A survey on the association between Blood glucose levels, lipidemia and selected Type 2 diabetes predisposing risk factors in Bulawayo district Zimbabwe.

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Abstract
The present study was undertaken to determine association between Blood glucose levels lipidemia and selected diabetes predisposing risk factors in Bulawayo district Zimbabwe. Measurement of, blood glucose, weight, height, mid-upper arm circumference, skin fold thickness over the triceps region, waist circumference, hip circumference, and blood pressure in 313 adults is reported. In certain age categories blood glucose has significant correlation with mid-upper arm circumference, waist circumference over hip circumference, blood pressure, age and Fat % Siri (P<0.05). The findings show that BMI and MUAC can be useful in the prediction of degree of blood glucose levels and lipidemia in Bulawayo district Zimbabwe. As blood glucose values increase the percentage of population exhibiting strong diabetes risk factors inversely increase. The majority in the population studied had fatness above acceptable ranges.

Introduction
The blood glucose and lipid content of the human body provides useful information about the health status of individuals in communities. Recently, however, there has been an increasing interest in the accurate estimation of blood glucose and body fat due to the recognition of their association with various chronic diseases such hypertension and diabetes mellitus [1, 2, 5, 17]. Obesity especially of the abdominal type is common in people who develop type 2 diabetes, and weight control by appropriate diet and physical activity is probably the most important measure to prevent type 2 diabetes. High (saturated) fat intake is associated with insulin resistance, obesity and increased risk of type 2 diabetes, whereas diets rich in carbohydrate seem to protect from glucose intolerance and diabetes mainly owing to their high fiber content [1, 5, 18]. There are two stages of type 2 diabetes, the early phase of impaired glucose tolerance (IGT) which is characterized by insulin resistance and hyperinsulinaemia and the later stage which is characterized by additional beta cell dysfunction leading to hyperglycemia, hyperlipidemia and development of clinical diabetes. Between 60 and 70% of newly diagnosed type 2 diabetic patients are obese. The degree and duration of obesity is critical in triggering type 2 diabetes [6, 8, 12, 14]. Previous studies indicate that generally obesity is an important risk factor for diabetes[18]. Studies have in most places shown that in a population where obesity is rare, diabetes is rare even in the presence of genetic susceptibility, but a study in Kenya indicated lack of strong obesity-type 2 diabetes relationship [18]. Type 2 diabetes mellitus seems to be an underestimated health problem in the developing countries due to lack of diabetic surveys. The prevalence rate in most of these countries (2-5%) is lower than in developed countries (4-10%)[6, 8, 14, 17]. The aim of this study was to determine blood glucose levels lipidemia and their relationship to selected diabetes predisposing risk factors in Bulawayo Province Zimbabwe.
Participants and Methods
The NUST Bioethical Committee and Medical Research Council of Zimbabwe sanctioned the study (Permit MRCZ980). The participants completed an informed consent form after they were briefed about the purpose of the study. This study was carried out in Bulawayo district Zimbabwe. Participants completed a questionnaire including questions on the state of health, (hypertensive, diabetic, diabetic relatives), health behavior (regular activities, their regular diet), and socioeconomic circumstances (age, incomes, social habits, and the period they had been in the area). The study design was a cross sectional systematic random sampling. A total of 313 healthy adults aged 20-70 years, born and living permanently in Bulawayo district Zimbabwe were studied. All measurements were made at the homes of the participants or at Premier Diagnostic Laboratories. The following data were recorded Body weight, Height, Blood pressure and mid-upper arm circumference (MUAC). Body mass index (BMI) for each subject was calculated from the weight and the height (weight in kg/height in m$^2$) and classified as follows: Underweight < 18.5; Normal 18.5 – 24.9; Overweight 25.0 – 29.9; Obese, > 30.0 For Waist-to-Hip Ratio (W/H women with> 0.82 and man with > 0.94 were considered very high risk for diabetes.

The skin fold thickness over the triceps was measured to the nearest 1 mm with calipers and used to determine fat% Sirri. Body fat Ranges for Ages >18 years were classified as follows : Unhealthy Range (too low) < 5% male and < 8% female; Acceptable Range (lower end) 6% – 15% and male 9% – 23% female; Acceptable Range (higher end) 16% – 24% and male 24% – 31% female; Unhealthy Range (too high) > 25%  and male > 32% female.

The blood glucose was determined by the Accucheck portable glucometer, as previously done in similar studies [14, 15, 16]. Spearman correlation coefficient was used to test for the association between Fat % Sirri, BMI, triceps fold, MUAC, weight and height. $P<0.05$ was considered statistically significant. The overall status of all the individuals pooled by sex was determined. BG mmol>11 was classified as diabetic, BG mmol>7.1 was classified as IGT, BG mmol>6.1 was classified Normal fasting plasma glucose. BP>140/90mmHg was classified as hypertensive, Fat % Sirri>25 for males and >32 for female was classified as excessive, W-H-R >0.94 for males and >0.84 for females was classified as excessive, BMI> 25 was classified as overweight.

Results
The studied population are all are black and Zimbabwean nationals. Maize meal (Sadza), goat meat, local vegetables, cow milk, fish, mopane worms, and beans constitute the major dietary items for the people living here. The following diabetes predisposing risk factors, BMI, BP, W/H, BG, MUAC fat % Sirri and age show a linear correlation with Blood glucose and lipidemia Fig 1 and Fig 2. The results for occurrence of excess lipidemia, glycemia and Blood pressure (diastole) in different age groups from a random sample in Bulawayo and measurements from subjects in various glucose levels categories showing other parameters like Bp, Fat%Sirri, and age in the high risk range are presented in Table1 and Table 2.
**Figure 1.** Prevalence of Lipid and glycemic disorders among diabetics as time progresses.

**Figure 2.** The occurrence of excess lipidemia, glycemia and Blood pressure (diastole) in different age groups from a random sample in Bulawayo.
### Table 1. Demographic data for diabetes predisposing risk factors among randomly selected undiagnosed Bulawayans

<table>
<thead>
<tr>
<th>Age in years</th>
<th>BG mmol/l</th>
<th>Wt kg</th>
<th>Ht m</th>
<th>Muac cm</th>
<th>Skin F mm</th>
<th>Wc cm</th>
<th>Hc cm</th>
<th>Bp mmHg</th>
<th>Chol/Trig mmol/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>3.9</td>
<td>60</td>
<td>1.65</td>
<td>25.0</td>
<td>11</td>
<td>97</td>
<td>73</td>
<td>58</td>
<td>4.20</td>
</tr>
<tr>
<td>21-30</td>
<td>3.6</td>
<td>63</td>
<td>1.57</td>
<td>24.0</td>
<td>11</td>
<td>103</td>
<td>84</td>
<td>40</td>
<td>4.84</td>
</tr>
<tr>
<td>31-40</td>
<td>5.1</td>
<td>75</td>
<td>1.70</td>
<td>31.0</td>
<td>20</td>
<td>101</td>
<td>90</td>
<td>80</td>
<td>4.02</td>
</tr>
<tr>
<td>41-50</td>
<td>5.2</td>
<td>88</td>
<td>1.76</td>
<td>35.5</td>
<td>22</td>
<td>111</td>
<td>86</td>
<td>70</td>
<td>2.10</td>
</tr>
<tr>
<td>51-60</td>
<td>4.8</td>
<td>74</td>
<td>1.61</td>
<td>29.3</td>
<td>10</td>
<td>102</td>
<td>93</td>
<td>72</td>
<td>3.03</td>
</tr>
<tr>
<td>61&gt;</td>
<td>5.5</td>
<td>72</td>
<td>1.74</td>
<td>25.5</td>
<td>15</td>
<td>103</td>
<td>94</td>
<td>90</td>
<td>2.19</td>
</tr>
</tbody>
</table>

### Table 2. Measurements from subjects in various glucose levels categories showing other parameters like Bp, Fat%Sirri, and age in the high risk range.

<table>
<thead>
<tr>
<th>BG mmol/l</th>
<th>Muac cm</th>
<th>WC/HC cm</th>
<th>Bp mmHg</th>
<th>Age</th>
<th>Fat % Sirri</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;7</td>
<td>24</td>
<td>0.857</td>
<td>60</td>
<td>58</td>
<td>28.58</td>
</tr>
<tr>
<td>7-8</td>
<td>19</td>
<td>0.71</td>
<td>90</td>
<td>69</td>
<td>25.06</td>
</tr>
<tr>
<td>9-11</td>
<td>26</td>
<td>0.71</td>
<td>110</td>
<td>69</td>
<td>32.07</td>
</tr>
<tr>
<td>&gt;11</td>
<td>32</td>
<td>0.91</td>
<td>110</td>
<td>66</td>
<td>49.90</td>
</tr>
</tbody>
</table>

### Results analysis

Age, body mass index (BMI) and hyperglycemia $\chi^2_{calc} = 6.59$ $\chi^2_{calc}(0.05) = 6.00$ Since the computed chi-square value is greater than the critical value ($\chi^2_{calc} > \chi^2_{0.05}$), we reject the null hypothesis of independence and conclude that age, body mass index and hyperglycemia are associated.

Age, hypertension and sex $\chi^2_{calc} = 6.90$ $\chi^2_{calc}(0.05) = 6.00$ (critical value) Since the computed chi-square value is greater than the critical value ($\chi^2_{calc} > \chi^2_{0.05}$), we reject the null hypothesis of independence and conclude that there is association between age, hypertension and sex (gender).
Discussion

The body mass index \([\text{wt (kg)/ht (m}^2]\)] has been widely used in the assessment of fatness in individuals and communities [12]. This is because the index is correlated with other estimates of fatness and it applies to all populations without the need for a reference population. In this study, we confirmed the relationship between body mass index and other body measurements, which were used in the estimation of hyperglycemia. The body mass index showed significant correlations with mid-upper arm circumference. Skin fold measurements and the body mass index appeared to be reliable indicators for assessment of body fat and lipidemia in Bulawayo district Zimbabwe. This is in agreement with previous studies in other parts of the world, which indicated that there was no difference in body composition between age groups [8, 9, 11]. In addition to age and genetic factors, the fat content of the human body is known to be influenced by socioeconomic status and the level of physical activity of individuals [9, 13]. In general, there is an apparent tendency for body fat to increase with increase in age. Poor socioeconomic conditions and lower levels of physical activity are often associated with increase in body fat [3, 4].

The prevalence of diabetes and lipidemia is consistent with other countries in the third world where studies have been made. This genetic predisposition, along with impaired glucose tolerance (IGT), often occurs together with the genetic tendency toward high blood pressure. The fat% values were higher in women than in men which agrees with similar observations in Nigeria [14, 15]. High blood pressure which is a strong risk factor for diabetes was also high. Some diuretics used in the treatment of high blood pressure and certain medications like pentamidine precipitate diabetes [7, 10, 17]. Diabetics in Zimbabwe die within 5 years of diagnosis [6]. This could account for lower numbers of diabetics compared to the frequency of IGT which antedates diabetes by some years. By measuring fat% we can have a fairly accurate prediction of persons likely to develop into overt diabetes in the near future. While in many countries there was association between obesity and diabetes such an association could not be established in Kenya [12]. Although Type 2 diabetes develops in people over 40 years generally some populations like Pima it develops in most individuals at the age of 20 years [6, 8, 17]. Therefore each population requires an independent study on its diabetic status. Fatness is a potent risk factor for many diseases, including hypertension, diabetes mellitus and certain types of cancer [3, 4].

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REFERENCES:


