Prevalence of obesity among military personnel in Saudi Arabia and associated risk factors

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ABSTRACT

الأهداف: تعتبر مشكلة السمنة من المشاكل الصحية الهامة في جميع أنحاء العالم، والمملكة العربية السعودية ليست استثناء. وهذه المشكلة قد تكون ذات أهمية خاصة في صفوف القوات المسلحة، إلا أن هناك نقص في البيانات ذات الصلة. وكان الهدف من هذه الدراسة قياس مدى انتشار السمنة بين الأفراد العسكريين في السعودية، وتحديد عوامل الاختطار ذات العلاقة.

الطريقة: أجريت هذه الدراسة المقطعية على الصعيد الوطني متضمنة جميع المناطق العسكرية الخمس بالمملكة، على عينة عشوائية طبقية متعددة المراحل شملت 10500 من العسكريين الموجودين بالخدمة. وقد استخدم النهج التدرجي لترصد عوامل اختطار الأمراض المزمنة لمنظمة الصحة العالمية في تصميم أداة جمع البيانات. وقد استمر العمل بالمشروع من يناير 2009 إلى فبراير 2011.

النتائج: كان معدل الاستجابة 97.4%، وتبين أن 40.9% من المشاركين كانوا يعانون من زيادة الوزن، و29% يعانون من السمنة، و42.4% من السمنة المركزية. وكشف التحليل الانحداري المتعدد أن العمر وسنوات التعليم والتاريخ العائلي لمرض السكري أو ارتفاع ضغط الدم كانت عوامل تنبؤية إيجابية مستقلة وذات دلالة إحصائية لزيادة مؤشر كتلة الجسم، في حين كانت الرتبة العسكرية الأعلى، والتدخين والنشاط البدني وتناول الفاكهة أكثر من مرتين في الأسبوع عوامل تنبؤية سلبية.

خاتمة: تمثل السمنة مشكلة صحية كبيرة بين العسكريين في هذا المسح الوطني لا سيما بين الجنود، ويترافق ذلك مع العادات غير الصحية في النظام الغذائي والنشاط البدني. ويوصى باتخاذ إجراءات فورية من قبل إدارة الخدمات الطبية العسكرية لعمل برامج توعية صحية موجهة بصفة خاصة للجنود وذوي الوزن الزائد، وينبغي أن تمتد حتى لأولئك الذين على قوائم القبول بالخدمة. ويوصى بإعادة تقييم معايير القياسات الجسمانية للقبول بالخدمة وأيضا للاستمرار بها وللترقي في الرتب العسكرية.

Objectives: To measure the prevalence of obesity among military personnel in the Kingdom of Saudi Arabia (KSA), and to identify its risk factors.

Methods: This nationwide cross-sectional study covered all 5 military regions of KSA. It included a multistage stratified random sample of 10,500 active military personnel. The World Health Organization STEP wise approach to chronic disease risk factor surveillance (STEPS) was used in the design of the data collection tool. The project lasted from January 2009 to February 2011.

Results: The response rate was 97.4%; 40.9% of the participants were overweight, 29% obese, and 42.4% had central obesity. Multivariate analysis revealed age, education years, and family history of diabetes or hypertension as statistically significant positive predictors of body mass index, while higher military rank, smoking, eating fruits more than twice per week, and heavy physical activities were negative predictors.

Conclusion: Obesity is a major health problem among military personnel in this survey especially among soldiers, and is associated with unhealthy dietary and physical activity habits. Prompt action must be taken by the military medical services department in terms of intervention programs primarily directed to soldiers and overweight personnel to control obesity and mitigate its consequences. Review of the anthropometric standards for recruitment, continuation, and promotion in military service is recommended.

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Obesity is globally on the rise, reaching epidemic proportions. It seems to be the heritage of modernization of society with all its features of unhealthy food and faulty dietary habits, increased stress, and less physical activity. These changes were drastic in the Middle Eastern region in the last 4 decades. The switch from the traditional healthy food to western style food low in fiber and high in fat was prominent, with the wave of fast-food restaurants covering the region. During this period, the daily per capita fat consumption increased by 143.3% in the Kingdom of Saudi Arabia (KSA).[1] The consequences of these changes are evident by the significant rises in the incidence and prevalence of lifestyle-related diseases such as hypertension, diabetes, and ischemic heart diseases, with associated increases in mortality and morbidity.[2] In the military service, physical fitness is crucial; standards for body composition are set for recruitment to ensure the ability to endure the physically demanding tasks. A high prevalence of obesity in a community can have a negative impact on recruitment of its military manpower. A number of studies reported high rates of obesity among civilians on military enlistment,[3] which has increased over time.[4] This may explain the increasing trend of overweight and obesity among militaries despite the presumed better fitness programs and controlled nutrition. Laclaustra-Gimeno et al[5] reported significant increases in body mass index (BMI) in military men in Spain in a follow-up from age 20-35 years. This increasing trend of obesity among military personnel was attributed to the lack of time as a main barrier to exercising and healthy eating.[6] In KSA, obesity is a major problem in the general population. The trends have increased over the last decade; the rates of overweight and obesity increased from 27.23% and 13.05% in 1999[7] to 35.1% and 43.8%.[8] Also, central obesity reached 43.5% in the Southern region of KSA.[9] These high rates in the general population are reflected on the rates in military personnel.[10] Obesity is a risk factor for a number of chronic diseases, especially diabetes and coronary heart diseases.[11] The military personnel are no exception so that overweight and obesity were found to have an increasing contribution to morbidity among them.[12] The incurred costs are increasing in terms of medical fees and sickness absence,[2] and losses of investments in training highly qualified military posts.[13] Therefore, a systematic review urged the need for further research in this area of obesity in military settings.[14] This study is an attempt to contribute to the promotion of health of military personnel in KSA. Its objectives were to measure the prevalence of obesity among its military personnel through a nationwide survey, and to identify associated risk factors.

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Methods. A cross-sectional descriptive study design was used in carrying out this nationwide study, which covered all 5 military regions of KSA; namely, eastern, western, northern, southern, and central. Any military person of any rank serving in the Saudi Armed Forces during the time of the study was eligible for inclusion in the sample, with no exclusion criteria. The sample size was calculated to estimate the prevalence of any disease or risk factor at a rate 10% or higher, with a standard error of 10%, at the 95% level of confidence, with a design effect of 2.5. The required sample (8613) was increased to 10,500 to compensate for an expected dropout rate of approximately 20%. A multi-stage stratified random sampling was used. Each of the 5 regions had 4 strata: air force, land, navy, and air defense. From each of these strata within each region, a systematic random sample of individuals was recruited. The sample was fixed in the 5 regions, 2,100 subjects each, to allow for comparisons among regions and armies. Within each region, the sample size was allocated according to ranks 3:7 for officers and soldiers.

The World Health Organization (WHO) STEP wise approach to chronic disease risk factor surveillance (STEPS) was used in the design of the data collection tool.[15] It involves in its first step collection of demographic and behavioral data as smoking, dietary habits, physical activity, and personal, and family history of hypertension and diabetes. The second step, physical assessment, included measurements of height and weight, waist and hip circumferences, and blood pressure using standardized methods.[16] The tool was formulated in Arabic language. It consisted of closed questions. It was thoroughly revised by experts for face and content validity.

For each of the 5 regions, one team was recruited for data collection. It consisted of at least one doctor, 2 nurses, 2 clerks, and a field coordinator. Training of each member of the team was carried out regionally.

Then, a central training workshop was held in Riyadh for standardization of the procedures. Guidelines were developed and distributed to team members regarding each of these procedures. Awareness campaigns with posters and pamphlets regarding the survey were implemented in various sites to encourage participation. A pilot study was carried out in Riyadh for testing the fieldwork procedures, and the tool clarity and feasibility. Its results helped to optimize the sequence of work for the field procedures, and in finalization of the tool.

The project lasted for 2 years, from January 2009 to February 2011. The actual fieldwork started in all regions in April 2009. The day before the data collection in a particular site, the sample of participants was prepared by the field coordinator. Those who gave their consent to participate were handed the form and instructed regarding filling it up. Then, the physical assessment was carried out with standard methods for anthropometric and blood pressure measurements.[17]

All principles of the Helsinki Declaration were followed. The study protocol was approved by the pertinent authorities. An informed written consent was obtained from all participants. They were assured that all data were considered confidential and would not be used outside this survey, and were informed regarding the right to refuse or withdraw at any time without giving a reason. No harmful maneuvers were performed. Professional help was provided to participants as needed.

Data management was carried out using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) version 14.0. Based on the findings of bivariate analyses, multiple linear stepwise regression analysis was performed after testing the normality to identify the independent predictors of BMI and the waist to hip ratio. Statistical significance was set at *p*-value <0.05.

Results. From 10,500 participants, 10,229 had valid complete forms (response rate 97.4%). Approximately three-quarters of the sample were below 40 years (**Table 1**). The median education years (12) indicate secondary level of education. They were mostly married (82.5%), with just sufficient income (43.5%) or were saving (26.5%). Only 31.2% of them undertook pure office work, and the mean duration of service was 13 years.

Regarding health-related habits, 48.6% of the participants were non-smokers, while 35% were current smokers (**Table 2**). More than two-fifths (44.8%) were eating fruits, and 32.6% ate vegetables less than 3 days per week. Eating fast food was common (87.6%), and 30.8% were not practicing physical activity of at least 30 minutes per day.

Table 1 - Socio-demographic characteristics of the survey sample (n=10,229).

Socio-demographic	Frequency	(%)
Age (years)		
<30	3028	(29.6)
30 - <40	4639	(45.4)
40 - <50	2483	(24.3)
≤50	79	(0.8)
Mean (SD)	34.12 (7.25)	
Total years of education		
Mean	11.79 (3.17)	
Median (25-75th quartiles)	12 (9-14)	
Marital status		
Single	1742	(17.0)
Married	8442	(82.5)
Divorced/widow	45	(0.5)
Income		
Saving	2713	(26.5)
Just sufficient	4446	(43.5)
Insufficient	2514	(24.6)
Refused to report	556	(5.4)
Military rank		
Officers	1592	(15.6)
Soldiers	8637	(84.4)
Job type		
Office	3190	(31.2)
Field	4830	(47.2)
Both	2209	(21.6)
Years of service		
Mean (SD)	12.91 (7.71)	
Median (25-75th quartiles)	12 (7-19)	

Table 2 - Smoking, eating, and physical activity habits in the survey sample (n=10,229).

Variables	Frequency	(%)
Smoking		
Non-smokers	4972	(48.6)
Ex-smokers	1679	(16.4)
Current smokers	3578	(35.0)
Eat fruits <3 days/week	4583	(44.8)
Mean days/week (SD)	2.79 (1.75)	
Median days/week (25-75th quartiles)	2 (2-3)	
Eat vegetables <3 days/week	3335	(32.6)
Mean days/week (SD)	3.61 (2.01)	
Median days/week (25-75th quartiles)	3 (2-5)	
*Eat fast food at least 1/week**	7392	(87.6)
Mean days/week (SD)	2.36 (2.01)	
Median days/week (25-75th quartiles)	2 (2-3)	
Practice physical activity at least 30 min daily	7082	(69.2)
Mean minutes/day (SD)	127.84 (159.24)	
Median minutes/day (25-75th quartiles)	68.57 (19.29-177.86)	

*missing in east and west regions

Overweight and obesity was highly prevalent (**Table 3**). Less than one-third of the sample (30.1%) was in the BMI categories of normal or underweight. Morbid obesity affected 7.5% of the sample, and central obesity was found in 42.4% of the sample.

Table 3 - Parameters of obesity in the survey sample (n=10229).

Parameters	Frequency	(%)
Body mass index (BMI)		
Underweight (<18.5 kg/m^2)	238	(2.3)
Normal (18.5-)	2845	(27.8)
Overweight (25-)	4179	(40.9)
Obese (30-)	2204	(21.5)
Morbid obese (35+ kg/m^2)	763	(7.5)
Mean BMI (SD)	27.63 (5.16)	
Median BMI (25-75th quartiles)	27.31 (24.30-30.50)	
Waist/hip ratio (WHR)		
Normal (<0.90)	5887	(57.6)
High (0.90+)	4342	(42.4)
Mean WHR (SD)	0.89 (0.07)	
Median WHR	0.90 (0.85-0.93)	

The best fitting multiple linear regression model for the value of BMI is presented in **Table 4**. The positive statistically significant independent predictors of BMI were age, eating vegetables more than twice per week, and family history of diabetes or hypertension. However, the negative predictors were a higher rank, smoking, and eating fruits more than twice per day. The education years and heavy physical activity at work had borderline significance.

Discussion. This study is a part of a large nationwide health survey for militaries in KSA. The findings indicate a high prevalence of overweight and obesity, along with prevalent risky behaviors such as smoking, unhealthy dietary habits, and lack of physical activity. These results point to the need for urgent action to address these problems that are considered important risk factors for ischemic heart diseases. Although the high prevalence of overweight and obesity among militaries is unexpected given the nature of the job and

Table 4 - Best fitting multiple linear regression model for body mass index (BMI).

Variables	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value	95% Confidence Interval for B	
	B	Std. Error				Lower	Upper
Constant	21.88	0.39		56.03	0.000	21.11	22.64
Rank (reference: private)	-0.58	0.18	-0.04	-3.14	0.002	-0.94	-0.22
Age	0.15	0.01	0.22	19.45	0.000	0.14	0.17
Education years	0.04	0.02	0.03	1.95	0.051	0.00	0.08
Smoking (reference: non)	-0.89	0.11	-0.08	-7.82	0.000	-1.11	-0.67
Eating fruits (>2 days/week)	-0.30	0.12	-0.03	-2.54	0.011	-0.53	-0.07
Eating vegetables (>2 days/week)	0.30	0.12	0.03	2.47	0.013	0.06	0.53
Heavy physical activity at work	-0.24	0.13	-0.02	-1.84	0.066	-0.49	0.02
Family history of diabetes mellitus	0.61	0.12	0.06	5.18	0.000	0.38	0.84
Family history of hypertension	1.05	0.12	0.10	8.99	0.000	0.82	1.28

r-square-=0.08, Model ANOVA: F=72.15, p<0.001.
Variables excluded by model: eating fast food, physical activity at leisure.

Table 5 - Best fitting multiple linear regression model for waist hip ratio.

Variables	Unstandardized Coefficients		Standardized Coefficients	t-test	*P*-value	95% confidence interval for B	
	B	Std. Error				Lower	Upper
Constant	0.79	0.00		197.97	0.000	0.78	0.80
Rank (reference: private)	-0.01	0.00	-0.03	-2.69	0.007	-0.01	0.00
Age	0.00	0.00	0.29	26.81	0.000	0.00	0.00
Smoking (reference: non)	0.00	0.00	-0.02	-2.06	0.040	-0.01	0.00
Walking 10 min/day	0.00	0.00	-0.03	-2.53	0.011	-0.01	0.00
Family history of hypertension	0.01	0.00	0.07	6.15	0.000	0.01	0.01

r-square-=0.10. Model ANOVA: F=108.43, p<0.001
Variables excluded by model: age, education years, smoking, eating fruits (>2 days/week), eating vegetables (>2 days/week), eating fast food, physical activity at work, physical activity at leisure, family history of diabetes mellitus, family history of hypertension

the lifestyle, it has been previously reported in a number of studies worldwide. In KSA, Al-Qahtani and Imtiaz[17] found that 33.1% of Saudi male soldiers in Northern KSA had central obesity, which is lower than our rate of 42.4%. However, the difference could be related to dissimilar cutoff points for the waist to hip ratio. In another report, Al-Qahtani et al[10] demonstrated that 82% of the Saudi soldiers were either overweight or obese. Their rate is slightly higher than our 69.9% rate. The discrepancy between our results and this study could be due to inclusion of both officers and soldiers in our study, and as we noted that BMI tended to be decreasing with higher ranks. At the international level, a study at a USA Navy medical center found a prevalence of overweight or obesity of 53%,[18] which is lower than the figure in the present study. In Finland, the mean BMI among military personnel was 26.02 which is in the overweight category, but lower than our mean (27.31). Even lower rates of overweight (26.5%) and obesity (4.7%) were reported in the Greek Army.[19] Therefore, the rate of obesity in the present study is overall higher than those reported in military settings elsewhere.

The variations among various studies regarding the prevalence of obesity could be attributed to different food and dietary habits in different countries. For instance, the Mediterranean food with low-moderate fat and much olive oil has been claimed to be associated with lower risks of obesity and ischemic heart disease.[20,21] Additionally, snacking and fast food intake is less common in Greece and Southern European countries compared with the USA and Nordic Countries.[22] Hence, overweight and obesity are much lower in these countries compared with the USA.[23] However, the dietary habits in KSA and the Gulf area have witnessed major changes towards unhealthy dietary practices as shown in our study, where the majority were eating fast food regularly, and the consumption of fruits and vegetables was low. In line with this, knowledge regarding a healthy diet was found to be inadequate among Saudi secondary school students,[24] and the traditional "kabsah" rich in saturated fats was shown to be associated with adverse health effects.[25] Moreover, Rasheed[26] reported that the perception of Saudi female adolescents of an ideal body image was the overweight female.

Our findings point to faulty dietary habits among military personnel. The rates of these faulty habits are much higher than those shown among military personnel in Belgium,[27] which might explain the high prevalence of obesity in our sample. However, the dietary habits had a conflicting effect on BMI in multivariate analysis. While the consumption of fruits 3 or more days per week was shown to be associated with a lower BMI by approximately 0.3 units, a similar consumption of vegetables was associated with an increase in BMI by almost the same value. The finding regarding fruits is plausible, but that of vegetables is quite paradoxical. The only possible explanation could be that the respondents confused the green fresh with cooked vegetables, which may contain a high amount of fat, and are usually eaten with large amounts of rice or bread. This confusion is probable since the questionnaire was self-administered.

The prevalence of faulty dietary habits and of obesity in a community undoubtedly has repercussions on the prevalence of these problems among its military personnel. Such a situation has been reported among USA civilian adults for military enlistment, where up to 54.4% were found to be overweight for enlistment.[3] Also, Hsu et al[4] noticed that the prevalence of overweight and obese increased from 22.8% to 27.1% and from 2.8% to 6.8% from 1993 to 2005 among civilian applicants to US army. This poses a challenge for military recruitment programs, and might lead to some relaxation in the criteria of admission as reported by Gantt et al,[18] who found that among those who were considered within the US Navy standards, 8.6% were obese and 48.6% were overweight. No such data regarding obesity among Saudi civilians on enlistment for military recruitment is available.

The lack of physical activity proved to be an important risk factor for obesity in our study. Around one third of our sample members were physically inactive, which is higher than the rates previously reported among military personnel. For example, Littman et al[28] reported a rate of 16.2% physically inactive military persons in USA, which is almost half of our rate. The high rate of physical inactivity revealed in our study is actually an extension of this unhealthy behavior during adolescence. For instance, a study on intermediate and secondary school students in Al-Khobar, KSA reported that only 45.6% of males practiced physical activity 3 or more times per week.[29] Moreover, 28.9% of King Faisal University male students in Dammam, KSA were not practicing any form of physical activity.[30] In the general population, over 53% of adult Saudi males were shown to be totally physically inactive, and another 27.5% were irregularly active, with the middle age group being the least active.[31]

Nevertheless, physical activity at work, and walking daily were found to be independent negative predictors of BMI. In congruence with these findings, Mikkola et al[32] in Finland demonstrated that military service led to changes in body composition, with more lean

tissue, and less fat. They attributed this to lifestyle changes, especially physical activity, as these benefits were more prominent among previously physically inactive persons with high BMI. Apart from dietary habits and physical activity, age was revealed as an independent positive predictor of BMI in the present study. The finding could be explained by lower physical activity at work and at leisure time with advancing age. It is in agreement with Mullie et al[27] in Belgium who found a significant increase in overweight and obesity rates among military personnel with increasing age. Thus, the problem of obesity is more noticeable among veterans.[12,33] Another factor demonstrated to be related to obesity in the present study was the military rank. A higher military rank was a negative independent predictor of BMI. This cannot be explained by the possible confounding effect of the level of education, as this was an independent positive predictor of BMI. A possible factor could be higher health awareness and health behavior with increasing rank, although this needs further investigation. Also, the position status and what this implies on the jobholder's appearance and behavior could be a factor as demonstrated by Sigrist et al.[6] Moreover, McLaughlin and Wittert highlighted the importance of the feeling of military obese persons that they cannot be active members of the military workforce, which could be of more importance in higher ranks.[14]

Our study findings also indicated that a family history of diabetes and/or hypertension was an independent predictor of obesity in terms of BMI. This could be related to the familial or genetic grounds underlying all 3 conditions, which are elements of the cardiometabolic risk,[34] and have been identified as independent predictors of metabolic syndrome.[35] Thus, family history has always been considered a confounding factor in the relation between diabetes and obesity.[36,37] Findings similar to ours were reported by Mahanta and Mahanta[38] who showed significantly higher BMI and body fat percentage among non-diabetic persons with family history of diabetes compared to a matched control group with no family history. Therefore, there is a need to assess the prevalence of metabolic syndrome in our military population, which might be high given this high prevalence of its predictors. For instance, Khazale and Haddad reported crude and age adjusted prevalence of metabolic syndrome as high as 15.3% and 18.0%, among Royal Jordanian Air Force pilots.[39]

In conclusion, the results of this national study points to a major problem with obesity among military personnel. This has been associated with unhealthy dietary and physical activity habits, and is more prominent among soldiers. However, the findings pertaining to risk factors should be interpreted cautiously taking into consideration the limitations of the cross-sectional design used in the study. The findings should lead to prompt actions to be taken by the military medical services department in terms of intervention programs to correct unhealthy habits related to diet and physical activity. Such programs should be primarily directed to soldiers and those who are overweight, and should be even extended to those on enlistment. Review of the anthropometric standards for recruitment and continuation and promotion in military service is recommended.

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