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Obesity and Body Fat Percentage in Riyadh, Saudi Arabia

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Abstract: ***Background: Obesity is a disease of global concerns, impacting different organ systems with lethal efficacy. Obesity is defined as having a body mass index of 30 kg/m2 or above. In our Kingdom, obesity is reaching new heights, for almost a third of our population is obese. We aim to shed light on this issue and evaluate the possible risk factors for this disease. Methodology: This was a cross-sectional study in which we collected data from mall goers in two different malls in Riyadh. We used booths and checkpoints to encourage subjects to participate in our campaign. We employed a validated questionnaire and equipment to gather the required data. Results: We compiled data from a total of 317 subjects with a slight male predominance. We found significant relation between Body Fat Percentage (BFP) and BMI (p = 0.002). We found significant relation between BFP and age (p = < 0.000) with the same result appearing in BFP and gender (p = < 0.000). 44% of females screened positive for self-reported depression. We found no relation between BFP and blood pressure.***

Keywords: Fat, BMI, BFP, KSA, Saudi Arabia

1. Introduction

Obesity is defined as excessive fat accumulation in the body that occurs when a persoon's energy intake exceeds his\her energy expenditure. Obesity is caused by diseases (such as hypothyroidism and cushing's syndrome), sedentary lifestyle, and diets rich in fats and sugar. Obesity increases the risk for cardiovascular complications, sleep apnea, and diabetes [1, 2]. These complications do not spare anyone, including children, for it is reported that obesity in a young age is associated with increased insulin resistance [3], adverse effects on adulthood lipid profiles, and orthopedic conditions such as slipped capital femoral epiphysis [4]. In Saudi Arabia, obesity has become a widespread disease. The Coronary Artery Disease in Saudis Study (CADISS) estimated a staggering level of obesity in Saudis: 35.3% of the population were obese[5]. In the latest study conducted by Mehmish et al, the prevalence of obesity in KSA was 29% overall, and they found that 33% of Saudi females were obese compared to 24% of Saudi males [6]. This recent study shows a decreased level of obesity in the Saudi population, albeit the prevalence is still considered high for almost a third of Saudis are obese. Physical inactivity is one of the leading causes for obesity[1]. In a study to measure the level of physical activity in the Saudi population (ages 30-70 years), the study found an inactivity prevalence of (96%), of which there were less active females (98%) than males (94%)[7]. Their physical activity was judged based on the Center for Disease Control (CDC) recommendation to have a minimum 150 minutes of moderate intensity workout, such as brisk walking [8]. It is crucial to educate the population about physical activity, for it is one of the pillars for achieving optimal health status, and with the advent of new ways to exercise, it has never been easier for a person to start living healthy [9].

Body fat percentage (BFP) is the percentage of fat that has accumulated in the body of a person. It is used with the body mass index (BMI) to assess a person's level of obesity and body fat percentage[10]. BMI and BFP are correlated with obesity[11], and data representing BMI and BFP are lacking in Saudi Arabia. Adequate BFPs for gender vary between resources, so we chose the most comprehensive recommendation. The American College of Sports Medicine (ACSM) recommends that average BFP for males should not exceed 22%, and females should not exceed 32%[13].

Unfortunately, Saudi Arabia is severely affected with obesity, as the referenced studies[5,6] show. The results from these studies encourage us to tackle this conundrum head on, shedding light on this issue to enlighten the path towards effective health education and services. To achieve our goals, we aim to find the average body fat percentage in Riyadh mall goers, their level of fitness, and the related co-morbidities which accompany obesity (increased blood glucose and high blood pressure). This will help us in assessing the seriousness of obesity and its related morbidities in Riyadh, and use the data to improve the general health of the population.

2. Methodology

Study Setting

This is a multicenter study. We collected information from two different malls (Granada mall and Hayat mall) in Riyadh, Saudi Arabia. We visited Hayat mall three times and Granada mall twice.

Inclusion Criteria:

All participants were at least 18 years or older, and have completed the questionnaire.

Exclusion Criteria:

Any participant who did not meet the inclusion criteria.

Study design:

This study was a cross-sectional study since we interviewed the sample in a specific point in time, without follow up nor intervention.

Sample Size:

The sample size was calculated through the use of an online software (Raosoft) with a margin of error of 5%, confidence level of 95 %, and the response distribution was set at 29% based on the recent study measuring the prevalence of

obesity[6]. The result of the sample size calculation was 312 samples.

Sampling Technique

Non-probability convenient sampling technique was used in this study. We employed booths and "checkpoints" with assigned medical students to invite mall goers to participate in the campaign.

Data Collection Method

In our study, we assessed the body fat percentage using the bioelectrical impedance analysis (BIA), which provides a rapid, non-invasive and relatively accurate measurement of body composition. BIA measures the different rates of electrical flow based on the different bodily composition [11,12]. We will use the ACSM recommendations for acceptable BFPs in both genders [13]. To assess the population in terms of obesity, we used the body mass index (BMI) which is the most widely applied measurement for a person's level of obesity or weight gain, and there is no difference between males and females in the procedure. We measure the weight, height, and then divide the weight by the height in meters squared, with the resulting number representing a person's level of obesity. So a BMI of >25 kg/m^2 and >30 kg/m^2 are considered to be overweight and obese, respectively [1]. A data collection sheet was designed to collect information about demographics, blood glucose level, diet, physical activity, and the feeling of general wellbeing. The data was taken by medical students in the mall who are properly educated about using the required equipment. We measured the random glucose level using a glucometer, and the blood pressure through a sphygmomanometer.

Statistical analysis

Quantitative variables (e.g. age and weight) are expressed as mean and SD. Categorical values (e.g. marital status and wellbeing) will be expressed as frequencies and percentages. Data are presented by graph (e.g. bar) and tabulate (e.g. gender, exercise) for better presentation of collected variables. Student t-test was used for quantitative variables and Chi-square and fisher exact test was used for categories. Data was entered using Microsoft excel and processed using SPSS 20, while the P-value significance was set at p less than 0.05.

3. Results

Variable	*Mean*	*SD*
Age	34.86	11.1
Sys BP	120.94	15.81
Dias BP	79.5	10.69
Height	164.39	9.76
Weight	78.37	17.6
BMI	28.84	5.66
BFP	30.44	8.32

We collected data from 317 participants in the campaign. The total mean age for our sample was 35 years. The blood pressure readings of our sample showed a mean of 121/80 mg/Hg. The measurement of weight and height for our sample gave us a total mean of 78 kg and 164 cm respectively. The mean BMI for our sample was 29 Kg/m^2, and the mean BFP was 30%. The gender distribution in our sample was almost the same. The males accounted for 50.5%, while the females accounted for 49.5%. Most of the participants were married (70%), 27% were single, 1% were divorced, and 2% were widowed.

Income	*Freq.*	*Percent*
≤2900	75	23.66
3000–4900	37	11.67
5000–7900	51	16.09
8000–11900	75	23.66
12000–19900	49	15.46
≥ 20000	28	8.83

Exercise	Freq.	Percent
Everyday	68	21.45
3 Times a week	63	19.87
Once a week	48	15.14
Less than that	138	43.53

To grasp an understanding of the participants' income, we choose 6 different monthly income payments in an ascending manner, arranged them in groups numbered from 1 to 6, and asked the participants to tick the group they were in. the groups were: 1 = income ≤ 2900 Saudi Riyals (SR), 2 = 3000 – 4900 SR, 3 = 5000 – 7900 SR, 4 = 8000 – 11900 SR, 5 = 12000 – 19900 SR, and 6 = ≥ 20000 SR. Most of our participants were in group 1 (24%) and group 4 (24%). Group 2 accounted for 12 %, group 3 for 16%, group 5 for 15.5%, and lastly group 6 for 9%. The level of exercise in our sample was sub-optimal, with 43% did not perform at least 20 minutes of brisk-walking once a week. 21% claimed the exercised daily (20 minutes of brisk-walking), 20% claimed they exercised 3-times a week, and lastly, 15% claimed they exercised once a week.

Fast Food	*Freq.*	*Percent*
At least once daily	42	13
4-5 meals a week	34	10.7
In the weekends	91	28.7
Few meals a months	71	22.4
rarely	46	14.5
never	33	10.4

We inquired about the dietary habits of our participants in regards to fast food consumption. 13% of our participants consumed fast food at least once daily, 11% consumed it 4-5 times a week, 29% consumed it in the weekends, 22 % consumed it a few times a month, 15% consumed it rarely, and 10% have stopped consuming it altogether.

Education	*Freq.*	*Percent*
Illiterate	2	0.63
Literate	2	0.63
Elementary	12	3.8
Intermediate	22	6.96
Secondary	68	21.52
Diploma	20	6.33
Bachelor	162	51.27
Higher Education	28	8.86

Regarding the educational level of our sample, 1% of our participants were illiterate, another 1% were literate, 4% finished elementary school, 7% finished intermediate school, 22% finished secondary school, 6% had a Diploma, 51% had a Bachelor degree, and 9% received Higher Education.

Chronic Disease	Freq.	Percent
Yes	87	27.44
No	230	72.56

Depression Screen	Freq.	Percent
Yes	100	31.55
No	217	68.45

Smoking	Freq.	Percent
Yes	50	15.77
No	267	84.23

In our questionnaire, we asked about smoking and 16% of our sample were active smokers. We screened for depression by asking questions about its main symptoms (feeling sadness, loss of interest, and guilt), and 32% screened positive for depression. In regards to gender, females had a higher prevalence of symptoms of depression (44%), on the other hand, only 20% of males complained of symptoms of depression. We inquired about comorbidities (chronic diseases: Hypertension, Dyslipidemia, and Hypothyroidism): 27% had chronic diseases, while 73% were disease free.

BFP	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Weight	0.1278797	0.0506387	2.53	0.012	0.0282431	0.2275163
Height	-0.2233646	0.0572313	-3.9	0	-0.3359726	-0.1107565
BMI	0.6130005	0.1394948	4.39	0	0.338531	0.88747
Gender	7.695358	0.7035867	10.94	0	6.310983	9.079733
_cons	27.94859	9.890962	2.83	0.005	8.487164	47.41001

Linear regression analysis was carried out using BFP as the dependent factor and weight, height, BMI and gender as the independent factors to see if these factors can predict BFP. All these factors significantly act as predictors in this model. Thus, all account for 73% predicting value for fat (R^2).

Gender	Age	Sys BP	Dias BP	Height	Weight	BMI	BFP
Male	36.2	122.3	81.9	171.3	85.5	28.9	26
Female	33.5	119.6	77.1	157.4	71.2	28.8	34.9

In our sample, females were younger than men (mean female age = 34 years, mean male age = 36 years). They did not differ much in regards to blood pressure (Male = 122/82, Females = 120/77) and BMI (Males = 28.9, Females = 28.8). Men were taller with a mean height of 171 cm, while the females had a mean height of 157 cm. Men weighed more at 86 kg, while females were lighter at 71 kg. They also differed in the amount of fat in the body; males had a 26% of body fat, while females had a 35% of body fat.

	N	Mean BFP(SD)	Single variable (p)	Multi Variable Analysis (p)
Gender			<0.001	<0.001
Male	160	26.0 (6.6)		
Female	157	35.0 (7.5)		

We have found that Gender is a predictor of BFP both in single and Multivariable analyses. This result goes with the established findings that BFP is related to gender; for females carry more body fat than males.

	N	Mean BFP(SD)	Single variable (p)	Multi Variable Analysis (p)
Age (yrs)			<0.001	<0.001
< 30	116	27.2 (7.8)		
≥ 30-39	97	30.6 (7.9)		
≥ 40-49	68	33.9 (7.7)		
≥ 50	36	34.2 (8.4)		

We have categorized Age into four groups. First group (N=116) will include all the participants whom are younger the 30 years old. The second group (N=97) will be for the samples that are 30 years old or older but younger than 40 years old. The third group (N=68) participants are 40 years old or older but younger than 50 years old. The final group (N=36) are 50 years old or older. As age increased BFP also increased. The first group has a mean BFP of 27.2 (SD=7.8), the second group mean was 30.6 (SD=7.9), the third group mean was 33.9(SD=7.7), and the fourth group mean was 34.2(SD=8.4). So we can conclude that age is another predictor of BFP as single variable and in multivariable analysis. As age increased BFP also increased.

	N	Mean BFP (SD)	Single variable (p)	Multi Variable Analysis (p)
Height (cm)			<0.001	NS
> 140 - 149	15	38.1 (7.6)		
>150 -159	93	35.0 (7.8)		
>160 -169	113	30.2 (7.2)		
>170	96	25.2 (6.8)		

Height (CM) was divided into four groups. (≥ 140-149) was libeled as the first group (N=15), their mean BFP was 38.1 (SD=7.6). Our second group were (≥150 -159) tall (N=93), their mean fat was 35 (SD=7.8). Then the participants whom height were (≥160 -169) (N=113), their mean fat was 30.2 (SD=7.2). The samples who were 170 cm or taller were in the fourth group (N=96), their mean BFP was 25.2 (SD=6.8). As you can see in the table above, height was only significant in single variable analysis. But failed significance in multivariate analysis. Interestingly, as height increased BFP decreased, suggesting that the shorter a person the more body fat they have.

	N	Mean BFP (SD)	Single variable (p)	Multi Variable Analysis (p)
Weight (kg)			<0.001	<0.001
<60	43	25.6 (9.1)		
60-69	69	29.9 (7.2)		
60-79	70	29.9 (8.5)		
80-89	55	30.8 (8.2)		
90-99	41	33.0 (8.5)		
≥ 100	39	34.3 (6.0)		

Weight was another predictor of BFP as single variable and in multivariable analysis. As weight increased body fat also increased. BMI was similar to weight; it was a predictor of body fat as single variable and in multivariable analysis. As BMI increased body fat also increased, and this result was expected due to BMI being a result of weight and height; both of which are correlated with body fat.

4. Discussion

The objective of our study was to find the average BFP of Saudi citizens in Riyadh, and investigate the possible association of BFP and obesity in different social and economic states, gender, and occupation.

The mean age of our sample was 35 years, representing the workforce of the Kingdom that would benefit from risk modification. We had a slightly increased male participation in our campaign than females: males accounted for 50.5% of our sample, and most were adults 36 years of age.

BFPs were and are, associated with increased BMI and correlated with obesity. Sadly, our results show an elevated BFPs in males and females: the males had a mean reading of 26%, while the females had a reading of 35%. The sample mean was 30%, reflecting increased BFP for the sample as a whole. These results show that the general health of our sample is at risk for obesity and its comorbidities, prompting us to increase our vigilance and strive to implement a healthier lifestyle that incorporates not only diet but includes proper exercise regimens and awareness about the alarming consequences of obesity.

Weight and BFP had a significant association (p-value = 0.001), which goes with increased BMI and decreased physical activity of our sample. This result shows that the excess weight is mostly composed of fat, which is an alarming feature of such a young age group (36 years is our sample's average age). The possibilities and methods have been discussed with each interviewee, and the participants were properly educated in hopes of achieving effective weight management to prevent obesity.

Blood glucose levels were not increased: our results showed a mean of 120 mg/dl which is normal for a blood glucose sample taken randomly. Using Pearson's correlation to measure the dependence of BFPs and blood glucose levels, we failed to find a significant association between the two (p-value = 0.78). We measured the blood pressure of our sample and found a mean of 121/80 mg/hg which adheres to the normal blood pressure readings of the world's population. Pearson's correlation failed to find a significant association between BFPs and blood pressure (p-value = 0.87).

Regarding exercise, as mentioned in the results, our sample had a poor level of physical activity, with most (43%) did not perform a minimum of 20 minutes of brisk walking a week. To contradict our expectations, physical activity was not significantly associated with BFP (p-value = 0.2) which goes with a study by Garza J, et al[14] that also could not find any association between BFP and physical activity.
Evidently, a more comprehensive and elaborate approach towards health education is becoming a necessity; since obesity is preventable disease and Saudi Arabia has a young population[15] that will benefit the most from early lifestyle changes.

Staggeringly, 44% of females screened positive for depression, and the sample mean was 32%. Males were not as severely affected by depression as females, for they had a mean of 20%. For emphasis, depression is associated with obesity, worsens the general outcome of the patient, and impedes the ability of the patient to effectively assail his/her illness[16]. Our analysis of the data could not reveal a statistical significance between BFPs and depression (p-value = 0.25). To thoroughly investigate the health of our participant, we screened them for chronic conditions, specifically Diabetes, Hypertension, Dyslipidemia and Hypothyroidism. 27% of our sample had a chronic condition, which did not show any statistical significance with BFPs (p-value = 0.062).

Our results showed a significant association between BFP and BMI (p-value = 0.002) and BFP and weight (p-value = 0.001). In addition, the mean sample BMI was 29, representing a sample that is overweight and lacking in physical activity as noted above. This association requires a stronger intervention to contain the rising situation and the considerable prevalence of obesity in Saudi Arabia[6].

Linear regression analysis showed that weight, height, BMI, and gender are significant predictors of BFP; these variables account for a predictability of 73% for BFP.

Several strengths about this study should be noted. Our study represents a "slice" of our population by including a multitude of people hailing from different socioeconomic background, different living states, and health status.

Secondly, we interviewed the participants in a comprehensive manner and inquired about their different living states to effectively assess our sample.

5. Limitations

Our research faced two main limitations. First, our study covered two malls in Riyadh which is not enough to represent the whole population of Saudi Arabia. Second, we used convenience sampling, which is a step-down from the proper sampling methods.

6. Conclusion

What we have discovered in our work goes with most published studies worldwide, showing an association between BFP and BMI, both of which are predictors of obesity. In addition, the increased BMI and BFP puts our population at risk of obesity and its multitude of complication, ranging from health issues to financial burdens to the afflicted and the country. Further areas of research into the possibility of early intervention in cases of increased BMI and BFP should be evaluated.

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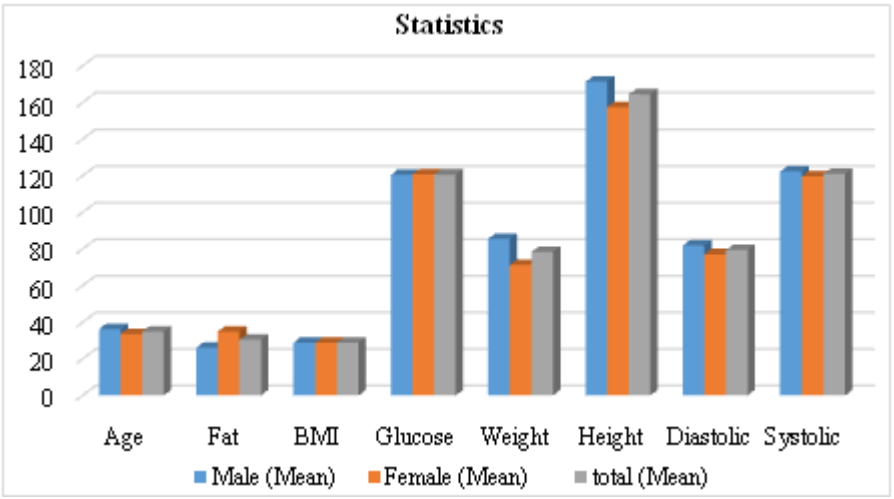
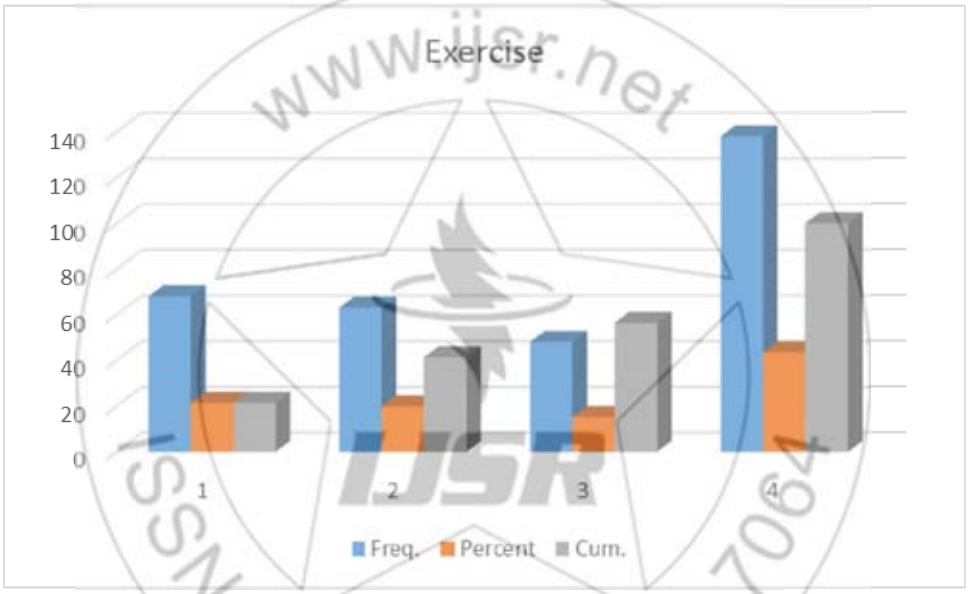
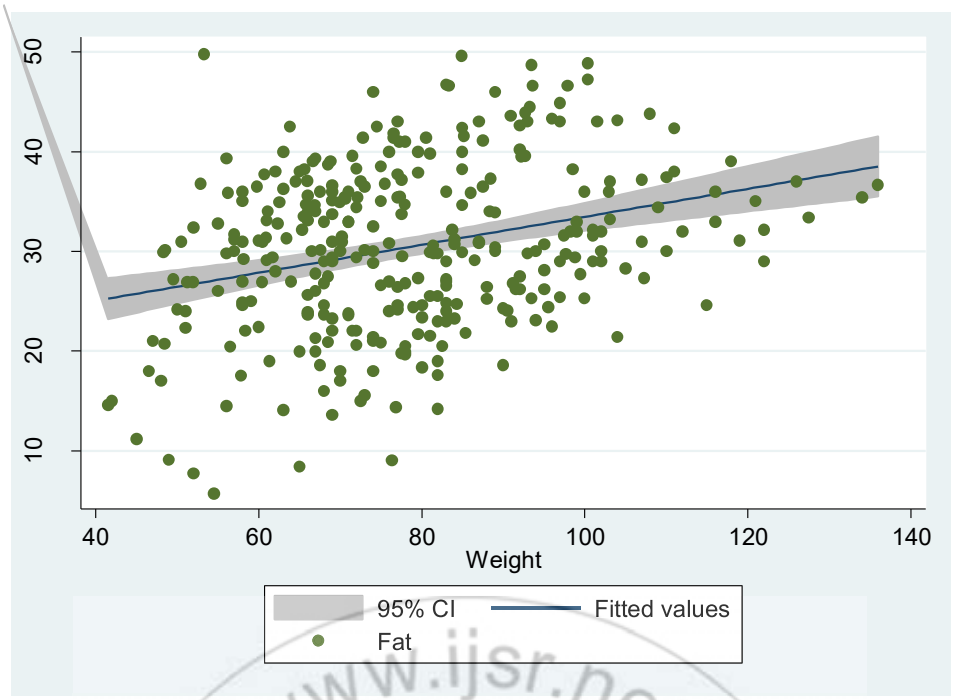
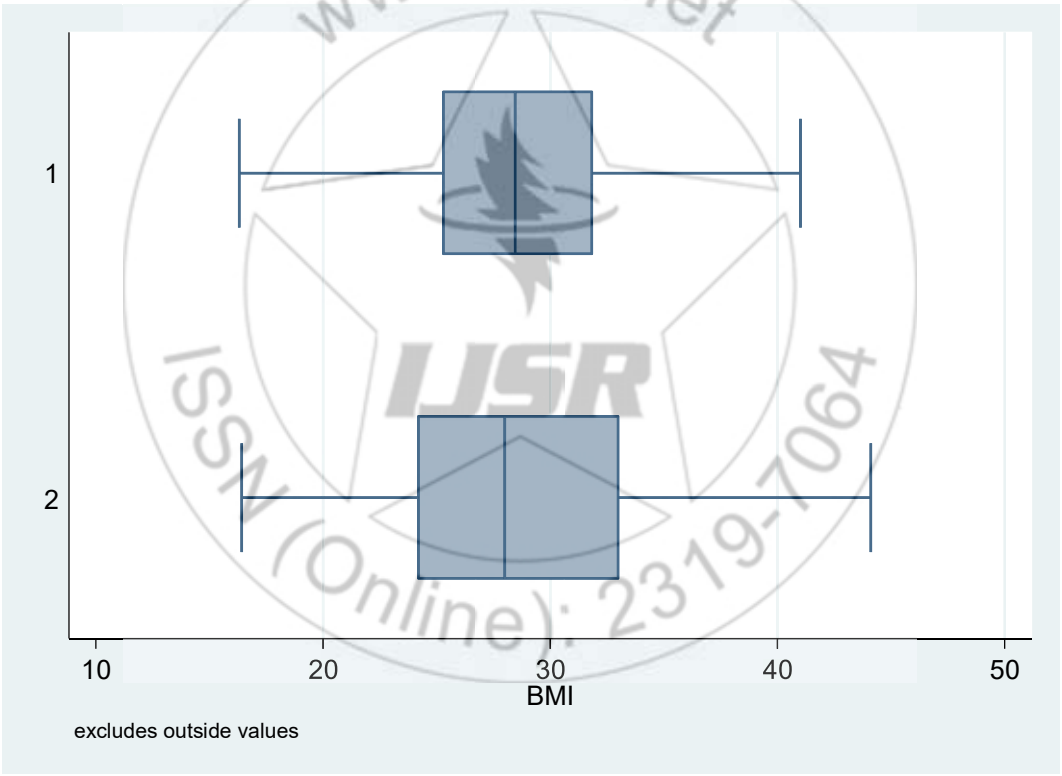
Appendix









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