Original Article

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A Prevalence Study Based on Relationship of Obesity Indices with Different Anthropometric Parametrs in Two Communities

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Abstract

Overweight refers to an excess body weight compared to set standards. Obesity specially refers to having an abnormally high proportion of total body fat. Most health providers agree that men with more than 25% total body fat and women with more than 30% total body fat should be considered obese [1]. A more important aspect of obesity is the regional distribution of excess body fat. Our research is a prevalence study to find out the distribution of obese and overweight girls from two different communities distributing them according to different anthropometric parameters. The 1001 girls residing in different hostels from different colleges were selected for the study. Two groups were made and the total girls were categorized into Gujarati and Non Gujarati groups respectively. They were further classified according to categories like waist circumference, hip circumference, waist hip ratio, obesity indices, body fat percent, total body fat, lean body mass, skinfold thickness, family history and blood pressure. Fourteen percent were overweight and eleven percent girls were obese according to waist circumference. Seventy one percent had hip circumference of more than 36 inches; waist hip ratio of more than 0.85 was observed in 47% girls; Twenty four percent had high waist circumference, waist hip ratio and BMI>25 kg/m^2; Eighty percent had body fat percent < 33%, 27% had total body fat > 20 kg; Fifty six percent had lean body mass > 42 kg and sixty nine percent had skinfold thickness > 50 mm. Seventy eight percent girls were without any family history of disease and 53%/46% had high normal systolic and diastolic blood pressure.

Keywords: Prevalence; Obesity; Anthropometry; Indices of Obesity.

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Introduction

In the assessment of obesity, the central distribution of body fat cannot be overlooked; hence there has been use of other anthropometric indices such as waist circumference, as measure of adiposity. Waist circumference has been recommended as a simple and practical measure for identifying overweight and obese patients. The waist-to-hip ratio (WHR) is one of the most commonly used anthropometric measures to indicate a central obesity pattern and increased risk of cardiovascular disease in normal weight women. Although the American Heart Association reported a waist hip ratio > 0.8 to be used to indicate increased risk of cardiovascular disease in female Not a single case was found in the first category of obesity indices which had high waist circumference, waist hip ratio and body mass index<25 kg/m^2. Total girls belonging to the second category of obesity indices as high waist circumference, waist hip ratio and body mass index>25 kg/m^2 were 24%. Total girls of third category of obesity indices as normal waist circumference, waist hip ratio and body mass index <25 kg/m^2 were 45% and total girls in the fourth category which were without and correlation with the obesity indices were 31%. Twenty five percent girls were in category two, 45% belonged to category three and 30% Gujaratis were from category four.

Twenty three percent were from category 2, 44% were from category 3 and 33% percent were from category 4.

Material and Method

Selection of Girls for the Study

This study has been conducted on 1001 girls who were residing in different institutional hostels. Actually these girls had come from different districts of Gujarat, Rajasthan mainly and also from other States for study purpose, so they were selected for this study. The subjects with any clinical or biochemical evidences were excluded from the study. Normal subjects of identical age group with that of respective obese group acted as control.

Measurement of Different Anthropometric Parameters

Blood Pressure

Waist Circumference

Hip Circumference

Waist Hip Ratio

WHR was determined by dividing WC by HC.

WHR= WC/HC Women with a WHR less than 0.80 was categorized as normal while between 0.80 – 0.84 were classified as overweight and women with a WHR >0.85 were classified as obese (Park 2005) [5].

Skin Fold Thickness

For measurement of Skin fold Thickness all measurements were taken, with the subject seated on a stool, on the right side of the body. The sites selected were as follows:

Biceps: Over the mid point of the muscle belly with the arm resting supinated on the subject's thigh.

Triceps: Over the mid point of the muscle belly, midway between the olecranon and the tip of the acromion, with the upper arm hanging vertically. (Edwards, Hammond, Healy, Tanner and Whitehouse, 1955).

Sub Scapular: Just below the tip of the inferior angle of the scapula, at an angle of about 45° to the vertical.

Suprailiac: Just above the iliac crest in the mid axillary line. The average of the four sites was taken as skin fold thickness in centimeter.

The instrument used was the Harpenden skin fold caliper. (British Indicators Ltd. St. Albans, Herts.); which exerts a constant pressure at varying openings of the jaws.

Total Body Fat Percent

Total body fat percent was calculated using the following formula as reported by YMCA formula (Young men Christian association). It uses only body weight and waist (at naval) measurements to calculate body fat percentage [35, 56].

$$\text{Body Fat \%} = \frac{-76.76+4.15 \times \text{Waist} - 0.082 \times \text{Weight} \times 100}{\text{Weight}}$$

Body Fat

Body Fat was calculated by multiplying body weight (kg) with body fat percentage [6].

Lean Body Mass (LBM)

Lean Body Mass (LBM) was obtained by subtracting the body fat (kg) from total body weight [9].

Results

Prevalence of Total, Gujarati and Non-Gujarati girls according to waist circumference and hip circumference

Fourteen percent were overweight and eleven percent girls were obese according to waist circumference. Twenty nine percent girls were overweight and obese according to hip circumference. The average weight and BMI of normal, overweight and obese girls according to waist circumference were 58±6.05kg, 65±4.18kg, 72±3.58kg; 23±2.71kg/m^2, 27±1.18kg/m^2, 29±2.04kg/m^2 respectively. The average weight and BMI of normal and obese girls according to hip circumference were 58.85±6.54kg, 62.21±7.02kg; 23.71±2.97kg/m^2, 25.43±3.61kg/m^2 respectively.

Prevalence of Total, Gujarati and Non-Gujarati girls according to waist hip ratio

Eight percent girls were overweight and forty percent were obese according to waist hip ratio. The average weight, body mass index, waist circumference, body fat percent, total body fat, lean body mass, skinfold thickness and systolic and diastolic blood pressure increased with increase in waist hip ratio from normal, overweight and obese

categories. They were 55±4.94kg < 59±3.93kg < 65±4.56kg; 21±1.93kg/m^2 < 24±1.69kg/m^2 < 27±2.04kg/m^2; 27±1.01cm < 30±1.14cm < 32±2.69cm; 20±3.90% < 27±3.90% < 32±6.79%; 14±2.55kg < 17±2.32kg < 21±2.92kg; 41±2.81kg < 42±2.16kg < 44±2.28kg; 51±6.65mm < 54±6.16mm < 61±6.89; 120±2.81mmHg < 122±3.45mmHg < 126±3.82mmHg; 79±2.93mmHg < 81±2.36mmHg < 83±2.16mmHg respectively.

Prevalence of Total, Gujarati and Non-Gujarati girls according to relation between obesity indices

In our study twenty four percent girls had BMI >25kg/m^2, high waist circumference, waist hip ratio while forty five percent had normal waist circumference, waist hip ratio and BMI <25kg/m^2. The average weight of high obesity indices category versus normal indices category were 66.78±4.04kg v/s 54.61±4.95kg. The average BMI of these two categories respectively was 27.98±1.46kg/m^2 v/s 21.44±1.92kg/m^2. The waist and hip circumferences of these categories were 34.41±1.92cm v/s 26.55±1.01cm and 37.22±1.92inches v/s 35.87±1.36 inches respectively. Waist hip ratio reduced from 0.92±0.03 to 0.74±0.03 from high to normal category and body fat percent, total body fat, lean body mass and skin fold thickness fell from 36.67±4.76%, 23.04±2.61kg, 43.74±1.94kg and 63.66±6.51mm in higher category of obesity indices to 19.71±3.92%, 13.61±2.55kg, 41±2.82kg and 50.87±6.69mm category of obesity indices respectively.

Prevalence of Total, Gujarati and Non-Gujarati girls according to body fat percent, total body fat, lean body mass and skinfold thickness

To look into this aspect of obesity we classified girls according to body fat percentage and total body fat. Twenty percent girls were overweight according to body fat percent; twenty seven percent had obesity according to total body fat. In our study fifty six percent girls were obese according to lean body mass and sixty nine percent were obese according to skinfold thickness. The average weight and BMI in category of body fat percent of more than 33%, total body fat of more than 20kg, lean body mass of more than 42kg and skinfold thickness of more than 50mm were 65±5.28kg;28±2.06kg/m^2,68±2.77kg; 28±1.33kg/m^2, 64.20±4.77kg; 25.53±2.96kg/m^2, 62.31±5.99kg; 25.35±2.95kg/m^2 which were quite high as compared to these in the lower categories (58±6.47kg; 23±2.89kg/m^2, 57±5.3kg; 23±2.57kg/m^2, 54.29±4.75kg; 22.54±2.84kg/m^2, 54.26±5.18kg; 21.66±2.37kg/m^2).

Prevalence of Total, Gujarati and Non-Gujarati girls according to Family History

Ten percent girls had family history of hypertension, seven percent had family history of coronary artery disease, and five percent had family history of diabetes mellitus while seventy eight percent had no family history of disease according to our study. In our study the average weight, body mass index, waist circumference, body fat percent, total body fat, lean body mass and skinfold thickness for the category of girls with family history were high as compared to these in category of girls who were without any family history of disease (65±5.28kg v/s 58±6.56kg, 27±2.36 kg/m^{2}v/s 23±3.05kg/m^2, 32±3.45cm v/s 29±2.99cm, 31±8.43% v/s 24±7.16%, 22±3.67kg v/s 16±4.25kg, 43±2.34kg v/s 42±2.86kg, 63±7.07mm v/s 54±7.63mm).

Prevalence of Total, Gujarati and Non-Gujarati girls according to blood pressure

In our study 53% girls who were overweight had high normal SBP and 46% of the same group had high normal DBP. The average weight, body mass index, waist circumference, body fat percent, total body fat, lean body mass and skinfold thickness for the category of girls with normal blood pressure were less as compared to these in high normal category (56±5.77kg/ 56±6.06kg v/s 64±5.38kg/ 64±5.32kg, 22±2.40kg/m^2/ 22±2.63kg/m^2 v/s 26±2.61kg/m^2/ 26±2.62k/m^2, 27±1.91cm/ 28±2.28cm v/s 31±3.37cm/ 32±3.39cm, 22±5.27%/ 23±5.92% v/s 29±8.20%/ 30±8.23%, 14±3.29kg/ 15±3.65kg v/s 20±3.75kg/ 21±3.73kg, 41±2.94kg/ 41±2.93kg v/s 43±2.32kg/ 43±2.28kg, 51±6.30mm/ 52±6.89mm v/s 61±7.06mm/ 61±7.12mm).

Table 1: Prevalance of Central obesity in Girls based on Waist Circumferance

Category Waist Circumferance	Gujrati Girls (N)	(%)	Non -Gujrati Girls (N)	(%)	Total Girls (N)
Normal <80cm	394	75%	360	76%	754
Overweight 80-87.9	75	14%	62	13%	136
Obese >88.0cm	57	11%	53	11%	111
Total Girls	526	100%	475	100%	1001

Table 2: Distribution of Girls according to the Hip Circumferance

Hip Circumferance (inches)	Gujrati Girls (N)	%	Non -Gujrati Girls (N)	%	Total Girls (N)
< 36	377	72%	337	71%	714
>36	149	28%	138	29%	287
Total Girls	526	100%	475	100%	1001

Table 3: Prevalance of Central obesity in Girls based on WHR

Waist Hip Ratio	Gujrati Girls (N)	(%)	Non -Gujrati Girls (N)	(%)	Total Girls (N)
Normal <0.80	242	46%	212	45%	454
Overweight 0.80-0.84	44	8%	35	7%	79
Obese >0.85	240	46%	228	48%	468
Total Girls	526	100%	475	100%	1001

Table 4: Distribution of Girls according to the correlation with or without the three obesity indices

Obesity indices	Gujrati Girls (N)	%	Non -Gujrati Girls (N)	%	Total Girls (N)
High WC WHR and BMI <25	0	0%	0	0%	0
High WC WHR and BMI >25	131	25%	109	23%	240
Normal WC WHR and BMI <25	239	45%	208	44%	447
Without Correlation to obesity indices	156	30%	158	33%	314
Total Girls	526	100%	475	100%	1001

Table 5: Distribution of girls according to Body Fat Percentage, Body fat, Lean Body Mass and Skin Fold Thickness

Category	Gujarati Girls		Non Gujarati Girls		Total Girls
Total body fat %	**(N)**	**(%)**	**(N)**	**(%)**	**N**
Less than 33%	421	80%	379	80%	800
More than 33%	105	20%	96	20%	201
Total Girls	526	100%	475	100%	1001
Body fat	(n)	(%)	(n)	(%)	n
Less than 21	394	75%	337	71%	731
More than 21	132	25%	138	29%	270
Total Girls	526	100%	475	100%	1001
LBM	(n)	(%)	(n)	(%)	n
Less than 42	233	44%	210	44%	443
More than 42	293	56%	265	56%	558
Total Girls	526	100%	475	100%	1001
SFT	(n)	(%)	(n)	(%)	n
Less than 51	178	34%	132	28%	310
More than 51	348	66%	343	72%	691
Total Girls	526	100%	475	100%	1001

Table 6: Distribution of Girls according to With Family History and Without Family History of disease

Disease	Gujrati Girls (N)	(%)	Non -Gujrati Girls (N)	(%)	Total Girls (%)
With Family History					
Hypertension	29	6%	71	15%	10%
Coronary Artery Disease	22	4%	46	10%	7%
Diabetes Mallitus	28	5%	23	5%	5%
Without Family History	447	85%	335	70%	78%
Total Girls	526	100%	475	100%	100%

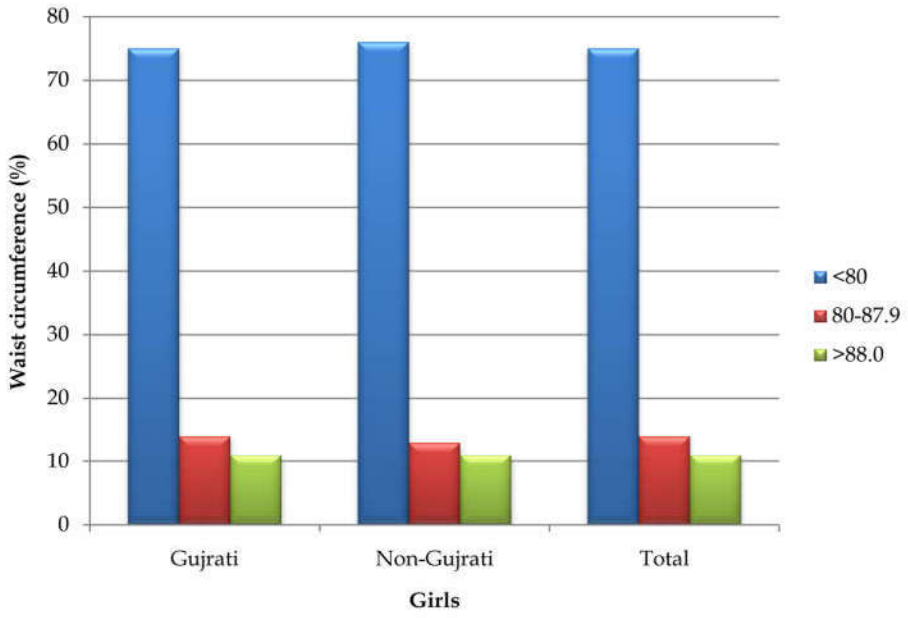
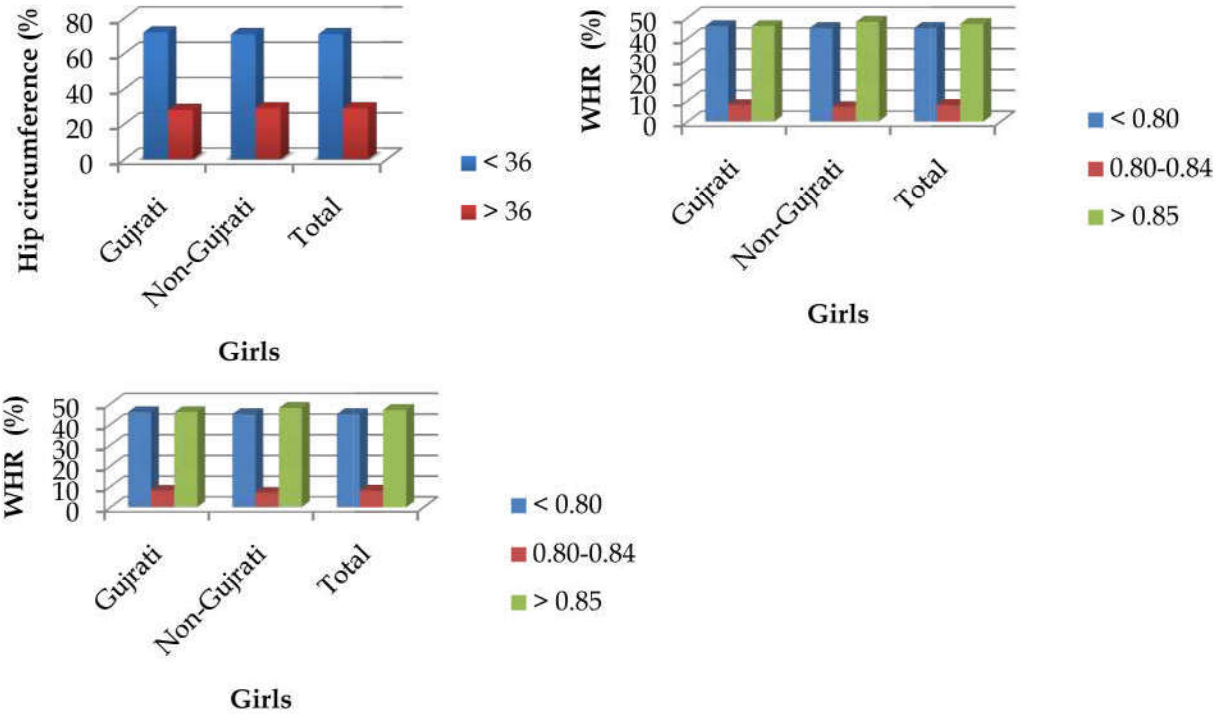
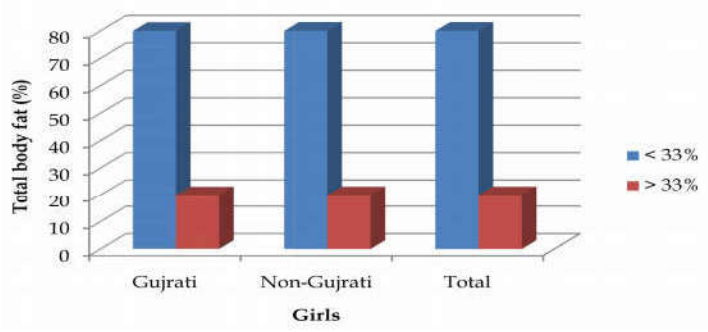
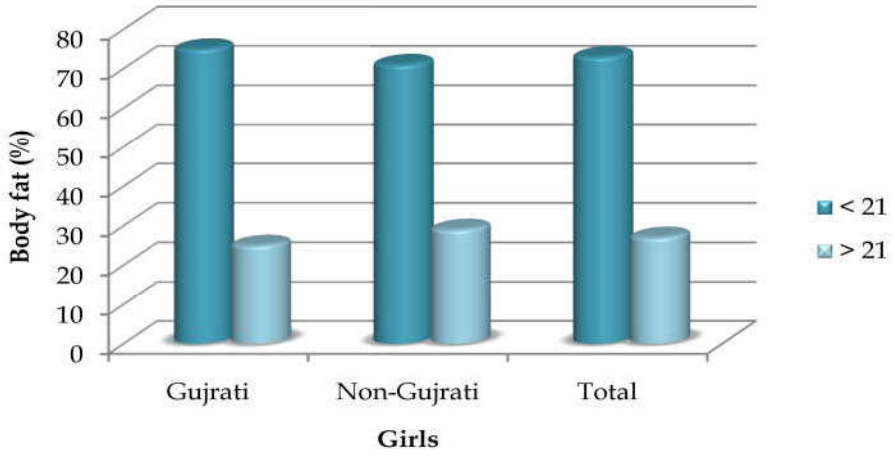


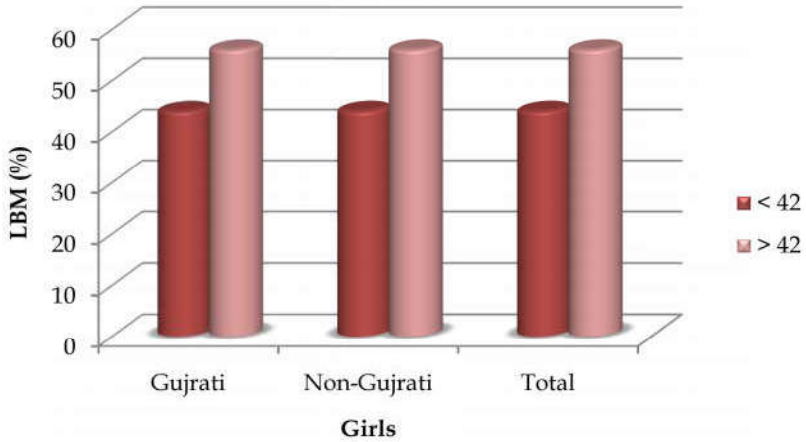
Fig. 1: Distribution of girls according to waist circumference

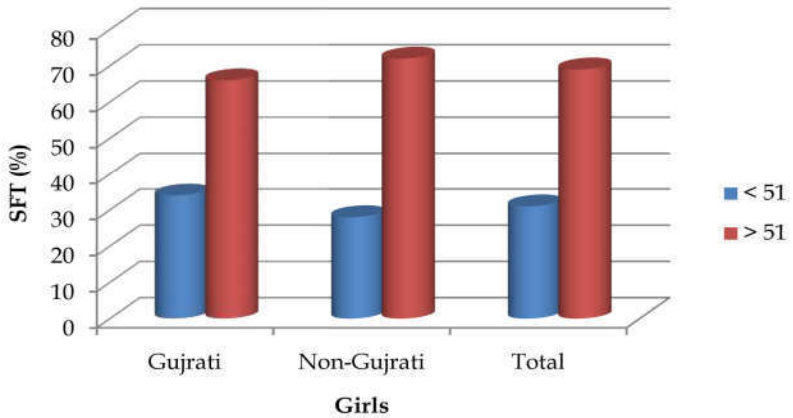


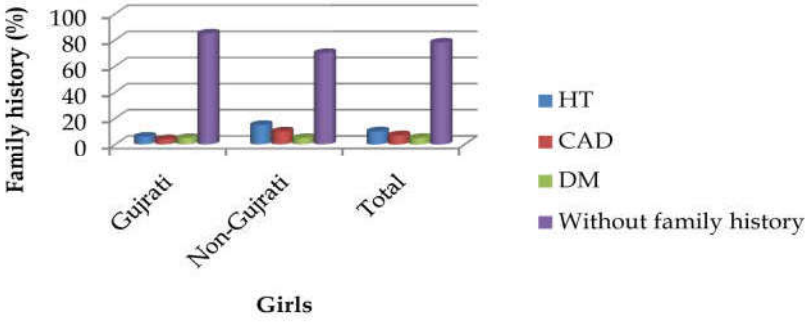




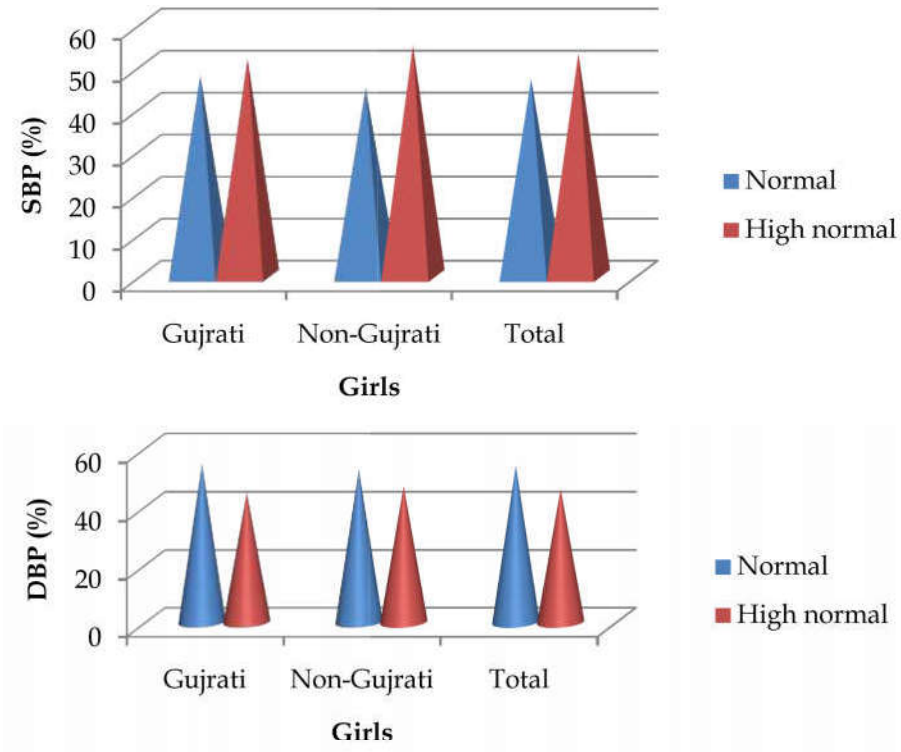
Distribution of girls according to hip circumference, WHR, obesity indices and total body fat







Distribution of girls according to body fat, lbm and sft



Distribution of girls according to blood pressure

Discussion

Prevalence of Total, Gujarati and Non-Gujarati girls according to waist circumference and hip circumference

Waist circumference is an important measure of obesity risk. It is practical indication of visceral abdominal fat. Evidence suggest that abdominal fat carry a higher health risk than peripheral fat and that visceral fat component correlates most strongly with increased risk.

Waist circumference is superior indicator of abdominal fat distribution [3]. Recently, the Health Ministry has declared that cut off's for waist circumference will now be 90cm for Indian men as opposed to 102cm globally, and 80cm for Indian women as opposed to 88cm at the international level [Singh AP 2009] [5].

WC for males with >94cm and females with WC >80cm should gain no further weight and males with WC >102cm and females with WC >88cm should reduce their weight. Hip circumference may have additional value in the elderly females in whom decreased muscle mass contribute to underestimation of obesity related risk by body mass index alone and in some ethnic groups genetically predisposed to unfavorable distribution of fat despite normal body weight [7].

Prevalence of Total, Gujarati and Non-Gujarati girls according to waist hip ratio

Although waist hip ratio and body mass index are interrelated, waist hip ratio provides an independent prediction of risk over and above that of body mass index. It is shown to be closely correlated with more direct measure of visceral fat in females [6].

Prevalence of Total, Gujarati and Non-Gujarati girls according to relation between obesity indices

We also classified the girls according to three obesity indices as high waist circumference, waist hip ratio and BMI<25 kg/m^2; high waist circumference, waist hip ratio and BMI >25 kg/m^2; normal waist circumference, waist hip ratio and BMI <25kg/m^2 and without any correlation with obesity indices. The National Heart, Lung and Blood Institute of Health developed a classification system in 1998 that used these obesity indices as screening tools for developing risk factors of overweight and obese adults [3].

Prevalence of Total, Gujarati and Non-Gujarati girls according to body fat percent, total body fat, lean body mass and skinfold thickness

According to Roberts SB and Heyman MB (2000) [6], body fat percentage is percentage of weight

contributed by fat. The recommended body fat percent depends on factors like gender, culture and lifestyle. American council of Exercise gives ranges of body fat percent for different category as: essential fat in females is 10-12%, acceptable range is 25-31%, and overweight category has 32-41%, while obese body fat percent is more than 42% [9].

Prevalence of Total, Gujarati and Non-Gujarati girls according to Family History

Fortunately, there is a simple way for public health genomics to start reducing the effect of obesity in population. It is through use of family history. It reflects genetic susceptibility and environmental exposures shared by close relatives (Ram B et al) (1999) [4].

Prevalence of Total, Gujarati and Non-Gujarati girls according to blood pressure

Last but not the least there is relation between obesity and hypertension. In fact obese people have high blood pressure than people with normal blood pressure. According to Raheena et al (2001) [2], the cardiovascular risk is increased with obesity. Many studies have shown that obesity leads to an increase in cardiac output, blood volume and arterial resistance. In fact obesity induces an increase in secretion of insulin to decrease high sugar concentration in blood. The insulin level is high compared to non obese subjects [7]. Bektas (2005)[3] reported that combining skin fold thickness (SFT) with waist hip ratio (WHR) measurements provides a more precise percentage of body fat in comparison to skinfold thickness or waist hip ratio alone and found relationship of body fat, total cholesterol with skinfold thickness at four sites (fore arm, triceps, suprailiac and sub scapular). They concluded that inclusion of height, skinfold thickness and lean body mass in determination of metabolic syndrome will produce a clear association between waist circumference and cardiovascular risk factors. Lean body mass for underweight is found to be 20.6kg and that for obese was 34.7kg ($P< 0.05$) [5]. For this reason we classified our girls according to family history of disease and also without any family history of disease. Thus our study, in general, correlates with most of the available reports.

Summary

Epidemiological Study

The 1001 girls residing in different hostels from different colleges were selected for the study. Two groups were made and the total girls were categorized into Gujarati and Non Gujarati groups respectively. They were further classified according to categories like waist circumference, hip circumference, waist hip ratio, obesity indices, body fat percent, total body fat, lean body mass, skinfold thickness, family history and blood pressure.

1. The total girls who belonged to normal category of waist circumference (<80cm) were 75% and those with waist circumference of (80-87.9 cm) were 14%, and 11% were part of obese category of waist circumference (>88cm). Seventy five percent Gujarati girls had waist circumference <80cm and were normal, 14% had waist circumference between 80-87.9 cm and were overweight, 11% had waist circumference <88cm and were obese. Seventy six percent Non Gujaratis had waist circumference <80cm and were normal, 13% had waist circumference between 80-87.9cm and were overweight and 11% percent had waist circumference > 88cm and were obese.
2. The total girls with hip circumference of <36 inches were 71% and with hip circumference of >36 inches were 29%. Seventy two percent Gujaratis had hip circumference <36 inches and 28% had hip circumference >36 inches. Seventy one percent Non Gujaratis had hip circumference <36 inches while 29% had hip circumference >36 inches.
3. The total girls who had waist hip ratio <0.8 were 45% (normal according to waist hip ratio), all those who had waist hip ratio between 0.8-0.84 were 8% (overweight according to waist hip ratio), girls of waist hip ratio >0.85 were 47% (obese according to waist hip ratio). Forty six percent Gujaratis were normal, 8% were overweight and 46% were obese according to waist hip ratio. Forty five percent Non Gujaratis were normal, 7% were overweight and 48% percent were obese according to waist hip ratio.
4. Not a single case was found in the first category of obesity indices which had high waist circumference, waist hip ratio and body mass index <25 kg/m^2. Total girls belonging to the second category of obesity indices as high waist circumference, waist hip ratio and body mass index>25 kg/m^2 were 24%. Total girls of third category of obesity indices as normal waist circumference, waist hip ratio and body mass index<25 kg/m^2 were 45% and total girls in the fourth category which were without and correlation with the obesity indices were 31%. Twenty five percent girls were in category two,

45% belonged to category three and 30% Gujaratis were from category four. Twenty three percent were from category 2, 44% were from category 3 and 33% percent were from category 4.

5. The total girls of body fat percent of less than 33% were 80%, and girls with more body fat percent than that were 20%. The same ratio of Gujaratis and Non Gujaratis was present in the respective categories.
6. The total girls with total body fat<20 kg were 73% and that belonging to total body fat>20 kg were 27%. Seventy five percent Gujaratis had total body fat<20 kg and 25% had it as >20. Seventy one percent Non Gujaratis had total body fat<20 kg while those having total body fat>20 kg were 29%.
7. The total girls with lean body mass <42 kg were 44% and those with lean body mass >42 kg were 56%. The same ratio of Gujaratis and Non Gujaratis had lean body mass <42 kg and >42 kg respectively.
8. The total girls with skinfold thickness <50 mm were 31% and total girls with skinfold thickness >50 mm were 69%. Thirty four percent Gujaratis had skinfold thickness <50 mm and 66% had skinfold thickness >50 mm. Twenty eight percent Non Gujaratis had skinfold thickness <50 mm and 72% had skinfold thickness >50mm.
9. The total girls who had family history of hypertension were 10%, those who had family history of coronary artery disease were 7%, those with family history of diabetes mellitus were 5% and maximum 78% of total girls were without any family history of disease. Six percent Gujaratis had family history of hypertension, 4% had that of coronary artery disease, 5% had family history of diabetes mellitus and 85% had no family history of disease. Fifteen percent Non Gujaratis had family history of hypertension, 10% had family history of coronary artery disease, 5% had family history of diabetes mellitus and 70% Non Gujaratis were without any family history of disease.
10. The total girls with normal systolic and diastolic blood pressure (<120/80mmHg) were 47%/54% and girls with high normal systolic and diastolic blood pressure (121-139/81-90mmHg) were 53%/46%. Forty eight percent/fifty five percent Gujaratis had normal blood pressure and 52%/45% had high normal blood pressure. Forty five percent/fifty three percent Non Gujaratis had normal blood pressure while 55%/47% had high normal blood pressure.

Conclusion

Fourteen percent were overweight and eleven percent girls were obese according to waist circumference. Seventy one percent had hip circumference of more than 36 inches; waist hip ratio of more than 0.85 was observed in 47% girls; Twenty four percent had high waist circumference, waist hip ratio and BMI>25 kg/m^2; Eighty percent had body fat percent < 33%, 27% had total body fat > 20 kg; Fifty six percent had lean body mass > 42 kg and sixty nine percent had skinfold thickness > 50 mm. Seventy eight percent girls were without any family history of disease and 53%/46% had high normal systolic and diastolic blood pressure. Success should be judged by the reduction in the severity of obesity rather than a return to an ideal body weight. Modest weight loss of 5-10% body weight has been shown to improve blood pressure, dyslipidemia and hyperglycemia. Long term changes in life style both in diet and in physical activity are required for weight maintenance.

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