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Günay CAN[1]
Peter SCHWANDT[2,3]
Altan ONAT[4,5]
Gülay HERGENÇ[6]
Gerda-Maria HAAS[2]

Body fat, dyslipidemia, blood pressure and the effects of smoking in Germans and Turks

Aim: Determining the difference regarding obesity in German and Turkish adults.

Materials and Methods: This study examined a cross-section of adults aged 30-79 years old. Age-adjustment was uniformly provided for comparisons.

Results: Among 3055 Germans and 2925 Turks, Turkish women had significantly higher markers of (abdominal) obesity than German women, while waist circumference (WC) was similar among males. Blood pressure (BP), concentrations of total, LDL-cholesterol, and apolipoprotein B were significantly higher among Germans, whereas Turks had markedly higher fasting triglycerides and lower HDL-cholesterol. Unlike Germans, the current trend of smoking among Turks correlates with lower WC and lower systolic BP compared to non-smokers. Hip circumference was associated positively with atherogenic dyslipidemia more strongly among Germans than Turks. Changes in circumferences of waist and hip were significantly associated with elevated LDL-cholesterol, independent of BMI, in Germans, but not among Turks. Excess of overall obesity in Germans and Turkish females, and abdominal obesity among Turkish men, in addition to different sex, appeared to be major determinants of SBP. In contrast to Germans and Turkish males, atherogenic dyslipidemia was significantly associated with higher SBP in Turkish females.

Conclusions: Distribution of adiposity, and its interrelationship in German and Turkish adults, reveals substantial disparity that reflects pathogenetic differences; this requires modified emphasis of preventive and therapeutic measures.

Key words: Blood pressure, dyslipidemia, ethnicity, metabolic syndrome, obesity, smoking habit

[1] Department of Public Health, Cerrahpaşa Medical Faculty, İstanbul University, İstanbul - TURKEY
[2] Arteriosklerose Präventions-Institut, Munich-Nuremberg, GEMANY
[3] University of Munich, GERMANY
[4] Turkish Society of Cardiology, İstanbul - TURKEY
[5] Department of Cardiology, Cerrahpaşa Faculty of Medicine, İstanbul University, İstanbul - TURKEY
[6] Department of Biology, Yıldız Technical University, İstanbul - TURKEY

Vücut yağ ölçütleri, dislipidemi, kan basıncı ve sigaranın etkisi açılarından Türk ve Alman erkek ve kadınlarının karşılaştırılması

Amaç: Alman ve Türk erişkinlerine ait birer kohortta obezite ölçütlerindeki farkları ve bunların ilişkilerini araştırmak.

Yöntem ve Gereç: Otuz ila 79 yaşlarındaki erkek ve kadınlar kesitsel biçimde incelendi. Karşılaştırmalarda yaş ayarlaması uygulandı.

Bulgular: Alman kohortu 3055, Türk kohortu 2925 kişiden ibaretti. Türk kadınları, Alman kadınlarına kıyasla anlamlı biçimde daha yüksek (abdominal) obezite ölçütlerine sahipken, bel çevresi erkeklerde benzerdi. Kan basıncı (KB), total ve LDL-kolesterol ile apolipoprotein B konsatrasyonları Almanlarda anlamlı olarak daha yüksek iken, Türklerde açlık gliseridleri daha yüksek ve HD-kolesterol daha düşüktü. Almanlardan faklı olarak, Türk sigara içicilerinde içmeyenlere kıyasla bel çevresi 3 cm, sistolik KB 4 mmHg daha düşüktü. Bel ve kalça çevrelerindeki değişiklikler Türklerde değil, ama Almanlarda beden kitle indeksinden bağımsız olarak LDL-kolesterol yüksekliği ile ilişkiliydi. Sistolik KB'nin ana belirleyicileri olarak, cinsiyet farkına ilaveten, Almanlar ve Türk kadınlarında genel obezite fazlalığı, Türk erkeklerinde ise abdominal obezite bulundu. Aterojen dislipidemi Türk kadınlarında, Almanlar ve Türk erkeklerinden farklı olarak, anlamlı biçimde daha yüksek sistolik KB ile ilişkiliydi.

Sonuç: Türk ve Alman yetişkinlerinde yağ dağılımı ve bunun ilişkileri, patogenetik farklılıkları yansıtan önemli ayrımları sergilemektedir. Bunlar koruyucu önlem ve tedavide vurgu faklılıkları gerektirebilir.

Anahtar sözcükler: Dislipidemi, etnisite kan basıncı, metabolic sendrom, obezite, sigara içiciliği

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Correspondence
Altan ONAT
Nisbetiye Cad. 37/24,
34335 Etiler,
İstanbul - TURKEY

alt_onat@yahoo.com.tr

Introduction

The unprecedented increase of obesity around the world in the past 2-3 decades (1) has brought to light its relevance in the dynamics of vascular atherosclerotic disease. Previously, in Western Europe and North America, elevated levels of LDL-cholesterol assumed far greater importance in the development of athero-thrombotic disease than other types of dyslipidemia that are closely related to (central) obesity. The impact of the rising prevalence of obesity on dyslipidemia, as well as the impact of certain lifestyle on (central) obesity in 'Western people' requires further study. Turkish adults, as an example of a population with a higher prevalence of metabolic syndrome (MetS) (2), yet not with a very high occurrence of type-2 diabetes, such as that of the people of the Indian subcontinent, have shown a deviation from 'Western people' in several aspects pertaining to body distribution of adiposity and the prevailing type of dyslipidemia (3,4).

Head-to-head comparisons of Germans and Turks are relatively scarce. The PROCAM Study compared German adults living in Munster with Turkish adults living in Kocaeli near İstanbul disclosing differences in the prevalence of obesity, hyperglycemia, as well as high LDL-cholesterol and triglyceride levels and smoking (5). The PEP Study compared Turkish and German children living in Nuremberg (6). The Giessen Study (7) described the prevalence of coronary disease risk factors among adult Turks living in Germany who were recruited from 25 general practitioners, without a comparison with German adults. It has been emphasized that low levels of HDL-cholesterol were found in the majority and that the greater chance of CHD in females occurred where obesity was a factor, without a direct comparison of ethnicities. In the past decade, the Turkish Adult Risk Factor (TARF) study demonstrated several different aspects in cardiovascular disease risk factors in Western populations, among which (abdominal) obesity lay in the center (8). Recently, a possible protective effect has been linked in cigarette smoking against the developments of both MetS and diabetes among Turkish women (9), an effect that differs from the generally known effects of smoking.

A study shedding a more accurate light on the potential ethnic differences in the interrelationship of smoking habits, obesity, blood pressure, and dyslipidemia might be of interest in public health, not only for Turkey, but also for member states given that 3.1 million Turks live in the EU. It is, therefore, the aim of this study to examine the major differences between German and Turkish adults with respect to a) distribution of adiposity, b) its relation to types of dyslipidemia and to blood pressure and c) interrelation of smoking with markers of obesity and dyslipidemias.

Materials and methods

Population samples

The sample of this study consists of 2 cohorts. One is derived from the German PEP Family Heart Study (henceforth referred to as the German group). The PEP Family Heart Study was a community-based 14-year prospective study that was designed to assess and improve cardiovascular risk factors in children and their families representing 92% of the elementary school districts in Nuremberg (6). The ethical committee of the medical faculty of the Ludwigs-Maximilian-University Munich, the Bavarian Ministry of Science and Education and the local school authorities approved the Prevention Education Program PEP. After gaining the written consent of parents, first graders with their parents and siblings were invited to participate in this study as index subjects. We reported on adults from the recruitment period of 1994-2003. The other groups consists of the surviving participants traced up to the period of 2002-2006 of the *TARF Study*, a study on the prevalence of cardiac disease and risk factors in a representative sample of adults in Turkey carried out almost biennially since 1990 in 59 communities throughout all geographical regions of the country (8). Details of the overall sampling were described previously (10). The ethics committee of the İstanbul University Medical Faculty had approved the Turkish study. Written consent was obtained from all participants. The Turkish Ministry of Health provided partial logistic support. Criteria for inclusion were participants between the ages of 30 to 79 years. Subjects with overt malignancies, or metabolic or cardiovascular disease were excluded from the PEP Study.

Measurement of risk factors

Trained research assistants or physicians performed all measurements. Systolic and diastolic blood pressure (BP) was measured twice on both arms after 5 min rest using standard clinical methods with appropriate cuff-sizes, and the mean of 2 recordings was recorded. Weight and height were measured without shoes with light clothing. Body mass index (BMI) was calculated as kg/m². Waist circumference (WC) was measured, according to WHO recommendations (11), at the end of expiration with a flexible inextensible tape placed horizontally at the midpoint between the lowest rib and the iliac crest and hip circumference (HC) at the widest circumference over the major trochanters with the subject standing erect.

Venous blood was taken after 12 h fasting in central schools on 5-6 Saturday mornings and collected on dry ice until centrifugation in the laboratory of the Gesundheitsamt Nuremberg to obtain serum and plasma, which was separated in aliquots and transported on dry ice either for deep freezing or storing at 4 °C. These samples were measured in the research laboratory of the Medical Department II of the University of Munich within 3-4 days, respectively, within a few weeks of storage at -75 °C until analyzed at the Yıldız Technical University in İstanbul. Samples with a creamy chylomicron layer on the top after 12 h storage were excluded. Serum concentrations of total cholesterol (TC) and triglycerides (TG) were measured enzymatically, HDL-cholesterol (HDL-C) measured after precipitation of apolipoprotein B containing lipoproteins by magnesium chloride and phosphotungstic acid. If the TG concentration was <400 mg/dL (4.6 mmol/L) as previously described, LDL-cholesterol (LDL-C) was calculated according to the Friedewald-formula (6). In the Turkish group, concentrations of TC, TG, HDL-cholesterol (HDL-C plus 2nd generation, directly without precipitation) and LDL-cholesterol (directly) were determined by using enzymatic kits from Roche Diagnostics with a Hitachi 902 autoanalyzer. Apolipoprotein (apo) B was measured by nephelometry (BN Prospec, Behring Diagnostics, Westwood, MA, USA).

Definitions and their unification

Self-reported cigarette smoking was categorized into never smokers, former smokers (discontinuance of 3 months or more), and current smokers (regularly 1 or more cigarettes daily), as elicited from interviews during examination. *Hypertension* was defined as a systolic blood pressure ≥140 mmHg and/or diastolic pressure ≥90 mmHg, or use of antihypertensive medication. *Atherogenic dyslipidemia* was identified according to the National Cholesterol Education Program ATP-III (12), namely combined presence of serum triglycerides >150 mg/dL and HDL-cholesterol <40/50 mg/dL.

Data analysis

In the TARF study, data of the last examination were used for anthropometric measures and lipid or non-lipid risk parameters, while the PEP data derive from the first examination. Data were generally presented by controlling or adjusting for age by covariance analysis; BMI and WC data were additionally presented in 3 age brackets. Descriptive parameters were shown as mean ± standard deviation or as age-adjusted mean estimate ± standard error and in percentages. Pairwise comparisons with Bonferroni adjustments were made to detect significance between groups of estimated means; 2-sided t-tests and Pearson's chi-square tests were used to analyze the differences between means and proportions of other groups. Multiple linear regression analyses were performed with continuous parameters. Likelihood estimates and 95% confidence intervals (CI) were obtained by use of logistic regression analyses in models that adjusted for potential confounders. BMI, WC, and HC values were dichotomized in one of the logistic regressions among Germans/Turks by cutpoints of 26/27 kg/m², ≥95/≥95 cm, and ≥100/≥101 cm in men, and 24/29 kg/m², ≥83/≥88 cm, and ≥105/≥107 cm in women, respectively, such that virtually 2 equal sex and ethnicity specific sample sizes were obtained. A value of $P < 0.05$ on the 2-tail test was considered statistically significant. Statistical analyses were performed using SPSS-10 for Windows.

Results

Group description

The German sample consisted of 3055 subjects (of whom 1713 female, 56.1%), median age being 37 years. Women are predominantly in the age group 30-39 years and men in the aged 40 or over group. In the Turkish sample 2925 subjects (1511 female, 51.7%), median age was 53 years, and similar numbers of men and women existed in the age brackets. Current analyses were performed by sex and either by 3 age brackets, or by age-adjustment, because of this divergence. The 3 age brackets were 30-39, 40-49, and 50-79 years and enabled comparison of the 2 groups by providing at least 76 subjects being comprised in each sex-specific bracket. Analyses made among participants confined to age group 40-49 years yielded similar findings; of these, we reported only the relationship between smoking and waist circumference.

Ethnic differences in various characteristics

The Figure highlights mean differences in WC and BMI among German and Turkish men and women. Before age 50, similar WC but (by 1-2 kg/m^2) significantly higher BMI exists among Turkish men. Conversely, past age 50, similar BMI, but (by 3 cm) significantly wider WC exists among German men. On the other hand, Turkish women exhibited significantly elevated BMI and WC throughout the

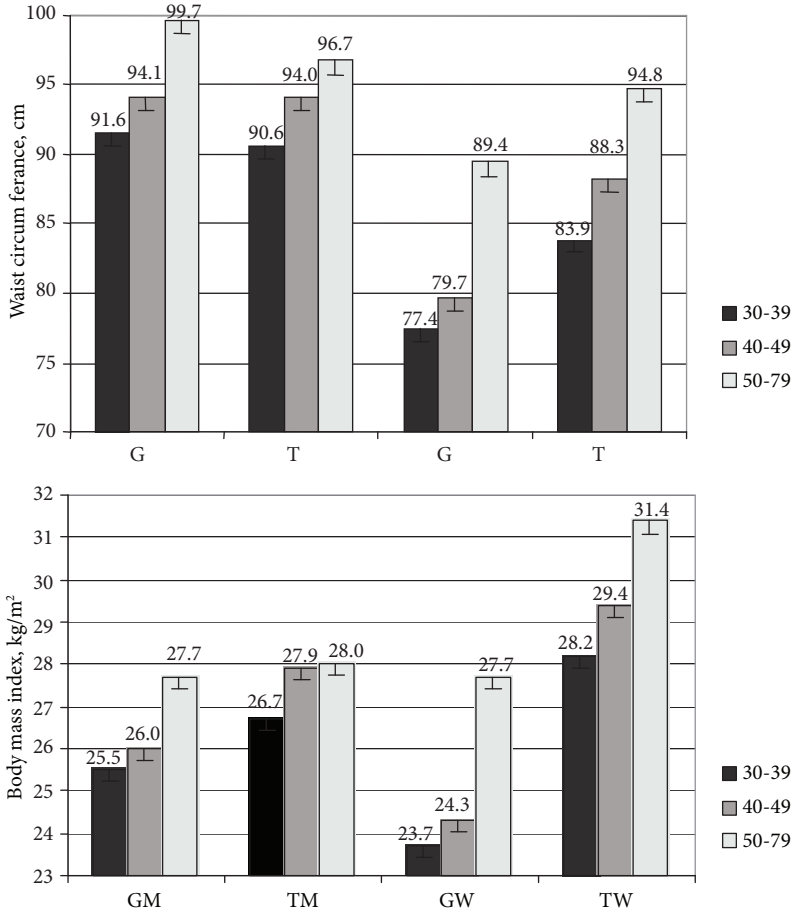

Figure. Mean waist girth (upper panel) and body mass index by indicated age brackets in German (G) and Turkish (T) males (M) and females (W). Standard deviations are provided, and significant differences across ethnic groups are indicated in bold figures. Number of Germans and Turks comprised in the 3 increasing age brackets were 2082, 816, and 157 and 228, 1047, and 1654, respectively.

age brackets. These findings were corroborated by age-adjusted mean marginal estimates (below): Turkish women display full 7 cm wider waist girth (P < 0.001) whereas this parameter is similar in men. Noteworthy is that analysis by age brackets discloses a greater increase in WC among German men across age 50.

Main characteristics of the study population (adjusted for age 46.1/44.4 years), stratified by group and sex, are presented in Table 1. Turkish women have significantly higher age-adjusted values for all 4 markers of (abdominal) obesity than German women. By contrast, WC and waist-to-hip ratio are similar among males, while BMI and waist-to-height ratio are slightly but significantly higher in Turkish men. Systolic and diastolic BP were significantly higher among Germans, this being strikingly so among men. Likewise, concentrations of total, LDL-cholesterol, and apo B were significantly higher among Germans, more pronouncedly so in men. Fasting triglycerides were higher among Turks by ~50% and HDL-cholesterol values lower by 20-25%. Table 1 depicts also age-adjusted ORs for certain medical conditions, which show that atherogenic dyslipidemia is 4- to 8-fold more common among Turks, whereas ORs for elevated LDL-cholesterol and (in males) hypertension are significantly higher in the Germans.

Diverging association of smoking habit with waist circumference

Table 2 summarizes findings between smoking and age-adjusted WC in both groups in 3 age brackets. WC in German adults younger than 40 years and older than 50 years did not appear to be affected by smoking, while in the age group 40-49 years women that smoked disclosed 3.6 cm (P = 0.03) and men 2 cm higher WC than subjects that never smoked. This stands in contrast to Turks in whom smoking was significantly associated in each age bracket with a narrowing of WC (by 3-3.5 cm in females and 2-3 cm in males, P < 0.001 in both).

Table 1. Estimated marginal means of certain age-adjusted risk variables in the sample (3055 Germans, 2925 Turks) and odd ratios of certain disorders, stratified by gender.

	Germans[a]		**Turks**					
	Men	*Women*	*Men*		*Women*		P value	P value
	1340	1715	n	1414	n	1511	Men	Women
Waist circumference, cm	94.5	81.3	1414	93.8	1511	**88.3**	0.16	<0.001
Body mass index, kg/m^2	26.1	24.8	1414	27.6	1511	**29.6**	<0.001	<0.001
Waist-to-hip ratio	0.921	0.798	901	0.942	962	**0.833**	0.12	<0.001
Waist-to-height ratio	0.528	0.488	901	**0.554**	962	**0.563**	<0.001	<0.001
Systolic BP, mmHg	**135.5**	**126**	1414	119.8	1511	121.5	<0.001	<0.001
Diastolic BP, mmHg	**86.7**	**80.3**	1414	77.6	1511	77.8	<0.001	<0.001
Total cholesterol, mg/dL	**209.6**	**202.4**	1414	189.0	1510	189.6	<0.001	<0.001
LDL-cholesterol, mg/dL	**136.8**	**121.2**	1150	113.8	1325	112.4	<0.001	<0.001
HDL-cholesterol, mg/dL	49.1	63.5	1310	**38.8**	1405	**46.8**	<0.001	<0.001
Triglycerides, mg/dL	118.7	86.8	1171	**173**	1356	**138**	<0.001	<0.001
Apolipoprotein B, g/L	**1.21**	**1.08**	1126	1.08	1230	1.02	<0.001	<0.001
	OR	OR		OR		OR		
Hypertension[b]	1	1	1414	0.28	1511	1.21	<0.001	0.082
LDL-cholesterol ≥ 130 mg/dL[b]	3.12	1.53	1138	1	1313	1	<0.001	<0.001
Trg/HDL-dyslipidemia[b]	1	1	1116	5.16	1296	8.17	<0.001	<0.001

[a] No missing values in the German group.
[b]age-adjusted

Table 2. Waist circumference stratified by age-adjusted smoking habit in age brackets, by gender and ethnic group.

	Germans (n = 2837[a])					*Turks* (n = 2910)				
	n	Men	SE	Women	SE	n	Men	SE	Women	SE
Age group 30-39 years										
Never smoker	837	91.2	0.5	77.0	0.5	131	91.8	1.8	84.6	1.2
Former smoker	520	92.7	0.7	**79.0***	0.6	5	86	6.0	85.5	8.6
Current smoker	573	91.4	0.6	76.4	0.6	91	90.1	1.3	81.8	2.2
	1930	0.19		0.004		227	0.56		0.53	
Age group 40-49 years										
Never smoker	288	**92.8***	0.8	**77.5***	1.0	447	95.3	1.0	89.6	0.6
Former smoker	266	95.7	0.8	81.0	1.1	94	96.9	1.2	89.9	2.6
Current smoker	207	94.8	0.8	81.1	1.3	495	**93.1***	0.6	**85.0***	0.9
	761	0.22		0.032		1036	0.009		0.000	
Age group ≥ 50 years										
Never smoker	74	97.7	1.9	90.7	1.9	941	98.0	0.7	95.1	0.4
Former smoker	44	102.8	1.8	86.9	3.2	226	98.7	0.8	97.7	2.1
Current smoker	28	98.2	2.1	82.3	4.9	480	**95.0***	0.6	**91.4***	1.1
	146	0.12		0.22		1647	0.000		0.003	

[a]passive smokers excluded.
*significantly different from the 2 other smoking groups

Association of atherogenic dyslipidemia with excess of anthropometric indices

In logistic regression analyses for atherogenic dyslipidemia as the dependent variable, the odds of dichotomized BMI, WC, HC variables, and smoking were explored in both ethnic groups, after adjustments were made for age and SBP (Table 3). In women of both ethnicities, but not in men, SBP and dyslipidemia were significantly associated. Atherogenic dyslipidemia was independently associated best with abdominal obesity in both genders, regardless of ethnicity, though more strongly in German than Turkish women. Dyslipidemia in German women was more age-dependent than in

Table 3. Likelihood of atherogenic dyslipidemia, adjusted for sex, age, smoking, SBP and dichotomous obesity markers, by ethnicity.

	Germans (n = 3025)				*Turks* (n = 1705)			
	Men (n = 1330)		*Women* (n = 1695)		*Men* (n = 796)		*Women* (n = 909)	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Age, years	*1.023*	0.998; 1.06	**1.059**	1.026; 1.09	*0.966*	0.46; 1.058	1.008	NS
Current smoking	**1.70**	1.13; 2.62	**2.51**	1.17; 5.42	1.26	NS	1.47	0.98; 2.20
Systolic BP, mmHg	1.003	NS	**1.027**	1.01; 1.046	1.003	NS	**1.015**	1.01; 1.02
BMI, high/low	**1.77**	1.05; 2.99	*3.50*	0.96; 12.7	*1.46*	0.993; 2.14	1.08	NS
Waist circumfer., high/low	**2.39**	1.36; 4.20	**5.13**	1.33; 19.8	**2.14**	1.38; 3.31	**1.89**	1.26; 2.82
Hip circumference, high/low	1.20	NS	1.21	NS	*0.70*	0.46; 1.058	0.87	NS

Included were 185 Germans and 521 Turks with atherogenic dyslipidemia
Encoded were 808 German and 598 Turkish current smokers

German men and Turks. Furthermore, while the association of current smokers with atherogenic dyslipidemia was nearly 2-fold among Germans of both sexes, smoking was not significantly associated with dyslipidemia among Turks.

Elevated LDL-cholesterol levels and anthropometric indices

Table 4 shows associations between elevated LDL-cholesterol and the identical 6 independent variables as in the previous logistic regression. Barring for age in both female ethnic groups, significant associations were absent except for waist girth in German subjects. Wider hips of German women showed a "protective" relationship to elevated LDL-cholesterol. The related odds for this dyslipidemia were moderate in magnitude.

Relation of obesity indices with systolic blood pressure

Findings of a linear regression analysis of BMI, WC, and HC with SBP are summarized in Table 5 wherein sex, age, smoking habit, and presence of atherogenic dyslipidemia served as covariates. Hip circumference was not significantly and independently associated with SBP in either ethnic group. Waist circumference was the significant obesity index in Turkish men alone, while in Turkish women and Germans BMI emerged as the determinant of SBP. One SD of obesity indices in both groups independently contributed to a total of over 4 mmHg. Three further notable differences among the groups concerned the relations of sex and smoking habit. Male sex was independently associated with over 7 mmHg higher SBP among Germans, contrasted to a 3 mmHg higher SBP in Turkish women than in men. Whereas smoking was not significantly associated with SBP among Germans, Turkish smokers, regardless of sex, had SBP virtually 4 mmHg lower than subjects that never smoked, after adjustment for confounders. Atherogenic dyslipidemia was significantly and independently associated with 5.5 mmHg higher SBP only in Turkish women, but not in the remaining participants. Of note is that age-dependent rise in SBP was least among German men, while a decade of aging contributed 6-7 mmHg to SBP in German women; this was similar in Turkish adults.

Discussion

Main findings of a cross-sectional analysis of 2 large ethnic population samples showed a significantly higher age-adjusted characteristics of (abdominal) obesity in Turkish than German women, significantly higher BP and concentrations of total, LDL-cholesterol, and apo B among Germans, while fasting triglycerides were markedly higher and HDL-cholesterol lower among Turks. The associations of current smoking diverged among the ethnic groups, tending to be positively associated with WC, SBP, and atherogenic dyslipidemia in Germans, contrasted to substantial inverse associations with the former

Table 4. Likelihood of elevated LDL-cholesterol, adjusted for sex, age, smoking, SBP and obesity markers, by ethnicity.

	Germans (n = 3025)				*Turks* (n = 1724)			
	Men (n = 1330)		*Women* (n = 1695)		*Men* (n = 814)		*Women* (n = 910)	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Age, years	1.007	NS	**1.052**	1.034; 1.07	0.998	NS	**1.032**	1.016; 1.05
Current smoking	1.17	NS	1.23	0.93; 1.61	0.99	NS	1.16	NS
Systolic BP, mmHg	**1.009**	1.001; 1.02	1.007	0.998; 1.016	1.008	1.000; 1.016	1.003	NS
Body mass ind, kg/m^2	0.997	NS	1.013	NS	1.010	NS	0.997	NS
Waist circumfer., cm	**1.029**	1.005; 1.05	**1.039**	1.018; 1.06	0.983	0.964; 1.002	1.008	NS
Hip circumference, cm	0.977	0.95; 1.003	**0.974**	0.95; 0.993	0.996	NS	0.992	NS

Included were 1210 Germans and 564 Turks with elevated LDL-cholesterol
Encoded were 808 German and 605 Turkish current smokers

Table 5. Association of dichotomized obesity markers with systolic blood pressure (mmHg), adjusted for age, smoking and dyslipidemia, by gender and ethnic group.

	Germans, 3023		Men, 1329		Women, 1694		Turks, 1703		Men, 795		Women, 908	
	β coef	P	β coef	P	β coef	P	β coef	P	β coef	P	β coef	P
Sex, male	**9.9**	0.000					**-1**	NS				
Age, years	**0.5**	0.000	**0.30**	000	**0.64**	0.000	**0.98**	0.000	**0.74**	0.000	**0.61**	0.000
Current smoking, 0-2	0.12	NS	0.80	0.072	-0.32	NS	**-1.9**	0.003	*-1.4*	0.092	**-2.43**	0.011
BMI, high/low	**4.8**	0.000	**5.16**	0.000	**4.6**	0.000	**7.6**	0.000	**7.0**	0.000	**8.6**	0.000
Waist girth, high/low	**2.6**	0.000	**2.44**	0.020	**2.85**	0.001	1.45	NS	2.5	0.19	0.77	NS
Hip circumf., high/low	**2.4**	0.000	**2.57**	0.009	**1.84**	0.038	1.23	NS	1.42	0.19	0.60	NS
Ather. dyslipidemia	**2.8**	0.007	0.71	NS	**7.9**	0.000	**3.9**	0.000	1.10	NS	**6.7**	0.002

All models were significant (P < 0.001), explained 29% of systolic BP variance in Germans and 18% in Turks.
HipC not determined in 29% of Turks.

variables and little association with atherogenic dyslipidemia among Turks. Atherogenic dyslipidemia was significantly and independently associated with higher SBP only in Turkish women, but not in the remaining participants. Finally, though 1 SD of obesity indices in both groups independently contributed to a total of over 4 mmHg, BMI emerged as the determinant of SBP in Germans and Turkish women, whereas waist circumference was the significant obesity index in Turkish men.

The 2 population samples differed widely in age distribution and slightly in sex distribution, yet all assessments were performed by age-adjustments and separately in genders, so that the elicited differences are considered valid.

Measures of obesity

Similarity in males of the 2 markers of abdominal obesity, despite significantly higher BMI among Turks, suggests that BMI is not as important in Turkish men as a cardiovascular risk marker as in German men. This is consistent with previously reported observations that the best surrogate of visceral adiposity assessed by CT in Turks was waist circumference and that a lower BMI at a given waist girth in Turkish men suggests the existence of a higher visceral adipose tissue area (13). It is also likely that BMI (a measure which emphasizes height by squaring) is not as appropriate an index of adiposity among Turks who have distinctly shorter stature than Westerners. Similar differences with respect to height had been pointed out among ethnicities; height had limited influence on the differences in WC between Caucasian subjects of different stature (14), whereas waist/height ratio rather than waist/hip ratio had been proposed as a better index of abdominal obesity in predicting CHD risk factors in Japanese men (15).

Among women, Turks had not only higher BMI, but also wider waist girth than Germans, which was more pronounced in premenopausal ages. Thus, Turkish women appear to have a greater susceptibility to abdominal obesity than their German counterparts and, in relative terms, than Turkish men. This is reflected also by a much smaller gender difference of age-adjusted WC in Turks (5.5 cm) than Germans (13 cm). It is noteworthy that Turkish women have substantially higher BMI and wider waist girth also than Greek women of similar age, although among men (who have a similar BMI distribution) the reverse is true concerning WC (16).

These ethnic features in body fat distribution were associated with higher BP and concentrations of LDL-cholesterol, apo B, and HDL-cholesterol, but lower serum triglycerides in the German sample group, in contrast to Turkish adults, who presented features of atherogenic dyslipidemia and had significantly higher age-adjusted prevalence of the latter. Differences in dietary patterns, such as Germans consuming more animal proteins and Turks starchy foods, are partly

responsible. As shown in identical twins, the response of plasma lipoproteins to chronic energy surplus has a significant genetic component, despite much more variation existing among twin pairs than within twin pairs (17). The common concomitance among Turks of high triglycerides with low levels of HDL-cholesterol suggests that much of the latter feature is at some variance with a hypothesis of genetically determined isolated low HDL-cholesterol levels (18) to prevail widely. Recently apolipoprotein A-V-gene polymorphisms were described to be associated with significant increases in plasma triglyceride levels with at least one of these alleles present in about 40% of the Turks (19). The surprising finding that LDL-cholesterol was associated with WC rather than BMI in German men might be accounted for by the clear independent reciprocal relations to LDL-cholesterol of the simultaneously adjusted waist and hip circumferences, which together form surrogates of components of BMI.

Divergent effect of cigarette smoking on abdominal obesity and atherogenic dyslipidemia across ethnicities

The current study confirmed that the smoking habit exerts different effects on abdominal obesity depending on ethnicity. While only German female current smokers exhibited wider age-adjusted WCs than subjects that never smoked, Turkish smokers of both sexes had clearly narrower waist girths. This protective effect against overall obesity demonstrated in women an additional tendency to lowering visceral fat accumulation in terms of a lower age-controlled mean visceral fat/fat mass ratio (20). Smoking was inversely associated with BMI also in Turks of the Giessen study (7). Noteworthy is that smoking was significantly associated with atherogenic dyslipidemia among Germans independently of adiposity measures (suggesting the role of additional direct mechanisms), while the link of smoking to the dyslipidemia appeared to be fully mediated by WC in Turks.

The effects of cigarette smoking extend to several aspects including a reduction in serum asymmetric dimithylarginine (21) and an increase in CRP in men, but no effect or a reduction in women (22). Multi-adjusted prevalence of overweight was significantly lower among current cigarette smoking than nonsmoking Chinese men, and the quantity of cigarettes smoked was inversely associated (23). Furthermore, in line with the observations in the TARF study, smoking cessation resulted in a substantial (3.9 cm) increase in WC in a recent Danish population-based study (24).

Smoking was not associated with SBP, independent of obesity measures, among Germans, but was significantly so in Turks, so that smokers had on average a nearly 4 mmHg lower SBP than subjects that never smoked. This may be due to the effect of nicotine in stimulating angiogenesis, especially in inflammatory milieus. Stimulation of nicotinic cholinergic receptors was shown to enhance the synthesis of NO in vivo (25).

Association between markers of obesity and atherogenic dyslipidemia

Of the 3 obesity markers as dichotomous variables for the likelihood of atherogenic dyslipidemia, abdominal obesity was the best surrogate, irrespective of ethnicity. This is expected from the knowledge that these 2 terms represent 3 fundamental components of the metabolic syndrome. Overall, obesity displayed an additional independent association with this dyslipidemia in Germans, but not in Turks. Gender-specific variations in hip girth have been demonstrated to have independent effects on serum lipoproteins (26,27), but were not observed in this study when analyzed in conjunction with the 2 other obesity indices except in the sense of protecting from elevated LDL-cholesterol in German participants.

Low association between serum LDL-cholesterol and markers of obesity

After adjusting for confounding factors and when BMI, WC, and HC were jointly analyzed multivariately, not BMI but WC and HC were reciprocally associated with elevated LDL-cholesterol levels among Germans. In the recent EPIC-Norfolk study (26), WC adjusted for BMI was associated with LDL-cholesterol in British women, but not in men. The reasons for this sex difference were unclear. Elevated LDL-cholesterol was not related to obesity markers among Turks.

Age is of importance for the 2 types of dyslipidemia only in women, and not in men of either group. This is considered largely related to the effects of menopause on dyslipidemia.

Overall and abdominal obesity, atherogenic dyslipidemia and blood pressure

A key independent determinant of *SBP* was (abdominal) obesity contributing for 1 SD of obesity indices ~5 mmHg to SBP in both study samples, after multiple adjustments. However, whereas overall obesity was the major element among Germans and Turkish women, waist girth was the key determinant in Turkish men. Of further interest is that atherogenic dyslipidemia was associated with systolic BP independently of obesity indices in no group other than Turkish women. This is, in our opinion, a reflection of the link of total body fat mass with this dyslipidemia in Turkish women, but not in men (data not shown).

Limitations of the study include its cross-sectional design, which precludes causal inferences. The considerable age difference in the compared samples has been addressed above. Its strengths are the large sizes of both population samples, including both genders, the evaluation by adjustment not only for age, but also for several other potential confounders including smoking habits.

In conclusion, substantial disparity existed related to obesity among the 2 studied groups, namely, higher (abdominal) obesity in Turkish women, higher BP and higher levels of LDL-cholesterol and apo B among Germans contrasted to higher fasting triglycerides and lower HDL-cholesterol levels among Turks. A divergent effect of cigarette smoking in the 2 population samples on abdominal obesity, SBP, and atherogenic dyslipidemia was remarkable. Reciprocal associations between waist/hip circumferences and elevated LDL-cholesterol, independent of BMI, existed only in German adults. Overall, obesity appeared to be the determinant of SBP in both groups, though the contributions of the 3 obesity indices were independent among Germans. Atherogenic dyslipidemia was significantly and independently associated with higher SBP in women, but not in men. Clinicians concerned with managing obesity and cardiometabolic risk in subjects of the 2 ethnicities may infer appropriate implications.

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