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Original Article

Physical Activity, Nutrition, and Dyslipidemia in Middle-Aged Women

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Abstract

Background: Cardiovascular disease is a major cause of death throughout the world. The aim of this study was to assess the prevalence of overweight/obesity, central obesity, hypertension and dyslipidemia, as well as dietary factors contributing to the development of dyslipidemia among middle-aged women.

Methods: The research design of the present study was a population-based cross-sectional study; anthropometric measures and blood chemistry were obtained. Physical activity was measured using the original International Physical Activity Questionnaires Long Form while food frequency questionnaire (FFQ) was used in assessing individual's habitual intake. Overall, 809 women, 30-50 years of age from fourteen active urban Primary Healthcare Centers (PHC) in Babol City, northern Iran, were obtained from 1,905 households across operational areas of 14 PHC using systematic random sampling method.

Results: The prevalence rates of women classified as overweight/obese, with central obesity, hypertension and dyslipidemia were 82.8%, 75.5%, 14.6% and 63.4%, respectively. Total physical activity did not correlate with cholesterol ratio. Soybean protein was inversely associated with cholesterol ratio (rho=-0.18, $P \leq 0.001$). The adjusted OR for dyslipidemia in women with moderate protein intake was significantly higher than in women with high and low intake (OR=2.31; 95% CI= 1.61, 3.30). No significant associations were found between dyslipidemia and carbohydrate, fat intake or physical activity.

Conclusion: This study showed very high prevalence of cardiovascular disease risk factors among Iranian middle-aged women. A more detailed study is suggested to develop definitively recommendations for the primary and secondary prevention of cardiovascular disease for the Iranian population.

Keywords: Nutrition, Physical activity, Dyslipidemia, Women's health

Introduction

Cardiovascular disease is recognized as the most common cause of death worldwide (1). Overweight/obesity, hypertension, dyslipidemia, and other manifestations are major risk factors (2). Improved long-term outcomes have been attained as a result of physicians' recommendations for dietary practices and physical activity that lead to several favorable parameters such as a healthier waist circumference and improved body mass index, lower blood pressure, improved HDL-cholesterol, and triglyceride levels (3). HDL-cholesterol is protective against cardiovascular disease and decreases cardiovascular morbidity and mortality (4). A meta-analysis has shown

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that glucose and lipid metabolism are strongly related and a high carbohydrate diet, which contributes to disorders of glucose metabolism, increase plasma triglycerides and decrease in HDL-cholesterol (5).

It is suggested that local eating habits, lifestyle patterns and consumption of high caloric foods are predisposing factors of obesity. Babolian women have access to a diet that is rich in carbohydrate (rice) (6). A diet high in carbohydrates has been associated with overeating and the risk of obesity. Some researchers reported the effects of high carbohydrate consumption on being overweight in which triglyceride concentrations appear to be greater in men than women (7, 8). The occurrence of obesity and other cardiovascular disease risk factors have not been extensively examined, particularly among Iranian middle-aged women. Therefore, we investigated the prevalence of overweight/obesity, central obesity, and other cardiovascular disease risk factors, namely high blood pressure and dyslipidemia among middle-aged women. Finally, we investigated the relationship of physical activity and nutrition with dyslipidemia.

Materials and Methods

This study was conducted with the approval of the Medical Research Ethics Committee of the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, and Babol University of Medical Sciences approved the study. Written informed consent was obtained from the participants. The research design of this study was a population-based cross-sectional study, in which a list of households managed by Primary Health Care Center (PHCs) (the official bodies responsible for the vaccination programs and collection of health-related statistics in urban) was used. A total of 5,782 households listed in the operational areas of the 14 PHCs in the urban area in Babol, Mazandaran, Iran were used as the sampling frame. Systematic random sampling was used to select 1,905 households. From these, eight hundred and nine women between 30 and 50 yr of age were found within these households and all were selected.

A Food Frequency Questionnaire (FFQ) was used for dietary factors; its validity and reliability has been assessed by Malekshah et al. This FFQ is based on the distinct cultural practices of northern Iran, the eastern part of Mazandaran province (new Golestan province) (9). Malekshah et al. has shown that this FFQ is both reliable and valid in middle-aged subjects in a developing country when compared with multiple 24 h recalls or biomarkers of nutrient intake. They reported that the FFQ provides valid and reliable measurements of habitual intake for energy and most of the nutrients studies (9). The Iranian food composition table was also used to calculate daily energy and nutrient intake (10). The data provided information regarding total calories consumed per day, protein, carbohydrate, fat, as well as percent of carbohydrate, protein, and fat.

Physical activity was measured using the original International Physical Activity Questionnaires (IPAQ) Long, usual week form (11, 12).

Fasting blood samples for the measurement of lipid concentrations were drawn from the right arm of each subject, in the resting position, by ante-cubital vein puncture with a 1.4-mm Wasserman needle, after an overnight fast of 12 h. Total cholesterol and triacylglycerols were determined using commercially available enzymatic reagents adapted to the selectra autoanalyzer (Parsazmon). HDL-cholesterol was measured after precipitation of the apolipoprotein B–containing lipoproteins with phosphotungstic acid. LDL-cholesterol level was calculated by the Friedewald formula (LDL-cholesterol= total cholesterol-HDL-cholesterol-triglyceride/5 mg/dl). Whenever triglyceride concentrations were more than 400 mg/dL, LDL-cholesterol was determined chemically (13). All blood samples were analyzed when internal quality control met the acceptable criteria. Inter-assay and intra-assay coefficients of variation were 8.6% and 2.5% for total cholesterol and 7.9% and 1.6% for triglyceride, respectively.

Body mass index was calculated from height and weight (kg/m^2) measured using standardized examination protocols. Waist circumference was measured to the nearest 0.1 centimeter, using a tape measure at the level midway between the lower rib margin and iliac crest (14).

Dyslipidemia was defined as total cholesterol ≥200 mg/dl or triglyceride ≥150 mg/dl or LDL-cholesterol ≥130 mg/dl or HDL-cholesterol <40 mg/dl (15). A total cholesterol/HDL-cholesterol ≥ 4 was also considered as adverse serum lipid profile (16).

High Blood Pressure (hypertension) was defined as; a systolic pressure of at least 140 mm Hg or diastolic pressure of at least 90 mm Hg (17).

Statistical Analysis

All analyses were performed with SPSS (version 16.0). All variables were tested for normality using skewness and kurtosis values as well as the Kolmogorov-Smirnoff test. The data were not normally distributed: hence, associations between groups were done using the chi square. To test the association between cardiovascular disease risk factors and characteristics of women, stepwise multiple logistic regression was used. The relationship between nutrition and physical activity with dyslipidemia were assessed by use of logistic regression. The correlations of continuous variables such as total physical activity and soybean protein with cholesterol ratio were assessed by use of Spearman's rank correlation coefficient (rho). Odds ratios (OR) are presented together with their 95% CI. Adjustments were made for independent variables, which include demographic, anthropometric and lifestyle factors (physical activity, nutrient intake). All analyses were employed using two-tailed hypothesis testing with level of significance set at 0.05.

Results

Out of 809 study subjects, 800 had FFQ and laboratory results and were therefore available for analyzing association between physical activity and dietary factors with dyslipidemia. Table 1 shows the characteristics of middle-aged women. The mean age of the participants was 39.6±6.0 yr and the median age was 39.0 yr. Study participants had a mean education of 6.8 yr. The mean monthly household income was 249,000. 2±196.3 Tomans (1 Tomans= 0.001 USD) and median household income was 200,000 Tomans. The prevalence rates of overweight/obesity, central obesity, hypertension, and dyslipidemia were 82.8%, 75.5%, 14.6%, and 63.4%, respectively (Table 2). Overall 82.6% of our participants had blood pressure within optimal range of systolic blood pressure <130 mmHg and diastolic blood pressure <85 mmHg. Prevalence of hypercholesterolemia (total cholesterol ≥200), hypertriglyceridemia (triglyceride ≥150), high LDL-cholesterol (≥130) and low HDL-cholesterol were 36.6%, 38.5%, 22.3%, and 17.5% for middle-aged women, respectively. The mean total cholesterol/HDL-cholesterol ratio was 3.9±1.3 and the median was 3.7.

Table 1: Characteristics of middle-aged women, Babol, Iran (n= 809)

Variables	n (%)
Age (years)	
30-40	478 (59.1)
41-50	331 (40.9)
Marital status	
Married	710 (87.8)
Single/ Widowed/ Divorced	99 (12.2)
Education level (years)	
<6	393(48.6)
6–11	203(25.1)
≥12	213 (26.3)
Occupation	
House wife	726 (89.7)
worker	83(10.3)
Income (Tomans /month)	
<150000	204 (25.2)
150,000-300,000	456 (56.4)
>300,000	149 (18.4)
Menstrual status	
Regular menstrual	710 (87.8)
Menopause	99 (12.2)

Notes: Toman; 10 Rials = 1 Tomans= 0.001 USD

As shown in Table 3, increasing age was significantly associated with hypertension and central obesity. Married women were more likely to be overweight and centrally obese than single women were (OR= 3.08; 95% CI= 1.64, 5.78 and OR= 1.86 (1.01-3.51) respectively). The likelihood of being overweight was higher in women with school education <12 yr compared with those with university education (OR =3.72; 95% CI= 1.74, 7.97 for 6-11 yr of education group and OR= 4.33; 95% CI= 2.12, 8.86 for <6 yr of education group). We did not find any factor that was significantly associated with the dyslipidemia.

A higher proportion of women had moderate and high physical activity (24.8%, 74.5%, respectively). Only nine women (0.6%) reported being inactive (low physical activity level). The mean total kilocalorie consumed per day was 2,966±1,080. Table 4 shows the adjusted odds ratio (with 95% CI) for different levels of carbohydrate, protein, fat intake, and physical activity. After controlling for age, total physical activity, years of school, income and body mass index, total energy intake, protein, fat, carbohydrate, the adjusted OR for dyslipidemia in women with moderate protein intake was significantly higher than in women with high and low intake (OR=2.31; 95% CI =1.61, 3.30). No significant associations were found between dyslipidemia and carbohydrate, fat intake or physical activity. Spearman correlation coefficient has shown soy bean protein was inversely associated with cholesterol ratio (rho= -0.18, *P*< 0.001) and total physical activity did not correlate with total cholesterol:HDL cholesterol ratio.

Table 2: Overweight, central obesity, hypertension, and dyslipidemia prevalence among middle-aged women, Babol, Iran (n=809)

Variable Age (year)[2]	Overweight/obese n (%)	Central obesity n (%)	Hypertension n (%)	Dyslipidemia[1] n (%)
30-40	393 (82.2)	345 (72.2)	59 (12.3)	292 (62.0)
41-50	277 (83.7)	266 (80.4)	59(17.8)	215 (65.3)
llarevO 30-50	670(82.8)	611(75.5)	118 (14.6)	507 (63.4)

[1] missing; 9 cases

Table 3: Simple Logistic regression: overweight, central obesity, hypertension, and dyslipidemia according characteristics of middle-aged women, Babol, Iran (n=800)

Variables	Overweight OR (95% CI)	Central obesity OR (95% CI)	Hypertension OR (95% CI)	Dyslipidemia OR (95% CI)
Age (years)				
30-40	0.90 (0.62-1.31)	0.63 (0.45-0.89) †	0.65 (0.44-0.96) *	0.87(0.65-1.16)
41-50	1.00	1.00	1.00	1.00
Marital status				
Married	3.08 (1.64-5.78)*	1.86 (1.01-3.51) *	0.95 (0.41-2.17)	1.10 (0.59-2.05)
Single/ Widowed/ Divorced	1.00	1.00	1.00	1.00
Education level (years)				
<6	4.33 (2.12-8.86) ‡	5.04 (2.49-10.24)	3.33 (0.78-14.11)	1.07 (0.51-2.24)
6–11	3.72 (1.74-7.97) ‡	2.84 (1.36-5.91)	1.62 (0.36-7.29)	0.97 (0.45-2.08)
≥12	1.00	1.00	1.00	1.00
Occupation				
House wife	1.07 (0.59-1.94)	1.37 (0.84-2.27)	1.13 (0.58-2.20)	0.85 (0.52-1.39)
worker	1.00	1.00	1.00	1.00
Income (Tomans /month)				
<150000	0.58 (0.34-0.1.0) *	1.25 (0.79-1.99)	2.42 (1.18-4.97)	1.06 (0.68-1.66)
150,000-300,000	1.06 (0.63-1.77)	1.73 (1.14-2.61)	2.43 (1.25-4.71)	0.86 (0.58-1.27)
>300,000	1.00	1.00	1.00	1.00
Menstrual status				
Regular menstrual	1.55 (0.93-2.57)	0.71 (0.42-1.20	1.04 (0.57-1.90)	0.86 (0.55-1.35)
Menopause	1.00	1.00	1.00	1.00

Notes: OR = odds ratio; CI = confidence interval, Toman; 10 Rials = 1 Tomans= 0.001 USD, * $p \leq .05$., † $p \leq .01$., ‡ $P \leq .001$.

Table 4: Multiple Logistic regression of dyslipidemia according to level of physical activity and different types of intake of nutrition (n=800)

Variables	Adjusted OR	95% Confidence interval	*P*-value
Physical activity (PA)			
Low/moderate PA	1.03	0.72-1.41	0.985
High PA	1.00		
Carbohydrate (CHO)			
Low CHO (<40%)[2]	0.74	0.26-2.11	0.576
Moderate CHO (40-60%)[2]	0.94	0.65-1.35	0.727
High CHO (>60%)[2]	1.00		
Protein (Pro)			
Low Pro (<15%)[2]	0.71	0.28-1.82	0.476
Moderate Pro (15-30%)[2]	2.31	1.61-3.30	≤0.001
High Pro (>30%)[2]	1.00		
Fat			
Low Fat (<30%)[2]	1.53	0.92-2.53	0.100
Moderate Fat (30-40%)[2]	0.94	0.61-1.44	0.77
High Fat (>40%)[2]	1.00		

[1] Adjusted for age, total physical activity, years of school, income and BMI, total energy intake, protein, fat, CHO.
[2] ….% of daily energy intake

Discussion

A striking finding of the present study was high prevalence of major cardiovascular disease risk factors, notably overweight/obesity, central obesity, and dyslipidemia among middle-aged women. The prevalence of overweight/obesity and central obesity reported here appear to be much higher than other surveys involving adults. However the World Health Organization (WHO) has estimated the mean body mass index in Africa and Asia at about 22-23 kg/m^2 (18). In this study the mean body mass index was 29.5±5.5 kg/m^2 which was greater than those of American, European and in some Latin American, North African and Pacific Island Countries as reported by WHO (2008) with mean BMI between 25-27 kg/m^2. The National Health and Nutrition Examination Surveys reported more than 75% of patients were overweight/obese (19). Summary data from seven developing countries reported 50% were overweight (20), while the present study indicates that 82.8% of urban middle-aged women are overweight/obese. The results of the univariate analysis showed that being overweight was related to education level of women. Those women with a lower education level were more likely than those with a higher education level to be overweight/ obese.

The waist circumference directly reflects abdominal fat mass and has been suggested as an index of central obesity (21) which is an independent predictor for cardiovascular disease (22). The mean waist circumference in our study was 96.9 cm which is more than what had previously been reported in a WHO project where the age-adjusted mean waist circumference in nineteen population studies was 78 to 91 cm in women (23). This was also more than that previously reported from Iran (the age-adjusted mean waist circumference in women was 89.6 cm) (24). The waist circumference in our study is closer to that found in Northeast Iran in Golestan Province (mean waist circumference in women was 98.0 cm) (25). In this study, we measured waist circumference based on the WHO Expert Committee on Physical Status definition. The mean waist circumference was higher than those in other

studies. The prevalence of central obesity was 75.5% in middle-aged women. The previous study in Tehran reported that the prevalence of central obesity was 93% in adult women (26). The univariate analysis showed central obesity was related to age and marital status of middle-aged women. Older and married women are more likely than younger and single women to have central obesity are.

The hypertension prevalence among the geographical areas in Iran is also considerably different. In a study in Tehran, the age-adjusted prevalence of hypertension in women was 23.3% (27); in Isfahan, it was 17.3% (28). The prevalence of hypertension in our study was lower than that of many other countries, such as France (22.2%) (29), Korea (25.9%) (30) and Malaysia (33%) (31). This may be due to the differences in age of the subjects and environmental or cultural conditions. Many factors, such as heredity, insulin resistance, environmental factors, and intake of sodium and calcium may affect the genesis of hypertension (32). Multivariable analysis demonstrated that increase in age (41-50 yr) was a risk factor for hypertension. Further evaluating the possible role of waist circumference in the pathogenesis of hypertension is needed.

In contrast to hypertension, the prevalence of dyslipidemia was greater than many other countries such as Portugal (32.0%) (33) and Brazil (24.2%) (34). In a study in Isfahan, prevalence of dyslipidemia was 66.3% (28). In our sample of middle-aged women, logistic regression analyses showed that none of the risk factors studied significantly correlated with dyslipidemia.

The total cholesterol/HDL-cholesterol ratio is a powerful predictor of coronary heart disease risk. The target level for total cholesterol/HDL-cholesterol is less than 4.0 (35). Some investigators suggest that this “cholesterol ratio” is a simplistic approach for lipid risk assessment. This ratio reflects two powerful components of risk (36, 37). A total cholesterol/HDL-cholesterol ≥4 is also associated with an unfavorable serum lipid profile (16). The mean total cholesterol/ HDL-cholesterol ratio was 3.9 and the prevalence of high total cholesterol/HDL-cholesterol ratio was 39.6%. This is in contrast to the mean level of total cholesterol/HDL- cholesterol ratio in two Swiss regions (4.2 and 4.4) and the prevalence of abnormal cholesterol/HDL-cholesterol ratio of 22.4% and 25.9%, respectively (38). We found a higher prevalence of women with abnormal cholesterol/HDL-cholesterol ratio compared to Turkey (39), Switzerland (38), and Canada (40).

Physical inactivity may contribute to the high prevalence of dyslipidemia (41). Physical activity increases HDL-cholesterol concentration (42-44) and decreases triglyceride concentrations (45). In this study, middle-aged women were physically very active. Our data also shows that the level of physical activity was not related to dyslipidemia. Assessment of selected indicators of physical activity may be needed to focus better preventive interventions at the population and individual levels. Due to this study being a cross-sectional design conclusions on causality are weak. A longitudinal study may better show the associations between physical activity and metabolic syndrome in women. Although physical activity was measured through self-reported questionnaires (IPAQ), this may be subject to underreporting and recall bias. In many physical activity questionnaires, the absence of household-related physical activity may be another source of misclassification, mainly in women (46).

The relationship between dietary carbohydrates and dyslipidemia is controversial. Parks and Hellerstein (7) stated that very high intakes of carbohydrate were associated with dyslipidemia while in this study, there was no relationship between carbohydrate intake and dyslipidemia.

Fatty acids can be classified into saturated fatty acids, monounsaturated fatty acids and polyunsaturated fatty acids. Intake of monounsaturated fatty acids is found to decrease LDL-cholesterol, but does not decrease HDL-cholesterol and does not increase triglycerides (47, 48). Polyunsaturated fatty acids can cause reduction in LDL-cholesterol, HDL-cholesterol, and triglycerides. In general, saturated fatty acids may also have harmful effects while polyunsaturated fatty acids

may have a protective role (49). In the present study, the association between dyslipidemia and fat intake was not significant. Our analysis did not discriminate between saturated, polyunsaturated and monounsaturated fatty acid and therefore it is not known whether lack of association between fats and dyslipidemia is due to high intake of saturated fat. However, physicians recommend maintaining a balance in the energy intake, restricting saturated fat and replacing this with either complex carbohydrates or unsaturated fat, based on the individual's personal or cultural preferences.

Carroll et al (1982) has reported a strong positive correlation between dietary animal proteins and mortality from cardiovascular disease. They also found a negative correlation between soybean protein and plasma cholesterol (50). In this study, an increase of odds ratio of dyslipidemia with moderate intake of protein was observed in middle-aged women. Meat products were positively associated with cholesterol ratio and soybean protein was inversely associated with cholesterol ratio.

We used the cross-sectional design to determine the association of dietary consumption and physical activity with dyslipidemia, whereas future studies that use longitudinal data should provide stronger evidence on this association. However, appropriate analysis of cross-sectional data represents a valuable initial step in identifying relationships between diet and disease (51).

In conclusion, despite the limitations mentioned, the results of this study may be useful for developing public health strategies for cardiovascular diseases in middle-aged women. This study showed a very high prevalence cardiovascular disease risk factor among middle-aged women in Babol, Iran.

Ethical Considerations

Ethical issues principles including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc. have been completely observed by the authors.

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References

1. Mehra R (2007). Global public health problem of sudden cardiac death. *J Electrocardiol*, Nov-Dec; 40(6 Suppl):S118-22.
2. McTigue K, Larson JC, Valoski A, Burke G, Kotchen J, Lewis CE, et al. (2006). Mortality and cardiac and vascular outcomes in extremely obese women. *JAMA*, Jul 5; 296(1): 79-86.
3. Sheppard L, Senior J, Park CH, Mockenhaupt R, Chodzko-Zajko W, Bazzarre T (2003). The National Blueprint Consensus Conference summary report: strategic priorities for increasing physical activity among adults aged >or=50. *Am J Prev Med*, Oct; 25(3 Suppl 2):209-13.
4. Mackness MI, Arrol S, Abbott C, Durrington PN (1993). Protection of low-density lipoprotein against oxidative modification by high-density lipoprotein associated paraoxonase. *Atherosclerosis*, Dec; 104(1-2): 129-35.
5. Garg A (1998). High-monounsaturated-fat diets for patients with diabetes mellitus: a meta-analysis. *Am J Clin Nutr*, Mar; 67(3 Suppl): 577S-82S.
6. From Wikipedia tfe. Babol. 13 September 2010 [cited 2010]; Available from: http://en.wikipedia.org/wiki/Babol
7. Parks EJ, Hellerstein MK (2000). Carbohydrate-induced hypertriacylglycerolemia: historical perspective and review of biological mechanisms. *Am J Clin Nutr*, Feb; 71(2):412-33.
8. Agarwal DP (2002). Cardioprotective effects of light-moderate consumption of alcohol:

a review of putative mechanisms. *Alcohol*, Sep-Oct; 37(5):409-15.
9. Malekshah AF, Kimiagar M, Saadatian-Elahi M, Pourshams A, Nouraie M, Goglani G, et al. (2006). Validity and reliability of a new food frequency questionnaire compared to 24 h recalls and biochemical measurements: pilot phase of Golestan cohort study of esophageal cancer. *Eur J Clin Nutr*, Aug; 60(8):971-7.
10. Dorosti A, Tabatabai M (2007). *Iran Food composition Table*. 1st ed: Donyaye Tagzie Co.
11. Questionnaire IPA (2005.) *International Physical Activity Questionnaire* [cited]; Available from: *http://www.ipaq.ki.se/*
12. Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, et al. (2003). International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc*, Aug; 35(8): 1381-95.
13. Friedewald WT, Levy RI, Fredrickson DS (1972). Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clin Chem*, Jun; 18(6): 499-502.
14. Jelliffe D, Jelliffe E (1989). *Community nutritional assessment*. 1st ed: Oxford University Press.
15. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III). (2001). *JAMA*, May 16; 285(19): 2486-97.
16. Morar N, Seedat YK, Naidoo DP, Desai DK (1998). Ambulatory blood pressure and risk factors for coronary heart disease in black and Indian medical students. *J Cardiovasc Risk*, Oct-Dec; 5(5-6): 313-8.
17. Joint National Committee on Prevention D, Evaluation, and Treatment of High Blood Pressure (2010). *Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure*. Available from: *http://www.nhlbi.nih.gov/guidelines/hypertension/jnc7full.pdf*
18. WHO (1999). WHO: Definition, Diagnosis and Classification of diabetes mellitus and its complications. *Report of a WHO consultation, Part 1: Diagnosis and Classification of Diabetes Mellitus*, [cited Feb. 15, 2008; Available from: *http://whqlibdoc.who.int/hq/1999/WHO_NCD_NCS_99.2.pdf*
19. Bays HE, Chapman RH, Grandy S (2007). The relationship of body mass index to diabetes mellitus, hypertension and dyslipidaemia: comparison of data from two national surveys. *Int J Clin Pract*, May; 61(5): 737-47.
20. Keys A, Menotti A, Aravanis C, Blackburn H, Djordevic BS, Buzina R, et al. (1984). The seven countries study: 2,289 deaths in 15 years. *Prev Med*, Mar; 13(2):141-54.
21. Reeder BA, Senthilselvan A, Despres JP, Angel A, Liu L, Wang H, et al. (1997). The association of cardiovascular disease risk factors with abdominal obesity in Canada. Canadian Heart Health Surveys Research Group. *CMAJ*, Jul 1; 157 Suppl 1: S39-45.
22. Kannel WB, Cupples LA, Ramaswami R, Stokes J, Kreger BE, Higgins M (1991). Regional obesity and risk of cardiovascular disease; the Framingham Study. *J Clin Epidemiol*, 44(2): 183-90.
23. Molarius A, Seidell JC, Sans S, Tuomilehto J, Kuulasmaa K (1999). Waist and hip circumferences, and waist-hip ratio in 19 populations of the WHO MONICA Project. *Int J Obes Relat Metab Disord*, Feb; 23(2):116-25.
24. Janghorbani M, Amini M, Willett WC, Mehdi Gouya M, Delavari A, Alikhani S, et al. (2007). First nationwide survey of prevalence of overweight, underweight, and abdominal obesity in Iranian adults. *Obesity*, Nov; 15(11):2797-808.
25. Bahrami H, Sadatsafavi M, Pourshams A, Kamangar F, Nouraei M, Semnani S, et al. (2006). Obesity and hypertension in an Iranian cohort study; Iranian women experience higher rates of obesity and hy-

pertension than American women. *BMC Public Health*, 6:158.
26. Mirmiran P, Azadbakht L, Azizi F (2007). Dietary behaviour of Tehranian adolescents does not accord with their nutritional knowledge. *Public Health Nutr*, 10(9): 897-901.
27. Azizi F, Ghanbarian A, Madjid M, Rahmani M (2002). Distribution of blood pressure and prevalence of hypertension in Tehran adult population: Tehran Lipid and Glucose Study (TLGS), 1999-2000. *J Hum Hypertens*, May; 16(5):305-12.
28. Shirani S, Kelishadi R, Sarrafzadegan N, Khosravi A, Sadri G, Amani A, et al. (2009), Awareness, treatment and control of hypertension, dyslipidaemia and diabetes mellitus in an Iranian population: the IHHP study. *East Mediterr Health J*, Nov-Dec; 15(6): 1455-63.
29. Asmar R, Vol S, Pannier B, Brisac AM, Tichet J, El Hasnaoui A (2001). High blood pressure and associated cardiovascular risk factors in France. *J Hypertens*, Oct; 19(10):1727-32.
30. Choi KM, Park HS, Han JH, Lee JS, Lee J, Ryu OH, et al. (2006). Prevalence of prehypertension and hypertension in a Korean population: Korean National Health and Nutrition Survey 2001. *J Hypertens*, Aug; 24(8):1515-21.
31. Lim TO, Morad Z (2004). Prevalence, awareness, treatment and control of hypertension in the Malaysian adult population: results from the national health and morbidity survey 1996. *Singapore Med J*, Jan; 45(1):20-7.
32. Krummel D (2004). Medical nutrition therapy in hypertension. In: Mahan LK, Escott Stump S. eds. Krause's food, nutrition and diet therapy. 11th ed: Philadelphia, WB Saunders.
33. Duarte C, Couto M, Vaz C, Ines L, Malcata A. (2009). [Cardiovascular risk profile in a Portuguese cohort of SLE Portuguese patients]. *Acta Reumatol Port*, Apr-Jun; 34(2B): 349-57.
34. de Souza LJ, Souto Filho JT, de Souza TF, Reis AF, Gicovate Neto C, Bastos DA, et al. (2003). Prevalence of dyslipidemia and risk factors in Campos dos Goytacazes, in the Brazilian state of Rio de Janeiro. *Arq Bras Cardiol*, Sep; 81(3): 249-64.
35. Letter L, Genest J, Harris S (2006) for the Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. Dyslipidemia in Adults with Diabetes. *Canadian Journal of Diabetes*, 30(3):230-40.
36. Gimeno-Orna JA, Faure-Nogueras E, Sancho-Serrano MA (2005). Usefulness of total cholesterol/HDL-cholesterol ratio in the management of diabetic dyslipidaemia. *Diabet Med*, Jan; 22(1):26-31.
37. Lemieux I, Lamarche B, Couillard C, Pascot A, Cantin B, Bergeron J, et al. (2001). Total cholesterol/HDL cholesterol ratio vs LDL cholesterol/HDL cholesterol ratio as indices of ischemic heart disease risk in men: the Quebec Cardiovascular Study. *Arch Intern Med*, Dec 10-24; 161(22): 2685-92.
38. Wietlisbach V, Paccaud F, Rickenbach M, Gutz-willer F (1997). Trends in cardiovascular risk factors (1984-1993) in a Swiss region: results of three population surveys. *Prev Med*, Jul-Aug; 26(4): 523-33.
39. Sanisoglu SY, Oktenli C, Hasimi A, Yokusoglu M, Ugurlu M (2006). Prevalence of metabolic syndrome-related disorders in a large adult population in Turkey. *BMC Public Health*, 6: 92.
40. MacLean DR, Petrasovits A, Connelly PW, Joffres M, O'Connor B, Little JA (1999). Plasma lipids and lipoprotein reference values, and the prevalence of dyslipoproteinemia in Canadian adults. Canadian Heart Health Surveys Research Group. *Can J Cardiol*, Apr; 15(4): 434-44.
41. Grundy SM, Blackburn G, Higgins M, Lauer R, Perri MG, Ryan D (1999). Physical activity in the prevention and treatment of obesity and its comorbidities. *Med Sci Sports Exerc*, Nov; 31(11 Suppl):S502-8.
42. Byberg L, Zethelius B, McKeigue PM, Lithell HO (2001) Changes in physical activity are associated with changes in metabolic cardiovascular risk factors. *Diabetologia*, Dec; 44(12): 2134-9.

43. Wilmore JH, Green JS, Stanforth PR, Gagnon J, Rankinen T, Leon AS, et al. (2001). Relationship of changes in maximal and submaximal aerobic fitness to changes in cardiovascular disease and non-insulin-dependent diabetes mellitus risk factors with endurance training: the HERITAGE Family Study. *Metabolism*, Nov; 50(11): 1255-63.
44. Leon AS, Sanchez OA (2001). Response of blood lipids to exercise training alone or combined with dietary intervention. *Med Sci Sports Exerc*, Jun; 33(6 Suppl):S502-15; discussion S28-9.
45. Fahlman MM, Boardley D, Lambert CP, Flynn MG (2002). Effects of endurance training and resistance training on plasma lipoprotein profiles in elderly women. *J Gerontol A Biol Sci* Med Sci, Feb; 57(2): B54-60.
46. Ainsworth BE, Haskell WL, Whitt MC, Irwin ML, Swartz AM, Strath SJ, et al. (2000). Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sports Exer*, Sep; 32(9 Suppl): S498-504.
47. Mensink RP, Zock PL, Kester AD, Katan MB (2003). Effects of dietary fatty acids and carbohydrates on the ratio of serum total to HDL cholesterol and on serum lipids and apolipoproteins: a meta-analysis of 60 controlled trials. *Am J Clin Nutr*, May; 77(5):1146-55.
48. Kris-Etherton PM, Pearson TA, Wan Y, Hargrove RL, Moriarty K, Fishell V, et al. (1999). High-monounsaturated fatty acid diets lower both plasma cholesterol and triacylglycerol concentrations. Am J Clin Nutr, Dec; 70(6): 1009-15.
49. Silberberg JS, Wlodarczyk J, Fryer J, Ray CD, Hensley MJ (1998). Correction for biases in a population-based study of family history and coronary heart disease. The Newcastle Family History Study I. *Am J Epidemiol*, Jun 15; 147(12): 1123-32.
50. Carroll KK (1982). Hypercholesterolemia and atherosclerosis: effects of dietary protein. *Fed Proc*, Sep; 41(11):2792-6.
51. Mirmiran P, Esmaillzadeh A, Azizi F (2005). Dairy consumption and body mass index: an inverse relationship. *Int J Obes (Lond)*, Jan; 29(1):115-21.