rapid urbanization and westernization of lifestyle, rapid decreased physical activity and changes in dietary habits. Furthermore in comparison to western countries or developed countries were conditions like diabetes have been prioritized by Governments and where there are massive national diabetes programs put across, little if not nothing is put in place to prevent, monitor or control conditions like diabetes mellitus in developing countries like Zambia. Therefore, this study will produce empirical information on the status of diabetes mellitus among bank employees in Ndola town.

This study will identify risk factors of diabetes mellitus in bank employees of Ndola Town; it will also help to assess the magnitude of diabetes in bank employees. After identifying these risk factors, this research hopes to educate these people on the risk factors of diabetes and come up with public health strategies on how best they can prevent it.

## 7. Measurements

- Age of candidates were identified in an ordinal manner with candidates being categorized as less than 45 years old and greater than 45 years old
- Sex of candidates was identified in a norminal measurement and was categorized as either male or female
- Smoking was identified in a norminal manner with categories of never used (representing those that have never smoked before) and ever used (representing those that have and do smoke)
- Alcohol was identified in a norminal manner with categories of never used (representing those that have never taken alcohol before) and ever used (represent those that have and do take alcohol)
- Body mass index were calculated from weights and heights of candidates, and identified as a ordinal. A spring balance scale was used to measure weight and a height stand ruler was used to measure height of candidates. Candidates were categorized as underweight, normal weight, overweight or obese.
- Blood pressure of candidates were identified in an ordinal manner with candidates being categorized as low blood pressure, normal blood pressure or high blood pressure. A digital blood pressure machine was used to measure the blood pressure.
- Blood glucose level of candidates was measured using a glucometer and were identified in an ordinal manner with candidates being categorized as non-diabetics or diabetics.
- Physical activity of candidates were identified as ordinal measure with candidates being categorized as either low physical activity or high physical activity.

## 8. Conceptual framework

The figure below shows how the independent variables relate to dependent variable, the dependent variable being diabetes mellitus and independent variables being non-modifiable (age and sex) and modifiable (BMI, smoking, alcohol, blood pressure and physical activity). Age greater than 45 years old, males, smokers, alcoholics, increased blood pressure, and low physical activity have increased risk of developing diabetes mellitus. Blood pressure rates are high among individuals who take alcohol and among those with increased BMI (overweight and obese).

## 9. Methodology

### 9.1. Study site

The study was carried out from nine (9) selected banks of Ndola town center. Which is located in.
Northern part of Zambia on the Copperbelt province.

### 9.2. Target population

Permanent Bank employees working in the nine selected banks, was the targeted study population in this research.

### 9.3. Study design

The study was a cross-sectional study.

### 9.4. Sample size

Literature review estimated a prevalence of 20% of diabetes among bank employees in developed countries and lower in developing countries. The total population of bank employees in the nine banks was found to be 255. Using confidence level of 95%, Epi info calculated the sample size to be 126.

### 9.5. Sampling procedure

A probability sampling method was used in this research. Nine banks were considered to be the sampling clusters from which samples was chosen. A systemic sampling type of probability sampling technique was employed to select randomly employees working in these clusters (banks).

### 9.6. Inclusion and exclusion criteria

This study included all bank employees belonging to the officer as well as clerical grades and excluded all bank employees who are not office workers, clerks. Also, all workers on part-time are excluded.

### 9.7. Data collection

Data was collected using self-report questionnaires, the questionnaires were in English since was dealing with candidates who are able to read and write. Laboratory investigation of random plasma glucose test was used to diagnose diabetes and followed the [2] criterion for the diagnosis of diabetes. Estimated weight and height were measured using spring balance and height stand meter ruler respectively. Also blood pressure of the participants was measured using a digital sphygmomanometer.

### 9.8. Data analysis

Statistical analyses were conducted using SPSS for Windows, version 20.0. To analyze the differences in proportions, the chi-squared test (X2) was used. After a bivariate analysis, a logistic regression analysis was performed using a dependent variable in the presence of Diabetes mellitus according to WHO diagnosis criteria. OR were calculated from the variables that were entered into the logistic regression model. All variables in the bivariate analysis were inserted into the regression model. In the final model,

only those variables that retained p < 0.05 were determined to be significant.

### 9.9. Ethical consideration

The proposal was submitted to Tropical Disease Research Center (TDRC) research committee for ethical clearance. Permission to conduct study was obtained from bank managers of respective banks under study. Participants were informed that participation in the study was voluntary and those willing to participate, informed consent was obtained. Lastly, anonymity and confidentiality of data collected during the study was maintained.

## 10. Results

Chapter 3 presents a summary of the research findings and analysis. Single, bivariate and binary logistic regression analysis is used. The main variables to be discussed are age, sex, smoking, alcohol intake, BMI, blood pressure and physical activity and their correlates with high glucose level (DM WHO diagnosis criteria.)

### 10.1. Sample characteristics

Data was collected from 121 bank employees, which was short by 5 participants from the sample size that was calculated. This was because some participants were declining to participate in the study. Among the 121 bank employees studied 12.4% had an impaired random blood glucose while 87.6% had normal random blood glucose. From the study 54.5% were males and 45.5% were females, 33.9% were of age greater than 45 years and 66.1% were of age less than 45 years old. Among the participants 17.4% confirmed to have smoked cigarettes before, 57% of participants confirmed to have taken alcohol while 29.8% were found to have high blood pressure. The study further showed 26.4% of the participants were falling in the obese category and 33.9% had low physical activity. This data has been tabulated on Table 1.

### 10.2. Bivariate analysis

Table 2 shows prevalence of DM participants by sex, age, smoking, alcohol, BMI, blood pressure and physical activity. Prevalence of DM was identified as 12.4% in this study. Analysis showed that prevalence of DM participants in males was 18.2% and females were 5.5% p = 0.034, therefore there is a positive correlation between males and DM.

The analysis further showed age greater than 45 years old correlated with DM participants (22.0%), Those of age less than 45 was 7.5% out of the 15 DM participants (p = 0.022), the data was significant.

DM participants in overweight was 7.5% while those who were obese was 37.5%. This showed that obesity correlated with DM. (p = 0.001). Hence this data was statistically significant.

Participants who had low physical activity was 24.4% compared to those with high physical activity which was 6.3%. Therefore low physical activity correlated with DM. (p = 0.004) and this data was statistically significant.

High blood pressure correlated with DM (low blood pressure = 2.4%, normal blood pressure = 7.0% and high blood pressure = 30.6%, p = 0.001). Hence this was statistically significant.

Smoking of cigarettes correlated with diabetes, DM participants who had history of smoking had higher risk (19.0%) compared to those who are diabetics with no history of smoking (11.0%). However statistically the data was not significant. (p = 0.309).

Alcohol intake did not correlated with DM, those who have taken alcohol before had rates of 11.6% and those who have never taken alcohol before had rates of 13.5%. p = 0.758. And this data was statistically insignificant.

### 10.3. Binary logistics regression analysis

Table 3 shows a binary logistic regression analysis which was done to ascertain any correlation between the dependant variable and the independant variable and to rule out any confounding. The confidence interval was 95%.

The risk of developing DM was 2.5 times higher in participants who were of age greater than 45 years old, compared to those who were less than 45 years old. Males were 4.8 times higher to have diabetes compared to females. Overweight and obese participants were 5.1 and 2.2 times, respectively more likely to develop diabetes compared with normal weight participants. Low Blood pressure and normal blood pressure participants were 0.34 and 0.10 times, respectively less likely to develop DM compared to high blood pressure participants. The risk of developing DM was 7.6 times more likely in participants with low physical activity compared to high physical activity.

**Table 1**
Sample characteristics.

| Variables | | Frequency | Percent |
|---|---|---|---|
| Age | greater than 45 | 41 | 33.9 |
| | less than 45 | 80 | 66.1 |
| Sex | Male | 66 | 54.5 |
| | Female | 55 | 45.5 |
| Smoking | never used | 100 | 82.6 |
| | ever used | 21 | 17.4 |
| Alcohol | never used | 52 | 43.0 |
| | ever used | 69 | 57.0 |
| Blood pressure | low blood pressure | 42 | 34.7 |
| | normal blood pressure | 43 | 35.5 |
| | high blood pressure | 36 | 29.8 |
| Body mass index | normal weight | 40.5 | |
| | Overweight | 40 | 33.1 |
| | Obese | 32 | 26.4 |
| Physical activity | low physical activity | 41 | 33.9 |
| | high physical activity | 80 | 66.1 |
| Blood glucose | non diabetic | 106 | 87.6 |
| level | Diabetics | 15 | 12.4 |

**Table 2**
Bivariate analysis.

| | | | Blood Glucose level | | p value |
|---|---|---|---|---|---|
| | | | non diabetic | diabetics | |
| Age | greater than 45 | N | 32 | 9 | 0.022 |
| | | % | 78.0% | 22.0% | |
| | less than 45 | N | 74 | 6 | |
| | | % | 92.5% | 7.5% | |
| Sex | Male | N | 54 | 12 | 0.034 |
| | | % | 81.8% | 18.2% | |
| | Female | N | 52 | 3 | |
| | | % | 94.5% | 5.5% | |
| Smoking | never used | n | 89 | 11 | 0.309 |
| | | % | 89.0% | 11.0% | |
| | ever used | n | 17 | 4 | |
| | | % | 81.0% | 19.0% | |
| Alcohol | never used | n | 45 | 7 | 0.758 |
| | | % | 86.5% | 13.5% | |
| | ever used | n | 61 | 8 | |
| | | % | 88.4% | 11.6% | |
| Body mass index | normal weight | n | 49 | 0 | 0.001 |
| | | % | 100.0% | 0.0% | |
| | Overweight | n | 37 | 3 | |
| | | % | 92.5% | 7.5% | |
| | Obese | n | 20 | 12 | |
| | | % | 62.5% | 37.5% | |
| Blood pressure | low blood pressure | n | 41 | 1 | 0.001 |
| | | % | 97.6% | 2.4% | |
| | Normal blood pressure | n | 40 | 3 | |
| | | % | 93.0% | 7.0% | |
| | High blood pressure | n | 25 | 11 | |
| | | % | 69.4% | 30.6% | |
| Physical activity | low physical activity | n | 31 | 10 | 0.004 |
| | | % | 75.6% | 24.4% | |
| | high physical activity | n | 75 | 5 | |
| | | % | 93.8% | 6.3% | |

**Table 3**
Binary regression analysis.

| Variables | | Sig. | odds ratio |
|---|---|---|---|
| Age | greater than 45 | .024 | 2.453 |
| | less than 45 | | 1.000 |
| Sex | Male | .043 | 4.780 |
| | Female | | 1.000 |
| BMI | Obese | .047 | 5.107 |
| | Normal weight | .297 | 1.000 |
| | Overweight | .051 | 2.161 |
| Blood pressure | high blood pressure | .086 | 1.000 |
| | low blood pressure | .452 | .335 |
| | normal blood pressure | .030 | .104 |
| physical activity | low physical activity | .046 | 7.596 |
| | high physical activity | | 1.000 |

## 11. Discussion

In this study diagnosis of diabetes mellitus was made using the WHO diagnostic criteria of random blood sugar greater than eleven milli-moles per deciliter (11 mmol/dl) and prevalence of diabetes in bank employees was found to be fifteen percent. Parashar p et al. (2009) did a similar study on bank employees of Meerut district in India and reported that the prevalence of diabetes was twenty percent (20%). Also Ramachandran A et al. found the prevalence ranged between nine to sixteen point six percent (16.6%) (Average of twelve percent) from a national urban diabetes survey which included six cities of India. A study on metabolic syndrome in bank employees of Victoria/ES in Brazil showed prevalence of diabetes to be twelve percent (12%) [14].

This study associated diabetes in bank employees with biosocial characteristics and certain important risk factors. Looking at age as a risk factor to diabetes, this study showed that bank employees who are greater than 45 years old had an increased risk of developing diabetes as compared to those who were less than 45 years old. These findings were in line with the epidemiological study of diabetes mellitus amongst high risk age groups. The study showed that prevalence of diabetes mellitus was 11.0% in age group greater than 45 [18]. Wild S et al [19] in a study on global prevalence of diabetes stretched the importance of age on prevalence of diabetes. The increasing trend of diabetes with advancing age can be contributed to an evolution of insulin resistance, increased visceral fat tissue with age and hormonal changes [24].

In this study diabetes prevalence was more among male bank employees as compared to female bank employees. Majority of epidemiological surveys shows a greater male preponderance worldwide [18,20]. However, a study by [13]; showed a greater female prevalence and attributed their findings to females being

more mentally stressed as compared to males, as they have to balance their professional as well as family responsibilities. Diabetes prevalence was more among obese individuals and also in participants with high blood pressure. These findings are similar to studies done by Luciane B et al. which associated diabetes with males, obesity and high blood pressure. Men when compared to women tend to accumulate visceral fat deposits and have abnormal distribution of body fat, these condition increases with age as well as BMI are associated with insulin resistance and abnormal metabolism of lipids. Insulin resistance are triggered by excessive levels of circulating fatty acids that are derived from visceral fat tissues in liver. This increases the production of triglycerides, LDL and lowers HDL. These effects together with increasing age and males are associated with high blood pressure [14,16].

In this study diabetes was more among ever smokers compared to never smokers and the opposite was true for alcoholics. Although these differences were not statistically significant. Aguilar-Salinas CA et al [25]. in there study on characteristics of patients with diabetes in Mexico found that tobacco smoking was more frequent in diabetic group and posed a significant risk on diabetes mellitus. A study on diabetes among Swedish men found that heavy alcohol consumption significantly increased the risk of diabetes mellitus (Carlsson S et al., 2000). These variations are probably due to variations in sample size and sampling procedures. Further extensive studies including quantities of smoking and alcohol intake and duration are needed to study smoking and alcohol impact on diabetes among bank employees.

In this study diabetic participants that engaged in low physical activity were more compared to those that engaged in high physical activity. A number of studies have found significant association between physical inactivity and diabetes. A study by Weinstein MC [26] found that diabetes incidence rate remained higher in less active men and women from all BMI groups. Correlation between diabetes and physical inactivity can be explained by a number of possible biological pathways, these include; Physical inactivity increases insulin sensitivity, a report by [27] reported physical activity greatly improved abnormal glucose tolerance when caused by insulin resistance.

During a single prolonged session of physical activity, contracting skeletal muscles increases blood flow in the muscles and enhances glucose transport into muscle cells [28].

Finally physical activity reduces intra-abdominal fat, which is a known risk factor for insulin resistance, physical inactivity can also reduce body fat stores [29].

These studies supports the hypnosis that physical inactivity could be a risk factor for diabetes in this study population. Physical inactivity had a 7.6 times higher risk of developing diabetes compared to individuals with high physical activity. This finding might be related to obesity that was also prevalent in this study population as well as the sedentary kind of work these bank employees are subjected to. In this study, physical inactivity came out as a risk factor for diabetes in bank employees and should be considered for further research.

## 12. Conclusion

Prevalence of diabetes mellitus was projected at 15% among bank employees of Ndola city, reflecting a high burden of diabetes among bank employees. The job of most bank employees is both sedentary in nature and involves high levels of stress. These people spend almost all their working hours seated as they carry out their work hence, are at an increased risk of being diabetic [13]. This has been shown in this study where diabetes has been associated with physical inactivity, BMI, Blood pressure, as well as non-modifiable factors that is age and sex. However, the study showed insignificant correlation of smoking and alcohol with diabetes mellitus. This study was a success as all the objectives were met.

### 12.1. Limitations

This study limitation was that when getting permission from the bank managers, some banks were referring us to human resource in Lusaka, this was a challenge as it was practically impossible to travel to Lusaka considering it was in the midst of school academic year.

Another limitation was that some banks kept on postponing the dates for data collection, as they were almost always busy. This caused my study duration to be prolonged.

Finances were also a challenge as the cost of the study overshot the budget.

### 12.2. Recommendations

Findings in this study support the need for programs to promote employee health, to help prevent and monitor the enormity and temporal trends of these factor as well as asses the actions that are directed toward this population group. There is need to educate the affected population on the importance of physical activity on their health, and also create more associations like Diabetes association of Zambia and encourage these people to join such associations. Also Studies on non-communicable diseases like diabetes mellitus, focused on such occupational groups are rarely, if not reported at all in this country, henceforth, more of such studies are needed.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dsx.2018.11.062.

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