

# POPULATION-BASED EPIDEMIOLOGICAL STUDY OF THE PREVALENCE OF OVERWEIGHT AND OBESITY IN SAUDI ARABIA, REGIONAL VARIATION

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This is a study of the pattern of distribution of body mass index and prevalence of overweight and obesity among the population of different regions of Saudi Arabia. It is a cross-sectional population-based national epidemiological randomized household survey. There were 13,177 Saudi subjects, over the age of 15 years. The sample was representative and in accordance with the national population distribution with respect to age, gender, regional and residency population distribution. Height and weight were measured for all study population. Body mass index (BMI) was calculated. WHO criteria was used for definition of overweight and obesity. The obesity/overweight (ob/ow) ratio was used to study the relation between prevalence of overweight and obesity. Mean BMI values for female subjects were significantly higher than for male subjects across all regions. Mean BMI values were highest at the fifth decade for male and female subjects in all regions. Mean and 90th percentile of BMI values of male and female subjects of the Eastern region across all age groups were higher than for other regions. There was a progressive increase in prevalence of overweight with age among male subjects; the highest prevalence was achieved in the age group 51-60 years across all the regions. The overall prevalence of overweight was higher among male subjects across all the regions. There was a progressive increase in the prevalence of obesity with age among male and female subjects. The highest was achieved in the age group of 41-50 years across all the regions. There was a regional variation with respect to the prevalence of overweight and obesity among Saudi subjects. The prevalence of overweight was higher among male subjects across all the regions, while the prevalence of obesity was higher among female subjects across all the regions. A high prevalence of obesity was observed in most of the regions. Underlying factors such as lifestyle, nutritional habits, social and cultural beliefs and habits in different regions need to be studied. There is a need to establish a national control program for combating obesity and related complications. *Ann Saudi Med* 1997;17(2):195-199.

Obesity is a major risk factor for several chronic diseases. Studies have shown that obese subjects suffer increased mortality from diabetes mellitus, coronary heart disease and cancer. Obesity is an associated or recognized risk factor for other diseases, such as diabetes mellitus, hypertension, coronary heart disease, gallbladder disease, osteoarthritis, endo-metrial and breast cancer.<sup>1,2</sup>

The prevalence of overweight (mild degree of fatness), and obesity (severe degree of fatness), is increasing worldwide.<sup>3</sup> It used to be more common in the developed countries,<sup>4-6</sup> however, there has been a major surge in the prevalence of obesity in some of the developing countries, among them, Saudi Arabia.<sup>7-9</sup> Such countries have gone through a major economical development over the last 30 years, which has resulted in a significant change in

lifestyle with respect to nutritional habits and exercise. Such changes in lifestyle, coupled with social and cultural beliefs in genetically predisposed subjects, have led to the emergence of obesity as a major health hazard.

We have previously conducted a population-based epidemiological study of chronic metabolic diseases among Saudi subjects over the age of 15 years and have reported on the prevalence of overweight and obesity in Saudi Arabia—29% and 15% for male subjects, respectively, and 27% and 24% for female subjects, respectively.<sup>10</sup> Such figures are among the highest reported in the literature.

Saudi Arabia is divided into five major administrative regions. We are reporting on the regional variation with respect to the pattern of body mass index distribution and prevalence of overweight and obesity and the relation between the prevalence of overweight and obesity among Saudi subjects over the age of 15 years.

## Material and Method

A National Epidemiological Household Survey was conducted for studying the prevalence of overweight and

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obesity among Saudi subjects over the age of 15 years in different regions of Saudi Arabia. A multistage stratified cluster sampling technique was used for selection of the study population. The assigned population sample of the study was distributed between the different regions in accordance with the regional population distribution as per the national population census (NPC). There was an initial adjustment for area type, urban versus rural population distribution in each region as per the NPC. Cities and villages of each region were listed and then random selection of a certain number of cities and villages was done in accordance with the allocated share of each region in the national sample. The administrative maps of the selected cities and villages were reviewed and there was a random selection of a number of districts in these cities and villages.

Primary care physicians who work in these districts were assembled and given orientation lectures and workshops in different aspects of the study, such as filling out the form during the house visit and the proper measurements of height and weight, which is done at the Primary Care Clinic (PCC), usually two to three days after the initial house visit. These physicians selected every third street and then every third house in their district and invited all the Saudi subjects over the age of 15 years in these houses to participate in this study. All these subjects were requested to attend the PCC for weight and height measurements. They were instructed to wear standardized traditional light clothes. The attendance rate for the suggested appointment in different regions ranged from 65% to 73%, with an overall attendance rate of 69%. Subjects were weighed on a lever balance, simple beam clinical scales, type Detecto. The scales were calibrated with every tenth subject, using a known weight to ensure accuracy. Height was measured on a portable measuring board and the meter rule was screwed perpendicular to the foot of the board. The measurements of all subjects in each district were done by one physician, responsible for that particular district; this kept the interobserver error to a minimum. Upon completing the target number, 100 or 50 subjects per physician working in city or village, respectively, the records were sent to the central office in Riyadh for data entry. A computer program was designed, using Database-IV for data entry. After completion of data entry, there was a final adjustment for gender, age, region, urban versus rural population distribution in accordance with the NPC through random selection, using the Statpack Gold Software Package, of number of records from different regions and age groups. The final adjusted sample was 13,177 subjects, 6852 (52%) male and 6325 (48%) female subjects (Table 1).

Quetelet body mass index (BMI) was calculated for each subject, using the equation (weight [kg]/height [m]<sup>2</sup>). The Quetelet index is generally correlated with skin fold

TABLE 1. *Body mass index for men in different regions of Saudi Arabia.*

Region	Age group (years)	Number	Mean	SD	Percentile		
					10th	50th	90th
West	15-20	476	21.3	5.0	16.2	20.2	27.2
	21-30	595	24.2	5.1	18.4	23.5	30.5
	31-40	457	25.7	4.7	19.7	25.5	31.9
	41-50	199	26.5	5.3	20.6	25.8	32.5
	51-60	142	26.2	4.7	19.9	26.0	31.9
	>60	139	25.7	5.0	20.1	25.1	32.0
	All	2008	24.3	5.3	-	-	-
Central	15-20	423	22.2	5.2	17.3	21.3	27.7
	21-30	480	24.7	4.5	19.2	24.2	30.1
	31-40	294	26.4	4.8	20.2	26.2	32.4
	41-50	184	27.3	4.7	21.5	27.1	33.2
	51-60	140	27.4	4.7	22.1	27.1	32.4
	>60	152	26.4	4.7	21.1	25.7	32.7
	All	1673	25.0	5.2	-	-	-
South	15-20	494	21.1	4.5	16.1	20.1	26.8
	21-30	457	23.8	4.8	18.4	23.1	29.9
	31-40	378	25.5	4.6	19.8	25.5	31.3
	41-50	158	26.5	4.9	20.6	26.0	32.9
	51-60	128	26.1	4.8	21.2	25.6	31.5
	>60	79	25.1	4.7	18.4	25.0	31.1
	All	1694	23.9	5.1	-	-	-
East	15-20	193	23.1	5.4	17.5	21.9	30.5
	21-30	291	25.7	5.4	19.2	24.9	33.3
	31-40	234	27.5	4.8	21.0	27.3	33.7
	41-50	118	28.2	5.1	22.3	27.9	34.6
	51-60	93	28.4	3.7	23.5	28.0	33.5
	>60	59	26.3	3.9	22.1	25.9	31.6
	All	988	26.2	5.3	-	-	-
North	15-20	102	21.6	4.7	16.2	20.4	29.0
	21-30	162	24.1	4.6	18.8	23.7	30.8
	31-40	123	25.7	4.6	19.6	25.6	31.7
	41-50	55	26.2	5.6	19.2	25.8	32.0
	51-60	40	27.7	3.7	23.4	27.3	32.0
	>60	28	25.6	4.3	19.4	24.9	32.2
	All	510	24.6	5.0	-	-	-

thickness measurements of body fat.<sup>11</sup> WHO specialized consultants met in 1984 to discuss definition and means of measuring obesity through a description of anthropometric data,<sup>12</sup> and recommended using BMI 25-30 for defining overweight and BMI>30 for defining obesity, which is an indication of high relative risk of disease. This cut-off stems from actuarial and prospective studies, which have shown a U-shaped mortality risk curve according to BMI, where increased association with morbidity and mortality occurs at both extremes of BMI values.

#### **Obesity/Overweight Ratio**

Ratio of obesity/overweight (ob/ow) was used in order to express their interrelation, where <1, 1, and >1 are in keeping with more prevalence of obesity, equal prevalence of overweight and obesity, and more prevalence of overweight, respectively.

TABLE 2. *Body mass index for women in different regions of Saudi Arabia.*

Region	Age group (years)	Number	Mean	SD	Percentile		
					10th	50th	90th
West	15-20	412	22.0	4.9	17.4	21.2	27.1
	21-30	644	24.8	5.6	18.6	23.8	31.9
	31-40	333	26.3	5.8	19.4	25.5	35.2
	41-50	190	27.7	6.2	20.4	25.7	32.5
	51-60	142	28.1	5.4	21.5	28.3	35.3
	>60	63	25.7	5.8	18.9	25.2	32.9
	All	1784	25.0	5.9	—	—	—
	Central	15-20	318	22.9	4.7	18.4	21.8
21-30		718	26.4	6.1	20.0	25.4	33.8
31-40		266	28.6	5.8	22.0	28.0	34.7
41-50		153	30.1	5.9	22.4	29.6	37.7
51-60		100	29.2	5.8	22.1	28.7	37.2
>60		65	27.8	5.4	21.4	27.1	35.8
All		1620	26.7	6.1	—	—	—
South		15-20	211	21.8	4.6	17.3	20.7
	21-30	562	24.6	5.3	18.7	23.7	31.2
	31-40	278	27.0	5.3	20.5	26.3	34.4
	41-50	189	27.1	5.2	20.3	26.7	34.4
	51-60	120	27.6	6.0	20.6	27.2	36.2
	>60	125	26.3	5.0	20.4	25.8	33.8
	All	1485	25.4	5.5	—	—	—
	East	15-20	267	23.9	5.7	18.1	22.6
21-30		350	26.8	5.9	19.7	26.1	34.3
31-40		161	30.2	5.9	22.2	29.8	38.7
41-50		78	31.5	5.8	25.0	31.1	38.6
51-60		54	30.3	6.7	21.8	29.9	39.2
>60		44	28.2	6.5	21.4	27.4	36.1
All		954	27.2	6.5	—	—	—
North		15-20	116	23.5	5.2	18.6	22.8
	21-30	172	26.6	6.2	19.1	25.8	34.6
	31-40	65	29.8	6.2	21.9	29.6	38.4
	41-50	48	31.8	5.1	24.9	31.6	36.9
	51-60	40	29.4	5.0	22.4	29.6	34.8
	>60	20	27.9	6.7	20.1	26.9	37.5
	All	461	27.1	6.3	—	—	—

### Statistical Analysis

Statistical analysis was done using the Statpack Gold statistical analysis package. Data were presented as median, mean (SD), percentiles and percentage. Student's *t*-test was used for comparison of continuous variables. A *P*-value of 0.05 was considered significant.

## Results

### Study Population

The total study population consisted of 13,177 subjects, 6873 (52%) males and 6304 (48%) females. There was no significant difference among means of age, whether among male or female subjects across all the regions, except for the Southern region, where the male and female subjects were significantly younger and older, respectively, when compared with subjects of other regions. This probably

reflects difficulties encountered in ascertaining the accurate age of the study subjects in the Southern region. Males were significantly older than females in the Western, Central and Eastern regions, whereas females were significantly older in the Southern region. Males were older, however, not significantly, in the Northern region.

### Body mass index (BMI) distribution

Mean BMI values for female subjects were significantly higher than for male subjects across all the regions (Tables 1 and 2). The highest means of BMI values were 26.2 and 27.2 among male subjects of the Eastern region ( $P=0.002$ ). There was a progressive increase in mean BMI values with age across all the regions, with the highest BMI value of 28.4 achieved between 51-60 years for male subjects of the Eastern region and a decade earlier for female subjects of the Northern region, with a BMI value of 31.8 ( $P=0.001$ ). Mean BMI values of male and female subjects of the Eastern region across all age groups were higher than for other regions.

The 90th percentile of BMI values for female subjects across all age groups were higher than for male subjects across all the regions. The 90th percentile of BMI values of male and female subjects of Eastern region, across all age groups, were higher than for other regions.

### Prevalence of overweight and obesity

There was a progressive increase in the prevalence of overweight with age among male subjects, the highest prevalence was achieved in the age group 51-60 years across all the regions. There was a variable pattern for prevalence of overweight with respect to age among female subjects in different regions (Tables 3 and 4).

The overall prevalence of overweight was higher among male subjects across all the regions. The highest and lowest prevalence of overweight among male subjects were 31.4% and 26.7% in the Eastern and Southern regions, respectively, and 29.5% and 24.1% among female subjects of Central and Western regions, respectively. There was no significant statistical difference, neither between the highest nor the lowest prevalence of overweight between male and female subjects ( $P=0.3$  and  $P=0.08$ ) respectively.

Among subjects over 40 years of age, the highest and lowest prevalence of overweight among male subjects were 44% and 34% in the Northern and Western regions respectively, and 37.1% and 25.6% among female subjects of the Southern and Eastern regions respectively.

There was a progressive increase in the prevalence of obesity with age among male and female subjects. The highest was achieved in the age group of 51-60 years across all the regions. The overall prevalence of obesity was higher among female subjects across all the regions.

TABLE 3. Prevalence of overweight and obesity for men in different regions of Saudi Arabia.

Region	Age group (years)	Number	Overweight (%)	Obese (%)	Ob/ow ratio
West	15-20	476	13	53	0.41
	21-30	595	27.6	11.6	0.42
	31-40	457	34.1	18.8	0.55
	41-50	199	34.2	23.6	0.69
	51-60	142	38.0	24.6	0.65
	>60	139	29.5	20.9	0.71
	All	2008	27.1	14.5	0.54
	>40	480	34.0	23.1	0.68
Central	15-20	423	11.8	7.6	0.64
	21-30	480	32.3	10.4	0.32
	31-40	294	35.4	23.5	0.66
	41-50	184	39.7	28.3	0.71
	51-60	140	47.9	23.6	0.49
	>60	152	43.4	16.4	0.38
	All	1673	30.8	15.6	0.51
	>40	476	43.3	23.1	0.53
South	15-20	494	11.3	5.5	0.49
	21-30	457	26.0	10.1	0.39
	31-40	378	37.3	15.9	0.43
	41-50	158	33.5	26.6	0.79
	51-60	128	42.2	14.8	0.35
	>60	79	38.0	12.7	0.33
	All	1694	26.7	12.0	0.45
	>40	365	37.5	19.5	0.52
East	15-20	193	13.0	12.4	0.95
	21-30	291	28.9	19.9	0.69
	31-40	234	37.6	30.3	0.81
	41-50	118	39.8	33.1	0.83
	51-60	93	48.4	31.2	0.64
	>60	59	35.6	18.6	0.52
	All	988	31.4	23.5	0.75
	>40	270	41.9	29.3	0.70
North	15-20	102	10.8	7.8	0.72
	21-30	162	25.3	13.6	0.54
	31-40	123	35.0	18.7	0.53
	41-50	55	40.0	20.0	0.50
	51-60	40	60.0	20.0	0.33
	>60	28	32.1	17.9	0.56
	All	510	29.4	15.1	0.51
	>40	123	44.7	19.5	0.44

TABLE 4. Prevalence of overweight and obesity for women in different regions of Saudi Arabia.

Region	Age group (years)	Number	Overweight (%)	Obese (%)	Ob/ow ratio
West	15-20	412	12.4	5.6	0.45
	21-30	644	24.7	16.0	0.65
	31-40	333	29.4	24.6	0.84
	41-50	190	25.8	34.7	1.34
	51-60	142	37.3	33.8	0.91
	>60	63	31.7	20.6	0.65
	All	1784	24.1	18.8	0.78
	>40	395	30.9	32.2	1.04
Central	15-20	318	14.8	10.4	0.70
	21-30	718	32.0	22.4	0.70
	31-40	266	39.8	35.0	0.88
	41-50	153	29.4	47.7	1.62
	51-60	100	28.0	43.0	1.54
	>60	65	33.8	30.8	0.91
	All	1620	29.5	26.1	0.88
	>40	318	29.9	42.8	1.43
South	15-20	211	9.0	8.5	0.94
	21-30	562	23.3	14.6	0.63
	31-40	278	32.7	27.3	0.83
	41-50	189	40.2	25.4	0.63
	51-60	120	30.0	31.7	1.06
	>60	125	39.2	21.6	0.55
	All	1485	27.1	19.5	0.72
	>40	434	37.1	26.0	0.70
East	15-20	267	20.6	11.6	0.56
	21-30	350	33.1	24.9	0.75
	31-40	161	31.7	49.7	1.57
	41-50	78	24.4	64.1	2.63
	51-60	54	27.8	50.0	1.80
	>60	44	25.0	36.4	1.46
	All	954	28.0	30.5	1.09
	>40	176	25.6	52.8	2.06
North	15-20	116	22.4	7.8	0.35
	21-30	172	25.0	30.2	1.21
	31-40	65	29.2	47.7	1.63
	41-50	48	22.9	66.7	2.91
	51-60	40	30.0	47.5	1.58
	>60	20	35.0	25.0	0.71
	All	461	25.6	32.1	1.25
	>40	108	27.8	51.9	1.87

The highest and lowest prevalence of obesity among male subjects was 23.5% and 12% in the Eastern and Southern regions, respectively, and 32.1% and 18.8% among female subjects of the Northern and Western regions, respectively. There was a significant statistical difference, whether between the highest or the lowest prevalence of obesity between male and female subjects ( $P<0.0001$  and  $P=0.0005$ , respectively).

Among subjects over the age of 40 years, the highest and lowest prevalence of obesity were 29.3% and 19.5% among male subjects of the Eastern and Southern regions, respectively, and 52.8% and 26% among female subjects of the Eastern and Southern regions, respectively. The major discrepancy between male and female subjects for this age group was in the Northern region, 20% versus 52% for

male and female subjects, respectively.

The lowest combined prevalence of overweight and obesity was among male and female subjects of the Southern region. The highest combined prevalence of overweight and obesity was among male and female subjects of the Eastern region.

#### Relation between prevalence of overweight and obesity

The high obesity/overweight (ob/ow) ratio value is indicative of a relatively higher prevalence of obesity. The ob/ow ratio values were higher for female subjects, when compared with male subjects of any given age group, across all the regions. The highest values were among female subjects of the Eastern and Northern regions.

Among subjects over 40 years of age, the highest and

lowest ratio were 0.76 and 0.4 among male subjects of the Western and Northern regions, respectively, and 2.0 and 0.7 among female subjects of the Eastern and Southern regions, respectively. Female subjects of all the regions, except for the Southern region, for this age group have ob/ow ratio >1.

### Discussion

This population-based epidemiological study addressed the issue of regional variation with respect to the pattern of BMI distribution and the prevalence of overweight and obesity among Saudi population.

The study population sample was representative of normal population distribution, as it was derived through a national household randomized survey. The administrative divisions of Saudi Arabia were adopted, as they reflect the nature of lifestyle of the populations residing in these regions. The Southern region, for example, specifically, Baha, Assir, Najran and Gizan, shared more or less the same lifestyle, especially with respect to nutritional habits. All measures were taken to ensure accuracy of weight measurement, whether through instructing the subjects on wearing standardized light clothes or through using clinical scales with periodic calibration.

Female subjects had higher means of BMI than male subjects across most age groups throughout all the regions. BMI distribution, whether the means or the 90th percentiles, gave an indication that the population of the Eastern and Northern regions have a higher prevalence of overweight and obesity.

The highest prevalence of overweight among male subjects across all regions was in the sixth decade, while the highest prevalence of obesity among male and female subjects across all the regions was in the fifth decade. Male subjects of the Eastern region and female subjects of the Northern and the Eastern regions had the highest prevalence of obesity, whether for all populations or for subjects aged over 40 years.

Factors affecting the regional variation with respect to the prevalence of obesity and the relationship between the prevalence of overweight and obesity are open for speculation. Social, cultural, economical and nutritional factors are important contributing elements. The Eastern region, an oil-producing province, has the longest history of adopting the Western lifestyle, with respect to nutritional habits and exercise, while the Northern region, with its strong tribal attitude, may consider obesity,

especially among female subjects, a sign of affluence and beauty. These may be important contributing factors to the surge of obesity in these two groups.<sup>13</sup>

The means, 90th percentiles of BMI and the prevalence of obesity among female subjects of the Northern and Eastern regions are higher than corresponding figures among female subjects of the European continents for most of the age groups.<sup>14</sup>

The prevalence of obesity in Saudi Arabia among female subjects and to a lesser extent, among male subjects over the age of 40 years, has reached an epidemic proportion, especially in the Eastern and Northern regions. The magnitude of the problem is expected to increase in the near future, with a larger segment of the population advancing in age.

There is a need to establish a national control program for prevention and treatment of obesity and related complications. All age groups and segments of the society should be targeted. Such a program should be monitored for its effectiveness over the years.

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