Prevalence of raised body mass indices and the association with high blood pressure and hyperglycaemia in the rural black population of Ga-Mothapo village, Capricorn District of Limpopo province

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Abstract

Objective: To assess the prevalence of elevated body mass index and to establish whether there was an association between raised body mass index (BMI) and high blood pressure (BP) and hyperglycaemia in the rural population of Ga-Mothapo village, Limpopo province.

Design: Cross-sectional and prospective in nature.

Setting: Ga-Mothapo village, a rural settlement with a population of 11 000, situated in the Capricorn region of Limpopo province, approximately 28 km east of Polokwane.

Subjects: The study sample comprised 382 participants, of whom 286 were females (74.9%) and 96 males (25.1%), aged 18-65 years.

Outcome measures: Fasting blood glucose samples were analysed using the ILab 300 Plus®. BP pressure was measured using an automatic BP monitor. Height and weight were measured using a height-measuring rod and weighing scale, respectively. The BMI was calculated.

Results: The overall prevalence rates of overweight, obesity, high BP and hyperglycaemia were 30.6%, 23.6%, 27% and 11.8%, respectively. The prevalence rates of overweight, obesity, high BP and hyperglycaemia in females were 34.6%, 29.4%, 27.3% and 13.6% respectively. They were 18%, 6.3%, 26.1% and 6.3%, in the males, respectively.

Conclusion: The study revealed high prevalence rates of raised BMI, high BP and hyperglycaemia in the Ga-Mothapo population. Females had higher prevalence rates of raised BMI and hyperglycaemia than males. The study highlighted the fact that raised BMI and hyperglycaemia were significantly associated with high BP.

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Introduction

Together, overweight, obesity, hypertension and diabetes mellitus comprise 24% of the global risk for mortality and these conditions demonstrate a linear relationship.[1] Obesity has been found to be a major risk factor for the development and progression of hypertension and diabetes mellitus, which often coexist in obese patients.[2,3] These conditions have been studied frequently in urban residents, but less frequently in rural people.[4] The researchers were interested in the simultaneous study of overweight, obesity, hypertension and hyperglycaemia in rural populations.

Globally, there are 1.1 billion overweight adults. At least 312 million of them are clinically obese.[5] The prevalence of overweight and obesity is commonly assessed by using body mass index (BMI), defined as the weight in kilogrammes divided by the square of the height in metres (kg/m^2). A BMI that is more than 25 kg/m^2 is defined as overweight and over 30 kg/m^2 as obese, according to the criteria of the World Health Organization (WHO).[6] Obesity is a common disorder that develops from the interaction between the genotype and the environment and involves social, behavioural, cultural, physiological, metabolic and genetic factors.[7]

Obesity is becoming an increasing problem in countries that are undergoing epidemiological transition, such as South Africa. The prevalence of overweight and obesity in South Africa is high. More than 29% of men and 56% of women are classified as overweight or obese.[8]

The prevalence of diabetes is increasing worldwide and is expected to reach 4.4% by 2030.[9] Data from South Africa show estimates of diabetes mellitus ranging from 3-28.7%.[10] Hyperglycaemia and diabetes are important causes of mortality and morbidity worldwide. Known risks for diabetes include advancing age, a family history of diabetes, obesity, hypertension, coronary artery disease, physical inactivity, socio-economic status and level of education.[9]

Hypertension affects approximately one third of adults in the USA and is a major risk factor for cardiovascular disease-related morbidity and mortality.[11] A blood pressure (BP) of 120/80 mmHg is classified as normal. A measurement of 140/90 mmHg or above, on three separate occasions, is classified as hypertention.[12] The prevalence of hypertension increases with age and is higher in black people than white people of all ages.[13] It is estimated that one in four South Africans between the ages of 15 and 64 years suffers from high BP, which is one of the leading causes of heart attacks, strokes, kidney failure and premature death.[14]

A study conducted by Huan et al demonstrated that high BP and obesity are both independently associated with a greater prevalence of abnormal glucose metabolism.[3] According to Alberts et al, previously it has been shown that central obesity that is associated with hypertension, diabetes mellitus and other metabolic syndromes, has more adverse consequences than peripheral obesity.[15] Hypertension and diabetes are quite common in obese individuals and there is a linear relationship between the degree of obesity and these diseases.[9] Obese and overweight individuals have also been found to have a high risk of diabetes and hypertension.[1] The risk of type 2 diabetes increases with the extent and duration of being overweight.[8] The likelihood of developing type 2 diabetes and hypertension is greater with a higher BMI. Approximately 85% of people with diabetes are type 2, and of these, 90% are obese or overweight.[16]

Lack of research into the prevalence of raised BMI and its association with high BP and hyperglycaemia in rural black populations motivated the researchers to conduct a study in a rural area to establish the status of these metabolic disorders in less-studied communities.

Method

The study was cross-sectional and prospective, and was undertaken in Ga-Mothapo village, a rural settlement with a population of 11 000. The village is situated in the Capricorn region of Limpopo province, approximately 28 km east of Polokwane city. Limpopo province is one of the most poverty-stricken provinces in South Africa, largely because of its high unemployment rate of 46%. Sampling was systematic. The first household was identified using the stand number and was included in the sample. Every second household thereafter was included. Recruiting was carried out by trained fieldworkers who explained the aims, objectives and confidentiality of the study to the participants.

Consent forms in English and the local language were issued to prospective participants to complete as proof of understanding and willingness to participate in the study. A questionnaire in English and the local language was used to obtain information on demographic characteristics, health status, lifestyle, eating habits and risk behaviours. To meet the inclusion criteria, participants had to be aged between 18 and 65 years and to reside in Ga-Mothapo. Those who were willing to participate in the study presented with completed questionnaires and consent forms at the health centre at Ga-Mothapo. The participants were assigned numbers to conceal their names for the sake of confidentiality. The results were handled only by the researchers. Abnormal results were disclosed to the treatment team for medical follow-up, but only with the participant's permission. The documentation was kept in an access-controlled record archive. Ethical approval was obtained from the ethics committee of the Tshwane University of Technology.

A professional nurse collected a 4.5-ml fasting blood sample for glucose estimation. A laboratory test for blood glucose was performed using the ILab 300 Plus Chemistry System®. A fasting glucose result ≥ 7 mmol/l was considered to be hyperglycaemic. Body weight was measured using an Omron® weight scale. Height was measured using a telescopic height-measuring rod. The BMI was calculated using the formula BMI = weight in kg/(height in m)^2. BP was measured using a calibrated digital automatic BP monitor, the Omron® MI-5. The average of the two readings (that were taken one minute apart) was recorded. Because fasting blood samples were collected, food was provided to the participants after blood sample collection. If any results indicated health risks, the participant was referred to the health centre with a copy of the results for further investigation and treatment.

The collected data were analysed with the Statistical Package for Social Sciences® version 18. The results were expressed in percentage prevalence. Results were considered to be valid only when the values obtained for the quality evaluation samples and materials were at least within two standard deviation limits from the assigned mean value. The results were regarded as significant if the p-value was 0.05 or less.

Results

The characteristics of the participants (286 females and 96 males) are demonstrated in Table I.

There was significant difference in age, height, weight, BMI, glucose and diastolic BP between males and females

Table I: Characteristics of the participants (mean standard deviation and p-value)

Variable	Overall (n = 382)	Men (n = 96)	Women (n = 286)	p-value
Age (years)	38.45 (± 17.283)	34.3 (± 18.198)	39.8 (± 16.769)	0.031
Height (metres)	1.62 (± 0.082)	1.69 (± 0.074)	1.59 (± 0.069)	0.001
Weight (kilogrammes)	69.79 (± 15.858)	65.60 (± 13.903)	71.19 (± 6.243)	0.003
Body mass index (kg/m^2)	26.80 (± 6.200)	23.06 (± 4.659)	28.06 (± 6.154)	0.002
Glucose (mmol/l)	5.42 (± 2.555)	5.026 (± 1.720)	5.557 (± 2.769)	0.075
Systolic blood pressure	125.65 (± 19.164)	127.54 (±19.592)	125.01 (± 19.011)	0.264
Diastolic blood pressure	81.06 (± 11.351)	78.63 (± 12.583)	81.87 (± 10.808)	0.015

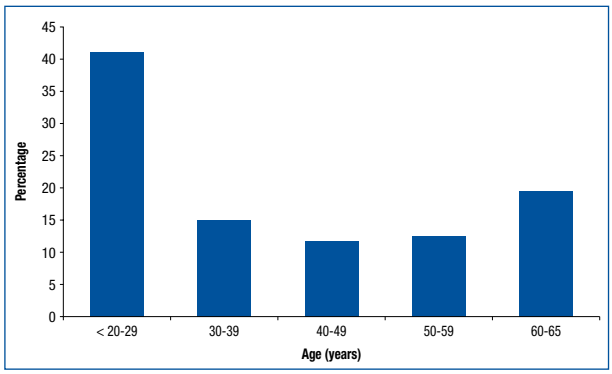
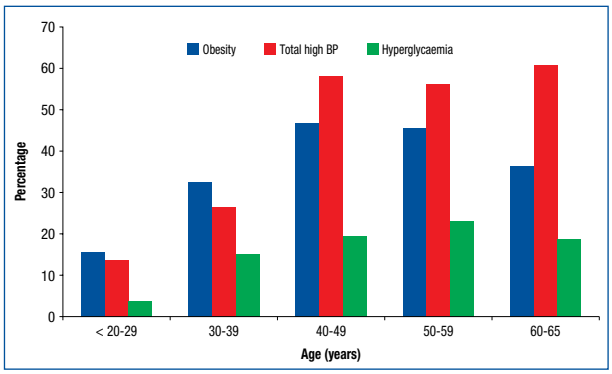
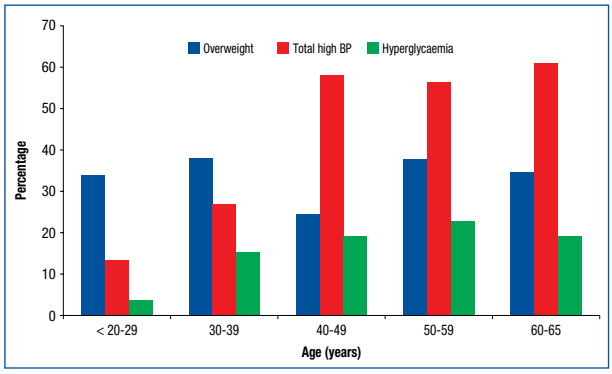


Figure 1: Distribution frequency of participants according to age (n = 382)



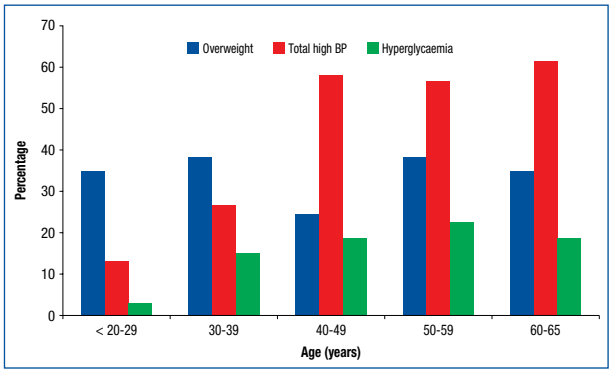
BP: blood pressure

Figure 3: Obesity, high blood pressure and hyperglycaemia in females (n = 286)



BP: blood pressure

Figure 2: Prevalence rates of overweight, high blood pressure and hyperglycaemia in women according to age (n = 286)



BP: blood pressure

Prevalence rate relationships between age, overweight, total high BP and hyperglycaemia for males are indicated in Figure 4.

Figure 4: The prevalence of overweight, high blood pressure and hyperglycaemia in men according to age (n = 96)

(p-value < 0.05). However, there was no significant difference in the systolic BP between males and females (p-value > 0.05).

The overall distribution of participants per age group for both genders is indicated in Figure 1.

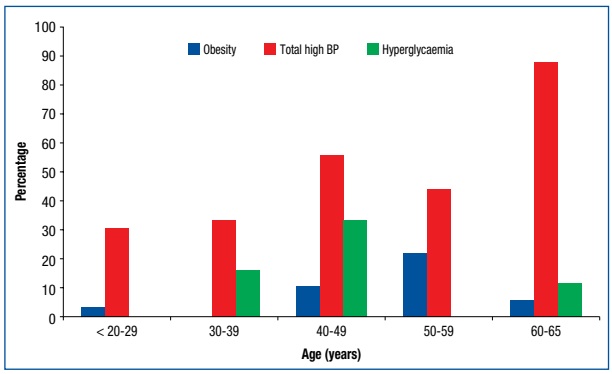
The age group < 20-29 years had the largest number of participants, while the 40- to 49-year age group had the fewest.

Prevalence rate relationships between age groups, overweight, total high BP and hyperglycaemia for females are indicated in Figure 2.

The overweight prevalence rate fluctuated with age, while high BP and hyperglycaemia prevalence rates generally increased with age (Figure 2). In this study, high BP prevalence rate increased linearly with the hyperglycaemia prevalence rate from age < 20 to the age group 50-59 year-olds. High BP prevalence rates remained high when overweight and hyperglycaemia prevalence rates decreased from the age of 60.

Prevalence rate relationships between age, obesity, total high BP and hyperglycaemia for females are indicated in Figure 3.

From age groups < 20 to 49 years, obesity, high BP and hyperglycaemia prevalence rates increased with age. In the age group 50-59 years, there was still an increase in the hyperglycaemia prevalence rate, but a slight decrease



BP: blood pressure

Figure 5: Prevalence rates of obesity, high blood pressure and hyperglycaemia in men according to age (n = 96)

in obesity and high BP prevalence rates. In the age group 60-65 years, obesity and hyperglycaemia prevalence rates slightly decreased, while the BP prevalence rate was higher than that of all the age groups.

The increase in the prevalence rates of overweight, high BP and hyperglycaemia did not show a linear relationship with one another. The relationship was irregular and haphazard, reflecting possible risk factor independence.

Table II: Overall prevalence of overweight, obesity, high blood pressure and hyperglycaemia (n = 382)

	Overweight	Obesity	High blood pressure	Hyperglycaemia
Overall	30.6%	23.6%	27.0%	11.8%

Table III: Prevalence rates of overweight, obesity, high blood pressure and hyperglycaemia, according to gender

	Women n (%)	Men n (%)	p-value
Body mass index			0.001
> 25 kg/m² = overweight	99 (34.6%)	18 (18.8%)	
> 30 kg/m² = obese	84 (29.4%)	6 (6.3%)	
Blood pressure			0.814
≥ 140/90 mmHg = high	78 (27.3%)	25 (26.1%)	
Hyperglycaemia			0.066
Blood glucose ≥ 7.0 mmol/l	39 (13.6%)	6 (6.3%)	

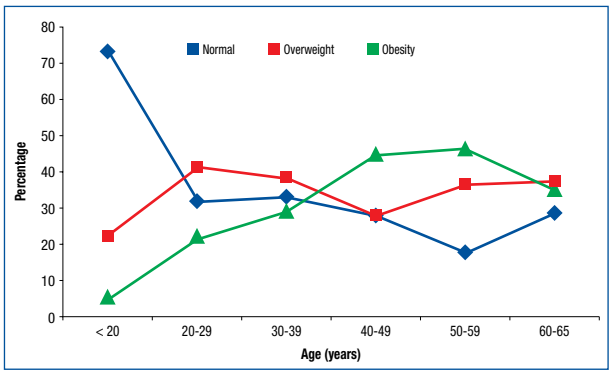


Figure 6: Distribution of body mass index in women according to age

Prevalence rate relationships between age, obesity, total high BP and hyperglycaemia for males are indicated in Figure 5.

No clear pattern of relationship between obesity, high BP and hyperglycaemia was evident in the various age groups.

Overall prevalence rates of overweight, obesity, hypertension and hyperglycaemia for males and females are indicated in Table II.

Gender prevalence rates for overweight, obesity, high blood pressure and hyperglycaemia and level of significance (p-values) between the male and female prevalence rates are indicated in Table III.

Prevalence rate differences of overweight and obesity between men and women were significant. Women were affected more by overweight and obesity than men (p-value = 0.001).

Men and women were similarly affected by high BP. The difference was not statistically significant (p-value = 0.814).

Although the two genders were affected by hyperglycaemia, the difference was not statistically significant, (p-value = 0.066).

Percentage distribution of normal weight, overweight and obesity for women according to age is indicated in Table IV.

Table IV: Body mass index distribution (normal, overweight and obesity) for women according to age

Condition	< 20 years	20-29 years	30-39 years	40-49 years	50-59 years	60-65 years
% normal	73.1	31.7	32.7	27.8	17.9	28.1
% overweight	21.9	40.9	38.5	27.8	35.9	36.8
% obese	4.9	21.3	28.9	44.4	46.2	35.1

Table V: Distribution of body mass index (normal, overweight and obesity) for men according to age

Condition	< 20 years	20-29 years	30-39 years	40-49 years	50-59 years	60-65 years
% normal	96.9	78.3	100	66.7	33.3	47.1
% overweight	0.0	17.4	0.0	22.2	44.4	47.1
% obese	3.0	4.4	0.0	11.1	22.2	5.9

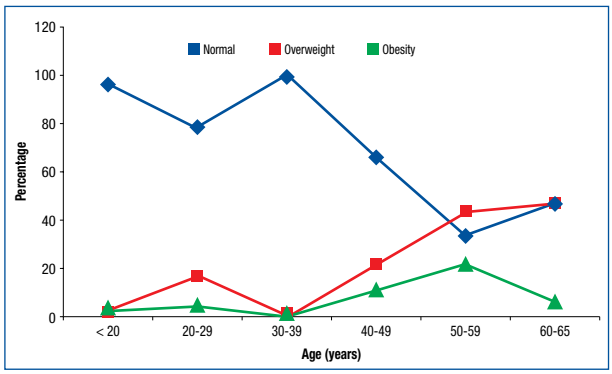


Figure 7: Distribution of male body mass index according to age

Percentage distribution of normal weight, overweight and obesity for females according to age is indicated in Figure 6.

The number of overweight participants increased in the age group < 20 years, and was higher in the age group 20 - 29 years, decreasing slightly to age 40-49 years.

The number of overweight participants increased again in the age group 50-59 years. The increase continued into the 60s.

The number of obese participants increased steadily from the age group < 20 years, until the number reached a plateau from age 40-59 years, after which it started to decrease into the 60s.

Percentage distribution of normal weight, overweight and obesity for males according to age is indicated in Table V.

Percentage distribution of normal weight, overweight and obesity for males according to age is indicated in Figure 7.

The number of overweight participants increased from age group < 20 years, and the number was high in the age group 20-29 years, after which it decreased progressively.

There were no overweight participants in the age group 30-39 years.

The number of overweight participants increased steeply again until the age group 50-59 years, and started to increase steadily into the 60s.

There were few obese men in the age group < 20 to 29 years, and no obese men in the age group 30-39 years.

The number of obese men increased steadily until at age group 50-59 years, and then decreased into the 60s.

Discussion

Prevalence of overweight and obesity

The overall prevalence rates of overweight and obesity in the population of Ga-Mothapo were 30.6% and 23.6% respectively (Table II). The prevalence rates were higher than those reported in Pakistan for the Indo-Asian population (prevalence rates of overweight and obesity of 25.0% and 10.3% respectively).[17] The prevalence in Ga-Mothapo was also higher than that reported for Ugandans (prevalence rates of 10.4% and 2.3% for overweight and obesity respectively).[18] The general prevalence rates in Ga-Mothapo were comparatively higher than those for Pakistan Indo-Asians and Ugandans. The prevalence rate of overweight and obesity together was 64% for women and 25% for men. These prevalence rates were found to be lower than those reported in Saudi Arabia, Qatar and Kuwait.[19] This study found that the prevalence rates of overweight and obesity (34.6% and 29.4% respectively) in women were higher than those in men (18.8% and 6.3% respectively) (Table III). A research study indicated that South African women were at higher risk of overweight and obesity than men, with prevalence rates of obesity ranging from 25.9-54.3% for women and 3-20.4% for men.[20] The South African findings also agree with the findings on the Ugandans.[18] However, a study in the Arabian Gulf states reported higher prevalence rates of overweight in men than in women and higher prevalence rates of obesity in women than in men.[19]

South Africa topped the world scale in 2008, with 36.4% of women and approximately 20% of men being obese. Overweight individuals comprised 50% of men and over 60% of women.[21] This prevalence rate is higher than that of Ga-Mothapo village. It is interesting to note that the prevalence rate of obesity was reported to be higher in North American males (30%) than in South African males (20%), although more South African females are obese (36.4%) compared to their North American counterparts, of whom only 31% were obese. In this study, obesity in males (6.3%) was less than that reported in North American and South African males. However, the prevalence rate of obesity among women (29.4%) was comparable to that of the North American women. In this study, the prevalence rates of obesity were lower than those for Southern Californian American Indians, with prevalence rates of 52.9% and 54.8% for men and women respectively.[22]

In women, the prevalence rates of overweight were high throughout the age groups (Table IV and Figure 6). This trend has been reported previously.[23] Generally, the prevalence rate of obesity increases with age in women (Table IV and Figure 6). This trend suggests that the Ga-Mothapo population is at risk of chronic disease and that overweight individuals are at risk of premature death. This risk is very high in people who are obese.[24]

Possible risk factors associated with overweight and obesity

Based on socio-economic factors, higher prevalence rates of overweight and obesity are expected in urban populations, rather than in rural populations. However, some factors may counter such a perception. These include environmental

influences, educational level, lifestyle, cultural influences, beliefs and attitudes, marital status and barriers to physical activity.

Urbanised populations are increasingly exposed to fast food and high-calorie carbonated drinks, more so than rural inhabitants.[25] Therefore, it is speculated that the prevalence of overweight and obesity is higher in urban populations, than in rural people. However, contrary to expectations, Baalwa et al did not observe significant urban-rural differences in Ugandans regarding the prevalence of overweight (10.2% and 10.6% respectively).[18] It has been suggested that rural South Africans have adopted a Western lifestyle in terms of nutrition. They have also adopted a sedentary routine.[26] Traditional diets of fruit and vegetables are being replaced by diets that are rich in animal fat and low in complex carbohydrates. Rural populations rely mostly on scarce food that is rich in carbohydrates and fats, which they consume late in the evening before going to bed. The intake of these calorie-rich diets, with little energy expenditure, predisposes them to fat deposition and increases in BMI.[27]

Culturally, many black women believe that having a relatively fat body signifies happiness, beauty, affluence, health, a negative human immunodeficiency virus/acquired immune deficiency virus status and being attractive. This projects a belief and an attitude in which an increasing BMI is not linked to health risks. The perception may also relate to a low educational standard and a lack of knowledge of the complications of overweight and obesity.[25] This perception is still prevalent among rural women.

Generally, lower levels of physical activity are associated with a high BMI and a risk of obesity. A fear of losing weight and poor environmental conditions, such as a high crime rate and a lack of resources, contribute to minimal physical activity, especially in rural populations, thus contributing to their being overweight and obese.[20] The availability of basic services, such as water and electricity, and reduced field hoeing and ploughing, have made walking long distances unnecessary, thus promoting a sedentary lifestyle among rural populations, especially women.

Association of overweight and obesity with high blood pressure and hyperglycaemia

Generally, overweight, high BP and prevalence rates of hyperglycaemia increase with age. In this study, high BP and hyperglycaemia prevalence rates increased linearly with overweight in general (Figures 2 and 4). These trends have been described in separate studies, which showed that hyperglycaemia and high BP increased linearly with overweight, and more so in black people than in white people.[1,9,13] A study that was conducted in India reported that overweight individuals were at high risk of diabetes and hypertension.[1]

The present study showed that the prevalence rates of obesity, high BP and hyperglycaemia increased with age in women. Usually, high BP and hyperglycaemia prevalence rates increased progressively with obesity (Figure 3). A study that was conducted in North India indicated that age can be a risk factor for obesity, hypertension and diabetes.[9] In the same study, obesity and hypertension were reported to be possible risk factors for diabetes, and hypertension and diabetes were common in obese individuals.[9] Obesity is a major risk factor for the development and progression of hypertension and diabetes, which often coexist in obese patients.[2,3] The WHO indicated that 90% of type 2 diabetes people are overweight.[16] A linear relationship was also reported between the degree of obesity and high BP and hyperglycaemia.[9] However, it was found that high BP and obesity can be independently associated with a greater prevalence of abnormal glucose metabolism.[3] In our study, this pattern was reflected (Figure 5).

Conclusion and recommendations

The study revealed high prevalence rates of raised BMI, high BP and hyperglycaemia in the Ga-Mothapo population. In general, overweight, obesity, high BP and hyperglycaemia increased with age. Women had a higher prevalence of raised BMI and hyperglycaemia than men, and more women than men were hypertensive. The statistical correlation co-efficient confirmed that raised BMI and hyperglycaemia were significantly associated with hypertension (p-value = 0.009 and p-value = 0.017 respectively).

It is important for the Department of Health in the Limpopo province to organise an intervention to educate the community about these risk factors and how to control and prevent them. Education campaigns should be conducted to alert the Ga-Mothapo community to good health practices, such as healthy eating habits and physical exercise. Weight loss can be achieved through lifestyle interventions, such as dietary adjustment and regular physical activity. These interventions are safe and are moderately effective measures with which to manage hypertension and diabetes as a result of obesity. Another study, with a larger sample size, is required to establish the prevalence rates of hypertension and diabetes, and to establish factors that contribute to the high prevalence rates of hyperglycaemia, hypertension and increased BMI in this rural population.

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