Community-based screening for pre-hypertension among military active duty personnel

Saeed M. Al-Asmary, FFCM, FSO, *Abdul-Salam A. Al-Shehri,* SBFCM, ABFM, *Fayssal M. Farahat,* MD, PhD, *Moataz M. Abdel-Fattah,* MD, PhD, *Muraya M. Al-Shahrani,* SSC-FM, ABFM, *Fahd K. Al-Omari,* SSC-FM, ABFM, *Fawaz S. Al-Otaibi,* SSC-FM, ABFM, *Dhif-Allah M. Al-Malki,* SSC-FM, ABFM.

ABSTRACT

الأهداف: التعرف على معدل انتشار كلا من: حالات ما قبل ضغط الدم المرتفع، ضغط الدم المرتفع، وعوامل الخطورة المرتبطة بكل منها بين العسكريين.

الطريقة: أجريت هذه الدراسة في ادارة مستشفيات القوات المسلحة بمنطقة الطائف – المملكة العربية السعودية، خلال الفترة مابين سبتمبر 2007م وحتى ديسمبر 2007م، شملت هذه الدراسة 1238 فرداً من العسكريين السعوديين، تم اختيارهم عشوائياً. وقد شمل الفحص تعبئة استبيان عن الخصائص الديموغرافية، التاريخ المرضي، العائلي، بالإضافة إلى فحص إكلينيكي عام للجسم، قياس الطول، الوزن، محيط البطن، القياس العشوائي للسكر بالدم، بالإضافة إلى قياس ضغط الدم.

النتائج: تراوحت أعمار المشاركين مابين 19 – 56 عاماً، ومتوسط عمر المشاركين في الدراسة 37.2±7.02 عاماً، وبتطبيق معايير (الجمعية الوطنية المتحدة)، وذلك لحماية، تحديد، تقييم، وعلاج ضغط الدم المرتفع، تبين أن عدد 214 (17.3%) من المشاركين يعانون من حالات ما قبل ضغط الدم المرتفع (Pre–hypertensive). وبتطبيق طريقة التحليل اللوجيستي متعدد المتغيرات، تبين أن الأشخاص المصابين بالسمنة هم الأكثر عرضة لضغط الدم المرتفع، وذلك بقياس كتلة الجسم (OR=2.71 CI: 1.39, 5.28)، كما كان التاريخ العائلي الايجابي (OR=1.46 CI:1.03, 2.06)، والذين سبق لهم التدخين (OR=1.45 CI:1.05, 2.02)، وزيادة محيط الخصر (OR=1.04 CI:1.02, 1.06)، كانت هي المحددات الأساسية لاحتمالية الإصابة بضغط الدم المرتفع بين العسكريين.

خاتمة: تمثل حالات ما قبل ضغط الدم المرتفع أحد المشكلات الصحية التي غالباً لا يتم تشخيصها. وبناء على نتائج الدراسة نوصي بتعديل أنماط المعيشة خاصة بين البالغين والعاملين في مهن ذات طبيعة خاصة مثل العسكريين، كما توصي الدراسة بعمل أبحاث أخرى لتحديد مدى الحاجة إلى استخدام أدوية في حالات ما قبل ضغط الدم المرتفع.

Objectives: To determine the prevalence of both pre-hypertension and hypertension, and risk factors associated with the newly diagnosed Saudi military active duty personnel.

Methods: A community-based cross-sectional screening of 1238 Saudi military active duty service personnel was conducted during the period from September to December 2007 at the military units of Taif region, western Saudi Arabia. Screening tools included self-administrated questionnaire, general physical examination, anthropometric measurements, and assessment of blood pressure.

Results: All participants were Saudi males. Their age ranged from 19-56 years old with mean±SD of 37.2±7.02. By applying the Joint National Committee on prevention, detection, evaluation, and treatment of high hypertension criteria, 214 (17.3%) were considered pre-hypertensive. Multivariate logistic regression analysis showed that obesity as measured by body mass index [odds ratio (OR)=2.71, confidence interval (CI): 1.39-5.28], positive family history (OR=1.46, CI: 1.03-2.06), ever smoking (OR=1.45, CI: 1.05-2.02), and increased waist circumference (OR=1.04, CI: 1.02-1.06) were the significant predictors of hypertension among military active duty personnel.

Conclusion: Pre-hypertension is a common hidden problem and it predicts the development of frank hypertension. Findings of the current study support the recommendation of lifestyle modification for pre-hypertension patients. However, further prospective studies are required to determine the role of pharmacotherapy in pre-hypertension.

Saudi Med J 2008; Vol. 29 (12): 1779-1784

From the Department of Family and Community Medicine, Al-Hada Armed Forces Hospital, Taif, Kingdom of Saudi Arabia.

Received 31st May 2008. Accepted 22nd November 2008.

Address correspondence and reprint request to: Dr. Saeed M. Al-Asmary, Department of Family and Community Medicine, Al-Hada Armed Forces Hospital, PO Box 1347, Taif, Kingdom of Saudi Arabia. Tel. +966 (2) 7541610. Fax. +966 (2) 7541238. E-mail: fmfayssal@yahoo.com / Ptrc_alhada@yahoo.com

Hypertension, a major public health problem world wide, is associated with high morbidity and mortality rates.[1] The majority of cases are asymptomatic and therefore, goes unrecognized and untreated, leading to a high risk of coronary artery disease, heart failure, renal failure, and cerebrovascular diseases.[2-4] The study on the prevalence of hypertension in Saudi Arabia are variant, ranging from 10-30%.[5-7] This high prevalence rate in the general population is attributed to several cultural and lifestyle factors, that had dramatically changed during the past few years.[5,8] However, military personnel are occupational group with special characteristics. Being away from their families for long periods, frequent movement away from their base for military maneuvers, punctual attendance at their place of work, and work overload contributed significantly to job strain, and consequently stress-related diseases.[2,3,9] Studies that was conducted to assess the prevalence of hypertension (and other chronic diseases), and associated risk factors among this special young occupational group are lacking worldwide.[1] Current blood pressure (BP) classification is based on the recent recommendations of the Joint National Committee (JNC-7) on the prevention, detection, evaluation, and treatment of high BP, and the 2003 European Society of Hypertension- European Society of Cardiology Guidelines for the management of Arterial Hypertension.[10] The JNC-7 introduced a new concept, pre-hypertension, for systolic BP levels of 120-139, and diastolic BP levels of 80-89 mm Hg, and recommended screening programs for early detection of pre-hypertensive cases and health-promoting lifestyle modifications for these individuals.[10] The purpose of this study was to determine the prevalence of both pre-hypertension and hypertension and risk factors associated with newly diagnosed Saudi military active duty service personnel.

Methods. Community-based screening of 1238 Saudi military active duty service personnel was conducted during the period from September to December 2007. Participants were randomly selected among those working at different military units in Taif region, western Saudi Arabia. The study was developed and implemented by the members of the Family and Community Medicine Administration, Kingdom of Saudi Arabia. These hospitals are serving military personnel and their families at Taif region. The study was conducted during regular working hours (between 8:00 am-4:00 pm) at the clinic of each military unit. Approval of the local research and ethics committee was obtained prior commencement of the study, and an informed consent was taken from each study participant to voluntary participate in this screening survey. The study included both non-commissioned officers and soldiers, where 73.9% were from infantry personnel (approximately 903 participants). A response rate of approximately 90% was obtained. Screening tools included self-administered questionnaire, general physical examination, anthropometric measurements (weight, height, and abdominal circumference), and assessment of BP. The questionnaire consisted of personal history (age, marital status, and educational level), history of morbidities (diabetes mellitus, hypertension), family history of chronic conditions (namely, diabetes, hypertension, heart disease), and personal smoking history. Anthropometric measurements were obtained at initial contact with each participant. A flexible, non-stretchable plastic measuring tape was used to determine waist circumference. Measurement was made at the midpoint between the costal margin and superior iliac crest to the nearest centimeter. According to the National Institute of Health guidelines, male waist circumference (WC) >102 cm is considered abnormal.[11,12] Height and weight were measured with Healthometer scales manufactured by Continental Scale Corporation, Bridgeview, Illinois, USA. These scales are ordinary non-electronic scales with weight and height scales in the same device. The scales were calibrated daily, before the start of the working day. Height was measured to the nearest 0.5 centimeter; barefooted and without any headgear. Body weight was measured with a 0.1-kgm precision in light clothing. Body mass index (BMI) was calculated by dividing weight in kilograms by the square of height in meters. Participants were classified according to the World Health Organization[13,14] into the following categories: underweight (<18.5 kg/m^2), normal (18.5-24.9 kg/m^2), overweight (25-29.9 kg/m^2), obese (≥30 kg/m^2). After each participant had seated for 5-10 minutes, BP was measured twice to the nearest 2 mm Hg with the participant sitting, and the left arm resting on the table using a standard mercury sphygmomanometer (Diplomat Presameter 660-360, Riester GMBH, Germany). The average of the 2 measurements was used for all analyses. Diastolic BP (DBP) was recorded at the 5th Korotkoff sound. Hypertension was defined as systolic BP ≥140 mm Hg, or DBP ≥90 mm Hg, or if there is history of taking anti-hypertensive medications.[10] A glucometer device was used to measure random serum blood glucose level (RBG) of each participant. Individuals with self-reported history of diabetes, with anti-diabetic medication, and those with RBG exceeding 199 mg/dl were considered diabetics.[15] The RBG was used, as it is more feasible than fasting glucose measurement, among those active duty personnel as testing was carried out at military units during regular working hours. However, some researchers reported that RBG values could be successfully used as a screening procedure to detect

previously undiagnosed diabetes.[16] In order to study the risk factors associated with hypertension and pre-hypertension, a nested case-control study was adopted, where those with systolic BP (SBP) ≥140 mm Hg, and/or DBP ≥90 mm Hg were considered as hypertensives, those with SBP of 120-139 and/or DBP levels of 80-89 mm Hg as pre-hypertension, while others were treated as controls.

Statistical Analysis. Data were entered into Epi Info software program version 3.3. This program is a statistical software used for epidemiological studies, and released by the Center for Disease Control and Prevention (Atlanta, Georgia, USA) in October 2004. Hypertension and pre-hypertension were treated separately as dependent variables, in both univariate and multivariate logistic regression analysis. Age, history, and duration of smoking, family history of hypertension, BMI, WC, and diabetes mellitus were treated as independent categorical variables. Univariate data analysis was performed and expressed as crude odds ratios (ORs), and their confidence intervals (95% CI). Multiple associations were evaluated in multiple logistic regression model based on the backward stepwise selection, where significant variables from the univariate analysis were included. This procedure allowed the estimation of the strength of the association between each independent variable, while taking into account the potential confounding effects of the other independent variables.

Table 1 - Demographic characteristics of the studied personnel.

Variables	Value n (%)
Age (years)	19-56
Mean±SD	37.2±7.02
Marital status	
Married	1080 (87.20)
Education	
Primary/intermediate	670 (54.1)
Secondary	489 (39.5)
University	79 (6.4)
Smoking	
Active smoker	424 (34.2)
Ex-smoker	177 (14.3)
Never smoked	637 (51.5)
Duration of smoking - mean±SD	10.93±6.61
Obesity	
Overweight (25-29.9 kg/m^2)	471 (38.04)
Obese (30-34.9 kg/m^2)	357 (28.84)
Waist circumference	
≥ 102 cm	316 (25.5)

Table 2 - Prevalence of newly diagnosed and controlled hypertension in the studied participants.

Past history of hypertension*	Blood pressure as measured during screening		
	Normal	Pre-hypertension	Hypertension
	n (%)		
Negative (n=1168)	757 (64.8)	194 (16.6)	217 (18.6)
Positive (n=70)	30 (42.9)	20 (28.6)	20 (28.6)
Total (n=1238)	**787 (63.6)**	**214 (17.3)**	**237 (19.1)**

* Past history of medical diagnosis or treatment of hypertension.

Results. All participants were Saudi males. Their age ranged from 19-56 years old, with a mean±SD of 37.2±7.02 years. Most of them were married, and only 6.4% of participants have university education. Approximately half of the participants ever smoked (48.5%), with a mean (±SD) duration of smoking of 10.93 years (±6.61). Obesity in the current study was measured using BMI, and abdominal circumference. Body mass index revealed that 38% of the participants were overweight, 28.8% were obese, and 7.5% were underweight. However, 25.5% have abdominal circumference of more than 102 cm (**Table 1**). Two hundred and seventeen active duty participants (17.53%) were newly diagnosed with high BP among all studied participants (they neither have past history of hypertension nor take any medication for high BP). Among those who reported past history of hypertension (n=70), 71.5% were controlled (either normal or pre-hypertension) compared to 28.6% with uncontrolled high BP (**Table 2**). High systolic and diastolic BP was reported in 5.9% of all participants, high diastolic in 11.8%, and high systolic in only 1.5%. By applying the NJC-7 criteria, 194 (16.6%) were considered as newly diagnosed pre-hypertensives (**Table 2**). Univariate logistic regression analysis was performed to determine risk factors among newly diagnosed hypertensive (n=217), and pre-hypertensive participants (n=194). Risk of hypertension was significantly higher among older participants (more than 40 years old), positive family history participants, ever-smoked, as compared to those who never smoked, duration of smoking more than 10 years, BMI of 25-29.9 kg/m^2, and BMI ≥29.9 kg/m^2, abdominal circumference ≥102 cm, and diabetics as compared to non-diabetics (**Table 3**). However, significant higher risk of pre-hypertension was associated only with obesity as measured by BMI ≥29.9 kg/m^{2,} and abdominal circumference ≥102 cm (**Table 3**). Multivariate logistic regression analysis showed that obesity as measured by BMI, positive family history, ever smoking, and increased WC were the significant predictors of workplace newly diagnosed hypertension among military active duty personnel (**Table 4**).

Discussion. Few national data exist on the prevalence of hypertension, and its associated risk factors among military personnel. This study provides community-based data on abnormal BP among active

Table 3 - Univariate logistic regression analysis of independent variables associated with newly diagnosed pre-hypertension and hypertension.

Parameters	Blood pressure			Unadjusted odds ratio Pre-hypertension versus Normal	Unadjusted odds ratio Hypertension versus Normal
	Normal	Pre-hypertension	Hypertension		
	n (%)			95% Confidence interval	
Age (years)					
< 40	600 (67.0)	146 (16.3)	150 (16.7)	1	1
≥ 40	157 (57.7)	48 (17.6)	67 (24.6)	1.26 (0.85-1.85)	1.71 (1.20-2.42)
Smoking					
Never smoked	410 (67.8)	100 (16.5)	95 (15.7)	1	1
Ever smoked	348 (61.8)	93 (16.5)	122 (21.7)	1.10 (0.79-1.52)	1.51 (1.10-2.07)
Duration of smoking					
Never smoked	410 (67.8)	100 (16.5)	95 (15.7)	1	1
< 10 years	155 (65.4)	39 (16.5)	43 (18.1)	1.03 (0.67-1.59)	1.20 (0.78-1.83)
≥ 10 years	192 (58.9)	55 (16.9)	79 (24.2)	1.17 (0.80-1.73)	1.78 (1.24-2.54)
Family history					
Negative	547 (67.0)	130 (15.9)	139 (17.0)	1	1
Positive	210 (59.7)	64 (18.2)	78 (22.2)	1.28 (0.90-1.82)	1.46 (1.05-2.04)
Body mass index					
Normal	237 (76.5)	42 (13.5)	31 (10.0)	1	1
Overweight	298 (68.0)	67 (15.3)	73 (16.7)	1.27 (0.82-1.98)	3.14 (2.00-4.94)
Obese	140 (42.7)	78 (23.8)	110 (33.5)	1.87 (1.16-3.02)	6.01 (3.75-9.67)
Waist circumference					
< 102 cm	634 (71.3)	131 (14.7)	124 (13.9)	1	1
≥ 102 cm	123 (44.1)	63 (22.6)	93 (33.3)	2.48 (1.71-3.60)	3.87 (2.74-5.46)
Diabetes mellitus					
Negative	719 (66.2)	178 (16.4)	189 (17.4)	1	1
Positive	38 (46.3)	16 (19.5)	28 (34.1)	1.70 (0.89-3.23)	2.80 (1.63-4.82)

Table 4 - Multivariate logistic regression analysis of predictors of pre-hypertension and hypertension among the studied participants.

Independent variables	Newly diagnosed hypertension					Newly diagnosed pre-hypertension				
	B	SE	*P*-value	Adjusted OR	95% CI	B	SE	*P*-value	Adjusted OR	95% CI
Family history	0.38	0.18	0.03	1.46	1.03-2.06*	-	-	-	-	-
Smoking	0.37	0.17	0.03	1.45	1.05-2.02*	-	-	-	-	-
Overweight (BMI 25-29.9 kg/m^2)	0.33	0.26	0.21	1.39	0.84-2.30	0.49	0.28	0.08	1.63	0.93-2.84
Obesity (BMI ≥ 29.9 kg/m^2)	1.00	0.34	0.003	2.71	1.39-5.28*	0.42	0.19	0.03	1.52	1.05-2.19*
Waist circumference	0.04	0.01	0.001	1.04	1.02-1.06*	0.30	0.01	0.001	1.03	1.01-1.05*
Diabetes mellitus	0.56	0.29	0.054	1.75	0.99-3.11	-	-	-	-	-

*Statistically significant, B - beta coefficient, SE - standard error, OR - odds ratio, CI -confidence interval.
Logistic regression model includes terms of family history (positive versus negative), smoking (ever versus never); overweight and obesity versus normal weight; waist circumference as a continuous variable and diabetics (high blood sugar or past history of diagnosis and/or treatment) versus non-diabetics.
Only variables that were significant using the univariate analysis were introduced in the multivariate model.

duty Saudi military personnel. Despite the young age, and potential physical activity of the majority of military personnel,[17] prevalence of hypertension in the current study (23.2%) was approximately similar to that of the general population.[5-7] This may reflect the impact of lifestyle factors (namely; eating habits, smoking, and lack of regular physical exercise), beside work related factors (job strain and stress), to which military personnel's are exposed.[4,5,9]

In the current study, obesity as measured by BMI and WC, was the only significant predictor of the newly diagnosed pre-hypertension, and it was also significantly associated with the newly diagnosed hypertension. This is in accordance with many other researchers who recognized obesity, as a major risk factor for the development of hypertension.[1,11,18,19] Saudi military is experiencing a trend toward increasing overweight that mirror the pattern among the general population.[6,7,8,12] Overweight and obesity in the current study was 66.9%, compared to similar figures reported among the US military male personnel, which were 75%,[4] and 63%.[20] A graded increase in the OR was observed with

increasing severity of overweight and obesity[20] similar to the findings of the current study. The addition of WC to BMI predicts a greater variance in health risk than does BMI alone.[18,21] Both WC and BMI were included in the same regression model. Waist circumference significantly predicts both pre-hypertension and hypertension, when used as a continuous variable. However, whether it is continuous or dichotomized as normal (<102 cm), or high (≥102 cm), BMI remains a significant predictor. Some researchers concluded that WC, and not BMI, explains obesity-related health risks.[21,22] Others reported that WC was not predictive of the metabolic syndrome, or component risk factors in men,[18] or suggested an equivalent value of both methods.[23] Hypertension is common in diabetics, and diabetes control is associated with prevention of cardiovascular complications.[24,25] The Framingham study reported that 21% of patients with hypertension had high blood sugar,[26] compared to 12.9% in the current study. The prevalence of smoking in the current study was considered very high. It is reported that 48.5% were either active, or ex-smokers. Reports on smoking in the general population range from 10-20% among Saudi males.[6] In the current study, smoking for long periods more than 10 years showed significant association with the newly diagnosed hypertension, both in the univariate and multivariate analyses. This finding supports the contribution of smoking to the occurrence of hypertension,[27-29] however, other studies[30-32] revealed that smokers had lower BP than non-smokers. Further in-depth studies are highly recommended to explore mechanisms by which smoking affects BP, and to investigate factors associated with smoking at the military workplace, and its relation to the work pattern.

In the current study, positive family history, a known risk factor of hypertension, was reported in 35.9% of the newly diagnosed cases, compared to 23.6% among all hypertensives (including those with past history of hypertension). This supports the findings of the previous studies,[7] in contrary to Gan et al,[30] who reported that parental history of hypertension does not show significant correlation in the regression model. While the prevalence of hypertension is low compared to the older age groups, it remains important to detect cases early, as appropriate treatment may mitigate long-term cardiovascular risks, and reduce target organ damage.[30,33] Prevention and regular screening for hypertension and significant associated risk factors should be emphasized, to improve readiness and reduce health care costs, and disease burden among this active group.[4] Screening for pre-hypertension is very important because pre-hypertension is very common,[1,2,9] most cases remained undetected, and moreover, it predicts the development of frank hypertension. Despite the importance of early detection of pre-hypertension, subjects with pre-hypertension should be closely followed.[9] A cross-sectional study conducted by Celik et al[34] revealed, that young patients with pre-hypertension have impaired aortic elasticity, compared with the healthy controls. They recommended further studies, to evaluate the clinical significance of impaired aortic elasticity in patients with pre-hypertension, and investigate the effectiveness of some pharmacologic and non-pharmacologic management strategies, to regress and/or prevent these pathologic changes.

This study supports the recommendation of lifestyle modification in the usual life, to prevent the progression to true hypertension, because the pre-hypertensive subject is not uncommon. Unhealthy lifestyle habits (namely, tobacco use, lack of regular exercise, high fat and salt diets) are known predisposing factors for vascular changes predisposing for pre-hypertension.[1,2] Furthermore, Wynd et al[35] reported that health promotion through diet and exercise programs among a pilot of military personnel has improved those with borderline hypertension. However, further prospective studies are required to determine the role of pharmacotherapy in pre-hypertension.[33,34] Concerted efforts should be implemented to prevent and treat risk factors of pre-hypertension (mainly obesity), rather than just their associated co-morbidities. The armed forces hospitals had a unique opportunity to respond to the epidemic of chronic diseases,[4,31] where comprehensive approach for workplace health promotion (for example, weight management programs) can be effectively implemented.[3,32] Moreover, there is an urgent need to motivate the physicians at the primary care level to identify the problem, and implement requisite remedial measures focusing on lifestyle modification practices.

Limitations of the study. It may be difficult to generalize the current findings to the general population because the study participants were a unique group (military personnel). However, future studies should focus on the impact of work pattern and job strain in the development of hypertension, especially in the military services, where the place of work, and work overload contributed significantly to job strain, and consequently stress-related diseases.[2,3,9] Another limitation is related to the characteristics of the cross-sectional studies. Thus, longitudinal studies are required, to assess the effect of early detection of pre-hypertension on the prevention of cardiovascular morbidity and mortality outcomes.

References

1. Israeli E, Schochat T, Korzets Z, Tekes-Manova D, Bernheim J, Golan E. Prehypertension and obesity in adolescents: a population study. ***Am J Hypertens*** 2006; 19: 708-712.
2. Grotto I, Grossman E, Huerta M, Sharabi Y. Prevalence of prehypertension and associated cardiovascular risk profiles among young Israeli adults. ***Hypertension*** 2006; 48: 254-259.

3. Kress AM, Hartzel MC, Peterson MR. Burden of disease associated with overweight and obesity among U.S. military retirees and their dependents, aged 38-64, 2003. ***Prev Med*** 2005; 41: 63-69.
4. Nowicki EM, Billington CJ, Levine AS, Hoover H, Must A, Naumova E. Overweight, obesity, and associated disease burden in Veterans affairs ambulatory care populations. ***Mil Med*** 2003; 168: 252-256.
5. Siddiqui S, Ogbeide DO, Karim A, Al-Khalifa I. Prevalence of hypertension in patients attending Al-Kharj military hospital. ***Saudi Med J*** 2000; 21: 558-560.
6. Al-Khashman AS. Screening for hypertension. Assessing the knowledge, attitudes and practice of primary health care in Riyadh, Saudi Arabia. ***Saudi Med J*** 2001; 22: 1096-1100.
7. Abolfotouh MA, Abu-Zeid HA, AbdelAziz M, Alakija W, Mahfouz AA, Bassuni WA. Prevalence of hypertension in south-western Saudi Arabia. ***East Mediteranean Health J*** 1996; 2: 211-218.
8. Al-Sharif AI, Al-Khaldi YM. Resources availability for care of hypertensives at primary health settings in South western Saudi Arabia. ***Saudi Med J*** 2003; 24: 466-471.
9. Grossman A, Grossman C, Barenboim E, Azaria B, Goldstein L, Grossman E. Pre-hypertension as a predictor of hypertension in military aviators: A longitudinal study of 367 men. ***Aviat Space Environ Med*** 2006; 77: 1162-1165.
10. National Institute of Health. Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. [Sept 2008]. Available from: http://www.nhlbi.nih.gov/guidelines/hypertension/jnc7full.pdf
11. Janssen I, Katzmarzyk PT, Ross R. Body mass index, waist circumference, and Health risk: evidence in support of current National Institutes of health guidelines. ***Arch Intern Med*** 2002; 162: 2074-2079.
12. Al-Nozha MM, Arafah MR, Al-Maatouq MA, Khalil MZ, Khan NB, Al-Marzouki K, et al. Hyperlipidemia in Saudi Arabia. ***Saudi Med J*** 2008; 29: 282-287.
13. National Center for Health Statistics. Mobile Exam Center Components Descriptions. [October 2008]. Available from: http://www.cdc.gov/nchs/data/nhanes/meccomp.pdf
14. Definition, Diagnosis and Classification of Diabetes Mellitus and its Complications. Part 1: Diagnosis and Classification of Diabetes Mellitus (WHO/NCD/99.2). Geneva (Switzerland): World Health Organization; 1999.
15. American Diabetes Association. Diagnosis and classification of diabetes mellitus. ***Diabetes Care*** 2006; 29 (Suppl 1): S43-S48.
16. Ostlund I, Hanson U. Repeated random blood glucose measurements as universal screening test for gestational diabetes mellitus. ***Acta Obstet Gynecol Scand*** 2004; 83: 46-51.
17. Lindquist CH, Bray RM. Trends in overweight and physical activity among U.S. Military personnel, 1995-1998. ***Prev Med*** 2001; 32: 57-65.
18. Harada K, Karube Y, Saruhara H, Takeda K, Kuwajima I. Workplace hypertension is associated with obesity and family history of Hypertension. ***Hypertens Res*** 2006; 29: 969-976.
19. Ardern CI, Katzmarzyk PT, Janssen I, Ross R. Discrimination of health risk by combined body mass index and waist circumference. ***Obes Res*** 2003; 11: 135-142.
20. Must A, Spadano J, Coakley EH, Field AE, Colditz G, Dietz WH. The disease burden associated with overweight and obesity. ***JAMA*** 1999; 282: 1523-1529.
21. Janssen I, Katzmarzyk PT, Ross R. Waist circumference and not body mass index explains obesity-related health risk. ***Am J Clinic Nutr*** 2004; 79: 379-384.
22. Wildman RP, Gu D, Reynolds K, Duan X, Wu X, He J. Are waist circumference and body mass index independently associated with cardiovascular disease risk in Chinese adults? ***Am J Clin Nutr*** 2005; 82: 1195-1202.
23. Bosy-Westphal A, Geisler C, Onur S, Korth O, Selberg O, Schrezenmeir J, et al. Value of body fat mass vs anthropometric obesity indices in the assessment of metabolic risk factors. ***Int J Obes*** 2006; 30: 475-483.
24. Tahtinen TM, Vanhala MJ, Oikarinen JA, Keinanen-Kiukaanniemi SM. Effect of smoking on the prevalence of insulin resistance-associated cardiovascular risk factors among Finnish men in military service. ***J Cardivasc*** 1998; 5: 319-323.
25. Raitakari OT, Porkka KV, Rasanen L, Viikari JS. Relations of life-style with lipids, blood pressure and insulin in adolescents and young adults. The cardiovascular risk in young Finns study. ***Atherscleros*is** 1994; 111: 237-246.
26. Kannel WB. Bishop lecture. Contribution of the Framingham Study to preventive cardiology. ***J Amer Coll Cardiol*** 1990; 15: 206-211.
27. Wells AJ. Passive smoking as a cause of heart disease. ***J Am Coll Cardiol*** 1994; 24: 546-554.
28. Humble C, Croft J, Gerber A, Casper M, Hames CG, Tyroler HA. Passive smoking and 20-year cardiovascular mortality among non-smoking wives, Evans Country, Georgia. ***Am J Public Health*** 1996; 80: 599-601.
29. Howard G, Wagenknecht LE, Burke GL, Diez-Roux A, Evans GW, McGovern P, et al. Cigarette smoking and progression of atherosclerosis. The atherosclerosis in communities (ARIC) study. ***JAMA*** 1998; 279: 119-124.
30. Gan SK, Loh CY, Seet B. Hypertension in young adults-an under-estimated Problem. ***Singapore Med J*** 2003; 44: 448-452.
31. Das SR, Kinsinger LS, Yancy WS, Wang A, Ciesco E, Burdick M, et al. Obesity prevalence among veterans at Veterans Affairs medical facilities. ***Am J Prev Med*** 2005; 28: 291-294.
32. Kress AM, Peterson MR, Hartzell MC. Association between obesity and Depressive symptoms among U.S. Military active duty service personnel, 2002. ***J Psychosom Res*** 2006; 60: 273-271.
33. Celik T, Iyisoy A, Kursaklioglu H, Turhan H, Cagdas Yuksel U, Kilic S, et al. Impaired aortic elastic properties in young patients with prehypertension. ***Blood Press Monit*** 2006; 11: 251-255.
34. Celik T, Iyisoy A, Acikel C, Yuksel C, Celik M, Yaman H, et al. The comparative effects of metoprolol and perindopril on aortic elasticity in young patients with prehypertension. ***Blood Press Monit*** 2008; 13: 169-176.
35. Wynd CA, Bonnefil C, Harris JS. A comparison of health needs and personal health goals of Army Reserve Military and civilian employees. ***Mil Med*** 2001; 166: 14-20.