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RESEARCH ARTICLE

# ASSESSMENT OF DIABETES: PREVALENCE AND PREDICTION OF RISK DEVELOPMENT IN A MANUFACTURING INDUSTRY IN OWERRI, NIGERIA

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**ABSTRACT**

The study investigated the risk of developing type-2 diabetes over the next 5 years amongst company workers. The Australian diabetic risk assessment tool was adopted for the study. A stratified random method was used to obtain a representative sample based on inclusion criterion. A total of 107 workers were physically and anthropometrically assessed with respect to blood pressure, fast blood sugar, waist circumference, weight, height and body mass index. Data on sex, age, etc were equally obtained. The prevalence of diabetes among the respondents was found to be 7.5%. It was found that 8 workers have 33.3% chance of developing diabetes in 5 years time. The high prevalence of diabetes and high risk stratification of developing diabetes among manufacturing industry workers demonstrates that diabetes mellitus is a major occupational health challenge.



## INTRODUCTION

Workplace health Assessment is a process of gathering information about the factors that support and/or hinder the health of employees at a particular workplace and identifying potential opportunities to improve or address them (CDC, 2013). A workplace health assessment helps to identify the current picture of health at a company as well as improve potential ways to increase productivity, decrease absenteeism, and health care costs for both employees and the organization. Workplace health Assessment will improve employee health, result in higher productivity and reduced number of missed work days, which will ultimately reduce organizational costs. It is a necessary first step before goals are developed, resources allocated, strategies adopted, intervention implemented and outcomes are measured.

Many factors influence health in the workplace and can be impacted by supportive changes within the following levels of influence:

i. Individual elements of an employee's health such as their health behavior. Health risk factors such as high blood pressure and diabetes;
ii. Interpersonal: elements of an employee's social network including relationship with managers, co-workers and family, mentors or role models; and
iii. Organizational: element of the workplace such as facilities and fittings where employees work as well as access opportunities for health promotion provided by the surrounding community where employees live.

Employee's health determined by a complex set of interaction between the individual and his social, physical environment and many other ways that will be useful for designing and evaluating a workplace health program. Such data sources include injury prevalence, workers' compensation, absenteeism, presenteeism, accident reporting and use of existing health program (EHP) or fitness facilities (ENWAP, 1997). Overall, a workplace health assessment can help make connection between the various types of risk factors affecting employee's health at the individual, intrapersonal, organizational and environmental levels that are supported through multiples pieces of data. It will help develop a deeper profile of what is going on at a workplace to help inform a workplace health program or making enhancement to an existing program. The workplace health assessment can provide solutions to the key health issues affecting employees' health and safety concerns and the strategies that are most appropriate to those health issues.

Diabetes mellitus describes a metabolic disorder characterized by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both (CDC, 2013). Type 2 diabetes mellitus usually develops in adulthood and is related to obesity, lack of physical activity, unhealthy diets and lifestyles. The World Health Organization (WHO) estimates that diabetes affects 366million people worldwide and many without efficacious diabetes care. A recent revelation by the WHO indicates that diabetes has tripled in the last decades globally with the highest prevalence rates found in the developing countries (IDF, 2011). The WHO report indicates that in extreme cases, up to 30-50% of the adult population in some developing countries have been afflicted with diabetes. The report further alerted that diabetes will continue to be major threat to public health beyond the year 2030 and is set to increase worldwide without appropriate prevention

strategies (IDF, 2011).

In 2012, an estimated 1.5 million deaths were directly caused by diabetes (WHO, 2014). Diabetes will be the 7th leading cause of death in 2030 (Mathers, 2006). In Africa, the estimated prevalence is 1% in rural areas, up to 7% in urban sub Saharan Africa, and between 8-13% in more developed areas such as South Africa and in population of Indian origin (Motala, 2003). The prevalence in Nigeria varies from 0.65% in rural Mangu, Plateau State to 11% in urban Lagos (Akinkugbe, 1997). World Health Organization suggested that Nigeria has the greatest number of people living with diabetes in Africa (Motala, 2003). According to a study carried out in Naze, South-East, Nigeria by Osuji *et al*, (2012) prevalence of 6.7% was reported.

## METHODOLOGY

### *Study Area*

Owerri is the study area; situated at latitude 5.48°, longitude 7.03 and 159 metres above the mean sea level. It is the capital of Imo state in Nigeria. The city is located in South-East of Nigeria and it is a part of the Niger-Delta, home of oil and gas activities in Nigeria (see Figure 1). It has an estimated population of about 400,000 people as at 2006 census. It is approximately 100km$^2$ in area (NBS,2010). Owerri is bordered by the Otamiri River to the east and Nworie River to the south (Acholonu and Okorie, 2003).

**Figure 1** Map of Study Area, owerri Nigeria

Source: Google Map, 2015

### *Justification for the Study*

The prevalence of type 2 diabetes mellitus is on the increase since 2015. Unless appropriate action is taken, it is predicted that there will be at least 350 million people in the world with type 2 diabetes mellitus by the year 2030 (IDF, 2011). Equally alarming and less well known is the fact that of these people, only one half are known to have this condition. An added concern is that half of those who present this condition already have complications of the disorder. Logically early detection will improve outcome of people with type 2 Diabetes mellitus.

The chronic hyperglyceamia of diabetes is associated with long term dysfunction, damage and failure of various organs, especially the eyes, kidneys, nerves, heart and blood vessels. Individuals with undiagnosed type 2 diabetes mellitus are also at higher risk for cerebrovascular accident, coronary heart disease and peripheral vascular disease than the undiabetic population. They also have a greater likelihood of having dyslipidaemia, hypertension and obesity. Because early detection and prompt treatment may reduce burden of diabetes and its complication, screening for diabetes may be appropriate under certain circumstances. This positive statement justifies and provides recommendation for diabetes risk assessment. Diabetes affects employers not only by reducing employment but contributing to work loss and health-related work limitations. This positive statement justifies and provides validity for diabetes risk assessment.

### *Data Collection*

### *Inclusive Criteria*

The criterion includes staff of the manufacturing company who are aged ≥ 18 years and who gave their informed written consent for the study.

### *Exclusive Criteria*

The criteria excluded pregnant workers and workers with physical deformities affecting the spine and/or deformities that could not stand for height and weight anthropometric measurements. This study also excluded hypertensive workers who are in anti-hypertensive medications that affect glucose metabolism like β-blockers and thiazide diuretics.

### *Sample Techniques*

A Stratified random method was used to obtain a representative sample based on the inclusion criteria; each job description in the organization was regarded as a stratum.

### *Sample Size Estimation*

The sample size was determined using the prevalence formula:

$$N=\frac{Z^2P(1-P)}{T^2} \quad (1)$$

where Z = 1.96, that is the level of significance (standard normal deviate) which corresponds to 95% confidence level; P = prevalence from a previous study (Nyenwe *et al*; 2003); T = tolerance error (0.05)

Using Equation (1), we have:

$$\frac{1.96^2\times0.07(1-0.07)}{0.05^2}=100.03$$

The sample size was determined to be 100. Allowance for 10% attrition rate gave a sample of 110 workers.

### *Training of Research Assistants*

Five Health Care Professionals were recruited and trained on the job of collecting data for the purpose of this study. They were tested and certified competent for the study.

### *Australian Diabetes Risk Assessment Tool (AUSDRISK)*

The Australian type 2 risk assessment tool (AUSDRISK) is a

short list of questions to help health professionals to assess the risk of developing type 2 diabetes over the next five years. This was developed to help predict incident diabetes based on demographic, lifestyle anthropometric factors known to be associated with an increased risk of diabetes. The tool has a sensitivity of 74% and specificity of 68% and positive predictive value of 13% (Chen *et al*, 2010). The Royal Australian College of General Practitioners and Diabetes recommends that people are assessed for diabetes risk based on AUSDRISK Scoring System before requesting further investigation. It is the first step one takes if diabetes is suspected (RCGP, 2012). It is a scoring system that assigns points for each risk factor. The final score is used to estimate the chance of developing incipient diabetes in the next 5 years. People who return a score ≥ 20 are classified as high risk; the risk continues to increase with increasing score. People who return a score greater than 20 have a 1 in 3 (i.e 33.3%) chance of developing diabetes (DHA, 2013).

The age distribution of the respondents ranged from 25 to 64 years. Fifty two (52) members of the staff are females while 55 are male. The age group of 35-44 years has 27 female respondents representing 51.9% of the female population and 29 male respondents representing 52.7% of the male population (see Table 1).

***Data Analysis***

The prevalence of diabetes was determined as a rate of developing diabetes and expressed in percentage. The diabetes risk assessment tool was used to predict workers risk of developing type 2 diabetes within the next 5 years. The blood glucose was determined after an overnight fast between 8.00 to 10.00Hrs. A strip was inserted into the Five Test Glucometer and after adequate disinfection of the finger, the Auto-Lancent was used to prick and a drop of blood sample was placed on the strip that automatically displayed the blood glucose result.

The blood glucose estimation was determined by the Glucose Oxidase/Peroxidase method. Glucose in the blood sample reacted to the electrodes in the test strip; this generated an electrical current that stimulated a chemical reaction. The chemical reaction produced a coloured compound whose intensity is directly proportional to the concentration of glucose in the blood. This is electrometrically read and displayed as blood glucose results in milligram/deciliter (Trinder, 1969; Onoh, 2014)

## RESULTS

A total of one hundred and seven workers who scaled through the inclusion criteria were involved and were physically examined, thereafter questionnaires were administered to them (see Table 1). The questionnaires were interviewer-administered and were properly filled and returned with a response rate of 97.3%. The high response rate must have been attributed to the company's high regards for health, safety and environmental policies.

The descriptive statistics and the distribution of the measured variables for the workers and the control group are as represented in Table 2. The mean systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting blood sugar (FBS), waist circumference (WC), weight (W), height (H), body mass index (BMI) of the respondents are as shown in Figure 2.

**Table 1** Age Distribution of Workers

| Age Group | Male Respondents | Male Proportion (%) | Female Respondents | Female Proportion (%) | Total |
|---|---|---|---|---|---|
| 15 – 24 | 0 | 0.0 | 1 | 1.9 | 1 |
| 25 – 34 | 12 | 21.8 | 6 | 11.5 | 18 |
| 35 – 44 | 29 | 52.7 | 27 | 51.9 | 56 |
| 45 – 54 | 12 | 21.8 | 14 | 26.9 | 26 |
| 55 – 64 | 2 | 3.6 | 4 | 7.7 | 6 |
| Total | 55 | 100.0 | 52 | 100.0 | 107 |

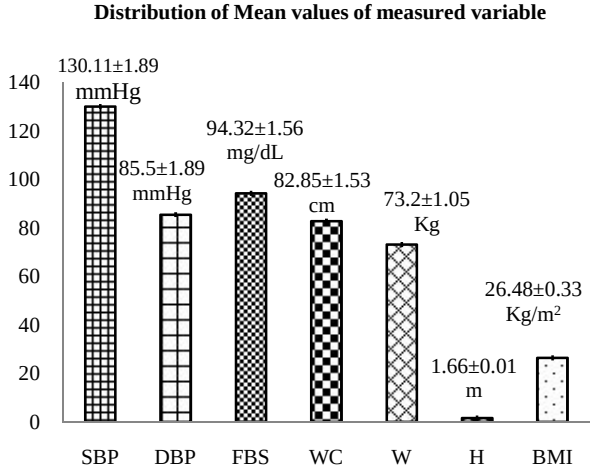


**Figure 2** Mean distribution of measured variables

The modal distributions for the measured variables such as systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting blood sugar (FBS), weight (W), height (H) and body

**Table 2** Descriptive Statistics for workers

| Description Statistics | SYSTOLIC BP (mmHg) | DIASTOLIC BP (mmHg) | FBS (mg/dl) | WAIST CIRM (cm) | WEIGHT (kg) | HEIGHT (m) | BMI (kg/m$^2$) |
|---|---|---|---|---|---|---|---|
| Mean | 130.11 | 85.50 | 94.32 | 82.85 | 73.21 | 1.66 | 26.48 |
| Median | 130 | 82 | 91 | 86 | 72 | 1.66 | 26.37 |
| Mode | 120 | 80 | 101 | 88 | 72 | 1.63 | 28.48 |
| Standard Deviation | 19.51 | 19.51 | 16.12 | 15.85 | 10.86 | 0.08 | 3.44 |
| Standard Error | 1.89 | 1.89 | 1.56 | 1.53 | 1.05 | 0.01 | 0.33 |
| Sample Variance | 380.59 | 380.57 | 259.80 | 251.30 | 117.88 | 0.01 | 11.81 |
| Kurtosis | 17.38 | 20.78 | 2.93 | 3.29 | 0.57 | -0.25 | 0.50 |
| Skewness | 2.74 | 2.82 | 1.70 | -0.91 | 0.30 | -0.25 | 0.65 |
| Range | 160 | 180 | 71 | 106 | 55 | 0.37 | 16.67 |
| Minimum | 100 | 40 | 73 | 9 | 51 | 1.5 | 19.59 |
| Maximum | 260 | 220 | 144 | 115 | 106 | 1.87 | 36.26 |
| Sum | 13922 | 9149 | 10092 | 8865 | 7833 | 177.84 | 2833.77 |
| Count | 107 | 107 | 107 | 107 | 107 | 107 | 107 |

**Table 3** Descriptive Statistics for the Control

| Description Statistics | SYSTOLIC BP (mmHg) | DIASTOLIC BP (mmHg) | FBS (mg/dl) | WAIST CIRM (cm) | WEIGHT (kg) | HEIGHT (m) | BMI (kg/m$^2$) |
|---|---|---|---|---|---|---|---|
| Mean | 123.76 | 79.80 | 81.38 | 76.81 | 67.84 | 1.70 | 23.32 |
| Median | 120 | 81 | 81 | 76 | 69 | 1.7 | 23.055 |
| Mode | 131 | 83 | 72 | 85 | 71 | 1.73 | 21.259 |
| Standard Deviation | 22.31 | 15.26 | 10.45 | 10.08 | 12.61 | 0.09 | 3.72 |
| Standard Error | 2.19 | 1.50 | 1.02 | 0.99 | 1.24 | 0.01 | 0.36 |
| Sample Variance | 497.80 | 232.88 | 109.21 | 101.65 | 153.03 | 0.01 | 13.84 |
| Kurtosis | 2.79 | 1.31 | -0.71 | 1.08 | 0.20 | -0.21 | 0.12 |
| Skewness | 1.32 | 0.90 | 0.40 | -0.27 | 0.40 | 1.17 | 0.31 |
| Range | 112 | 69 | 43 | 55 | 62 | 0.44 | 18.94 |
| Minimum | 85 | 53 | 61 | 49 | 42 | 1.52 | 15.81 |
| Maximum | 196 | 122 | 104 | 104 | 104 | 1.96 | 34.75 |
| Sum | 12871 | 8299 | 8463 | 7988 | 7055 | 177.25 | 2424.85 |
| Count | 104 | 104 | 104 | 104 | 104 | 104 | 104 |

The range distribution for systolic blood pressure was from 100 to 260 mmHg, diastolic blood pressure was from 40 to 220 mmHg, fasting blood sugar was from 73 to 144 mg/dL, waist circumference was from 29 to 115 cm, weight was from 51 to 106 Kg, height was 1.5 to 1.87m, and BMI was from 19.59 to 36.26 Kg/m$^2$.

***Risk Factor Analysis***

The respondents were subjected to risk of obesity, hypertension and diabetes analyses. It was found that 14 respondents representing 13.1%, fifty two respondents representing 23.4% 25 respondents representing 23.4% of the sampled population were at risk of developing obesity, hypertension and diabetes respectively.

Thus the prevalence of diabetes among these workers was 7.5%.

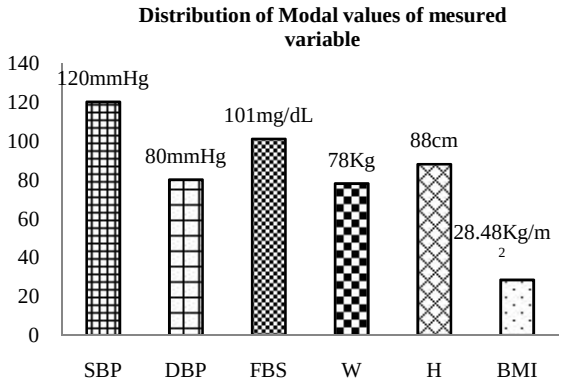


**Figure 3** Modal Distribution values for measured variables

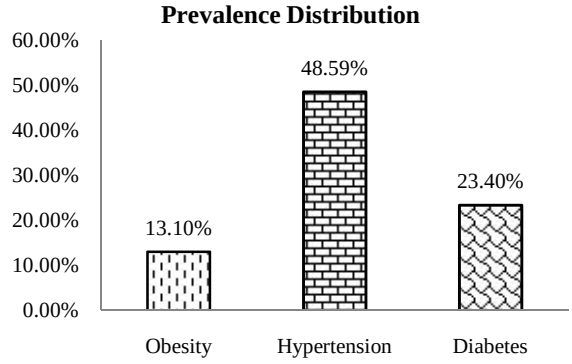


**Figure 4** Risk Factor Analyses

Ten workers representing 9.3% scored 0 – 5 points in diabetes risk assessment (Figure 5). This means that they have 1% chance of developing diabetes in 5 years.

Similarly, the following scores: 6 – 8, 9 – 11, 12 – 15, 16 -19, and ≥ 20, with corresponding percentage of workers (see Figure 5) were obtained; this means that these workers have 2.0, 3.3, 7.1, 14.3 and 33.3% chances of developing diabetes in 5 years, respectively. Workers have the opportunity to know their chances of developing diabetes in 5-year time.

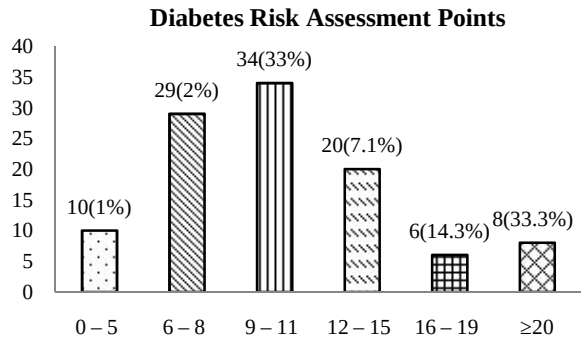


**Figure 5** Diabetes Risk Assessment Points
**Key:** 0 – 5: one person in every 100 will develop Diabetes in 5 years;
6 – 8: one person in every 50 will develop Diabetes in 5 years;
9 – 11: one person in every 30 will develop Diabetes in 5 years
12 – 15: one person in every 7 will develop Diabetes in 5 years
16 – 19: one person in every 3 will develop Diabetes in 5 years

The prevalence of diabetes among the study population was 7.5%, the modal age of workers in the manufacturing company was 35-44 years while the modal age of the control group was 25-34 years. Other demographic characteristics of the workers in the manufacturing company and their control group are shown in Tables 2 and 3.

## DISCUSSION

The result of the Diabetes Risk Assessment revealed that 7.5% of the workers have 33.3% risk of developing diabetes in 5 years. The prevalence of diabetes among the study population was 7.5%. This is higher than 6.7% reported earlier in Naze, Owerri (Osuji *et al*, 2012). In different parts of Nigeria and Africa, the prevalence of diabetes has been reported to vary from 1% to 7.4% ( Rotimi *et al*, 1999; Mbanya *et al*, (1997); Bakari *et al*, (1999); Motala *et al*, (2003). The prevalence of 7.5% is slightly higher than that of 6.5% obtained by Nyenwe *et al*, (2013) in Port Harcourt. A closer rate of 7.2% was reported for Lagos Mainland by the

National Non-Communicable Disease Survey (Akinkugbe, 1997). Moreover, the investigators had a prevalence rate of 7.4% for those aged 45 years and above who live in urban areas. This compares favorably with the prevalence of 7.5% reported for the study population. This is a high figure and demands adequate interventions to protect workers, the high rate of morbidity could affect job performance through absenteeism.

Urbanization carries along with it, life style changes that tend to predispose to the development of type 2 diabetes mellitus. The prevalence of 7.5, 6.7, 6.8 and 7.2% were reported in Owerri, Naze -Owerri, Port Harcourt and Lagos Mainland respectively. These are urban cities in Nigeria and have shown a similar trend. Urbanization with the attendant lifestyle changes has been adjudged to be the cause of the rising trend in the prevalence rates of type 2 diabetes mellitus in Nigeria ( Onoh, 2014; Osuji *et al*, 2012; Nyenwe *et al*, 2013; Akinkugbe, 1997). Age is an epidemiological risk factor for the development of type 2 diabetes mellitus. Thus, the prevalence increases with age. The modal age of 35-44 years represents 52.3% of the study population. Advancing age has been shown to be an independent risk factor for type 2 diabetes mellitus (Nyenwe *et al*, 2003; Onoh, 2014). The peak incidence of type 2 diabetes mellitus in Nigeria and Tanzania was found to be after 45 – 50 years of age (Johnson, 1971; McLarty *et al*, 1991).

The worsening of insulin resistance and increasing survival rate of diabetic patients through improved health care could be contributory to the rising prevalence of type 2 diabetes mellitus (Zimmet *et al*, 1997; Zimmet, 1982). The prevalence of hypertension in this study population was reported to be 48.6%. Hypertension is a frequent co-morbidity in patients with diabetes. There is a well-known association of type 2 diabetes mellitus and hypertension in the metabolic syndrome. Type 2 diabetes mellitus and hypertension frequently co-exist, much more commonly than is predicted by chance.

Stroke is a major public health problem and an important cause of morbidity and mortality. Epidemiological data from United States showed that stroke is the third leading cause of death and disability. Both arterial hypertension and type 2 diabetes mellitus are independent risk factors for stroke. However, when these disorders co-exist, the risk of stroke is further increased.

## CONCLUSION

This study has demonstrated a high prevalence of type 2 diabetes mellitus. There was also a high prevalence of hypertension in the study population. Although, the underlying explanation for this co-existence constellation of clinical features in diabetes and hypertension remains unexplained. Insulin resistance seems to play a pivotal role in the pathogenesis of hypertension (Isoma *et al*, 2001). The following are the summary of major findings:

i) The prevalence of diabetes in Owerri population is 7.5%;
ii) The prevalence of hypertension is 48.6% in the population studied; and
iii) Eight (8) workers in the company scored more than 20 in diabetes risk assessment points which translates to 33.3% chance of developing type 2 diabetes mellitus in 5-year time. This is a high number to contend with not just in our society but more so a manufacturing industry.

***Recommendation***

As a result of this study, the following recommendations are made:

i) There is need to provide effective occupational health services through the provision of a well-articulated company policy. For good occupational service to be realized, top management health service to be realized, top management must show leadership and commitment;
ii) Occupational health programmes must be instituted. It has the potential of preventing and controlling diabetes and hypentension, thus promoting a healthy workplace and consequently increasing productivity;
iii) There should be a comprehensive work promotion in the company. They should be able to organize regular physical activities like jogging and other healthy life style changes;
iv) The occupational health Services (OHS) initiated should also provide executive health in the workplace;
v) The OHS should be able to maintain health surveillance which enables the identification of those employees likely to be at risk from occupational ill-health; and
vi) The Dietary Approach to Stop Hypentension (DASH) diet plan and the Medical Nutrition Therapy for diabetes are advocated as they help in prevention and control of diabetes and hypertension and thus a work performance.

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