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Section: International comparison of health determinants

Cardiovascular risk factors in an Iranian urban population: Tehran Lipid and Glucose Study (Phase 1)

Summary

Objectives: Coronary artery disease is becoming more prevalent in developing countries, particularly in urban areas. This study was conducted to determine the prevalence of cardiovascular risk factors among Tehran urban population.

Methods: The prevalence and distribution of high blood pressure, cigarette smoking, dyslipoproteinemia, diabetes mellitus, and obesity was determined in 15005 subjects, aged three years and over, selected by cluster random sampling in Tehran urban district-13 between February 1999 to August 2001. Total energy intake, percent of energy derived from protein, carbohydrate, and fat were assessed in a subsidiary of 1474 persons by means of two 24-hour dietary recalls.

Results: In adults, 78 % of men and 80 % of women presented at least one CVD risk factor. The percentage of adult women with two or more risk factors was significantly greater than the one for men. Prevalence of DM, hypertension, obesity, high TC, low HDL, high TGs, and smoking was 9.8, 20.4, 14.4, 19.3, 32, 5.3, and 22.3 %, respectively. In children and adolescents, two or more CVD risk factors were found in 9 % of boys and 7 % of girls. Prevalence of hypertension, obesity, high TC, low HDL, and high TGs, was 12.7, 5.2, 5.1, 10.2, and 5 %, respectively. The mean percentage values of energy intake derived from carbohydrate, protein, and fat were 57.8 ± 6.9, 11.1 ± 1.8, and 30.9 ± 7.2, respectively.

Conclusion: The prevalence of cardiovascular risk factors among Tehran urban population is high; particularly of high total cholesterol, low HDL cholesterol levels, and high waist to hip ratio. An effective strategy for life style modification is a cornerstone of a population approach to the cardiovascular risk factors. Moreover, these results will serve as a baseline for assessment of future trends in the risk factors studied.

Keywords: Cardiovascular disease – Risk factor – Diabetes mellitus – Hypertension – Dyslipoproteinemia.

Coronary artery disease (CAD) is one of the most common causes of morbidity and mortality in different communities (Stamler et al. 1993; Stamler 1978; Murray et al. 1997; Uemura & Pisa 1985; Sempos et al. 1988) and identification of individuals at increased risk of arteriosclerosis is a major public health issue.

There is evidence from epidemiological, pathological, clinical, and genetic studies that atherosclerosis begins during childhood, and that some cardiovascular risk factors in childhood are useful parameters in predicting adult atheroscelerotic risk (Boreham et al. 1993; Vobecky et al. 1988; Strong 1991; McGill et al. 1997). Moreover, risk factors for cardiovascular disease (CVD) frequently cluster, which may increase CVD risk multiplicatively (Yusuf et al. 1988).

It has been shown that lipid concentrations and prevalence of hypertension in children and adults of many countries have risen in recent years (Akerblom et al. 1984; Plaza et al. 1989; Stray 1989; Lenfant & Savage 1995), and it appears that the prevalence of dyslipidemia and hypertension in these countries are approaching values found in a population with high incidence of ischemic heart disease (Aguilera et al. 1996; Monge & Beita 2000). This tendency maybe related with the progressive decrease in the consumption of the traditional diet as the country becomes industrialised, with increased consumption of processed foods rich in saturated fats (Garaulet et al. 2000; Campos et al. 1991), however, the importance of diet has not been clearly determined (Gliksman et al. 1993).

Despite the lack of accurate mortality data, there is enough evidence to indicate that CAD is increasing in magnitude in Iran. While in many developed countries CAD mortality has declined over the last 20 years (Sytkowski et al. 1996;

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Beaglehole et al. 1997), age-adjusted mortality rate due to CAD increased by 20–45% in Iran (WHO-EMRO 1995; Zali et al. 1993).

Cigarette smoking, elevated blood pressure, obesity, high waist-hip ratio, diabetes mellitus, elevated concentration of total cholesterol, and low density lipoprotein cholesterol (LDL-C), and low concentration of high density lipoprotein cholesterol (HDL-C) have been identified as risk factors for CHD in clinical and epidemiological studies (Hall et al. 1997; Newman et al. 1986; Raftopoulos et al. 1999).

Few studies focusing on the prevalence of cardiovascular risk factors in children, adolescents, adults, and elderly have been conducted in Iran (Azizi 1996; Azizi et al. 2001; Rafei et al. 1999). Recognising the need to obtain relevant data on prevalence and distribution of the factors responsible for excess cardiovascular risk in Iranian population, the Endocrine Research Center initiated the Tehran Lipid and Glucose Study (TLGS) in 1999. The objective of the present paper is to report the distribution and prevalence of CVD risk factors among 15005 people aged over 3 years in the selected population (final report of phase 1).

Methods

Study population

The TLGS is a study to determine the risk factors for atherosclerosis among Tehran urban population and to develop population-based measures to change the lifestyle of the population and to prevent the rising trend of diabetes mellitus and dyslipidemia. Detailed description of methodology, rationale and design of this study have been published (Azizi et al. 2000; Azizi et al. 2001; Azizi et al. 2002). The protocol of this study was based on the WHO-recommended model for field surveys of diabetes and other non-communicable diseases and the WHO-MONICA protocol for population surveys (Dowse & Zimmet 1992; WHO 1990). The design of this study encompasses two major components: phase 1 is a cross-sectional prevalence study of CAD and associated risk factors and phase 2 is a cohort and prospective interventional study, planned for the next 20 years. A multistage stratified cluster random sampling technique was used to select more than 15000 people aged over three years from Tehran urban district 13. The sampling frame is chosen from the urban District 13 of Tehran. Tehran, the capital of the Islamic Republic of Iran, is a metropolitan city composed of 20 urban districts, which make up a population of more than 6.7 million people (Iran National Census 1996). Two important rationales for choosing District 13 have been considered: 1) high stability of the population residing in that district in compare to the other districts of Tehran, and 2) the age distribution of the population of District 13 is representative of the overall population of Tehran. Crude response rate was approximately 57.5% and the reasons for non-response are now being investigated to find out if there is any essential difference between respondents and non-respondents. However, preliminary data revealed there was no significant different between responders and non-responders.

Medical history and clinical examination

All subjects were studied at the TLGS Clinic between February 1999 to August 2001. All invited participants, after signing informed written consent, were studied by trained physicians according to a uniform protocol. Demographic, and lifestyle information were obtained by the use of a standard and validated questionnaire.

For measuring blood pressure, the participants remained seated for 15 minutes, then a qualified physician measured blood pressure two times after one more measurement for determining peak inflation level using a standard mercury sphygmomanometer calibrated by Iranian Institute of Standards and Industrial Researches. On the basis of the circumference of the participant's arm a pediatric, regular adult, or large cuff were chosen. The cuff was placed on the right arm, which was at the heart level and inflated in as high rate as possible increments until the cuff pressure was 30 mmHg above the level at which the radial pulse disappeared. There was at least a 30-second interval between these two separate measurements, and the mean of two measurements was recorded as the participant's blood pressure. The systolic blood pressure was defined as the appearance of the first sound (Korotkoff phase 1), and the diastolic blood pressure was defined as the disappearance of the sound (Korotkoff phase 5) during deflating the cuff at a 2–3 mm per second decrement rate.

Anthropometrical measurements were taken with shoes removed and the participants wearing light clothing. Weight and height were measured according to the standard protocol. Waist circumference was measured at the level of the umbilicus and hip circumference was measured over light clothing at the widest girth of the hip. Body mass index (BMI) was calculated by dividing the weight in kilograms to the square of height in meters. A blood sample was drawn between 7:00 and 9:00 AM into vacutainer tubes from all study participants after 12–14 hours overnight fasting. Blood samples were taken in a sitting position according to the standard protocol and centrifuged within 30 to 45 minutes of collection. All blood lipid analyses were done at the TLGS research laboratory on the day of blood collection. For oral glucose tolerance test (OGTT), 82.5 g glucose

monohydrate solution (equivalent to 75 g anhydrous glucose; Cerestar EP, Spain) was administered orally in subjects aged more than 20 years except in diabetics on medication.

Dietary assessment

A subsidiary population of 1474 persons was randomly selected for dietary assessments. Expected sample size was 1200 people in 283 households, but because of limited number of men in some age groups we increased the sample size. Energy, percent of energy derived from protein, fat and carbohydrate intakes from each meal and snack were assessed by means of two 24-hour dietary recall questionnaire. The first recall was performed at subjects' home and the second at a clinic visit in the diet unit of TLGS. In terms of children < 6 years, dietary data were obtained from their mothers. Standard reference tables were used to convert household portions to grams for computerisation. Following coding of dairies, the dietary recall form was linked to a nutrient database (Nutritionist III) and nutrient intakes calculated from quantity of food consumed. Underreporting was considered as energy intake or EI divided by basal metabolic rate (BMR) < 1.27 (Hirvonen et al. 1997). RDA (recommended dietary allowance) recommendations were considered as cut-off points of energy intake in different age groups (Food and Nutrition Board, National Research Council, National Academy of Sciences 1989).

Biochemical measurements

The analyses of samples were performed using Selectra 2 auto-analyzer (Vital Scientific, Spankeren, Netherlands).

An overnight fasting blood sample was obtained for every participant for biochemical measurements. Utilising TC (total cholesterol) and TGs (triglycerides) kits (Pars Azmon Inc., Iran), TC and TGs were assayed using enzymatic calorimetric tests with cholesterol esterase and cholesterol oxidase and glycerol phosphate oxidase, respectively. HDL-C was measured after precipitation of the apolipoprotein B containing lipoproteins with phosphotungistic acid. LDL-C was calculated from the serum TC, TGs, and HDL-C concentrations expressed in mg/dl using Friedwald formula (Friedwald et al. 1972) if TGs concentration was lower than 400 mg/dl. Assay performance was monitored in every 20 tests interval using the lipid control serum, Precinorm (normal range) and Precipath (pathologic range) wherever applicable (Boehringer Mannheim, Germany; cat. no. 1446070 for Precinorm and 171778 for Precipath). Lipid standard (C.f.a.s, Boehringer Mannheim, Germany; cat. no. 759350) was used to calibrate the Selectra 2 auto-analyzer on all days of laboratory analyses. All samples were analysed when internal quality control met the acceptable criteria. Inter- and intra-assay coefficients of variation were 2 and 0.5% for TC and 1.6 and 0.6% for TGs, respectively.

Besides measuring fasting blood sugar, another blood sample was obtained 120 minutes after the ingestion of 82.5 g glucose monohydrate solution (equivalent to 75 g anhydrous glucose). Utilising glucose kit (Pars Azmun Inc., Iran), glucose was assayed using enzymatic colorimetric method with glucose oxidase technique. Assay performance was monitored at every 20 test intervals using the glucose control serum, Precinorm (normal range) and Precipath (pathologic range) wherever applicable (Boehringer Mannheim, Germany; cat. no. 1446070 for Precinorm and 171778 for Precipath). Glucose standard (C.f.a.s, Roche, Germany; cat. no. 759350) was used to calibrate the Selectra 2 auto-analyzer on all days of laboratory analyses. All samples were analysed when internal quality control met the acceptable criteria. Inter- and intra-assay coefficients of variations were both 2.2%.

Different categories of smoking status were defined according to WHO guidelines (1998). Daily smoker was defined as who smokes cigarettes at least once a day; occasional smoker is who smokes cigarettes but not every day; ex-smoker was formerly a daily or occasional smoker, but currently does not smoke at all; never smoked defined as who never smoked before or smoked too little in the past.

According to the JNC-VI (Joint National Committee) criteria (The Sixth report of the Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure 1998), hypertension in adults was defined as mean systolic blood pressure (SBP) ≥ 140 mmHg, mean diastolic blood pressure (DBP) ≥ 90 mmHg, or current treatment with antihypertensive medications either at the time of interview or in the previous one month. Awareness of hypertension reflects any prior diagnosis of hypertension by a physician and was defined positive answer to relevant question at the time of the interview. Blood pressure readings in children and adolescents were evaluated using the guidelines from the 1987 Task force reports (National High Blood Pressure Education Program Working Group on Hypertension Control in children and Adolescents. Update on 1987 Task Force Report on High Blood Pressure in Children and Adolescents 1996). A BMI of 25 to 29.9 kg/m^2 in adults was considered as overweight and a BMI equal to or more than 30 kg/m^2 was defined as obesity. Obesity and overweight in children and adolescents were defined due to international cut-off points for BMI (Cole et al. 2000). Truncal obesity was defined as a WHR more than 0.95 in adult men and a WHR of more than 0.8 in adult women.

Derived from those of Franklin et al. (1998) the 95th percentile of serum TC, LDL-C, and TGs distributions was used

as the cut-points in children and adolescents to assign subjects at different level of cardiovascular risk (Franklin et al. 1998). The 5th percentile of concentration of serum HDL-C in total population of children and adolescents in each age group and sex were used as cut-off point for the low HDL-C levels (Franklin et al. 1998). In adults, the desirable level for TC was defined as less than 200, moderate risk as 200–239, and high risk as 240 mg/dl or greater. For LDL-C the desirable level was defined as less than 130, moderate risk as 130-159, and high risk as 160 mg/dl or greater. The desirable level for TGs was defined as less than 200, moderate risk as 200–400, and high risk as 400 mg/dl or greater. Moreover we have defined HDL-C in three levels of risk; less than 35, 35–59, and 60 mg/dl or greater (US Department of Health and Human Services, Public Health Service 1992; Maclean et al. 1996).

The results of the oral glucose tolerance test of each subject was used to classify glucose metabolism status according to the WHO criteria (WHO 1985), and subjects were classified as normal glucose (2 h postload plasma glucose-2 h PG < 140 mg/dl), IGT (200 > 2 h PG ≥ 140), or diabetic (2 h PG ≥ 200 mg/dl).

Statistical analysis

Statistical analyses were done with an IBM computer using the SPSS 9.05 statistical software package (SPSS Inc., Chicago, IL), and data were presented as mean and standard deviation. All analyses were performed separately for males and females in all age strata. The degree of significance of differences between means was calculated using Student's t-test. P-values less than 0.05 were considered to be statistically significant.

This study was approved by National Research Council of Islamic Republic of Iran its Research Ethics Committee and informed consent was obtained from each family.

Results

There were 15005 Tehranian children, adolescents, and adults, 44% males and 56% females. Nearly, 5% of the study population was between 3–6 years, 6% between 7–10 years, 9% between 11–14 years, 19% between 15–24 years, 17% between 25–34 years, 16% between 35–44 years, 12% between 45–54 years, and 10% between 55–64 years, and 7% over 64 years. Age and sex distributions are shown in Table 1.

Demographic findings

Among those 15 years old and over, 3071 (25.5%) were single, 8328 (69.2%) were married, and 631 (5.3%) were widowed or divorced. Defining individual who can read and write as "literate", 5997 (95.6%) of men and 7246 (90.1%) of women aged 7 years and over were literate. Among participants aged 20 years and over, 746 (18%) of men and 515 (10%) of women had various levels of university certificate. Of the male population aged 10 years and over, 3195 (62%) were employed. Among the female population, 606 (9%) were employed.

Smoking status

Among the people aged 15 years old and over, 10.6% were daily smokers, 1.5% occasional smokers, 6.1% ex-smokers, and 81.8% non-smokers. The prevalence of daily smoking in men was almost ten times as much as that in woman (22% vs 2%, $p < 0.001$) (Tab. 3). The highest rate among men (38.1%) and women (4.3%) were seen in 35–44 year-old subjects followed by 45–54 age group. In both sexes the rate increased with age and reached its maximum at ages 35 to 44 years (data are not shown).

Anthropometric findings

The mean BMI level was higher in adult women than in men (27.5 vs 25.7 kg/m^2, $p < 0.001$) (Tab. 2). In adults, the preva-

Table 1 Age distribution of men and women participated in the study using WHO STEPS categories, Tehran Lipid and Glucose Study

Age groups (year)	Men		Women		Total	
	No.	Percent	No.	Percent	No.	Percent
3–6	336	49.1	349	50.9	685	4.6
7–10	469	49.2	484	50.8	953	6.4
11–14	667	49.9	670	50.1	1337	8.9
15–24	1195	42.0	1650	58.0	2845	19.0
25–34	985	39.8	1489	60.2	2474	16.5
35–44	1011	42.6	1360	57.4	2371	15.8
45–54	724	39.8	1094	60.2	1818	12.1
55–64	624	43.0	827	57.0	1451	9.7
≥ 65	599	55.9	472	44.1	1071	7.1
Total	6610	44.1	8395	55.9	15005	100.0

Table 2 Mean value, standard deviation, and 95th percentile of the characteristics of Tehranian adult population aged ≥ 20 years, Tehran Lipid and Glucose Study.

Characteristic	Men			Women		
	Mean	SD	95th percentile*	Mean	SD	95th percentile*
SBP (mmHg)	120†	17	151	116	17	148
DBP (mmHg)	77†	11	96	77	10	94
TC (mg/dl)	202	41	272	210	47	293
HDL-C (mg/dl)	39	9	56	45	11	63
LDL-C (mg/dl)	131	36	194	135	40	206
TGs (mg/dl)	162	78	323	149	76	305
FBS (mg/dl)	98	29	145	98	34	153
BMI (kg/m^2)	25.7	4.1	33	27.5	5.0	36
WHR	0.92	0.007	1.03	0.84	0.009	0.99

Number of subjects varies from 3940 to 4008 for men and from 5224 to 5457 for women.
SBP = Systolic blood pressure, DBP = Diastolic blood pressure, TC = Total cholesterol, HDL-C = High density lipoprotein cholesterol, LDL-C = Low density lipoprotein cholesterol, TGs = Triglycerides, BMI = Body mass index, WHR = Waist hip ratio, FBS = Fasting blood sugar.
* The 5th percentile of HDL-C was 25 and 28 mg/dl for males & females, respectively.
† Individuals with no history of using antihypertensive drugs.

Table 3 Prevalence of major factors influencing cardiovascular disease risk in Tehranian adult population aged ≥20 years, Tehran Lipid and Glucose Study.

Risk factor	Men	Women	Total
	% (95CI)	% (95CI)	% (95CI)
New diabetes mellitus	5.7 (5 – 6.4)	5.7 (5–6.4)	5.7 (5–6.4)
Known diabetes mellitus	4.1 (3.5–4.7)	5.4 (4.7–6.1)	4.9 (4.3–5.1)
IGT	11.3 (10.3–12.3)	13.2 (12.3–14.1)	12.4 (11.7–13.1)
Hypertension [a]	20.4 (19.2–21.6)	25.1 (24.0–26.2)	22.9 (22.1–23.7)
Obesity [b]	14.4 (13.4–15.4)	29.5 (28.3–30.7)	23.1 (22.3–23.9)
Overweight [c]	42.5 (41.0–44.0)	38.1 (36.9–39.3)	40.0 (39.0–41.0)
Central obesity [d]	33.0 (31.6–34.4)	67.2 (66.0–68.4)	52.6 (51.6–53.6)
High TC [e]	19.3 (18.1–20.5)	26.7 (25.6–27.8)	23.6 (22.8–24.4)
High LDL-C [f]	19.8 (18.6–21.0)	24.9 (23.8–26.0)	22.8 (22.0–23.6)
Low HDL-C [g]	32.0 (30.6–33.4)	13.3 (12.4–14.2)	21.1 (20.3–21.9)
High TGs [h]	5.3 (4.6–6.0)	3.4 (2.9–3.9)	4.2 (3.8–4.6)
Smoking [i]	22.3 (21.1–23.5)	2.1 (1.8–2.4)	10.6 (10.0–11.2)

Number of subjects varies from 3870 to 4306 for men and from 5359 to 5862 for women.
[a] Blood pressure ≥ 140 or DBP ≥ 90 mmHg or on anti-hypertensive medication.
[b] BMI ≥ 30 Kg/m^2.
[c] 30 > BMI ≥ 25 .
[d] WHR ≥ 0.95 in men and WHR ≥ 0.8 in women.
[e] Total cholesterol ≥ 240 mg/dl.
[f] Low density lipoprotein cholesterol ≥ 160 mg/dl.
[g] High density lipoprotein cholesterol < 35 mg/dl.
[h] Triglycerides ≥ 400 mg/dl.
[i] At least 1 cigarette a day in subjects over 15 years old.

lence of obesity was significantly higher in women than in men (29.5% vs 14.4%, $p < 0.001$) whereas, the prevalence of overweight was greater in men than in women (42.5% vs 38.1%, $p < 0.01$) (Tab. 3). In children and adolescents, the prevalence of obesity was higher in boys than in girls (5.2% vs 3.6%, $p < 0.01$). Among this population, 12.7% of boys and 13.8% of girls were overweight (NS).

In adult population, the prevalence of central obesity (high WHR) was greater in women than in men (67.2% vs 33.0%, $p < 0.001$) (Tab. 3). The mean WHR level tended to gradually increase with age both in men and women (data are not shown).

Blood pressure status

In adults, mean systolic and diastolic blood pressure were higher in men than in women (119.5 ± 17.1 vs 116.1 ± 16.8 mmHg, $p < 0.001$ for systolic and 77.4 ± 10.8 vs 76.9 ± 10.0 mmHg, $p < 0.05$ for diastolic blood pressure) (Tab. 2).

The crude prevalence rate of hypertension among the adult population was 22.9%. Age-adjusted prevalence of hyper-

tension was 20.4% (CI 95%: 19.2–21.6) and 25.1% (24.0–26.2%) in men and women, respectively ($p < 0.001$, Tab. 3). In both sexes, prevalence of hypertension increased with age. In 20–29 year-old men, the prevalence of hypertension was about twice that of women of the same age group. In 30–39 year-old group, there was no significant difference between men and women, but in those 40 years and over the prevalence of hypertension was higher in women than in men (data are not shown).

Among children and adolescents, the prevalence of hypertension was slightly higher in boys than in girls (12.7% vs 10.9%, NS) (Tab. 4).

Glucose tolerance

The prevalence (95% CI) of new diabetes mellitus was 5.7% (5.0–6.4) in males and 5.7% (5–6.4) in females, and that of IGT was 11.3% (10.3–12.3) and 13.2% (12.3–14.1) in males and females, respectively. The prevalence of known diabetes mellitus was 4.1% (3.5–4.7) in males and 5.4% (4.–6.1) in females. In both sexes prevalence of DM and IGT increased with age; in case of DM from 0.7% in 20–29 to 27% in the 70 years old and over, and in the case of IGT from 1.8% to 23.9% within the same age group.

Lipid profile

The mean level of TC in adults aged 20 years and over was 204 ± 43 in men and 212 ± 49 mg/dl in women ($p < 0.001$). The study showed that 23.6% of adults had high TC levels, 31% had borderline levels and 45.4% had desirable levels (Tab. 3). The prevalence of high TC was higher in women than in men (26.7% vs 19.3%, $p < 0.001$). The mean level of HDL-C in adults was 39 ± 9 in men and 45 ± 11 mg/dl in women ($p < 0.001$). Thirty two percent of men and 13% of women had low HDL-C levles. 22.8% of adults had high LDL-C levels, 27.7% had borderline, and 49.5% had desirable levels. The mean LDL-C level was higher in women than in men (135 ± 40 vs 131 ± 36 mg/dl, $p < 0.05$). The mean TGs level was significantly greater in men than in women (162 ± 78 vs 149 ± 76, $p < 0.001$). 5.3% of men and 3.4% of women had TGs level more than 400 mg/dl.

The 95th percentile of TC in children and adolescents were 205–226 in boys and 223–229 mg/dl in girls. The mean level of TC was 166 ± 33 in boys and 172 ± 32 mg/dl in girls ($p < 0.01$). The mean level of LDL-C cholesterol in this group was 102 ± 29 in boys and 106 ± 28 in girls ($P < 0.05$). The mean HDL-C level was 44 ± 11 and 44 ± 10 mg/dl for boys and girls, respectively (NS). The mean level of triglycerides in was 103 ± 60 in boys and 106 ± 54 mg/dl in girls ($p < 0.05$).

Dietary findings

Underreporting of energy intake was more prevalent in women than in men (29% vs 13%, $p < 0.001$). The prevalence of underreporting increased with age in an ascending trend both in men and women (data are not shown). The mean (±SD) values of energy intake were 2119 ± 598, 2629 ± 650, and 2687 ± 669 kcal/day in children, adolescents, and adults, respectively. The mean of energy intake has been shown in Table 5 according to RDA age strata. The mean energy intake values in women were lower than recommended energy intakes of RDA in all age strata. These values in men was higher than RDA recommended references. The mean percentage values of energy intake derived from carbohydrate, protein, and fat were 57.8 ± 6.9, 11.1 ± 1.8, and 30.9 ± 7.2, respectively. (Fig. 3).

Cumulative frequency of cardiovascular risk factors

Figure 1 demonstrates the cumulative frequency of risk factors in adults studied by gender. In adults, 78% of men and

Table 4 Prevalence of major factors influencing cardiovascular disease risk in Tehranian children and adolescents aged 3–19 years, Tehran Lipid and Glucose Study.

Risk factor	Boys	Girls	Total
	% (95CI)	% (95CI)	% (95CI)
Hypertension	12.7 (11.3–14.1)	10.9 (9.6–12.2)	11.7 (10.8–12.6)
Obesity	5.2 (4.2–6.2)	3.6 (2.8–4.4)	4.3 (3.7–4.9)
Overweight	12.7 (11.3–14.1)	13.8 (12.4–15.2)	13.3 (12.3–14.3)
High TC[a]	5.1 (4.1–6.1)	5.1 (4.2–6.0)	5.1 (4.4–5.8)
High LDL-C[b]	4.9 (4.0–5.8)	4.9 (4.0–5.8)	4.9 (4.3–5.5)
Low HDL-C[c]	10.2 (8.9–11.5)	6.6 (5.6–7.6)	8.3 (7.5–9.1)
High TGs[d]	5.0 (4.1–5.9)	5.1 (4.2–6.0)	5.0 (4.4–5.6)

Number of subjects varies from 2000 to 2160 for boys and from 2269 to 2366 for girls. Hypertension was defined according to the report of Second Task Force. Obesity and overweight was defined according to TJ Cole's international Survey.

[a] Total cholesterol > 95th.

[b] Low density lipoprotein cholesterol > 95th.

[c] High density lipoprotein cholesterol < 5th and [d] Triglycerides > 95th percentile for each age group of children and adolescents.

Table 5 The mean value of energy intake (kcal/day) according to RDA (Recommended Dietary Allowance) age strata in Tehranian population aged ≥ 3 years, Tehran Lipid and Glucose Study.

Age groups (year)	Men		Women		Total	
	No.	Mean ± SD	No.	Mean ± SD	No.	Mean ± SD
3–6	37	1886 ± 617	38	1783 ± 589	75	1833 ± 601
7–10	64	2109 ± 552	74	2036 ± 475	138	2069 ± 511
11–14	85	2682 ± 568	102	2346 ± 530	187	2498 ± 571
15–18	72	3077 ± 705	90	2379 ± 536	162	3690 ± 707
19–24	44	3132 ± 814	86	2300 ± 429	130	2582 ± 706
25–50	193	3063 ± 640	167	2439 ± 478	360	2774 ± 650
≥ 50	68	2711 ± 646	43	2106 ± 331	111	2477 ± 620
Total	563	2784 ± 751	600	2279 ± 520	1163	2524 ± 690

80% of women presented at least one CVD risk factor. The percentage of adult women with two or more risk factors was significantly greater than the one for men (54% vs 47%, $p < 0.05$). The cumulative frequency of modifiable CVD risk factors (hypertension, obesity, total cholesterol ≥ 95th, LDL-C ≥ 95th, HDL-C < 5th, and triglycerides ≥ 95th percentile for each age group) in children and adolescents is shown in Figure 2. Cumulative frequency of modifiable risk factors was lower in girls than in boys. Seventy five percent of girls had no risk factor compared with 71% in boys ($p < 0.01$). Two or more risk factors were found in 9% of boys and 7% of girls (NS).

Discussion

High prevalence of CVD risk factors among Iranian adults is probably associated with the increased CVD mortality and morbidity observed in Iran (Zali et al. 1993; Azizi 1996; Azizi et al. 2001; Rafei et al. 1999). This report summarises the results of that analysis, which indicated that 47% of

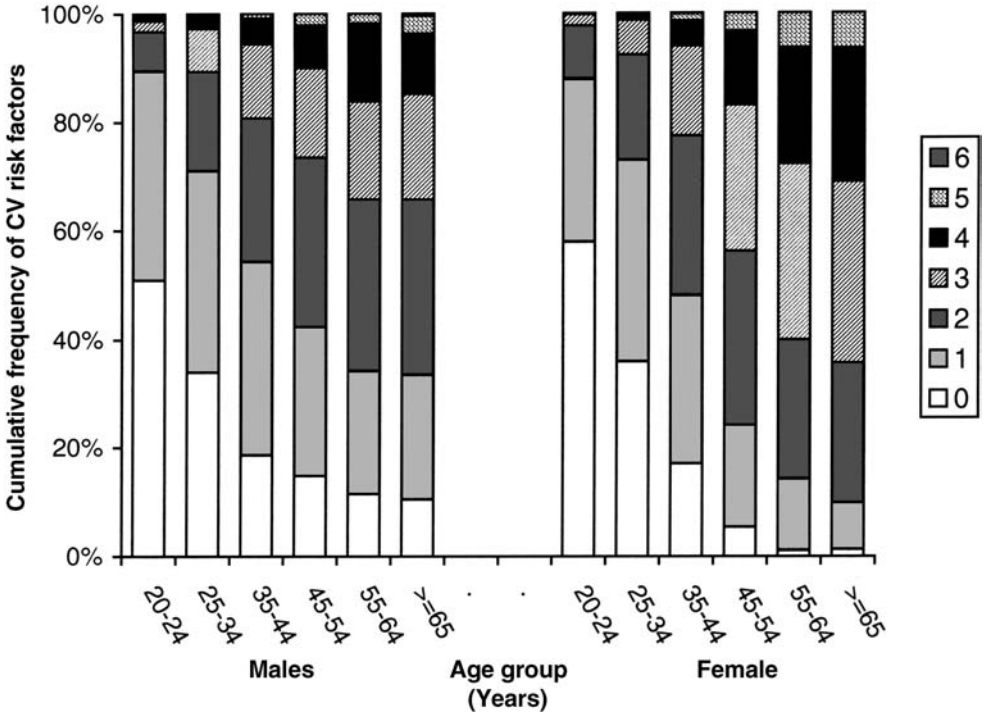

Figure 1 Cumulative frequency of cardiovascular risk factors including hypertension, generalised obesity (BMI ≥ 30 kg/m^2), central obesity (WHR ≥ 0.95 in men and WHR ≥ 0.8 in women), smoking, diabetes mellitus, total cholesterol ≥ 240 mg/dl, LDL cholesterol ≥ 160, HDL cholesterol < 35, and triglycerides ≥ 400 mg/dl in Tehranian adult population, Tehran Lipid and Glucose Study.

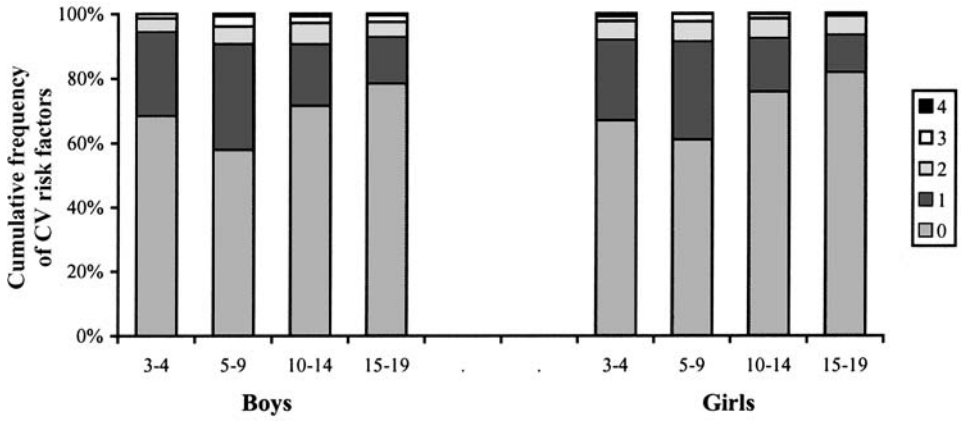

Figure 2 Cumulative frequency of cardiovascular risk factors in children and adolescents including hypertension, obesity, total cholesterol ≥ 95th, LDL cholesterol ≥ 95th, HDL cholesterol < 5th, and triglycerides ≥ 95th percentile for each age group of children and adolescents, Tehran Lipid and Glucose study.

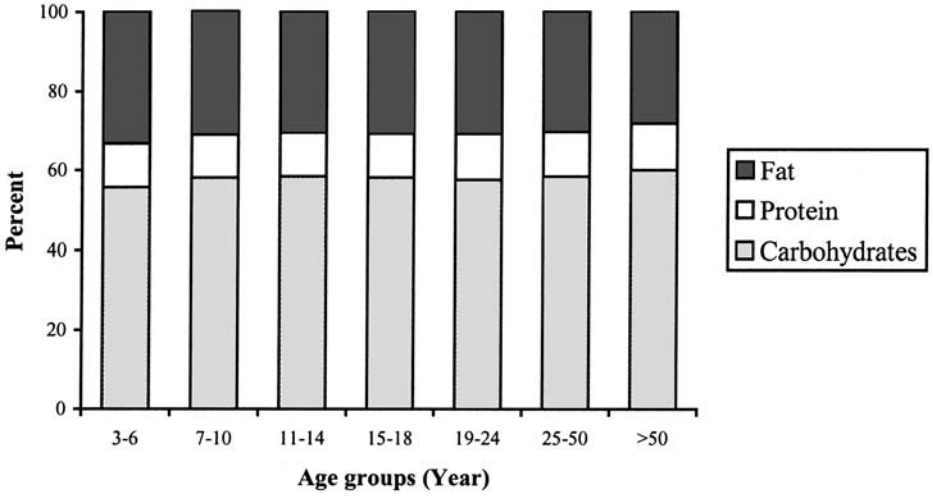

Figure 3 The percentage of energy derived from carbohydrates, protein, and fat in Tehranian urban population, Tehran Lipid and Glucose Study.

adult men and 64% of adult women who participated in the survey had two or more CVD risk factors. This is alarming, as this prevalence is higher than that reported in adults from industrialised countries such as Canada and the United States (Maclean et al. 1996; CDC 1997; Sempos et al. 1999; Hutchinson RG et al. 1997). Likewise the percentage of children and adolescents with one or more CVD risk factors (about 20%) is higher than estimates from several studies in the United States (Rabbia et al. 1994; Andersen et al. 1989; Lauer et al. 1975).

Nevertheless, CVD mortality rates are still lower in Iran than in developed countries such as the United States (unpublished data). This is probably owing to the lower prevalence of hypertension found among Iranian population when compared to U.S. and other developed country populations (CDC 1997; Sempos et al. 1999; Hutchinson et al. 1997). Iranian population like other developing country residents are being exposed to rapid changes in their lifestyle because of increasing availability of processed food, high fatty food consumption, and decreasing physical activity (Azizi et al. 2001). It is possible that in the near future, these changes may contribute to increase the prevalence of obesity, sedantarism, hypertension, and dyslipoproteinemia, and consequently more elevate the prevalence of CVD morbidity and mortality in this area.

On the other hand, the prevalence of antiatherogenic factors like high HDL-C is lower in our populattion than the reports of other countries (Maclean et al. 1996). It also may con-

tribute to accelerate this trend. Low HDL-C is a risk factor for CVD in populations of industrialized countries and is usually associated with high saturated fat intake (Hegsted et al. 1993; Hayes 1995). Low HDL-C may be also associated with low physical activity (Harsha 1995; O'Connor et al. 1995).

LDL-C is recognised as the major atherogenic lipoprotein fraction (Sempos et al. 1993; Castelli 1986). Significant reduction in incidence and mortality from CAD has occurred with treatments that reduce LDL-C and TC levels (Anonymous 1984a; 1984b). LDL-C level closely reflects the level of TC because normally 75% of TC is contained in LDL-C, with only 20% in HDL-C and 5% in VLDL-C, ascertained by TGs in the fasting state. In our study, the increasing mean values of LDL-C, as well as TC and TGs, with age may be related in part to the increasing prevalence of overweight in older men and women. Mean LDL-C in Tehranian population is above the recommended level for women (135 mg/dl), which is higher than those for Saudi Arabia (Al-Nuaim et al. 1996). The prevalence of LDL-C ≥ 160 mg/dl in this study is moderately higher than corresponding values from Canada (43) and India (Singh et al. 1998), but slightly lower than the report of Saudi Arabia (Al-Nuaim et al. 1996).

The adverse effect of overweight and obesity on cardiovascular diseases has been shown in children, adolescents, and adults (Webber et al. 1995; Gidding 1997). More than 60% of adults in the present study were obese or overweight. Moreover, it is worth mentioning that more than 17% of the children and adolescents in our study suffered from obesity or overweight. The high mean value of energy and percentage of energy intake derived from fat may be responsible for the great prevalence of obesity and overweight in our study subjects. It shows that if this population does not modify dietary and physical activity patterns promptly, a high percentage of adults will develop alterations in lipoprotein, blood pressure, and other CVD risk factors. The prevalence of obesity in our study is approximately similar to CARDIA and Bugalusa Heart Study in both children and adults (Webber et al. 1995; Lewis et al. 1997).

In conclusion this paper reports the prevalence and magnitude of population risk for CAD in Tehran, the capital of Islamic Republic of Iran. The reported increase of the number of cardiovascular risk factors with age is characteristic of industrialised countries having diets high in energy and rich in fat, particularly saturated fat and cholesterol, and with a sedentary lifestyle predisposing to obesity. The percentage of people with multiple CVD risk factors in our study highlight the importance of enhancing primary prevention activities among communities of Tehran. This information may facilitate a plan of action to prevent hyperlipidemia, hypertension, obesity and ischemic heart disease from reaching higher proportions. Moreover, these data are important for the design of public health policy, clinical guidelines, public and professional education programmes, and the design of protocols for optimal identification of patients at high risk of CAD. Since the present findings demonstrate that more than half of adults are at a significantly increased risk of CAD, the necessity for an integrated public health approach through health education and health promotion programmes targeted to the whole population as well as to the groups at higher risk is strongly recommended. An effective strategy for lifestyle modification is a cornerstone of a population approach to the dyslipoproteinemia, hypertension, and obesity issues. Since many of precursors to cardiovascular disease begin in childhood and primary prevention should begin in early years of life, the results suggest a need for special attention to health status in Tehranian children and adolescents.

In case of comparing TLGS data with other studies, complementary data of TLGS according to The WHO STEPwise approach are shown as appendix.

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References

Aguilera F, Lupianez L, Magana D, Planells E, Mataix FJ, Liopis J (1996). Lipid status in a population of Spanish schoolchildren. Eur J Epidemiol *12*: 135–40.

Akerblom HK, Viikari J, Uhari M, et al. (1984). A study of cardiovascular risk factors and their determinats in finnish children. Ann Clin Res *16*: 23–33.

Al-Nuaim AR, al-Rubean K, al-Mazrou Y, al-Attas O, al-Daghari (1996). Prevalence of hypercholesterolemia in Saudi Arabia, epidemiological Study. Int J Cardiol *54*: 41–49.

Andersen LB, Henckel P, Saltin B (1989). Risk factors for cardiovascular disease in 16–19-year-old teenagers. J Int Med *225*: 157–63.

Anonymous (1984a). The Lipid Research Clinics Coronary Primary Prevention Trial results II: the relationship of reduction in incidence of coronary heart disease to cholesterol lowering. JAMA *251*: 365–74.

Anonymous (1984b). The Lipid Research Clinics Coronary Prevention Trials results I: reduction in incidence of coronary heart disease. JAMA *251*: 351–64.

Anonymous (1997). The sixth report of the Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure (published erratum appears in Arch Intern Med 1998; 158: 573). Arch Intern Med *157*: 2413–46.

Azizi F (1996). Diabetes mellitus in Islamic Republic of Iran. IDF Bulletin *41*: 38–39.

Azizi F, Rahmani M, Emami H, Madjid M (2000). Tehran Lipid and Glucose Study: Rationale and Design. CVD Prev *3*: 242–7.

Azizi F, Rahmani M, Madjid M, et al. (2001). Serum lipid levels in an Iranian population of children and adolescents: Tehran Lipid and Glucose Study. Eur J Epidemiol *17*: 281–88.

Azizi F, Allahverdian S, Mirmiran P, Rahmani M, Mohammadi M (2002). Dietary factors and body mass index in a group of Iranian adolescents: Tehran Lipid and Glucose Study-2. Int J Nutr Res *71*: 123–27.

Beaglehole R, Stewart AW, Jackson R, et al. (1997). Declining rates of coronary heart disease in New Zealand and Australia, 1983–1993. Am J Epidemiol *145*: 707–13.

Boreham C, Savage JM, Primrose D, Strain J (1993). Coronary risk factors in schoolchildren. Arch Dis Child *68*: 182–86.

Campos H, Willet WC, Peterson RM, et al. (1991). Nutrient intake comparisons between Framingham and rural and utban Puriscal, Costa Rica: association with Lipids, lipoproteins, apolipoproteins and LDL particle size. Arteriosclerosis *11*: 1089–99.

Castelli WP (1986). The Triglycerides issue: a viwe from Framingham. Am Heart J *112*: 432–37.

CDC (1997). Prevalence of selected cardiovascular disease risk factors among American Indians and Alaska Natives-United States. MMWR 2000; *49*: 461–65.

Cole TJ, Bellizzi MC, Flegal KM, Dietz WH (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ *320*: 1240–43.

Dowse G, Zimmet P (1992). A model protocol for diabetes and other noncommunicable disease field surveys. World Health Stat Q *45*: 360–72.

Food and Nutrition Board, National Research Council, National Academy of Sciences (1989). Recommended dietary allowances. 10th ed, Washington: National Academy Press.

Franklin FA, Dashti N, Franklin CC (1998). Evaluation and management of dyslipoproteinemia in children. Endocrinol Metabol Clin North Am *27*: 641–54.

Friedwald WT, Levy RI, Fredridson DS (1972). Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem *18*: 499–502.

Garaulet M, Martinez A, Victoria F, Perez-Llamas F, Ortega RM, Zamora S (2000). Difference in dietary intake and activity level between normal-weight and over weight or obese adolescents. J Pediatr Gastroenterol Nutr *30*: 253–58.

Gidding S (1995). A perspective on obesity. Am J Med Sci *310:* 68–71.

Gliksman MD, Lazarus R, Wilson A (1993). Differences in serum lipids in Australian children: is diet responsible? Int J Epidemiol *22*: 247–54.

Hall WD, Ferrario CM, Moore MA, et al. (1997) Hypertension-related morbidity and mortality in the southeastern United States. Am J Med Sci *313*: 195–209.

Harsha DW (1995). The benefits of physical activity in childhood. Am J Med Sci *310*: 3–7.

Hayes KC (1995). Saturated fat and blood lipids: new slant on an old story. Can J Cardiol *11*: 39–46.

Hegsted DM, Ausman L, Johnson J, Dallas G (1993). Dietary fat and serum lipids: An evaluation of the experimental data. Am J Clin Nutr *57*: 875–83.

Hirvonen T, Mannisto S, Roos E, Pietinen P (1997). Increasing prevalence of underreporting does not necessarily distort dietary surveys. Eur J Clin Nutr *51*: 297–301.

Hutchinson RG, Watson RL, Davis CE, et al. (1997). Racial differences in risk factors for atherosclerosis, the ARIC study. Angiology *48*: 279–90.

Lauer RM, Connor WE, Leaverton PE, Reiter MA, Clarke WR (1975). Coronary heart disease risk factors in school children: the Muscatine Study. J Pediatr *86*: 697–706.

Lenfant C, Savage P (1995). The early natural history of atherosclerosis and hypertension in the young: National Institute of Health Percpectives. Am J Med Sci *310*: 3–7.

Lewis CE, Smith DE, Wallace DD, Williams OD, Bild DE, Jacobs DR Jr (1997). Seven year trends in weight and weight gain in black and white young adults: The CARDIA Study. Am J Public Health *87*: 635–42.

McGill HC, McMahan CA, Malcom GT, Oalmann Mc, Strong JP (1997). Effects of serum lipoproteins and smoking on atherosclerosis in young men and women, the PADY Research Group: pathobiological determinants of atherosclerosis in youth. Arterioscler Thromb Vasc Biol *17*: 95–106.

Maclean DR, Petrasovits A, Connelly PW, Joffres M, O'Connor B, Little JA (1996). Plasma lipids and lipoprotein reference values, and the prevalence of dyslipoproteinemia in Canadian adults. Canadian Heart Health Surveys Research Group. Can J Cardiol *15*: 434–44.

Monge R, Beita O (2000). Prevalence of coronary heart disease risk factors in costa rican adolescents. J Adoles Health *27*: 210–17.

Murray CJL, Lopez AD (1997). Mortality by cause for eight regions of the world: global burden of disease study. Lancet *349*: 1269–76.

National High Blood Pressure Education Program Working Group on Hypertension Control in children and Adolescents (1996). Update on 1987 Task Force Report on High Blood Pressure in Children and Adolescents: A Working Group Report on High Blood Pressure Education Program. Pediatrics *98*: 649–58.

Newman WP 3rd, Freedman DS, Voors AW, et al. (1986). Relation of serum lipoprotein levels and systolic blood pressure to early atherosclerosis: The Bugalusa Heart Study. N Engl J Med *314*: 138–44.

O'Connor G, Hennekens C, Willett WC, et al. (1995). Physical exercise and reduced risk of non fatal myocardial infarction. Am J Epidemiol *12*: 1147–52.

Plaza I, Mariscal RP, Ros-Jellici J, et al. (1989). The Fuenlabrada Study: lipids and lipoproteins in children and adolescents. Rev Esp Cardiol *42*: 444–48.

Rabbia F, Veglio F, Pinna G, et al. (1994). Cardiovascular risk factors in adolescents: prevalence and familial aggregation. Prev Med *23*: 809–15.

Rafei M, Boshtam M, Sarafzadegan N (1999). Lipid Profiles in the Isfahan population: an Isfahan cardiovascular disease risk factor survey, 1994. EMHJ *5*: 766–77.

Raftopoulos C, Bermingham MA, Steinbeck KS (1999). Coronary heart disease risk factors in male adolescents, with particular reference to smoking and blood lipids. J Adoles Health *25*: 68–74.

Sempos C, Cooper R, Kovar MG, McMillen M (1988). Divergence of the recent trends in coronary mortality for the four major race-sex group in the United States. Am J Public Health *78*: 1422–27.

Sempos CT, Cleeman JI, Carroll MD, et al. (1993). Prevalence of high blood cholesterol among US adults. An update based on guidelines from the second report of the National cholesterol Education Program Adult Treatment Panel. JAMA *269*: 3009–14.

Sempos CT, Bild DE, Manolio TA (1999). Overview of the Jackson Heart Study: a study of cardiovascular diseases in African American Men and Women. Am J Med Sci *317*: 142–46.

Singh RB, Rastogi V, Niaz MA, Ghosh S, Sy RG, Janus ED (1998). Serum cholesterol and coronary artery disease in populations with low cholesterol levels: The Indian Paradox. Int J Cardiol *65*: 81–90.

Stamler J (1978). George lyman Duff Memorial Lecture: lifestyles, major risk factors, proof, and public policy. Circulation *58*: 3–19.

Stamler J, Dyer AR, Shekelle RB, Neaton J, Stamler R (1993). Relationship of baseline major risk factors to coronary and all-cause mortality, and to longevity: findings from long term follow-up of Chicago cohorts. Cardiology *82*: 222.

Stray HC (1989). Evolution and progression of atherosclerosis lesions in coronary arteries of children and young adults. Artheriosclerosis 9: 19–32.

Strong JP (1991). The Natural history of atherosclerosis in childhood. Ann N Y Acad Sci *623*: 9–15.

Sytkowski PA, Agostino RB, Belanger A, Kannel WB (1996). Sex and time trends in cardiovascular disease incidence and mortality: the Framingham Heart Study, 1950-1989. Am J Epidemiol *143*: 338–50.

Uemura K, Pisa Z (1985). Recent trends in cardiovascular disease mortality in 27 industrialized countries. World Health Stat Q *38*: 142–62.

US Department of Health and Human Services, Public Health Service (1992). National Cholesterol Education Program: highlights of the Report of the Expert Panel on Blood Cholesterol Levels in Children and Adolescents. National Institutes of Health, National Heart, Lung, and Blood Institute. J Am Osteopath Assoc *92*: 380–88.

Vobecky JS, David P, Vobecky J (1988). Identification of risk factors of hypercholesterolemia in children: 9 year follow-up. Rev Epidemiol Sante Publique *36*: 409–20.

Webber L, Waftigney W, Srinivasan S, Berenson G (1995). Obesity studies in Buglusa. Am J Med Sci *310*: 53–61.

World Health Organization (1985). Diabetes Mellitus: report of a WHO Study Group. Geneva: World Health Organization: Tech Rep. Ser. No 727.

World Health Organization (1990). MONICA manual. Geneva: WHO

World Health Organization, Eastern Mediterranean Regional Office (1995). Prevention and control of cardiovascular diseases. Alexandria: WHO-EMRO: 24.

World Health Organization (1998). Guideline for controlling and monitoring. The Tobacco Epidemic. Geneva.

Yusuf HR, Giles WH, Groft JB, Anda RF, Casper ML (1988). Impact of multiple risk factor profiles on determining cardiovascular disease risk. Prev Med *27*: 1–9.

Zali M, Kazem M, Masjedi MR (1993). Health and disease in Iran. Deputy of Research, Ministry of Health. Bulletin No. 10. (In Farsi)

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Appendix

Table A1 Mean value, standard deviation, and selected percentiles of total serum cholesterol in Tehranian population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean (mg/dl)	SD	Percentile				
			10	25	50	75	90
Male							
3–4	166.79	24.12	140.0	152.0	166.0	180.8	200.0
5–9	168.74	30.22	133.0	149.0	168.0	185.0	204.0
10–14	168.17	31.70	131.0	145.0	166.0	187.0	207.0
15–19	161.70	35.31	122.8	138.0	156.0	179.0	208.0
20–24	170.82	33.68	128.8	146.0	169.0	189.0	216.2
25–29	188.53	38.72	142.0	162.5	184.0	210.5	237.0
30–34	199.35	39.89	154.0	172.0	197.0	223.0	251.4
35–39	207.91	42.49	154.7	178.0	206.0	234.3	261.0
40–44	212.23	46.04	160.0	180.8	207.5	236.0	263.0
45–49	213.85	42.21	163.0	185.0	214.0	240.0	265.0
50–54	212.52	42.08	162.2	182.5	210.0	236.0	265.6
55–59	216.04	39.56	166.8	189.0	215.0	239.0	264.2
60–64	218.41	41.65	167.6	190.0	219.0	246.0	271.0
>64	211.91	41.76	159.0	183.0	208.0	236.0	264.0
Female							
3–4	172.56	29.18	136.0	156.0	170.0	190.0	210.0
5–9	174.87	33.01	138.0	154.0	172.0	190.0	214.0
10–14	171.78	31.62	136.0	150.0	169.0	189.0	211.0
15–19	169.59	31.50	132.0	147.0	167.0	189.0	211.5
20–24	174.05	34.71	133.1	151.0	171.0	195.0	219.0
25–29	186.84	38.21	142.8	161.0	183.0	208.0	234.2
30–34	197.59	38.39	154.1	171.0	194.0	219.0	242.9
35–39	203.64	37.32	157.0	177.0	201.0	229.0	251.9
40–44	209.29	39.65	159.0	182.0	208.0	232.0	260.0
45–49	221.21	44.06	168.6	192.0	218.0	248.0	276.4
50–54	243.35	46.09	188.0	211.0	241.0	274.0	301.0
55–59	249.70	50.67	194.0	212.0	244.0	277.0	314.0
60–64	248.64	48.10	190.5	217.8	244.0	278.3	310.5
>64	246.38	51.08	185.0	215.3	244.0	273.0	305.5

Table A2 Mean value, standard deviation, and selected percentiles of serum triglycerides in Tehranian population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean (mg/dl)	SD	Percentile				
			10	25	50	75	90
Male							
3–4	80.68	33.05	44.6	57.0	76.0	96.0	125.6
5–9	88.49	39.86	50.0	62.0	81.0	103.0	135.2
10–14	101.98	58.45	51.0	64.0	88.0	119.8	170.1
15–19	116.26	71.42	56.0	71.0	97.0	141.0	197.4
20–24	125.50	101.45	56.0	76.0	105.0	141.5	208.4
25–29	164.46	117.03	66.0	90.0	131.0	208.0	288.0
30–34	189.85	128.30	75.0	106.0	155.0	230.0	342.0
35–39	192.12	122.17	81.0	115.8	166.0	226.5	336.9
40–44	217.92	191.04	86.6	121.0	175.0	254.5	349.2
45–49	212.58	143.71	86.0	122.5	177.0	254.0	365.0
50–54	186.23	100.01	88.4	118.0	167.0	226.5	325.0
55–59	201.24	128.08	87.8	122.0	171.0	239.0	355.2
60–64	189.63	123.16	85.0	120.5	160.0	226.5	320.4
>64	172.94	119.29	74.0	102.0	142.0	213.5	293.0
Female							
3–4	86.32	28.05	55.0	66.0	82.0	101.0	123.0
5–9	92.04	40.66	52.0	64.8	82.0	109.0	144.3
10–14	120.14	62.07	61.0	78.0	106.0	147.0	195.2
15–19	103.48	51.82	55.0	71.0	91.5	121.8	163.0
20–24	100.30	52.57	51.0	65.0	89.0	122.0	165.0
25–29	118.47	77.47	56.0	70.0	96.0	142.0	211.0
30–34	137.71	92.85	61.0	81.0	113.0	166.0	243.0
35–39	151.69	90.20	70.0	90.0	129.5	188.3	259.0
40–44	174.59	98.73	80.1	104.0	150.5	217.0	301.9
45–49	183.86	113.31	79.6	114.0	160.0	219.0	309.0
50–54	216.79	137.26	96.0	131.0	181.0	255.0	369.2
55–59	211.04	115.52	99.0	135.5	187.0	257.5	346.6
60–64	207.18	145.59	97.0	128.8	176.5	252.8	324.5
>64	204.42	125.36	91.5	130.0	177.0	251.8	329.0

Table A3 Mean value, standard deviation, and selected percentiles of serum HDL-Cholesterol in Tehranian population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean (mg/dl)	SD	Percentile				
			10	25	50	75	90
Male							
3–4	46.70	10.90	32.0	40.5	46.0	53.0	56.0
5–9	46.51	11.32	32.0	39.0	46.0	53.0	60.0
10–14	45.44	10.80	32.0	39.0	46.0	53.0	60.0
15–19	40.38	9.20	28.0	35.0	39.0	46.0	53.0
20–24	40.17	9.12	28.0	35.0	39.0	46.0	53.0
25–29	38.24	8.55	28.0	32.0	39.0	42.0	49.0
30–34	37.43	9.71	25.0	32.0	35.0	42.0	49.0
35–39	37.46	9.19	28.0	32.0	35.0	42.0	49.0
40–44	37.50	9.18	28.0	32.0	35.0	42.0	49.0
45–49	37.26	8.99	28.0	32.0	35.0	42.0	49.0
50–54	37.76	9.39	28.0	32.0	35.0	42.0	49.0
55–59	38.76	9.90	28.0	32.0	39.0	42.0	49.0
60–64	39.25	9.60	28.0	32.0	39.0	46.0	53.0
>64	40.08	10.15	28.0	32.0	39.0	46.0	53.0
Female							
3–4	43.78	9.10	32.0	39.0	42.0	49.0	56.0
5–9	46.16	11.10	34.1	39.0	46.0	53.0	60.0
10–14	42.89	10.31	32.0	35.0	42.0	49.0	56.0
15–19	43.96	10.10	32.0	39.0	42.0	49.0	56.0
20–24	45.90	10.80	32.0	39.0	46.0	53.0	60.0
25–29	46.43	12.19	32.0	39.0	46.0	53.0	63.0
30–34	44.94	11.16	32.0	39.0	42.0	53.0	60.0
35–39	44.00	10.50	32.0	35.0	42.0	49.0	56.0
40–44	42.19	10.04	32.0	35.0	42.0	49.0	56.0
45–49	44.02	11.42	32.0	35.0	42.0	49.0	57.6
50–54	45.62	11.38	32.0	39.0	46.0	53.0	60.0
55–59	45.73	10.93	32.0	39.0	46.0	53.0	60.0
60–64	46.48	11.58	32.0	39.0	46.0	54.5	60.0
>64	46.07	11.41	32.0	39.0	46.0	53.0	60.0

Table A4 Mean value, standard deviation, and selected percentiles of serum LDL-Cholesterol in Tehranian population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean (mg/dl)	SD	Percentile				
			10	25	50	75	90
Male							
3–4	104.19	21.82	74.8	92.9	104.4	116.9	133.8
5–9	104.41	27.52	72.8	85.4	103.8	121.0	135.7
10–14	102.28	27.59	70.0	84.2	99.8	117.9	138.1
15–19	98.33	30.41	64.8	79.0	94.4	114.4	132.4
20–24	106.16	29.08	69.6	86.0	105.0	124.9	144.4
25–29	118.49	33.36	80.0	96.6	117.0	134.9	160.9
30–34	126.62	33.38	85.1	104.0	124.7	148.8	167.9
35–39	133.39	35.73	89.3	109.3	132.0	155.4	176.3
40–44	134.98	37.07	91.5	109.3	134.1	156.4	179.6
45–49	136.94	37.03	90.5	110.6	137.4	159.8	183.8
50–54	137.13	34.52	93.2	114.2	135.4	156.0	182.6
55–59	138.61	33.36	95.8	116.1	137.0	161.7	181.8
60–64	142.29	35.26	98.8	119.1	143.8	166.2	188.4
>64	138.39	36.60	92.8	113.7	136.1	159.8	187.4
Female							
3–4	110.78	24.77	81.0	94.5	109.4	129.5	138.5
5–9	110.41	28.98	81.0	92.6	107.0	123.8	143.2
10–14	104.83	28.62	72.2	85.6	102.2	119.8	140.2
15–19	104.91	27.68	73.4	86.2	101.8	121.5	141.8
20–24	107.96	30.13	72.4	88.0	104.8	124.7	147.1
25–29	117.19	33.13	77.6	94.4	113.8	135.1	158.6
30–34	125.72	33.07	89.2	103.4	122.8	143.8	160.0
35–39	129.61	32.38	89.8	107.0	128.0	151.6	171.4
40–44	132.87	32.59	91.8	111.2	130.3	152.6	177.4
45–49	140.47	37.19	93.9	117.4	137.4	162.6	187.4
50–54	156.06	37.22	107.8	130.7	155.4	180.2	206.0
55–59	162.50	42.01	114.0	133.2	156.8	187.2	217.3
60–64	161.49	40.96	113.1	132.3	159.0	185.8	214.0
>64	160.29	42.31	107.1	133.9	160.5	184.2	214.4

Table A5 Mean value, standard deviation, and selected percentiles of fasting blood sugar (FBS) in Tehranian population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean (mg/dl)	SD	Percentile				
			10	25	50	75	90
Male							
3–4	78.67	10.05	67.6	73.3	79.0	84.0	89.7
5–9	86.22	8.83	75.0	81.0	86.0	92.0	97.0
10–14	89.83	13.60	80.0	84.0	90.0	95.0	99.0
15–19	88.93	8.87	79.0	85.0	88.0	94.0	98.2
20–24	87.21	10.53	77.0	81.0	87.0	92.0	97.0
25–29	88.55	10.85	78.0	83.0	88.0	93.0	99.0
30–34	90.86	12.99	79.5	84.0	90.0	96.0	101.0
35–39	92.41	21.41	78.0	84.0	89.0	96.0	103.0
40–44	96.43	22.96	81.0	86.0	93.0	99.0	110.3
45–49	101.73	34.38	81.0	87.0	93.0	100.0	120.0
50–54	102.18	33.37	82.0	86.0	93.0	103.0	126.0
55–59	110.47	42.97	82.0	87.0	95.0	111.0	163.2
60–64	112.15	46.79	83.0	89.0	96.0	108.5	173.4
>64	110.54	42.66	82.0	88.0	96.0	112.0	165.0
Female							
3–4	78.68	8.59	68.0	73.0	79.0	84.0	89.0
5–9	83.44	8.41	73.0	78.0	84.0	89.0	94.0
10–14	88.93	8.07	78.0	84.0	89.0	94.0	99.0
15–19	85.99	8.02	76.0	81.0	86.0	91.0	95.0
20–24	84.17	8.12	75.0	79.0	84.0	89.0	94.0
25–29	86.21	10.05	76.0	81.0	86.0	91.0	96.0
30–34	88.08	15.06	76.1	82.0	87.0	92.0	98.0
35–39	93.11	27.89	78.0	83.0	88.0	95.0	105.0
40–44	96.85	28.41	78.1	84.0	90.0	99.0	113.0
45–49	103.13	38.33	80.0	86.0	93.0	103.0	127.4
50–54	110.61	49.80	81.0	87.0	94.0	107.5	160.6
55–59	113.70	51.71	81.0	87.0	96.0	113.5	171.0
60–64	117.48	52.68	83.0	88.0	98.0	119.3	189.0
>64	114.25	46.53	83.0	89.0	97.0	114.0	177.0

Table A6 Mean value, standard deviation, and selected percentiles of two hours post-load blood sugar (2hPG)* in Tehranian adult population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean (mg/dl)	SD	Percentile				
			10	25	50	75	90
Male							
20–24	88.61	20.68	63.2	75.0	89.0	102.0	113.0
25–29	92.16	27.46	63.0	72.3	90.0	107.8	123.0
30–34	96.44	31.67	64.0	76.0	91.0	112.0	130.0
35–39	102.55	42.71	64.0	78.0	96.0	117.0	139.8
40–44	112.80	53.83	68.0	83.0	102.0	123.0	157.6
45–49	120.48	64.09	66.2	86.0	108.0	130.5	176.8
50–54	126.94	68.32	73.0	90.5	112.0	136.5	202.0
55–59	137.00	71.25	71.0	92.0	119.0	157.0	235.0
60–64	137.51	76.35	77.0	95.5	120.0	157.0	196.0
>64	147.06	77.97	81.8	99.0	123.0	167.0	248.2
Female							
20–24	94.35	21.45	70.0	80.0	92.0	105.0	118.0
25–29	99.66	30.26	73.0	83.0	95.0	112.0	127.0
30–34	103.47	30.09	74.0	85.0	99.0	116.0	136.0
35–39	114.85	40.59	79.0	92.0	107.0	129.0	154.0
40–44	124.30	48.33	82.0	97.0	113.0	136.0	180.0
45–49	132.67	56.79	85.0	100.3	116.0	145.0	203.1
50–54	135.94	60.88	86.4	100.0	122.0	151.5	202.6
55–59	138.00	62.04	85.2	104.0	123.0	152.0	203.6
60–64	153.69	90.07	89.0	106.0	127.0	163.0	239.0
>64	144.76	58.90	95.8	110.0	131.0	159.0	213.6

* Oral GTT with 75 g glucose in subjects over 19 years old.

Table A7 Mean value, standard deviation, and selected percentiles of systolic blood pressure (SBP) in Tehranian population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean (mmHg)	SD	Percentile				
			10	25	50	75	90
Male							
3–4	97.09	11.31	84.2	90.5	98.0	104.0	109.0
5–9	104.22	11.73	90.0	96.0	103.0	112.0	119.0
10–14	103.38	11.33	89.6	95.0	103.0	111.0	119.0
15–19	110.51	12.14	96.0	102.0	110.0	118.0	127.0
20–24	114.14	11.78	99.0	107.0	114.0	122.0	130.2
25–29	115.08	11.41	100.4	107.0	115.0	122.0	130.0
30–34	113.67	10.60	100.0	106.0	113.0	121.0	127.0
35–39	113.52	12.55	98.4	105.0	113.0	121.0	130.0
40–44	114.78	14.77	98.0	104.0	114.0	122.0	133.0
45–49	117.91	15.00	101.0	108.0	116.0	126.0	135.8
50–54	123.39	17.57	104.0	111.0	120.0	133.0	144.5
55–59	129.68	20.50	107.0	116.0	128.0	140.0	154.0
60–64	133.59	22.63	109.0	118.0	129.0	146.0	163.0
>64	138.00	23.03	110.9	121.0	136.0	151.8	168.0
Female							
3–4	95.36	13.18	77.2	89.0	95.0	104.0	111.0
5–9	101.80	11.98	87.0	95.0	101.0	110.0	117.0
10–14	101.79	11.23	88.0	94.5	101.0	109.0	117.0
15–19	106.34	10.78	93.0	99.0	105.5	113.0	120.5
20–24	107.10	10.38	95.0	100.0	106.0	114.0	121.2
25–29	108.78	10.45	95.0	101.0	108.0	115.0	122.0
30–34	109.14	10.66	95.0	102.0	109.0	116.0	123.0
35–39	112.70	12.65	98.0	104.0	111.0	120.0	129.0
40–44	116.53	14.89	99.0	107.0	115.0	125.0	135.0
45–49	121.41	17.44	102.0	110.0	120.0	131.0	145.0
50–54	129.43	21.03	105.0	115.0	126.0	141.0	156.0
55–59	131.83	21.65	106.0	116.0	130.0	145.0	159.0
60–64	138.40	22.01	113.0	123.0	136.0	150.0	169.0
>64	142.30	23.04	115.0	125.0	140.0	158.0	174.0

Table A8 Mean value, standard deviation, and selected percentiles of diastolic blood pressure (DBP) in Tehranian population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean (mmHg)	SD	Percentile				
			10	25	50	75	90
Male							
3–4	66.01	8.75	55.0	60.0	67.0	71.0	77.0
5–9	71.26	10.24	58.0	64.0	72.0	79.0	83.2
10–14	69.59	9.45	58.0	63.0	70.0	77.0	81.4
15–19	72.66	8.65	61.0	67.0	72.0	79.0	84.0
20–24	72.96	9.34	61.0	67.0	73.0	79.0	85.0
25–29	74.59	9.77	62.0	69.0	74.0	81.0	87.0
30–34	76.34	9.07	65.0	70.0	76.0	82.0	88.0
35–39	76.95	9.83	65.0	70.0	76.0	83.0	89.0
40–44	77.80	11.25	64.0	70.0	77.0	84.0	92.0
45–49	79.04	10.42	67.0	71.0	78.0	86.0	92.8
50–54	81.06	10.44	69.0	74.0	81.0	87.0	95.0
55–59	81.09	11.22	68.8	73.0	81.0	88.0	95.0
60–64	82.13	13.29	67.0	72.0	80.0	90.0	101.0
>64	79.35	12.98	63.0	71.0	79.0	87.0	97.1
Female							
3–4	65.26	10.39	53.0	60.0	66.0	70.0	79.0
5–9	70.30	10.33	58.0	63.0	70.0	78.0	82.0
10–14	69.72	9.74	58.0	63.0	70.0	77.0	81.0
15–19	72.95	8.40	62.0	68.0	73.0	79.0	83.0
20–24	71.78	8.44	60.8	66.0	71.0	78.0	83.0
25–29	73.21	8.76	61.0	67.0	73.0	80.0	84.0
30–34	74.24	8.62	63.0	68.0	75.0	80.0	84.0
35–39	77.55	8.75	66.0	71.0	78.0	82.0	89.0
40–44	78.78	10.17	67.0	71.0	78.0	85.5	92.0
45–49	80.71	10.52	68.6	73.0	80.0	88.0	94.0
50–54	83.50	11.62	70.0	76.0	82.0	90.0	100.0
55–59	82.96	11.00	70.0	76.0	81.0	89.0	99.0
60–64	83.46	11.60	70.0	76.0	82.0	91.0	98.0
>64	81.00	11.32	68.0	73.0	80.0	89.0	95.0

Table A9 Mean value, standard deviation, and selected percentiles of height in Tehranian population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean (cm)	SD	Percentile				
			10	25	50	75	90
Male							
3–4	99.67	6.60	93.0	96.0	100.0	104.0	106.0
5–9	120.16	9.66	107.0	113.0	121.0	127.0	132.0
10–14	148.53	11.85	133.0	140.0	147.0	157.0	166.0
15–19	171.10	7.76	162.0	167.0	172.0	176.0	180.0
20–24	173.99	6.38	166.0	170.0	174.0	178.0	182.0
25–29	173.00	6.16	166.0	169.0	173.0	177.0	182.0
30–34	171.66	5.97	165.0	168.0	171.0	175.0	179.0
35–39	171.22	6.35	163.0	167.0	171.0	175.0	179.0
40–44	170.07	5.84	162.0	166.0	170.0	174.0	177.0
45–49	169.00	6.19	161.0	165.0	169.0	174.0	177.0
50–54	168.21	6.30	161.0	164.0	168.0	172.0	176.0
55–59	167.01	6.20	159.8	162.0	167.0	171.0	175.0
60–64	166.70	6.37	159.0	162.0	166.0	172.0	175.0
>64	165.38	6.45	157.0	161.0	165.0	170.0	173.4
Female							
3–4	100.20	6.04	94.6	97.0	100.0	104.0	107.0
5–9	120.69	10.15	107.0	113.0	121.0	128.0	133.0
10–14	149.34	9.78	136.0	142.0	150.0	157.0	161.0
15–19	159.55	5.88	152.0	156.0	159.0	163.0	167.0
20–24	159.60	5.98	152.0	156.0	160.0	163.5	167.6
25–29	159.15	5.58	152.0	155.8	159.0	163.0	166.0
30–34	157.93	5.50	151.0	154.0	158.0	162.0	165.0
35–39	157.39	5.70	150.0	153.0	157.0	161.0	165.0
40–44	156.83	5.58	150.0	153.0	157.0	160.0	164.0
45–49	155.68	5.77	148.0	152.0	156.0	160.0	163.0
50–54	154.68	5.60	148.0	151.0	155.0	158.0	162.0
55–59	154.46	5.39	147.5	151.0	155.0	158.0	161.0
60–64	152.88	5.19	146.0	149.0	153.0	156.0	159.7
>64	151.71	5.60	145.0	148.0	151.0	155.0	159.0

Table A10 Mean value, standard deviation, and selected percentiles of weight in Tehranian population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean (Kg)	SD	Percentile				
			10	25	50	75	90
Male							
3–4	15.11	2.14	12.0	14.0	15.0	16.0	18.0
5–9	22.86	5.78	17.0	19.0	22.0	26.0	30.0
10–14	41.72	13.28	28.0	32.0	39.0	49.0	60.0
15–19	63.30	14.59	48.0	54.0	61.0	71.0	83.0
20–24	70.88	13.16	57.0	62.0	69.0	79.0	87.0
25–29	75.25	14.90	58.6	66.0	73.0	84.0	93.0
30–34	76.17	12.90	60.0	66.3	75.0	85.0	93.0
35–39	76.55	13.47	60.0	67.5	75.0	84.0	94.0
40–44	75.01	11.78	60.5	67.0	75.0	83.0	91.0
45–49	76.08	12.10	61.0	69.0	75.0	83.0	90.0
50–54	75.22	11.83	58.0	68.0	75.0	83.0	91.0
55–59	74.16	11.72	58.8	66.0	74.0	82.0	88.0
60–64	73.87	12.26	58.5	66.0	73.0	82.0	90.0
>64	70.71	11.37	57.0	63.0	70.0	78.0	85.0
Female							
3–4	15.04	2.38	12.6	14.0	15.0	16.0	18.0
5–9	23.02	7.06	16.0	18.0	22.0	26.0	31.0
10–14	42.16	11.89	29.0	33.0	41.0	50.0	59.0
15–19	55.54	10.16	44.0	49.0	54.0	60.0	70.0
20–24	59.09	11.32	46.0	51.0	58.0	65.0	74.0
25–29	64.45	12.59	49.0	56.0	64.0	72.0	81.0
30–34	66.51	11.88	52.0	58.0	66.0	74.0	82.0
35–39	68.67	11.81	55.0	61.0	68.0	76.0	83.0
40–44	71.30	12.57	56.0	63.0	70.0	79.0	89.0
45–49	72.12	12.00	57.6	64.0	71.0	79.0	86.4
50–54	71.53	11.52	58.0	64.0	70.0	78.0	86.0
55–59	70.01	11.51	57.0	62.0	69.0	76.0	86.0
60–64	68.01	11.70	53.0	60.0	68.0	76.0	82.0
>64	64.45	11.05	50.0	57.0	64.0	72.0	79.0

Table A11 Mean value, standard deviation, and selected percentiles of waist in Tehranian population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean (cm)	SD	Percentile				
			10	25	50	75	90
Male							
3–4	56.50	9.19	50.0	50.0	56.5	–	–
5–9	52.93	5.49	47.0	49.0	52.0	55.0	59.2
10–14	64.22	10.77	54.0	56.0	62.0	69.0	81.0
15–19	73.97	11.23	62.2	66.0	71.0	80.0	89.0
20–24	79.58	10.77	68.0	72.0	77.5	85.0	94.0
25–29	84.42	11.92	70.0	76.0	84.0	92.0	100.0
30–34	86.74	10.76	73.0	79.0	86.5	94.0	100.0
35–39	88.49	10.82	74.0	81.0	89.0	96.0	102.0
40–44	88.86	9.82	76.0	82.0	89.0	96.0	101.0
45–49	91.27	10.51	77.0	85.0	92.0	99.0	103.0
50–54	91.65	10.26	78.0	85.0	92.0	99.0	104.0
55–59	92.02	10.69	78.0	85.0	93.0	99.0	106.2
60–64	92.51	10.77	80.0	86.0	92.0	99.0	107.0
>64	91.72	10.98	78.0	84.0	92.0	99.0	106.0
Female							
3–4	58.29	10.95	45.0	48.0	57.0	68.0	–
5–9	54.32	6.89	47.0	50.0	53.0	58.0	63.2
10–14	66.24	9.77	55.0	59.0	65.0	72.0	79.0
15–19	72.57	8.77	62.0	66.0	71.0	77.3	85.0
20–24	75.21	10.27	63.0	68.0	74.0	81.0	90.0
25–29	80.82	11.02	67.0	73.0	80.0	88.0	95.0
30–34	83.52	10.81	71.0	75.0	82.0	90.0	98.8
35–39	86.57	11.21	73.0	78.0	86.0	94.0	101.0
40–44	90.37	11.65	75.9	83.0	90.0	98.0	106.0
45–49	92.67	11.19	79.0	85.0	93.0	100.0	106.0
50–54	94.38	10.82	80.0	87.0	95.0	101.0	108.0
55–59	95.47	10.86	82.0	88.0	95.0	102.0	110.0
60–64	95.35	11.36	80.0	88.0	96.0	104.0	110.0
>64	94.58	11.31	80.0	86.8	95.0	103.0	109.0

Table A12 Mean value, standard deviation, and selected percentiles of hip circumference in Tehranian population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean (cm)	SD	Percentile				
			10	25	50	75	90
Male							
3–4	72.50	23.33	56.0	56.0	72.5	–	–
5–9	61.63	6.36	54.0	57.0	61.0	65.0	69.0
10–14	77.13	10.15	66.0	70.0	76.0	83.5	90.0
15–19	90.31	8.95	81.0	84.0	89.0	95.0	102.0
20–24	94.02	7.58	85.0	89.0	93.0	98.0	103.0
25–29	96.44	8.06	87.0	91.0	96.0	101.0	106.0
30–34	96.98	6.95	88.0	92.0	97.0	102.0	105.9
35–39	96.95	7.29	88.0	93.0	97.0	101.0	106.0
40–44	96.29	6.50	88.0	92.0	96.0	100.0	105.0
45–49	97.25	6.83	89.0	93.0	97.0	101.0	105.0
50–54	96.84	6.53	89.0	93.0	97.0	100.0	105.0
55–59	96.26	6.69	89.0	91.0	96.0	100.0	104.0
60–64	96.44	7.21	87.5	92.0	96.0	101.0	105.0
>64	95.50	7.28	87.0	91.0	95.0	99.0	104.0
Female							
3–4	73.00	21.26	50.0	55.0	62.0	90.0	–
5–9	64.04	7.80	55.0	58.0	63.0	69.0	74.0
10–14	82.93	10.74	69.0	75.0	82.0	90.0	97.0
15–19	95.53	7.97	86.0	90.0	95.0	100.0	106.0
20–24	98.07	8.57	87.0	92.0	98.0	103.0	109.0
25–29	101.76	9.39	90.0	96.0	101.0	107.0	114.0
30–34	103.45	8.98	93.0	97.0	103.0	108.0	115.0
35–39	104.68	8.97	93.3	99.0	104.0	110.0	116.0
40–44	106.95	9.69	96.0	100.0	105.0	112.0	120.0
45–49	107.34	9.42	96.0	101.0	106.0	113.0	118.0
50–54	107.33	9.19	96.7	101.0	106.0	113.0	120.0
55–59	106.09	9.91	94.0	100.0	105.0	111.0	120.0
60–64	104.59	9.88	92.0	97.0	103.0	111.0	118.8
>64	102.54	9.31	91.0	96.0	102.0	108.3	114.0

Table A13 Mean value, standard deviation, and selected percentiles of wrist circumference in Tehranian population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean (cm)	SD	Percentile				
			10	25	50	75	90
Male							
3–4	13.55	2.05	12.1	12.1	13.6	–	–
5–9	12.57	0.94	11.5	12.0	12.5	13.1	13.9
10–14	14.94	1.45	13.2	13.8	14.8	16.0	16.9
15–19	16.79	0.99	15.6	16.2	16.8	17.4	18.0
20–24	17.08	0.86	16.0	16.5	17.0	17.6	18.1
25–29	17.33	0.93	16.3	16.7	17.3	18.0	18.5
30–34	17.48	0.89	16.4	16.9	17.5	18.1	18.6
35–39	17.62	0.91	16.5	17.0	17.5	18.2	18.9
40–44	17.62	0.92	16.5	17.0	17.5	18.3	18.9
45–49	17.79	0.88	16.6	17.1	17.8	18.4	19.0
50–54	17.87	0.95	16.6	17.2	17.9	18.5	19.0
55–59	17.97	0.90	16.9	17.3	18.0	18.5	19.1
60–64	18.01	0.95	17.0	17.4	18.0	18.6	19.2
>64	17.89	0.94	16.7	17.2	17.9	18.5	19.1
Female							
3–4	13.36	2.12	11.0	11.5	12.5	15.0	–
5–9	12.35	1.02	11.0	11.5	12.3	13.0	13.7
10–14	14.53	1.11	13.0	13.8	14.5	15.3	16.0
15–19	15.18	0.85	14.2	14.5	15.0	15.6	16.3
20–24	15.20	0.88	14.0	14.5	15.2	15.7	16.5
25–29	15.59	0.93	14.5	15.0	15.5	16.0	16.8
30–34	15.74	0.91	14.7	15.0	15.5	16.3	17.0
35–39	15.92	0.91	14.8	15.3	16.0	16.5	17.0
40–44	16.19	0.97	15.0	15.5	16.0	16.8	17.5
45–49	16.42	0.99	15.2	15.7	16.5	17.0	17.7
50–54	16.56	1.01	15.3	15.8	16.5	17.3	18.0
55–59	16.60	1.00	15.5	16.0	16.5	17.0	18.0
60–64	16.59	1.11	15.2	16.0	16.5	17.3	18.0
>64	16.44	1.01	15.2	15.7	16.5	17.0	18.0

Table A14 Mean value, standard deviation, and selected percentiles of body mass index (BMI) in Tehranian population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean (Kg/m^2)	SD	Percentile				
			10	25	50	75	90
Male							
3–4	15.27	2.32	13.4	14.1	15.1	16.0	16.9
5–9	15.64	2.32	13.5	14.3	15.1	16.4	18.4
10–14	18.54	3.94	14.7	15.8	17.4	20.4	24.4
15–19	21.53	4.44	17.1	18.5	20.3	23.5	27.4
20–24	23.41	4.16	18.8	20.5	23.1	25.5	28.7
25–29	25.11	4.61	20.0	22.0	24.7	27.5	30.7
30–34	25.83	4.07	20.4	23.2	25.7	28.7	31.1
35–39	26.07	4.10	20.8	23.3	26.0	28.6	31.1
40–44	25.91	3.71	21.0	23.4	25.7	28.3	30.5
45–49	26.63	3.90	21.5	24.4	26.6	29.0	31.2
50–54	26.56	3.84	21.6	24.2	26.3	29.0	31.1
55–59	26.56	3.81	22.2	23.9	26.3	29.0	31.4
60–64	26.54	3.88	22.1	23.9	26.5	28.7	31.6
>64	25.86	3.94	21.1	23.2	25.7	28.2	30.8
Female							
3–4	14.97	2.09	13.2	13.8	14.8	15.7	16.6
5–9	15.60	3.70	13.0	13.9	14.9	16.5	18.6
10–14	18.63	3.80	14.4	15.7	17.9	20.8	23.7
15–19	21.75	4.08	17.5	19.1	21.2	23.7	27.2
20–24	22.92	4.82	18.1	19.9	22.6	25.6	28.7
25–29	24.89	5.87	19.0	21.9	24.8	28.2	31.3
30–34	26.37	5.44	21.0	23.3	26.0	29.4	32.8
35–39	27.62	4.89	22.3	24.6	27.4	30.4	33.7
40–44	28.97	4.73	23.5	25.8	28.6	31.8	35.1
45–49	29.75	4.65	24.3	26.8	29.4	32.4	35.4
50–54	29.90	4.58	24.3	26.7	29.5	32.8	36.0
55–59	29.36	4.68	24.1	26.1	28.7	32.1	35.4
60–64	29.06	4.62	23.0	25.6	28.9	32.1	34.7
>64	27.78	5.00	22.1	25.1	27.6	30.7	33.8

Table A15 Mean value, standard deviation, and selected percentiles of waist-to-hip ratio (WHR) in Tehranian population, Tehran Lipid and Glucose Study.

Age group (Year)	Mean	SD	Percentile				
			10	25	50	75	90
Male							
3–4	0.80	0.13	0.71	0.71	0.80	–	–
5–9	0.86	0.05	0.82	0.83	0.85	0.89	0.92
10–14	0.83	0.06	0.76	0.79	0.83	0.86	0.90
15–19	0.82	0.06	0.75	0.78	0.81	0.85	0.89
20–24	0.84	0.06	0.78	0.80	0.83	0.89	0.93
25–29	0.87	0.06	0.79	0.83	0.88	0.91	0.95
30–34	0.89	0.06	0.81	0.85	0.89	0.94	0.97
35–39	0.91	0.06	0.83	0.87	0.91	0.95	0.99
40–44	0.92	0.06	0.84	0.89	0.92	0.96	1.00
45–49	0.94	0.07	0.85	0.90	0.94	0.98	1.02
50–54	0.94	0.06	0.86	0.90	0.94	0.99	1.02
55–59	0.95	0.07	0.87	0.91	0.96	1.00	1.04
60–64	0.96	0.07	0.88	0.91	0.96	1.00	1.03
>64	0.96	0.07	0.87	0.91	0.96	1.00	1.04
Female							
3–4	0.82	0.10	0.71	0.71	0.80	0.92	–
5–9	0.85	0.07	0.77	0.81	0.84	0.89	0.93
10–14	0.80	0.07	0.72	0.75	0.79	0.85	0.89
15–19	0.76	0.06	0.69	0.72	0.75	0.78	0.84
20–24	0.77	0.07	0.68	0.72	0.76	0.81	0.86
25–29	0.79	0.07	0.71	0.75	0.79	0.84	0.88
30–34	0.81	0.07	0.72	0.76	0.80	0.85	0.90
35–39	0.83	0.07	0.74	0.78	0.82	0.87	0.92
40–44	0.84	0.07	0.76	0.80	0.84	0.89	0.94
45–49	0.86	0.07	0.77	0.82	0.86	0.91	0.96
50–54	0.88	0.08	0.78	0.82	0.88	0.93	0.98
55–59	0.90	0.07	0.81	0.85	0.90	0.95	0.99
60–64	0.91	0.08	0.82	0.86	0.91	0.96	1.01
>64	0.92	0.08	0.82	0.87	0.92	0.98	1.03