

# Overweight and Obesity among Adults Aged 18-45 Years Residing in and around Giyani Town in Mopani District of Limpopo Province, South Africa

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**Citation:** Motadi SA, Veldsman T, Mohlala M, Mabapa NS (2017) Overweight and Obesity among Adults Aged 18-45 Years Residing in and around Giyani Town in Mopani District of Limpopo Province, South Africa. *J Nutr Health Sci* 5(1): 102. doi: 10.15744/2393-9060.5.102

**Received Date:** August 27, 2017 **Accepted Date:** February 06, 2018 **Published Date:** February 09, 2018

## Abstract

**Objective:** To describe the prevalence of overweight and obesity among adults aged 18-45 years residing in and around Giyani town.

**Methods:** This study included 100 participants recruited from a location in Greater Giyani Municipality of Mopani district, Limpopo Province, South Africa. This Municipality was purposively selected and convenience sampling was used to choose study participants. Body weight and height were measured using standard techniques. Waist circumference, systolic, diastolic, glucose, cholesterol and body fat levels were also assessed.

**Results:** The prevalence of overweight and obesity was 18.1% and 20.5%, respectively. Obesity was more prevalent in females (19%) than males (1.5%). The risks found in study participants included hypertension, diabetes, high total cholesterol, alcohol consumption and cigarette smoking. There was a significant difference in systolic blood pressure ( $p \leq 0.03$ ) between males and females. Systolic blood pressure of about 22.9% of male participants compared to females (20%) was in the hypertensive range. However, only 9.2% of females had prehypertension of between 85-89 mmHg. Furthermore, 17.1% of males had hypertension values  $\geq 90$  mmHg as compared to 9.2% of their female counterparts.

**Conclusion:** Overweight and obesity were common in adults residing in urban areas. The results observed here call for intervention to combat the rising problem of overweight and obesity among adults in the form of nutrition education to ensure food diversification and reduction of food containing fats and hidden fats.

**Keywords:** Overweight; Obesity; Body mass index; Body fat; Waist circumference; Total cholesterol

## Introduction

Historically, obesity and overweight were considered problems of affluent countries, but and is increasingly affecting developing countries like South Africa [1]. In South Africa, obesity is fundamentally driven by environmental changes such as urbanisation, accompanied by cultural modernisation which promotes the adoption of an unhealthy lifestyle plus unhealthy eating habits and decreased physical activity [2]. Furthermore, South Africa has become a market liberalised country in which many people in rural areas access fast food due to market globalisation that leads to a change in dietary patterns and reduced levels of exercise [3].

In many rural communities around South Africa, obesity and overweight are still associated with a sign of good health as well as affluence, today this perception has drastically changed on the basis of evidence that obesity and overweight are associated with a wide range of serious health complications and increased risk of non-communicable diseases (NCDs), such as cardiovascular disease, type 2 diabetes, hypertension and high serum triglycerides which are leading causes of death [4-8]. The unhealthy situation of high levels of physical inactivity and obesity provides a basis for non-communicable disease, also known as "chronic diseases of lifestyle" [9].

In South Africa the burden of NCDs has increased over the past 15 years causing an estimated 37% of mortalities and 16% of disability-adjusted life years [10]. According to Miranda *et al.* non-communicable diseases (NCDs) are the leading causes of

morbidity and mortality in most in low and middle-income countries [11]. These diseases mostly result from behaviours such as tobacco use, physical inactivity, unhealthy diet, and the harmful use of alcohol that lead to four key metabolic/physiological changes such as raised blood pressure, overweight/obesity, raised blood glucose and raised cholesterol [12].

South Africa, like any other developing country, is undergoing a rapid transition with increased intake of energy dense foods and decreased level of physical activity due to increasing urbanisation, changing modes of transportation and sedentary working environments [13-15]. In several developing countries, obesity has established itself as a public health concern with many communities having higher prevalence, particularly among those of higher socioeconomic status [4,16-18]. The highest rate of overweight and obesity among adults in sub-Saharan Africa is found in South African women (42%), while the combined rate of both overweight and obesity is 69.3% [19]. Guthold *et al.* in their survey on low- and middle-income countries, reported that South Africa was ranked as the country with the third prevalence of physical inactivity [20]. In view of this, this study was conducted to evaluate prevalence of obesity and overweight among adults in and around Giyani in Mopani district of Limpopo Province, South Africa.

## Methodology

### Study Population

The study was conducted in Mopani District, which is one of five municipal districts of Limpopo Province. Mopani district's economy is predominately rural-based and the district was selected due to its vast development of modern shopping centres with all the well-known chain stores presented which could lead to lifestyle changes. Lifestyle changes have a very important impact on shopping behavior. During the student placement at this district, the community profiling revealed that majority of rural adults visiting the health centres this district were overweight and obese. The district is divided into six local municipalities, namely Ba-Phalaborwa, Greater Giyani, Greater Letaba, Greater Tzaneen and Maruleng. Convenience sampling was used to select one Greater Giyani Municipality. Greater Giyani had an estimated population of 244217. Giyani town is divided into five sections, namely section A, D1, D2, E, F and Kremataart [21]. Giyani is a north-eastern town in the Limpopo Province, South Africa and a former capital of the then Gazankulu bantustan. Giyani is situated at the intersection between the R578 road (South Africa) and the R81. It is located in the heart of Limpopo Bushveld, on the northern bank of the Klein (Little) Letaba River west of Kruger National Park. Convenience sampling was used to select one hundred (100) participants. The study was conducted at AM Fitness centre in the heart of Giyani town in the Limpopo Province of South Africa. Data was collected during a three days' period by a team of health professionals (a nurse, a nutritionist and a biokineticists) in October 2015. Participants were aged between 18 and 45 years, consented and were present on the day of data collection. Participants who were in wheelchairs were excluded due to the lack of equipment to measure their weight and height. The questionnaire used to determine health status and health practices was adopted from the Belloc and Breslow [22]. Eating habits were determined using closed questions regarding consumption and frequency of fast foods. Fast were considered to be take away purchased from fast foods restaurants. An expert from the Department of Linguistics at the University of Venda translated the questionnaire into the local language used in Giyani which is Xitsonga. Anthropometric assessments were performed according to standard procedures as described by the International Society for the Advancement of Kinanthropometry. The following measurements were taken in duplicate using calibrated equipment with the adult wearing light clothing and no shoes: standing height and weight. Height was measured to the nearest 0.1 cm using a calibrated portable stadiometer and weight was measured to the nearest 0.01 kg on a portable Seca solar scale (model 0213) (Seca, Hammer Steindamm, Hamburg, Germany). The solar scale and stadiometer were calibrated before measurements using a calibration weight and steel tape respectively [23].

### Biochemical Analysis

Resting blood pressure (OMRON, Intelli-sense M6 comfort, Japan) was measured with a validated OMRON M6 Comfort device after the participants had been seated for ten minutes. Two resting measurements, five minutes apart, were performed. The participants were seated upright and relaxed, the right arm supported at heart level. The blood pressure, glucose and cholesterol were taken by a professional nurse. The glucose (random) and cholesterol concentrations were determined by means of peripheral blood sampling (Cardiochek® PA, Indiana). Total body fat was determined using Tanita innerScan V (model BC-601, Japan) by a Biokineticists.

### Definition of Overweight, Obesity, Diabetes, Hypertension, Hyperlipidaemia and Body Fat Percentages

Overweight was defined as 25-29.5 kg/m<sup>2</sup> and obesity was defined as BMI >30 kg/m<sup>2</sup> [23]. A glucose level between 6.0-6.9 mmol/L was considered as moderate while glucose level of >7 mmol was considered high (diabetic range) [24]. Hypertensive range was defined as Systolic blood pressure of 140 mmHg and Diastolic blood pressure of >90 mmHg while systolic blood pressure of 130-139 mmHg and Diastolic blood pressure of 85-89 mmHg was considered as prehypertensive range [25]. Hyperlipidaemia was defined as total cholesterol of >7 mmol/L while 5.2-7 mmol/L was considered borderline high [24]. Total body fat of 15-20% for males and 24-30% for females was considered ideal/optimal while 16-29% was considered as slightly overfat [26].

### Ethical Considerations

Ethical clearance was obtained from the University of Venda Research Ethics Committee and the study was approved by the

Provincial Department of Health Research Committee. The study was performed in accordance with the principles of the Declaration of Helsinki (2008), Good Clinical Practices and the laws of South Africa. An oral and written explanation of the study, including possible risks, was provided to the participants. Participants gave signed consent before they could participate in the study.

### Statistical Analysis

The data was exported into Statistical Package for Social Sciences (IBM SPSS Statistics., Armonk, NY) version 23 for further analysis along with the biochemical measurements. Descriptive statistics were computed on the data and the mean and standard deviation were used to describe continuous data while frequencies were used to describe categorical data. Spearman's correlation coefficients were computed to compare relationships between anthropometric measurements and biochemical measures. For comparison of gender, the Independent t-tests were used. A  $p \leq 0.01$  and  $p \leq 0.05$  were considered statistically significant.

### Results

Table 1 provides the socio-demographic characteristics of males and females. About 27.7% of females were married compared to 25.7% of males. Furthermore, 85.7% of males had tertiary education compared to 84.6% of females. The majority (50.8%) of females worked 8 hours/day compared to 34.3% of their male counterparts.

	Males (n=35) %	Females (n=65) %
<b>Marital status</b>		
Married	9 (25.7)	18 (27.7)
Divorced	2 (5.7)	2 (3.1)
Widowed	0 (0)	5 (7.7)
Cohabiting	0 (0)	1 (1.5)
Single	23 (65.7)	38 (58.5)
Missing value	1 (2.9)	1 (1.5)
<b>Educational level</b>		
Never attended school	0 (0)	0 (0)
Primary education	1 (2.9)	1 (1.5)
Secondary education	4 (11.4)	6 (9.2)
Tertiary education	30 (85.7)	55 (84.6)
Other	0 (0)	2 (3.1)
Missing value	0 (0)	1 (1.5)
<b>Occupation</b>		
Cleaner	0 (0)	2 (3.1)
Clerk	2 (5.7)	6 (9.2)
Typist	0 (0)	1 (1.5)
Secretary	0 (0)	7 (10.8)
Artisan	2 (5.7)	0 (0)
Security guard	3 (8.6)	4 (6.2)
Student	23 (65.7)	24 (36.9)
Other	5 (14.3)	21 (32.3)
<b>Work/study hours</b>		
6 hours/day	12 (34.3)	17 (26.2)
7 hours/day	3 (8.6)	4 (6.2)
8 hours/day	12 (34.3)	33 (50.8)
>8 hours	4 (11.4)	7 (10.8)
Other	2 (5.7)	2 (3.1)
Missing value	2 (5.7)	2 (3.1)

**Table 1:** Demographic characteristics of male and female participants

The prevalence of overweight and obesity was 18.1% and 20.5%, respectively. Obesity was more prevalent in females (19%) than males (1.5%), although not statistically significant. About 9.5% of males were overweight compared to 8.6% of females ( $P \leq 0.01$ ) (Table 2).

BMI category	Male (n=35) n (%)	Female (n=65) n (%)	Total (n=100) n (%)	P- value
Normal BMI	21(16)	30(24)	51(40.2)	0.02
Overweight BMI 25-29.5	12(9.5)	11(8.6)	23(18.1)	0.0
Obese BMI>30	2(1.5)	24(19)	26(20.5)	0.28

BMI: Body Mass Index  
The level of significance is set at:  $p \leq 0.01$  and  $p \leq 0.05$ .

**Table 2:** Prevalence of obesity and overweight between male and female participants

The mean age was 30.37y in males and 33.97y in females. There was a significant difference in SBP ( $p \leq 0.03$ ) between males and females. There was no significant difference in non-fasting glucose level between males and females (Table 3).

Variables	Males	Females	P
Age (years)	30.37±13.83	33.97±12.13	0.20
SBP (mmHg)	132.36±26.42	121.16±19.04	<b>0.03</b>
DBP (mmHg)	76.26±16.57	73.99±11.21	0.47
Glucose (mmol/L)	6.42±4.34	6.01±2.60	0.61
Cholesterol (mmol/L)	4.24±1.32	4.18±1.27	0.84
Body fat (%)	23.55±13.35	36.55±6.95	-
Waist circumference (cm)	81.14±14.13	87.94±16.55	-

SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure; BMI = Body Mass Index; SD = Standard Deviation

The level of significance is set at:  $p \leq 0.05$ .

**Table 3:** Results of the clinical characteristics and comparison thereof between male and female participants

In the total population, BMI was positively correlated with SBP ( $r=0.32$ ;  $p=0.001$ ) and DBP ( $r=0.39$ ;  $p=0.000$ ). Furthermore, BMI was also positively correlated with blood glucose level ( $r=0.31$ ;  $p=0.001$ ) and total body fat ( $r=0.622$ ;  $p=0.000$ ). In addition, BMI was positively correlated with total cholesterol ( $r=0.19$ ;  $p=0.05$ ) and waist circumference ( $r=0.78$ ;  $p=0.000$ ). Waist circumference was positively correlated with SBP ( $r=0.43$ ;  $p=0.000$ ), DBP ( $r=0.48$ ;  $p=0.000$ ), blood glucose level ( $r=0.25$ ;  $p=0.01$ ), total body fat ( $r=0.52$ ;  $p=0.000$ ) and total cholesterol ( $r=0.12$ ;  $p=0.20$ ) (Table 4).

		Systolic	Diastolic	Blood sugar	Body fat	Cholesterol	BMI	Waist
BMI	r	<b>0.32</b>	0.39	<b>0.31</b>	0.622	<b>0.19</b>	-	0.78
	p	<b>0.001</b>	0.000	<b>0.001</b>	0.000	<b>0.05</b>		0.000
WC	r	0.43	0.48	<b>0.25</b>	0.52	0.12	0.78	-
	p	0.000	0.000	<b>0.01</b>	0.000	0.20	0.000	

BMI: Body Mass Index; WC = waist circumference

The level of significance is set at:  $p \leq 0.05$ . and  $p < 0.01$

**Table 4:** Correlation between Anthropometric measurements (BMI and Waist) and biochemical variable

In males, BMI was positively correlated with SBP ( $r=0.45$ ;  $p=0.006$ ), DBP ( $r=0.35$ ;  $p=0.03$ ), blood glucose level ( $r=0.64$ ;  $p=0.000$ ) body fat ( $r=0.53$ ;  $p=0.001$ ), total cholesterol ( $r=0.17$ ;  $p=0.32$ ) and waist circumference ( $r=0.79$ ;  $p=0.000$ ). Waist circumference was positively correlated with SBP ( $r=0.47$ ;  $p=0.004$ ), DBP ( $r=0.42$ ;  $p=0.01$ ) and blood glucose level ( $r=0.35$ ;  $p=0.03$ ).

		Systolic	Diastolic	Blood sugar	Body fat	Cholesterol	BMI	Waist
<b>Males</b>								
BMI	r	0.45	<b>0.35</b>	0.64	<b>0.53</b>	0.17	-	0.79
	p	0.006	<b>0.03</b>	0.000	<b>0.001</b>	0.32		0.000
WAIST CIRCUMFERENCE	r	<b>0.47</b>	<b>0.42</b>	<b>0.35</b>	0.44	-0.04	0.79	-
	p	<b>0.004</b>	<b>0.01</b>	<b>0.03</b>	0.007	0.78	0.000	
<b>Females</b>								
BMI	r	0.45	0.53	<b>0.23</b>	0.73	0.22	-	0.77
	p	0.000	0.000	<b>0.05</b>	0.000	0.07		0.000
WAIST CIRCUMFERENCE	r	0.56	0.60	<b>0.23</b>	0.62	0.22	0.77	
	p	0.000	0.000	<b>0.05</b>	0.000	0.07	0.000	

BMI: Body Mass Index

The level of significance is set at:  $p \leq 0.05$ . and  $p < 0.01$

**Table 5:** Correction between anthropometric measurements and biochemical variable in male

In females, BMI was positively correlated with SBP ( $r=0.45$ ;  $p=0.006$ ), DBP ( $r=0.35$ ;  $p=0.000$ ), blood glucose level ( $r=0.23$ ;  $p=0.05$ ), total body fat ( $r=0.73$ ;  $p=0.000$ ), total cholesterol ( $r=0.22$ ;  $p=0.07$ ) and waist circumference ( $r=0.79$ ;  $p=0.000$ ). Waist circumference was positively correlated with SBP ( $r=0.56$ ;  $p=0.000$ ), DBP ( $r=0.60$ ;  $p=0.000$ ), blood glucose level ( $r=0.23$ ;  $p=0.05$ ), total body fat ( $r=0.62$ ;  $p=0.000$ ) and total cholesterol ( $r=0.22$ ;  $p=0.07$ ) (Table 5).

About 20% of males purchased fast food everyday compared to 7.7% of females. In addition, only 23.1% of females purchased fast food once a week compared to 20% of their male counterparts. About 28.6% of males preferred to purchase KFC while 40% of females purchased fish and chips (Table 6).

Frequency of purchasing fast food		
	Males n (%)	Females n (%)
Everyday	7 (20)	5(7.7)
Once a week	7(20)	15(23.1)
Twice a week	5(14.3)	3(4.6)
3 times a week	4(11.4)	7(10.8)
Once a month	4(11.4)	12(18.5)
Twice a month	4(11.4)	10(15.4)
More than twice a month	4(11.4)	8(12.3)
Fast food usually purchased		
Romans	3(8.6)	5(7.7)
Chicken Licken	2(5.7)	2(3.1)
KFC	10(28.6)	2(3.1)
Fish and chips	5(14.3)	26(40)
Nando's	8(22.9)	2(3.1)
Galito's	3(8.6)	15(23.1)
Chisa nyama	1(2.9)	6(9.2)

**Table 6:** Differences in fast food consumption

Table 7 provides the distribution of non-communicable disease risk factors between males and females. About 22.9% of males had SBP in the hypertensive range compared to 20% of females. In addition, only 17.1% of males had higher than normal DBP in the hypertensive range compared to 9.2% of females. About 17.1% of males had blood glucose level higher than 7 mmol/L compared to 20% of their female counterparts. Males (17.1%) had moderate total cholesterol compared to 15.4% of females. About 95.4% of females had high total body fat compared to 45.7% of males. At total of 46.1% of females were alcohol drinkers compared to 37.1% of males. In addition, 11.4% of males were smokers compared to 3.1% of females.

Variables	Males (n=35) %	Females (n=65) %
SBP (mmHg)		
Normal (120-129)	22(62.9)	40(70.8)
Prehypertension (130-139)	5(14.3)	6(9.2)
Hypertension ( $\geq 140$ )	8(22.9)	13(20)
DBP (mmHg)		
Normal (80-84)	29 (82.9)	53 (81.5)
Prehypertension (85-89)	0 (0)	6 (9.2)
Hypertension ( $\geq 90$ )	6 (17.1)	6 (9.2)
Glucose (mmol/L)		
Low (5.5-5.9)	21 (60)	40 (61.5)
Moderate (6.0-6.9)	8 (22.9)	12 (18.5)
High ( $>7$ )	6 (17.1)	13 (20)
T-Cholesterol (mmol/L)		
Low ( $<5.2$ )	28 (80)	54 (83.1)
Moderate (5.2-7.5)	6 (17.1)	10 (15.4)
High ( $>7$ )	1 (2.9)	1 (1.5)

Variables	Males (n=35) %	Females (n=65) %
<b>Body fat (%)</b>		
Lean (<8)	11 (31.4)	3 (4.6)
Optimal (males 15-20; females 24-30)	8 (22.9)	0 (0)
Overweight (16-29 males; females 31-36)	16 (45.7)	62 (95.4)
<b>BMI (kg/m<sup>2</sup>)</b>		
Normal (18.5-24.0)	21 (60)	30 (46.2)
Overweight (25-25.9)	12 (34.3)	11 (16.9)
Obese (>30)	2 (5.7)	24 (36.9)
<b>Waist circumference (cm)</b>		
Low (male 94; female 80)	28 (80)	21 (32.3)
High (male 94-102; female 80-88)	5 (14.3)	13 (20)
Very high (male >102; female >88)	2 (5.7)	31 (47.7)
<b>Smoking status</b>		
Non-smokers	31 (88.6)	59 (90.8)
Smokers	4 (11.4)	2(3.1)
<b>Alcohol consumption</b>		
Non-drinkers	22(62.9)	32(49.2)
Drinkers	13(37.1)	30(46.1)
<b>PA status</b>		
PA	22 (62.9))	23 (35.4)
PIA	13 (37.1)	42 (64.6)

SBP = Systolic Blood pressure; DBP = Diastolic Blood Pressure; T-Cholesterol = Total Cholesterol;  
BMI = Body Mass Index; PA = Physical activity; PIA = Physical inactivity.

**Table 7:** Risk factors in male and female participants residing in and around Giyani town n (%)

## Discussion

The aim of the study was to determine the prevalence of overweight and obesity among adults aged 18-45 years residing in and around Giyani town in Mopani District of Limpopo Province, South Africa. The results of the study revealed that the prevalence of overweight and obesity was 18.1% and 20.5% respectively. The results are higher than the provincial prevalence of 4.8% (overweight) and 3.3% (obesity). The results also showed that the prevalence of overweight and obesity was higher in females than in males (8.6% and 19% for females as compared with 9.5% and 1.5% of males, respectively). The prevalence of overweight and obesity in the current study was lower than the national prevalence of overweight and obesity in females and males (25% and 40.1% compared with 19.6% and 11.6% for females and males, respectively) [2]. However, the prevalence was lower when looking at provinces with Limpopo having 24% and 32.6% compared with 16.3% and 11.5% for females and males, respectively [2].

The high prevalence of overweight and obesity in the current study may be explained by the fact that more males are eating fast food daily and weekly combined (40%) while still have a low percentage of overweight /obesity compared to females. The consumption of fast food may be enhanced by meals that cost less than R50 in various fast food outlets which the public regards as cheap and convenient. Increased consumption of fast food meals every day coupled with a lack of physical activity can lead to increased calories resulting in weight gain and other health conditions. The environment in South Africa has obviously changed during the last decades, whereas opportunities to eat energy-dense foods are omnipresent [27]. Today, fast food restaurants that sell greasy burgers, chips and sugary drinks are found at most intersections in every town around Limpopo Province. This fast food outlets make it hard for people to plan their meals ahead and work or even shop because of the availability and accessibility. Egger and Swinburn suggested that the increasing obesogenic environment is the driving force for the increasing prevalence of obesity rather than any 'pathology' in metabolic defects or genetic mutations within individuals [28]. Additional factors that could explain the high rates of overweight and obesity in South Africa include changes in nutritional patterns over time and the degree of urbanisation that Africans are undergoing [29]. Overweight and obesity in adults increase the risk of debilitating health problems such as type 2 diabetes, hypertension, high serum triglycerides and cardiovascular disease which are leading causes of death [7].

South Africa has one of the highest levels of alcohol consumption in the world [30-32]. In this study, females (46.1%) were found to be more frequent alcohol drinkers than males (37.1%). Surprisingly, the SANHANES report Shisana *et al.* divulged

that males (31%) were more prone to drinking than females (9.3%) [2]. Alcohol may have a negative impact on the health of an individual. Although alcohol is high in kilojoules (28 kJ/g), it is not metabolised as efficiently as carbohydrates and fats and is deficient in essential micronutrients [33]. Impaired digestion may result in malabsorption of vitamins thiamine, B12, folic acid, zinc and amino acids. Furthermore, metabolism is also altered and certain nutrients are frequently affected (thiamine, vitamin B6, vitamin D, zinc, vitamin A, magnesium, phosphorus and selenium) [34]. Nevertheless, consuming alcohol with meals may have some protective factors to overindulgence and this may in turn reduce intoxication [35-38]. Excessive alcohol intake may be contributing significantly to energy intake and may eventually facilitate weight gain in participants [39].

Another possible cause of overweight and obesity is physical inactivity. Physical inactivity among the female participants was particularly high and this could be one of the possible reason for this alarming high rate of overweight and obesity in the female participants. Congruently, WHO revealed that 42.2% of males and 51.6% of females in South Africa are physically inactive [40]. In South Africa, overweight and obesity in women is perceived as a sign of good health as well as affluence, happiness and prosperity [4,8,41]. This was also confirmed in a study done by Faber and Kruger in rural villages of KwaZulu-Natal, where females who were obese did not perceive themselves as being too big or overweight [41]. Being an overweight and obese female in an African community has many positive connotations [4].

This study showed that the majority (50.8%) of females spend 8 hours per day working/studying compared to 34.3% of their male counterparts. This could be the leading cause of physical inactivity among the study participants, as most participants have little time for physical activity. According to Milia and Mummery and Kim *et al.* long working hours can lead to poor sleeping habits and less time for exercise and maintaining a balanced diet which are strongly linked to obesity and increased risk for cardiovascular diseases [42,43]. Furthermore, several studies have reported an association between long working hours and obesity in several countries, including Hong Kong, Australia and Finland [43-45]. At the same time, Micklesfield *et al.* reported that the prevalence of physical activity in South Africa is estimated to be between 43-49% among adolescents and adults [46]. Lifestyle changes generated by technology and capitalism have affected the way we exercise and eat, leading to a risk of diseases [47].

Results show that females had higher body fat percentages compared to their male counterparts, exceeding the recommended optimal body fat of 31-36% [48]. Perhaps the scientific explanations for females having a higher fat percentage may also be due to differences in hormones, hormone receptors and enzyme concentrations [49]. Concurrently, Whitney and Rolfes reported that fat accumulation is higher in females than in males, due to essential body fat deposited in the mammary glands and pelvic region in preparation for child bearing [50]. Another factor that might contribute to females having a higher fat percentage than their male counterparts, may be the use of hormonal contraceptives [51]. The high prevalence of overweight and obesity indicated by BMI values and the fat percentage of the female participants is in line with the high prevalence of waist circumferences above the normal values of 88 cm for women. Only a small portion of the male participants had a greater than 102 cm waist circumference [48].

University or college is known to be a critical period for making unhealthy changes in eating behaviours and weight gain [52-55]. This study showed that the majority (65.7%) of males were students compared to 36.9% of females. According to Deliens *et al.* when students fail to adapt adequately to the new environment, this could have negative consequences towards their health behaviour and subsequent weight status [55]. Eating behaviour is an important factor influencing students' weight [53]. However, dietary changes have been observed in South African adults from low fat diets to typical westernised high fat diets [56]. South Africa has become a market liberalised country in which many people in rural areas access fast food due to market globalisation which leads to change in dietary patterns and reduced levels of exercise [3].

This study showed that females (47.7%) had a very high central obesity compared to 5.7% of their male counterparts. Perhaps this could be attributed to the fact that the hormones oestrogens and androgens help to regulate body fat distribution. Furthermore, postmenopausal women tend to increase storage of fat around their abdomen because the distribution of fat in the body changes after middle age [57-59]. Therefore, with the increase in age, the risk of overweight and obesity increases gradually.

About 17.1% of males were at risk of hypertension compared to 9.2% of females, when using DBP, while 22.9% of males were at risk of hypertension compared to 20% of females, when using SBP. This could be explained by the fact that 11.4% of males were smokers compared to 3.1% of females. Smoking cigarettes acutely exerts a hypertensive effect, mainly through the stimulation of the sympathetic nervous system [60]. The association between BMI and metabolic diseases among adults was further explored in this study. The results indicated that hypertension, diabetes and hyperlipidemia had a positive association with BMI and WC, which is consistent with previous studies [61,62]. One possible explanation for this is that BMI is very highly correlated with WC. The risk of metabolic diseases can be more accurately predicted by WC after adjustment for the influence of BMI. The results further showed that people with BMI above normal and very high WC have a higher risk of metabolic diseases.

## Conclusion and Recommendation

A high prevalence of both overweight and obesity exists among adults in urban areas of Giyani. The prevalence of overweight and obesity in the current study was lower than nationally and provincially. Hypertension, diabetes and hyperlipidemia were significantly associated with BMI and WC among adults in Giyani, Mopani district. The high prevalence could be a result of

dietary changes that have been observed in South Africa, from low fat diets to typical westernised high fat diets and market liberalisation which makes people access fast food due to market globalisation which leads to a change in dietary patterns. The high prevalence of obesity among females compared to their male counterparts could be a result of South African overweight and obesity in women being associated with a sign of good health as well as affluence, happiness and prosperity. Nutrition education programs on the consequences of overweight and obesity and the consumption of fast foods should include the importance of dietary diversification of meals, especially the inclusion of fruits and vegetables and the reduction of food that contain high fat content and hidden fats. Physical activity should be introduced at school level as this is known to prevent overweight and obesity which delays manifestation of non-communicable disease. Furthermore, Government and health departments should take measures to improve people's awareness of the consequences of overweight and obesity.

## Acknowledgements

The authors would like to acknowledge the University of Venda and students from the Department of Nutrition, Biokineticists, Nursing Sciences and Psychology for assisting with data collection. Furthermore, we would like to pass our message of appreciation to participants residing in and around Giyani town for their participation and cooperation.

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