Overweight and obesity in the eastern province of Saudi Arabia

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ABSTRACT

الأهداف: وصف تأثير العوامل الديموغرافية، الاجتماعية، وعوامل الخطورة الأخرى في حدوث السمنة.

الطريقة: أجريت هذه الدراسة في المنطقة الشرقية – المملكة العربية السعودية، خلال عام 2004م، حيث دُعِي جميع السعوديين ممن أعمارهم 30 عاماً فأكثر من المقيمين في نفس المنطقة للاشتراك في حملة الاكتشاف المبكر لمرضي السكري و ارتفاع ضغط الدم. باستخدام استبيان معد مسبقاً، تم تسجيل العمر، الجنس، الحالة الاجتماعية، المستوى التعليمي، الحرفة، التاريخ الطبي والعادات. كما تم أخذ قياسات: الوزن، الطول، ضغط الدم، وسكري الدم وذلك بواسطة فرق متدربة. تم تحديد السمنة وزيادة الوزن بحساب قياس كتلة الجسم (BMI) ≥30 kg/m^2 - 25-29.9 kg/m^2 على التوالي.

النتائج: كان عدد المشاركين 195,874، كانت نسبة السمنة (43.8%)، (35.1%) لديهم زيادة الوزن، و(1.3%) كانت أوزانهم تحت المعدل الطبيعي. أعلى معدل للسمنة كانت للذين أعمارهم بين 50–59 عاماً، كما إن السمنة كانت مرتفعةفي النساء عنها في الرجال، خاصة لدى ربات البيوت، ولذوي التعليم المنخفض (p<0.0001). أوضحت نتائج التحاليل اللوجستية الخطية أن هناك علاقة قوية بين معدل كتلة الجسم (BMI) ومرضى السكري، ارتفاع ضغط الدم، نسبة الدهون الثلاثية والكولسترول، وعلاقة عكسية مع التدخين والنشاط الحركي.

خاتمة: تعتبر السمنة وزيادة الوزن مشكلة صحية هامة تصيب نسبة هائلة من المجتمع السعودي.

Objective: To describe anthropometric characteristics of participants and the influence of sociodemographic and cardiovascular risk factors involved in the prevalence of obesity in the eastern province of Saudi Arabia.

Method: In the year 2004, all Saudi residents in the Eastern province aged 30 years and above, were invited to participate in a community screening campaign for early detection of diabetes and hypertension. Demographic data, medical history, life habits, weight, height, blood pressure, and glucose concentration were recorded using a structured questionnaire. Obesity and overweight were defined by body mass index (BMI) ≥30 kg/m^2 and 25-29.9 kg/m^2, respectively. Logistic regression was used to predict the association of the significant factors with the prevalence of obesity.

Results: Out of 195,874 participants, the overall prevalence of obesity was 43.8%, while 35.1% were overweight. The prevalence of underweight was 1.3%. The peak prevalence of obesity was observed in the age group 50-59 years. Obesity was higher among women than men, higher in housewives, and among the less educated than others (p<0.0001). Linear regression analysis showed a strong proportional association of BMI with diabetes, hypertension, triglycerides and cholesterol, and an inverse proportional association with physical activity and smoking

Conclusion: Obesity and overweight constitute an important health problem affecting a high proportion of Saudi population. Addressing associated factors, and enhancing public health education is an important aim to focus on for weight control.

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Obesity is a major risk factor for multiple chronic diseases,[1] related to coronary disease, type II diabetes, neoplasia, musculoskeletal, digestive diseases, and many other causes of chronic morbidity and disability.[2] Therefore, it is a national burden on the mortality, morbidity, and socioeconomic cost of any country.[3] A considerable increase in the prevalence of obesity has been reported in most of the developed and developing countries.[4,5] Its epidemics are one of the major sequel of the world's modernization, where the changing lifestyle plays a major role in rendering it as the most frequent metabolic disease. Globally, there are more than one billion overweight adults; at least 300 million of them are obese.[6] Saudi Arabia (SA) is considered as one of the most affluent developing countries, resulting in a high rate of obesity. The prevalence of obesity in SA has been reported in different places and ranges from 11.8%-36.1%[7,8] in an increasing rate over years, and the trend is expected to shoot on accelerating form. Evaluation of the problem and influencing factors, which had a significant impact, can help targeting at risk groups and community health intervention programs. This study was carried out to estimate the prevalence of over-and underweight in addition to obesity and its association to sociodemographic, and other health factors in the Eastern Province of SA.

Methods. This is part of a screening campaign that was conducted between 28th August 2004 and 18th February 2005 aimed for the early detection of diabetes mellitus (DM) and hypertension. Details of the study design and methods were published earlier.[9] A scientific committee was formed and established the detailed process to carry out the campaign, including establishment of the standards to run the campaign, accreditations of instruments and health education materials to be used, besides training, financial, supervision and health education committees, data processing and entry committees. A media campaign was organized in each sector using the written materials and audiovisual media. In addition, posters were put on billboards along the streets and public places in the eastern province. The target population was 650,000 subjects. A structured questionnaire was developed through a focused group, validated by experts in the fields of DM and hypertension and used by pre-trained health teams who attended a training course for conducting the campaign. All Saudi residents in the eastern province aged 30 years and above (excluding pregnant women) were invited to participate in this campaign. A face-to-face interview using the structured questionnaire and measurements were performed by Arabic speaking trained teams at more than 300 posts distributed in the eastern province of SA, including all primary health care centers, governmental hospitals, and several private health places, mobile teams, and other venues. The questionnaire consisted of demographic information, medical history, life style regarding physical activity and smoking. The data were collected from 197,681 participants. Physical activity was grouped into 4 categories: no physical activity with complete sedentary lifestyle (reading, watching television), mild physical activity (ordinary housework, walking less than 3 hours per week), moderate as exercise for at least 3 hours per week practicing sports like cycling, walking or other activities that needed effort, and strenuous physical activity such as exercise for at least 5 hours per week involving in sports like jogging, swimming, and so forth. Education was categorized as low (illiterate, read and write, and primary schooling), average (intermediate and secondary schooling), and high (university and more education). Income in Saudi Riyals was categorized randomly into 3 categories: <5000, 5000-6999, and 7000, and above. Occupation was recorded as self-employed, housewives, military, professional, technical, non-technical, administration employee, and unemployed.

Weight was measured to the nearest 0.5 kilogram using standardized beam weight scales and recorded to the lowest unit without footwear and with only light clothes on. Height was measured to the nearest centimeter with the subjects barefoot and standing with the feet together, ensuring the nape, back, calves, and with the ankles pressed against the measuring tape, which is part of weighing scale. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Those with a BMI of 25.0-29.9 kg/m^2 were classified as overweight, while those ≥30.0 kg/m^2 were classified as obese, and the normal range was 18.5-24.9 kg/m^2.[10] Blood pressure was measured with a calibrated mercury sphygmomanometer following the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7th) protocol.[11] Blood glucose concentration was measured using standardized methods. Diabetes mellitus and hypertension were diagnosed after confirmation of positive screening or previous diagnosis. Triglyceride and cholesterol level were taken for screened positive subjects only. The participants were assured of confidentiality of information collected, after explaining the purpose of this campaign. Ethical and cultural consideration regarding examination by same gender was considered. In addition, health education material was distributed to the high-risk group.

Statistical analysis. Data were analyzed using the Statistical Package for Social Sciences version 15, where t-test was used to compare BMI with smoking status, and Analysis of Variance to compare the means of BMI with demographic variable. Chi squared test was used to compare categorical BMI with socioeconomic variables,

those variables found to be associated with obesity were included in multiple logistic regression, (multiple logistic regression was used to explore the association of individual characteristics with the probability of obesity was dichotomized into 2 categorical variables; obese and normal weight, whereas individuals with overweight and underweight were excluded from this analysis). We entered socioeconomic variables and cardiovascular risk factors separately in the regression model, age and gender were included in each model. Age, triglyceride and cholesterol were treated as continuous measurement and other variables (gender, marital status, education, occupation, income, smoking status, and physical activity), as categorical. The odds ratio and 95% confidence interval were calculated. *P* value of <0.05 was considered statistically significant.

Results. Data on BMI measurement were recorded for 195,874 out of 197,681 participants (99.1%). The overall mean weight was 76.95±16.43 kg, and that for men was 80.45±15.94 kg and women was 73.29±16.1 kg. The overall mean height was 1.61±0.095 meter and that for men was 1.67±0.0714 meter and women was 1.54±0.065 meter. The mean BMI was 29.69±6.00 kg/m^2. **Table 1** presents the distribution of BMI according to age and socioeconomic factors. The BMI was observed to increase significantly with age. The maximum value was observed at the age groups of 50-59 years, after which it decreased in both men and women. The married individuals have the highest BMI, while the unmarried had the lowest (p<0.0001), the highest reading was among housewives, lower education and income for all of them (p<0.0001). Obesity was observed

Table 1 - Distribution of mean body mass index (BMI) according to age and socioeconomic factors.

Factors	Males	Confidence intervals	Females	Confidence intervals	Total	Confidence intervals
	Mean BMI±SD		Mean BMI±SD		Mean BMI±SD	
Age						
30-39	28.41±5.45	28.36-28.45	29.70±6.47	29.64-29.76	29.04±6.00	29.00-29.08
40-49	29.20±5.14	29.14-29.26	32.07±6.41	31.99-32.14	30.64±5.98	30.59-30.69
50-59	29.13±4.90	29.04-29.21	32.22±6.31	32.11-32.33	30.68±5.86	30.61-30.75
60-69	28.30±4.82	28.18-28.41	30.58±6.10	30.42-30.74	29.35±5.56	29.25-29.45
>70	27.18±4.80	27.03-27.33	28.76±6.09	28.52-28.99	27.83±5.42	27.70-27.96
Marital status						
Single	26.91±5.75	26.76-27.06	27.35±7.05	27.18-27.53	27.15±6.47	27.03-27.26
Married	28.77±5.21	28.74-28.81	31.00±6.37	30.95-31.04	29.80±5.88	29.77-29.82
Widowed	28.59±5.65	28.05-29.14	30.88±6.57	30.73-31.02	30.76±6.55	30.62-30.90
Divorced	27.69±5.97	26.97-28.42	30.97±7.08	30.69-31.26	30.65±7.05	30.38-30.92
Occupation						
Self-employed	28.67±5.36	28.58-28.76	29.84±6.88	29.23-30.45	28.71±5.42	28.62-28.80
Housewife			31.24±6.50	31.19-31.28	31.24±6.50	31.19-31.28
Military	28.53±5.08	28.46-28.59			28.53±5.08	28.46-28.59
Professional	28.84±5.21	28.75-28.93	28.95±6.02	28.82-29.07	28.88±5.57	28.81-28.96
Technical	28.79±5.33	28.66-28.93	29.57±6.54	29.30-29.84	29.00±5.69	28.88-29.12
Non-technical	28.25±5.45	28.10-28.40	30.51±6.82	30.12-30.90	28.67±5.80	28.53-28.82
Administration employee	28.81±5.19	28.75-28.87	29.53±6.10	29.38-29.69	28.95±5.38	28.89-29.00
Unemployed	28.24±5.36	28.14-28.35			28.42±5.77	28.32-28.52
Education						
low	28.42±5.40	28.36-28.48	31.53±6.54	31.47-31.59	30.42±6.3	30.38-30.46
average	28.79±5.23	28.74-28.83	30.30±6.41	30.21-30.38	29.30±5.7	29.26-29.34
high	28.77	28.70-28.84	28.60±5.96	28.50-28.69	28.70±5.5	28.64-28.75
Income						
<5000	28.30±5.45	28.25-28.35	30.93±6.65	30.87-30.99	29.68±6.25	29.64-29.72
5000 - <7000	28.77±5.21	28.70-28.84	30.31±6.43	30.20-30.42	29.35±5.75	29.29-29.41
≥7000	29.11±4.96	29.05-29.16	30.21±6.07	30.12-30.30	29.51±5.42	29.47-29.56

Table 2 - Prevalence of obesity, overweight and underweight according to age and marital status.

Factors	Underweight	Normal	Overweight	Obese	Total number
			n (%)		
Age					
30-40	1,624 (1.7)	22,556 (23.7)	33,917 (35.6)	37,241 (39.1)	95,338
41-50	474 (0.8)	8,287 (14.6)	19,392 (34.1)	28,663 (50.4)	56,816
51-60	163 (0.7)	3,417 (14.1)	8,258 (34.2)	12,338 (51.0)	24,176
60-69	161 (1.4)	2,332 (19.7)	4,353 (36.7)	5,000 (42.2)	11,846
70+	170 (2.7)	1,785 (28.2)	2,398 (37.9)	1,979 (31.3)	6,332
Gender					
Men	1,309 (1.3)	22,219 (22.2)	40,315 (40.3)	36,103 (36.1)	99,946
Women	1,308 (1.4)	16,446 (17.1)	28,443 (29.7)	49,708 (51.8)	95,905
Marital status					
Single	502 (4.3)	4,406 (37.9)	3,505 (30.1)	3,214 (27.6)	11,627
Married	1,911 (1.1)	32,081(18.7)	61,575 (35.8)	76,400 (44.4)	171,967
Widowed	149 (1.8)	1,384 (16.7)	2,423 (29.3)	4,310 (52.1)	8,266
Divorced	45 (1.7)	534 (20.1)	757 (28.5)	1,322 (49.7)	2,658

*Total varied for some missing data, †All differences were statistically significant $p<0.000$.

Table 3 - Prevalence of obesity, overweight and underweight according to socioeconomic factors.

Factors	Underweight	Normal	Overweight	Obese	Total number
			n (%)		
Occupation					
Self-employed	216 (1.5)	3,259 (22.8)	5500 (38.5)	5,299 (37.1)	14,274
Housewife	888 (1.2)	10,629 (14.8)	20,508 (28.6)	39,731 (55.4)	71,756
Military	303 (1.4)	4,884 (22.3)	8,977 (41.1)	7,701 (35.2)	21,865
Professional	262 (1.2)	4,933 (22.9)	8,270 (38.3)	8,100 (37.6)	21,565
Technical	123 (1.5)	1,791 (21.6)	3,223 (38.8)	3,173 (38.2)	8,310
Non-technical	119 (1.9)	1,596 (25.1)	2,263 (35.6)	2,378 (37.4)	6,356
Administration employee	330 (1.0)	7,339 (21.5)	13,604 (39.9)	12,864 (37.7)	34,137
Unemployed	288 (2.3)	3,260 (25.6)	4,723 (37.0)	4,480 (35.1)	12,751
Education					
Low	1,268 (1.5)	15,214 (17.5)	27,354 (31.5)	43,071 (49.6)	86,907
Average	829 (1.2)	13,823 (20.4)	25,666 (37.8)	27,513 (40.6)	67,831
High	473 (1.3)	8,875 (23.9)	14,243 (38.4)	13,486 (36.4)	37,077
Income					
<5000	1,444 (1.7)	18,179 (21.1)	28,612 (33.2)	37,923 (44.0)	86,158
5000 - <7000	440 (1.2)	7,377 (20.5)	13,345 (37.2)	14,741 (41.1)	35,903
≥7000	366 (0.8)	8,569 (18.2)	18,396 (39.0)	19,858 (42.1)	47,189
Physical activity					
Complete sedentary	710 (1.4)	9,452 (18.9)	16,665 (33.3)	23,184 (46.4)	50,011
Mild	1,381 (1.4)	20,322 (19.5)	36,247 (34.8)	46,124 (44.3)	104,074
Moderate	452 (1.3)	7,410 (20.7)	13,509 (37.8)	14,359 (40.2)	35,730
Strenuous	57 (1.2)	1,182 (25.6)	1,809 (39.2)	1,567 (34.0)	4,615

*Total varied for some missing data, †All differences were statistically significant $p<0.0001$.

Table 4 - Prevalence of obesity, overweight and underweight according to health sector

Sector	Underweight	Normal	Overweight	Obesity	Total number
			n (%)		
Dammam	340 (1.1)	5,438 (18)	10,756 (35.5)	13,733 (45.4)	30,267
Khober	314 (1.0)	5,761 (19.0)	11,177 (36.8)	13,108 (43.2)	30,360
Qateef	653 (2.1)	7,970 (26.0)	11,042 (36.0)	10,999 (35.9)	30,664
Al-Hassa	653 (1.1)	10,106 (17.7)	18,758 (32.8)	27,601(48.3)	57,118
Hafr baten	132 (1.1)	2,021 (17.5)	4,145 (35.8)	5,268 (45.5)	11,566
Ras Tanura	82 (1.4)	1,243 (21.6)	2,125 (37.0)	2,293 (39.9)	5,743
Bqaiq	69 (1.5)	822 (17.3)	1,650 (34.7)	2,208 (46.5)	4,749
Safwa	81 (1.8)	1,194 (26.7)	1,504 (33.7)	1,686 (37.8)	4,465
Jubail	76 (1.2)	1,480 (22.4)	2,531 (38.3)	2,520 (38.1)	6,607
Khafji	56 (1.3)	722 (17.3)	1,463 (35.1)	1,927 (46.2)	4,168
Oraiera	14 (1.8)	123 (15.4)	268 (33.6)	393 (49.2)	798
Nuairia	38 (1.0)	690 (17.6)	1,492 (38.1)	1,699 (43.4)	3,919
Sarar	42 (1.9)	416 (18.8)	794 (35.9)	962 (43.5)	2,214
Qaria Olia	43 (2.3)	414 (21.9)	594 (31.4)	840 (44.4)	1,891
Rafia	24 (1.8)	270 (20.2)	462 (34.5)	582 (43.5)	1,338

*Total varied for some missing data, †All differences were statistically significant $p<0.0001$.

in 43.8%, whereas severe obesity (BMI ≥40 kg/m^2) was detected in 12.9% of them. On the other hand, 35.1% were overweight. The prevalence of underweight was 1.3%, and only 19.7% subjects had a normal BMI. The relation of prevalence of overweight and obesity to sociodemographic variables is presented in **Tables 2 and 3.** On comparing the prevalence of obesity by gender and age, there were statistically more women than men who were obese (51.8% versus 36.1%) in all age groups ($p<0.0001$). The reverse was true about overweight, where the overall excess weight (BMI ≥25-29.99kg/m^2) was detected significantly in more women (81.5%) than men (76.4) ($p<0.0001$). Obesity was also detected significantly in more subjects who were widows and were lowest in unmarried subjects ($p<0.0001$). Among the occupations, the highest rate of obesity was detected among housewives 55.4% ($p<0.0001$). Regarding educational status, the lowest prevalence of obesity was among individuals with high education and was highest among those who have lower educational levels ($p<0.0001$). Significantly, more subjects smoked cigarettes with a low BMI than those who did not (BMI 28.13±5.52 versus 30.01±6.04 kg/m^2 [$p< 0.0001$]). On stratifying the regional difference (**Table 4**), it was found that there is geographical variation in the prevalence of obesity. Oraiera (49.2%) and Al-Hassa (48.3%) region had the highest rate of obesity compared with Qateef sector (35.8%) ($p<0.0001$). **Table 5** illustrates the results from the logistic regression model that was applied to evaluate variables that were associated with the likelihood of being obese. Female gender, being housewives, and having low education were found to be positively associated with being obese. The odds ratio for obesity was 2 or more for each of being married, widowed or divorced compared with being single ($p<0.0001$).

After controlling the age and gender, linear regression analysis showed that BMI was strongly associated with presence of diabetes (standardized ß coefficient =0.09, $p<0.0001$), hypertension (standardized ß coefficient=0.183, $p<0.0001$), cholesterol level (standardized ß coefficient=0.03, $p<0.0001$), and triglycerides level (standardized ß coefficient=0.046, $p<0.0001$). It was inversely associated with physical activity (standardized ß coefficient=-0.018, $p=0.025$), and smoking (standardized ß coefficient=-0.066, $p<0.0001$).

Discussion. This study involves a large sample of the Saudi population in the eastern province, with the aim of estimating the magnitude of obesity. The prevalence of overweight, obesity, and associated risk factors were analyzed. More than 3 quarters of those participants involved in the screening campaign were above normal weight. The rates of overweight and obesity observed in the study were alarming since it is one of the highest rates in the world.[6] This figure obtained from our study is in agreement with the earlier figures obtained in SA.[8] It also revealed increasing trend of excess weight over time and the fact that the eastern province of SA has one of the highest reported excess weight rates among all regions in the Kingdom. Similar findings have also been detected in other Arabian Gulf countries with same social trends.[12,13] This figure could be attributed to the rapid economic transition in the last 3 decades in SA and its major influence on the life style of the

Table 5 - Multiple logistic regression models of variables associated with obesity.

Factors	Obesity versus normal			
	Logistic regression coefficient	Odds ratio	Confidence intervals	*P*-value
Age	0.006	1.006	1.005-1.008	<0.0001
Gender				
Men		1		
Women	-0.133	0.876	0.836-0.917	<0.0001
Marital status				
Single		1		
Married	0.917	2.503	2.365-2.649	<0.0001
Widowed	0.793	2.211	2.012-2.430	<0.0001
Divorced	0.804	2.234	1.969-2.534	<0.0001
Occupation				
Self-employed		1		<0.0001
Housewife	0.521	1.683	1.569-1.806	<0.0001
Military	-0.083	0.920	0.862-0.981	0.011
Professional	-0.004	0.996	0.930-1.066	0.906
Technical	0.050	1.051	0.970-1.139	0.222
Non-technical	-0.122	0.885	0.815-0.961	0.004
Administration employee	0.057	1.058	0.997-1.124	0.065
Unemployed	-0.253	0.777	0.722-0.835	<0.0001
Education				
Low		1		
Average	-0.070	0.932	0.897-0.969	<0.0001
High	-0.412	0.666	0.632-0.701	<0.0001
Income				
<5000		1		
5000 - <7000	0.188	1.207	1.161-1.255	<0.0001
≥7000	0.407	1.500	1.441-1.562	<0.0001
Tobacco smoking				
Not smoker				<0.0001
Smoking	-0.450	0.637	0.614-0.616	<0.0001
Physical activity				
Complete sedentary		1		
Mild	-0.101	0.904	0. 874-0.934	<0.0001
Moderate	-0.155	0.857	0.822-0.893	<0.0001
Strenuous	-0.420	0.657	0.600-0.719	<0.0001

population, which may contribute to multiple metabolic abnormalities especially cardiovascular disease. The overall mean BMI was significantly higher in women than men and this is in agreement with several other international studies.[8,13] This figure was maintained by the alarming prevalence of obesity and overweight among the housewives which exceeded 80%. This can be explained by lack of employment at jobs other than being homebound housewives; consequent limited physical participation in sporting due to the traditional local culture and restriction of sporting activities in schools for girls. Moreover, the wide-availability of housemaids in most of the houses of Saudi nationals, beside pregnancy related circumstances[14] could be implicated as a cause for prevalence of sedentary life-styles among women. Generally, in the Arabian Gulf region, the hot climate during most of the time, could affect people exercising outdoor, limit their activities in closed conditioning environment, viewing television programs, and eating while watching television has a major impact on prevalence of obesity.[13,15,16] The study also revealed that obesity is more related to lower occupational status and low education level. These are probably emerging as additional associated variables for the problem. This finding is supported through consistent studies, which reveals clear inverse relationship in most societies, between the level of education or socioeconomic status, and the prevalence of obesity, which is being seen increasingly as a feature of the poor.[17,18] This may be explained by that people without much education, and consequently lower occupation, does not recognize the health consequences of obesity and overweight, and some of them considered desirable and a sign of beauty, and in some as a feature of affluence. Regarding the geographical distribution of obesity, the study revealed higher rates of obese persons in Oraiera and Al-Hassa. The socioeconomic factors such as level of education and lifestyle could not explain this geographical variability of prevalence of obesity in the eastern province of SA, and such findings may need further search to clarify the background of this variation. In this study, we studied the correlation between obesity and cardiovascular risk factors such as hypertension, DM and dyslipidemia and we observed a significant positive relation between these variables; the regression analysis suggested that BMI is an important anthropometric index to predict those cardiovascular problems. It has been shown that an increase of 30% to 40% over the ideal body weight results in a decline in insulin sensitivity of 30%-40%,[19] and consequently hyperinsulinemia. So, it is obvious that obesity will contribute to insulin resistance and its compensatory hyperinsulinemia,[20] and ultimately to cardiovascular risk factors such as DM, hypertension and dyslipidemia.[21] Consistent studies[22] have shown that central adiposity appears to contribute to a greater extent than general adiposity to the development of cardiovascular risk, but as revealed from this large sample, BMI acts as a similar strong predictor. With regard to physical activity, the relationship between obesity and the level of physical activity was maintained statistically after controlling the remaining variables, and as the intensity of physical activity increase, it becomes more protective against obesity. Our study also showed that tobacco use appears to be a predictor for lower BMI. This finding is consistent with results of other studies,[23] although it

may increase the risk of higher waist-hip ratio (WHR) which is related to potential risk of DM, and of course, this point needs to be clarified and validated in a further study. Finally, this study is not free of limitations. Firstly, central obesity in the form of waist measurement and WHR was not measured. Secondly, the BMI does not take into account the difference between muscularity and increased total body fat. Thirdly, the self-report of physical activity is purely subjective and finally, although this campaign was focused on screening, it overcame by taking the whole population aged 30 years and above as the targeted population. Almost one-third of the population was involved in this study, and consequently there was involvement of a huge number of participants in this campaign, completing the necessary data for BMI, which reached 99.1% of the respondents. In addition, the very close comparability of the percentage of our participants with the latest census carried out in the eastern province of SA[24] regarding age and gender makes this study as a representative estimate of the prevalence of overweight and obesity from the Eastern province.

In conclusion, the problem of overweight and obesity in SA is of high magnitude and should raise a high public health concern and it should be taken seriously. There will be much difficulty regarding its prevention, but weight control should be an important strategy to reduce mortality, morbidity and health-related expenditures. This could be achieved through multi-disciplinary levels of health promotion activities at the community level. Focusing on activity patterns with emphasis on healthy food practices, employing the best evidence in this regard, and keeping into consideration the link between obesity and lower socioeconomic status in all strategy to manage this problem.

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