



High prevalence of obesity and diabetes mellitus in Konya, a central Anatolian city in Turkey

Volkan D. Yumuk^{a,b,*}, Husrev Hatemi^{a,b}, Tunc Tarakci^b, Nurettin Uyar^b,
Nurten Turan^c, Nazif Bagriacik^b, Ali Ipbuker^b

^a Department of Medicine, Division of Endocrinology, Metabolism and Diabetes,
Istanbul University Cerrahpasa Medical Faculty, 34303 Istanbul, Turkey

^b Turkish Diabetes Association, Istanbul, Turkey

^c Department of Biostatistics, Istanbul University Istanbul Medical Faculty, Istanbul, Turkey

Received 4 November 2004; received in revised form 24 January 2005; accepted 4 March 2005

Available online 26 April 2005

Abstract

Introduction: The objective of this study was to determine the prevalence of overweight, obesity, impaired fasting glucose, diabetes and the relationship between adiposity and carbohydrate metabolism, by age and gender in Konya, a city in central Anatolia.

Methods: A cross-sectional population based survey was performed. One month before the field survey a media campaign was started in each district by local municipalities. Ten percent of the target population age 20 and over were invited to participate and the participation rate was 82.1%. Twelve thousand eight hundred and sixty-six inhabitants (7000 women and 5866 men, mean age 46.7 ± 15.9 years) were evaluated for height and body weight between May and September of 2001. Two thousand eight hundred and thirty consecutive subjects (1788 women and 1042 men, mean age 48.2 ± 15.7 years) were tested for fasting blood glucose in addition to an anthropometric evaluation.

Results: The crude IFG rate was 24% (27.1% in women and 18.5% in men) and the diabetes rate 8.4% (8% in women and 9.1% in men). The survey identified previously undiagnosed diabetes in 3.7% (4.3% of women and 2.9% of men). The prevalence of diabetes ($p = 0.0005$) and obesity ($p = 0.0005$) increased with age. Obese men and women had a higher risk of being diabetic than their normal weight counterparts (OR, 2.05; CI 95%, 1.13–3.71; $p = 0.0186$ and OR, 2.53; CI 95%, 1.57–4.07; $p = 0.0001$, respectively). Overall, the overweight rate was 34.2% (33.5% of women and 36.3% of men) and the obesity rate was 23.7% (32.4% of women and 14.1% of men) ($n = 12,866$). Women had a significantly higher risk of being obese than men (OR, 2.84; CI 95%, 2.62–3.08; $p = 0.0005$). The diabetes rate was 3.4% (4.1% in women and 2.1% in men).

Conclusion: Carbohydrate intolerance and adiposity are highly prevalent in Konya, and the two conditions are positively correlated with each other, by age and gender.

© 2005 Elsevier Ireland Ltd. All rights reserved.

Keywords: Obesity; Overweight; Impaired fasting glucose; Undiagnosed diabetes; Gender; Age

* Corresponding author. Tel.: +90 542 315 2161.

E-mail address: volkanyumuk@superonline.com (V.D. Yumuk).

1. Introduction

Type 2 diabetes has become a leading public health problem worldwide. There are around 200 million people, who have the condition and numbers, are expected to reach 300 million by 2025. The reason for this increase is particularly due to the rise in overweight and obesity globally [1].

Type 2 diabetes is a common and serious condition that is associated with morbidity and reduced life expectancy and it may remain undetected for a number of years. The adoption of a Western-type lifestyle has resulted in populations changing to a diet high in saturated fat and sugar, with a reduction in physical activity levels [2]. This has resulted in an epidemic of what has been termed “diabesity” [3].

Overweight and obesity are risk factors for type 2 diabetes and cardiovascular diseases. On the other hand, diabetes may lead to microvascular (blindness, renal failure, neuropathy) and macrovascular (stroke, myocardial infarction, lower extremity amputations) complications [4]. Therefore, early detection of obesity and undiagnosed type 2 diabetes in asymptomatic individuals is necessary so that preventive measures can be taken in order to cut down treatment costs, decrease disability and increase life expectancy.

Our objective was to determine the prevalence of obesity, impaired fasting glucose diabetes and the relationship between adiposity and carbohydrate metabolism, with respect to age and gender in Konya.

2. Subjects and methods

The study in Konya was carried out between May and September of 2001. The Turkish Diabetes Association, the Turkish Association for the Study of Obesity and the Endocrinology, Metabolism and Diabetes Division of Istanbul University Cerrahpasa Medical Faculty organized the screening in collaboration with Istanbul University Medical Faculty, Department of Biostatistics, local municipalities and local health care units in Konya. Twenty-seven districts with a well-equipped government health unit, which had the required logistic support were chosen. One month before the field survey a media campaign was started in each district by the local municipalities. Public announcements were started by the local

officials 4 weeks before the survey and continued weekly until the day of the survey. Non-pregnant residents aged 20 years and over (156,624 people) were selected as the target population in accordance with household registration records. Ten percent of these inhabitants were invited to participate and the participation rate was 82.1%.

A cross-sectional population based study was performed. The total study sample involved 12,866 inhabitants (7000 women and 5866 men, mean age 46.7 ± 15.9 years) whose height and body weight were evaluated. Two thousand eight hundred and thirty consecutive subjects (1788 women and 1042 men, mean age 48.2 ± 15.7 years) were tested for fasting blood glucose levels in addition to anthropometric evaluations.

Each survey team comprised a general practitioner, a nurse and a medical secretary. The members of the team were trained in taking anthropometric measurements and measuring blood glucose with a glucometer. Body weight and height were measured while subjects were wearing light clothing without shoes. Body mass index (BMI) was calculated as weight (in kilograms) divided by the square of height (in meters). Diagnosis of overweight and obesity was made if the BMI was between 25.0–29.9 and ≥ 30 kg/m², respectively. Subjects arrived at the study center after an overnight fast (8–12 h). Capillary blood was drawn and analyzed by a glucometer, which used a glucose oxidase method of estimation. In our study, diagnosis of diabetes was based on 1999 diagnostic criteria as recommended by the World Health Organization [5] and diagnosis of impaired fasting glucose (IFG) was based on the Follow-up Report of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus [6]. Fasting blood glucose (FBG) values of 100–125 mg/dl were taken as IFG, and values of 126 mg/dl and above as diabetic. Previously known diabetes was defined based on self-reported diagnosis and blood glucose values in the diabetic range. All prevalence rates, otherwise mentioned as crude, have been adjusted to the population of Turkey as recorded in the 2000 census. The study protocol was approved by the local ethics board.

SPSS Windows (Version 10.0; SPSS, Chicago, IL) was used for data management and statistical analysis. All statistical analyses were performed for women and men separately. The odds of being diabetic and having

IFG by BMI, age and gender were defined from odds ratios (OR) coefficients and 95% confidence intervals (CI) using logistic regression. Relations among different groups and variables were analyzed with χ^2 -test. A level of $p < 0.05$ was used to indicate statistical significance in all analyses.

3. Results

The crude IFG rate was 24% (27.1% in women and 18.5% in men) and the diabetes rate 8.4% (8% in women and 9.1% in men) (Table 1). The overall IFG rate was 20.2% (24.9% in women and 15.1% in men) and the prevalence of diabetes was 4.9% (6.9% in women and 5.5% in men). The survey identified previously undiagnosed diabetes in 4.3% of women and 2.9% of men. The prevalence of diabetes ($p = 0.0005$) and obesity ($p = 0.0005$) increased with age. The prevalence of diabetes showed a steady increase up to the age group 60–69 years, after which the prevalence fell. We did not find a statistically significant difference between the prevalence of diabetes in men and women (Table 1). Diabetes was significantly associated with BMI in men ($\chi^2 = 13.53$; $p = 0.009$) and women ($\chi^2 = 20.52$; $p = 0.0005$). Obese men and women had a higher risk of becoming diabetic than their normal weight counterparts (OR, 2.05; CI 95%, 1.13–3.71; $p = 0.0186$ and OR, 2.53; CI 95%, 1.57–4.07; $p = 0.0001$, respectively). Fifty-one percent of diabetic women and 23.2% of diabetic men were obese compared to 37.6% of women and 18% of men in the studied population ($n = 2830$). The diabetes rate of the population was 3.4% (4.1% in women and 2.1% in men). Forty percent of women and 23.3% of men who had IFG were obese. Age and

Table 2
BMI distribution of the population ($n = 2830$) studied for carbohydrate disturbance

Age group (years)	BMI (kg/m ²)		
	<25.0	25.0–29.9	>30.0
20–29			
Men	98 (64.5)	47 (30.9)	7 (4.6)
Women	173 (63.2)	65 (23.7)	36 (13.1)
30–39			
Men	84 (46.4)	66 (36.5)	31 (17.1)
Women	106 (33.6)	106 (33.5)	104 (32.9)
40–49			
Men	63 (34.2)	87 (47.3)	34 (18.5)
Women	57 (16.6)	125 (36.3)	162 (47.1)
50–59			
Men	59 (31.7)	80 (43.0)	47 (25.3)
Women	63 (17.2)	113 (30.8)	191 (52.0)
60–69			
Men	63 (28.9)	109 (50.0)	46 (21.1)
Women	73 (21.9)	124 (37.4)	135 (40.7)
>70			
Men	57 (47.1)	42 (34.7)	22 (18.2)
Women	52 (33.6)	58 (37.4)	45 (29.0)
Total			
Men	424 (40.7)	431 (41.4)	187 (17.9)
Women	524 (29.3)	591 (33.1)	673 (37.6)

Data are n (%); BMI: body mass index.

gender-specific prevalences of IFG and diabetes are shown in Table 1 and BMI distribution according to age groups and gender is shown in Table 2.

Overall, the overweight rate was 34.2%, 33.5% in women and 36.3% in men; obesity rate was 23.7%, 32.4% in women and 14.1% in men. The prevalence of obesity showed a steady increase up to the age group 60–69 years in men and 50–59 years in women, after

Table 1
Age and gender-specific prevalence of IFG and type 2 diabetes mellitus ($n = 2830$) in Konya

Age group (years)	Total group		IFG		Diabetes	
	IFG	Diabetes	Men	Women	Men	Women
20–29	60 (14.1)	3 (0.7)	15 (9.9)	45 (16.4)	0 (0)	3 (1.1)
30–39	84 (16.9)	13 (2.6)	18 (9.9)	66 (20.9)	3 (1.7)	10 (3.2)
40–49	132 (25.0)	39 (7.4)	34 (18.5)	98 (28.5)	13 (7.1)	26 (7.6)
50–59	170 (30.7)	55 (10.0)	48 (25.8)	122 (33.2)	29 (15.6)	26 (7.1)
60–69	154 (28.0)	92 (16.7)	49 (22.5)	105 (31.6)	36 (16.6)	56 (16.9)
>70	78 (28.3)	36 (13.0)	29 (24.0)	49 (31.6)	14 (11.6)	22 (14.2)

Data are n (%); IFG: impaired fasting glucose.

Table 3
BMI distribution of the population ($n = 12,866$) studied for overweight and obesity prevalence

Age group (years)	BMI (kg/m^2)		
	<25.0	25.0–29.9	>30.0
20–29			
Men	713 (71.4)	232 (23.3)	53 (5.3)
Women	698 (59.5)	327 (27.8)	150 (12.7)
30–39			
Men	494 (44.7)	454 (41.1)	157 (14.2)
Women	459 (30.4)	545 (36.2)	503 (33.4)
40–49			
Men	397 (35.7)	504 (45.4)	210 (18.9)
Women	215 (16.1)	451 (33.8)	668 (50.1)
50–59			
Men	333 (33.9)	427 (43.6)	220 (22.5)
Women	236 (18.4)	434 (33.9)	610 (47.7)
60–69			
Men	360 (34.8)	435 (42.2)	237 (23.0)
Women	273 (23.9)	426 (37.2)	445 (38.9)
>70			
Men	312 (48.7)	218 (34.1)	110 (17.2)
Women	192 (34.3)	204 (36.4)	164 (29.3)
Total			
Men	2609 (44.5)	2270 (38.7)	987 (16.8)
Women	2073 (29.6)	2387 (34.1)	2540 (36.3)

Data are n (%); BMI: body mass index.

which there was a decline. Women had a significantly higher risk of being obese than men (OR, 2.84; CI 95%, 2.62–3.08; $p = 0.0005$). Distribution of BMI according to age group and gender is shown in Table 3.

4. Discussion

The Turkish Diabetes Association pioneered epidemiological studies in the field of diabetes with the first study being performed in 1959 [7]. At that time screening was performed by detecting glucosuria. Several surveys were done afterwards in Turkey with FBG and/or random blood glucose, and with 2 h plasma glucose test, but with varying criteria for screening and diagnosis [8,11,14,15,25]. We have reported for the first time the prevalence of overweight, obesity, IFG and diabetes and their association with each other and with age and gender in a large population in Konya, a central Anatolian city.

Anatolia, a peninsula forming most of the Turkish mainland, is also known as Asia Minor. Geographically, it is divided into seven regions whose inhabitants have unique eating habits and a traditional lifestyle (e.g. Mediterranean diet in the west and south, high saturated fat and carbohydrate diets in central Anatolia and the southeast). Fasting blood glucose measurement was chosen as the method for evaluation because it is more reproducible than the 2 h plasma glucose test, it has less intraindividual variation, and has a similar predictive value for the development of microvascular complications of diabetes [9].

Abnormal glucose tolerance affects 28.6% of the study population ($n = 2830$) aged >20 years. The overall IFG rate was 24% (27.1% in women and 18.5% in men) that is 10–15 times greater than the Turkish Adult Risk Factor Study (TEKHARF) which was the first population based study undertaken by the Turkish Society of Cardiology in 59 randomly selected cities in 7 geographic regions throughout the country [10], and the Adana (a southeastern city) surveys [11]. According to the Third National Health and Nutrition Examination Survey (NHANES III), 10.1% of adult Americans [12] and in the KORA survey 7.2% of Germans aged 55–74 years had IFG [13]. Diabetes affects 8.4% (8% in women and 9.1% in men) of the subjects in Konya. The prevalence rate was higher than that of Kayseri, another central Anatolian city (6.9%) [14] and higher than the rate for the central Anatolia region (6.7%) in another large-scale survey, the Turkish Diabetes Epidemiology Study (TURDEP) [15] which was carried out in a total of 540 centers across the nation. If we had performed 2 h plasma glucose test to those with normal blood glucose and IFG as the next step we would have diagnosed even more diabetics especially in the female population. Moreover, differences in environmental influences such as eating habits and physical activity and in the gene pool would play a significant role in determining the variations in diabetes frequency within and among regions of the country (Tables 4 and 5). The prevalence of diabetes in the year 2000 was found to be 7.4% in Australian adults [16] and 7.9% in adults in the United States [17]. Estimated prevalence rates in the year 2003 for the 20–79 age group are 30.2% in Nauru, 20.1% in United Arab Emirates, 12.3% in Singapore and 10.2% in Germany [18]. These rates are substantially higher than our findings in Konya and elsewhere in Turkey (Tables 4 and 5).

Table 4
Prevalence of IFG, diabetes, overweight and obesity in Turkish cities

	Mean age (years)	Age range (years)	n	DM	Known DM	New DM	IFG	Overweight	Obesity	Mean age (years)	Age range (years)	n
Adana ^a												
Total	–	20–79	1637	11.6	7.4	4.2	1.5	27.2	43.4			
Men			607	12.9	8.1	4.8	1.2	–	–			
Women			1030	10.9	7.0	3.9	1.7	–	–			
Kayseri ^b												
Total	45.9 ± 11.6	30–92	1452	6.9	4.0	2.9	–	31.0 ^c	12.0 ^c	36.8 ± 14.9 ^c		10069 ^e
Men			607	6.8	3.8	3.0	–	28.0 ^c	15.1 ^c			5128 ^e
Women			845	6.9	4.2	2.7	–	33.8 ^e	8.6 ^e			4941 ^e
Trabzon ^c												
Total	37.7	≥20	2646	6.0	3.4	2.6	–	36.8 ^f	23.5 ^f		≥20 ^f	5016 ^f
Men			1324	5.5	3.2	2.3	–	46.5 ^f	16.5 ^f			2288 ^f
Women			1322	6.7	3.7	3.0	–	28.6 ^f	29.4 ^f			2728 ^f
Mersin ^d												
Total				–	–	–	–	38.4	29.3		20–74	1496
Men				–	–	–	–	43.2	22.3			641
Women				–	–	–	–	34.9	34.5			855
Konya												
Total	48.2 ± 15.7	≥20	2830	8.4	4.7	3.7	24.0	34.2	23.7	46.7 ± 15.9	≥20	12866
Men	49.2 ± 16.2		1042	9.1	6.2	2.9	18.5	33.5	14.1	47.5 ± 16.4		5866
Women	47.6 ± 15.3		1788	8.0	3.7	4.3	27.1	36.3	32.4	46.1 ± 15.4		7000

Data are %; DM: diabetes mellitus; IFG: impaired fasting glucose.

^a Gokcel et al. [11].

^b Kelestimur et al. [14].

^c Erem et al. [24].

^d Akbay et al. [26].

^e Krasass et al. [27].

^f Erem et al. [25].

The survey identified previously undiagnosed diabetes in 4.3% of women and 2.9% of men. In other words, 53.8% of the total women diabetics and 31.9% of diabetic men were previously undetected. The undiagnosed diabetes rate was higher than the diagnosed diabetes rate among women in Konya and might be explained by factors such as less utilization of health care and frequent utilization of traditional health care practices by women. The prevalence of undiagnosed diabetes in women and in men in previous studies in Turkey has been shown to be nearly equal to or less than (Tables 4 and 5) that of diagnosed diabetes. According to NHANES III, 4.3–6.3% of adult Americans had undiagnosed diabetes [12]. High prevalence of undiagnosed diabetes (9.3% in men and 6.9% in women aged 55–74 years, by 2 h plasma glucose) was found in southern Germany in the year 2000 [13]. Buysschaert et al. reported the prevalence of

undiagnosed diabetes in a Belgian at risk adult population (age > 60 years) to be 14%, which was higher than they expected (diagnosis by FBG) [19].

Obesity is a powerful risk factor for the development of type 2 diabetes and more than two-thirds of patients with type 2 diabetes are obese. In the Nurses Health Study, the risk of developing diabetes increased five-fold in women with BMI of 25 kg/m² compared with those with BMI of 22 kg/m². The risk becomes higher reaching 28-fold with BMI of 30 kg/m² and 93-fold with BMI >35 kg/m² [20]. Our survey demonstrated that diabetes was significantly associated with BMI in both sexes and obese men and women had a higher risk of becoming diabetic than their normal weight counterparts.

Fifty-one percent of the diabetic women and 23.2% of diabetic men were obese compared to the prevalence of 37.6% in women and 18.0% in men

Table 5
Prevalence of IFG, diabetes, overweight and obesity in Turkey

	Mean age	Age range	n	DM	Known DM	New DM	IFG	Overweight	Obesity
TEKHARF 1990 ^a									
Total		≥30	3681	3.5	–	–	–	–	18.6
Men			1863	2.8	–	–	–	–	12.5
Women			1818	4.2	–	–	–	–	32.0
TEKHARF 2000 ^a									
Total		≥30	2494	–	–	–	–	58.7 ^d	21.9 ^d
Men			1250	8.3	6.4	1.9	2.3	49.8 ^d	11.3 ^d
Women			1244	9.5	5.5	4.0	2.6	67.7 ^d	32.6 ^d
TURDEP ^b									
Total		≥20	24788	7.2	4.9	2.3	–	–	22.3
Men	41.3 ± 14.4		11081	6.2	–	–	–	–	12.9
Women	40.9 ± 14.7		13707	8.0	–	–	–	–	29.9
TOHS ^c									
Total		≥20	20119	–	–	–	–	25.0	19.4
Men	47.9 ± 14.4		15144	–	–	–	–	25.9	14.4
Women	44.0 ± 14.7		4975	–	–	–	–	24.3	24.6

Data are %; DM: diabetes mellitus; IFG: impaired fasting glucose.

^a TEKHARF: Turkish Adult Risk Factor Study, Sansoy et al. [10].

^b TURDEP: Turkish Diabetes Epidemiology Study, Satman et al. [15,22].

^c TOHS: Turkish Obesity Hypertension Study, Hatemi et al. [23].

^d Data provided by A. Onat, personal communication, August 2004.

in the general study population ($n = 2830$). Ayata et al. reported that 32.9% of the type 2 diabetics who were seen at a university out-patient diabetes clinic were obese and 44.3% were overweight [21]. Forty percent of women and 23.3% of men who had IFG were obese.

The TEKHARF study carried out in 1990 and in 2000 [10], the TURDEP study in 1999 [15,22] the Turkish Obesity and Hypertension Study (TOHS) in 2000 [23] were nationwide surveys that looked at the prevalence of obesity, diabetes and hypertension in Turkey. Despite differences in methodology one can observe the magnitude of each health problem and especially the rising trend in obesity during the last decade (Table 5).

Recent local field studies in Trabzon city [24,25], in Adana where both fasting blood glucose and 2 h plasma glucose values were used for diagnosing diabetes [11], Mersin [26], and in Kayseri [27] have revealed the current magnitude of obesity in Turkey, although the telephone survey used in the Kayseri study may have underestimated the prevalence of obesity (Table 4).

We found the overall overweight rate to be 34.2% (33.5% of women and 36.3% of men), obesity rate to

be 23.7% (32.4% of women and 14.1% of men) in Konya ($n = 12,866$). Both prevalences are in accordance with the findings in recent national and local obesity prevalence surveys (Tables 4 and 5). The prevalence of obesity increased with age in subjects 20–59 years of age ($p = 0.0005$). The prevalence of obesity was higher in young women than in young men. Women had a significantly higher risk of becoming obese than men ($p = 0.0005$). In the US, the prevalence of obesity rose from 15 to 30.9% between 1980 and 2000 (27.5% in men and 33.4% in women) [28] and in the UK, 17% of men, 21% of women are obese [29]. Prevalence of overweight was 39.0% and obesity 20.8% in Australia [30].

Over 300,000 deaths were attributed directly to poor diet and lifestyle in the US in 1990 [31]. Life expectancy increases substantially in obese patients with type 2 diabetes who achieve weight loss [32]. A modest weight loss has shown to have a beneficial effect on the degree of glucose tolerance as well as other obesity-related diseases [33].

The major contributor to the impairment of carbohydrate metabolism is adiposity, mainly located in the abdominal area. The prevalence of obesity and

diabetes in industrialized countries generally shows increasing trends over time. The same feature has started to be adopted by the developing countries due to lifestyle changes. A survey looking into the eating habits and energy intake of the inhabitants of Gaziantep metropolitan area in southeastern Turkey demonstrated the increased consumption of red meat and sweets. The difference between energy intake and energy expenditure was 550 cal in women and 1100 cal in men in the study [34]. Similar dietary habits and a physical inactivity rate of 79.2% were reported from Kayseri (central Anatolia) [14] and in Trabzon (Black Sea region) only 10.5% of those who were obese were exercising once a week for 20 min [25].

In conclusion, Konya has been shown to have alarming rates of obesity and a significant amount of adult diabetics, one-half of women and one-third of men being undiagnosed. Diabetes constitutes a major health problem in the world and in Turkey as well. Our study has clearly demonstrated this positive correlation between BMI and glucose intolerance among Turkish men and women. This urgently demands action on many levels to prevent further rises in the prevalence of type 2 diabetes and cardiovascular diseases. Consuming healthy food and adopting a physically active lifestyle can help solve this problem over time. The outcome of prevention and treatment should be evaluated by periodic national comparative surveys with standardized methods that would give us the actual trend.

Acknowledgements

The study was supported by Turkish Diabetes Association, Turkish Association for the Study of Obesity, Turkish Foundation of Diabetes and Obesity and The Turkish Ministry of Health.

References

- [1] H. King, R. Aubert, W. Herman, Global burden of diabetes, 1995–2025. Prevalence, numerical estimates and projections, *Diab. Care* 21 (1998) 1414–1431.
- [2] P. Zimmet, K.G.G.M. Alberti, J. Shaw, Global and societal implications of the diabetes epidemic, *Nature* 414 (2001) 443–474.
- [3] A. Astrup, N. Finer, Redefining type 2 diabetes: “diabesity” or obesity dependent diabetes mellitus? *Obes. Rev.* 1 (2000) 57–59.
- [4] American Diabetes Association, Standards of medical care in diabetes, *Diab. Care* 27 (Suppl. 1) (2004) S15–S35.
- [5] World Health Organization, Definition, Diagnosis and Classification of Diabetes Mellitus and its Complications: Report of a WHO Consultation. Part 1: Diagnosis and Classification of Diabetes Mellitus, Geneva, World Health Organisation, 1999.
- [6] The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus, Follow-up report on the diagnosis of diabetes mellitus, *Diab. Care* 26 (2003) 3160–3166.
- [7] C. Öker, 1959 yılından beri yapılan diabet tarama sonuçları, *Türk Diabet Rakamları*, İstanbul, 1977.
- [8] A. Onat, Türk erişkinlerinde glukoz intoleransı ve diyabet, MAS, İstanbul, 2003, pp. 85–89.
- [9] US Preventive Services Task Force, Screening for type 2 diabetes mellitus in adults: recommendations and rationale, *Ann. Intern. Med.* 138 (2003) 212–214.
- [10] V. Sansoy, Türk erişkinlerinde obezite, abdominal obezite ve diğer risk faktörlerinin ilişkileri, MAS, İstanbul, 2003, pp. 64–69.
- [11] A. Gokcel, A.K. Ozsahin, N. Sezgin, H. Karakose, M.E. Ertorer, M. Akbaba, et al. High prevalence of diabetes in Adana, a southern province of Turkey, *Diab. Care* 26 (2003) 3031–3034.
- [12] M.I. Harris, K.M. Flegal, C.C. Cowie, M.S. Eberdhardt, D.E. Goldstein, R.R. Little, et al. Prevalence of diabetes, impaired fasting glucose, and impaired glucose tolerance in US adults. The Third National Health and Nutrition Examination Survey, 1988–1994, *Diab. Care* 21 (1998) 518–524.
- [13] W. Rathmann, B. Haastert, A. Icks, H. Löwel, C. Meisinger, R. Holle, et al. High prevalence of undiagnosed diabetes mellitus in southern Germany: target populations for efficient screening. The KORA Survey 2000, *Diabetologia* 46 (2003) 182–189.
- [14] F. Kelestimur, M. Cetin, H. Pasaoglu, B. Coksevim, F. Cetinkaya, K. Unluhizarci, et al. The prevalence and identification of risk factors for type 2 diabetes mellitus and impaired glucose tolerance in Kayseri, central Anatolia, Turkey, *Acta Diabetol.* 36 (1999) 85–91.
- [15] I. Satman, M.T. Yilmaz, A. Sengul, S. Salman, F. Salman, S. Uygur, et al. the TURDEP Group, Population based study of diabetes and risk characteristics in Turkey. Results of the Turkish Diabetes Epidemiology Study (TURDEP), *Diab. Care* 25 (2003) 1551–1556.
- [16] D.W. Dunstan, P.Z. Zimmet, T.A. Welbourn, M.P. De Courten, A.J. Cameron, R.A. Sicree, et al. The rising prevalence of diabetes and impaired glucose tolerance (The Australian Diabetes, Obesity and Lifestyle Study), *Diab. Care* 25 (2002) 829–834.
- [17] A.H. Mokdad, E.S. Ford, B.A. Bowman, W.H. Dietz, F. Vinicor, V.S. Bales, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors 2001, *JAMA* 289 (2003) 76–79.
- [18] International Diabetes Federation, Diabetes Atlas Executive Summary. The Global Burden of Diabetes, 2003 pp. 7–14.

- [19] M. Buysschaert, C. Vandenbroucke, S. Barsoum, A type 2 diabetes screening program by general practitioners in a Belgian at risk population, *Diab. Metab.* 27 (2001) 109–114.
- [20] G.A. Colditz, W.C. Willet, M.J. Stampfer, A. Roititzky, J.E. Manson, Weight gain as a risk factor for clinical diabetes mellitus in women, *Ann. Intern. Med.* 122 (1995) 481–486.
- [21] E. Ayata, V. Yumuk, U. Gursu, T. Samanci, Z. Osar, T. Damci, et al. A heavy burden on type 2 diabetes mellitus, *Diab. Res. Clin. Pract.* 50 (Suppl. 1) (2000) S123.
- [22] I. Satman, M.T. Yilmaz, A. Sengul, S. Salman, S. Uygur, I. Bastar, et al. the TURDEP Group, Obesity prevalence in Turkey, in: Turkish Congress on Endocrinology and Metabolism, Antalya, Turkey, 19–23 October, 1999, Abstract book, p. S-20.
- [23] H. Hatemi, V.D. Yumuk, N. Turan, N. Arik, Prevalence of overweight and obesity in Turkey, *Metab. Syndr. Relat. Disord.* 1 (2003) 285–290.
- [24] C. Erem, R. Yildiz, H. Kavgaci, C. Karahan, O. Deger, G. Can, et al. Prevalence of diabetes, obesity and hypertension in a Turkish population (Trabzon city), *Obes. Res.* 54 (2001) 203–208.
- [25] C. Erem, C. Arslan, A. Hacıhasanoglu, O. Deger, M. Topbas, K. Ukinc, et al. Prevalence of obesity and associated risk factors in a Turkish population (Trabzon City, Turkey), *Obes. Res.* 12 (2004) 1117–1127.
- [26] E. Akbay, R. Bugdayci, H. Tezcan, K. Konca, A. Yazar, C. Pata, The prevalence of obesity in adult population in a city on the Mediterranean coast of Turkey, *Turk. J. Endocrinol. Metab.* 7 (2003) 31–35.
- [27] G.E. Krassas, F. Kelestimur, D. Micic, T. Tzotzas, T. Konstandidis, M. Bougoulia, et al. The Balkan Group for the Study of Obesity, Self reported prevalence of obesity among 20,329 adults from large territories of Greece, Serbia and Turkey, *Hormones* 2 (2003) 49–54.
- [28] K.M. Flegal, M.D. Carroll, C.L. Ogden, C.L. Johnson, Prevalence and trends in obesity among US adults, 1999–2000, *JAMA* 288 (2002) 1723–1727.
- [29] Joint Health Survey Unit on behalf of the Department of Health, Health Survey for England—Cardiovascular Disease 1998, The Stationery Office, London, 1999.
- [30] A.J. Cameron, T.A. Welbourn, P.Z. Zimmet, D.W. Dunstan, N. Owen, J. Salmon, et al. Overweight and obesity in Australia: the 1999–2000 Australian Diabetes, Obesity and Lifestyle Study (AusDiab), *MJA* 178 (2003) 427–432.
- [31] J.M. McGinnis, W.H. Foege, Actual causes of death in the United States, *JAMA* 270 (1993) 2207–2212.
- [32] M.E. Lean, J.K. Powrie, A.S. Anderson, P.H. Garthwaite, Obesity, weight loss and prognosis in type 2 diabetes, *Diab. Med.* 7 (1990) 228–233.
- [33] I.L. Mertens, L.F. Van Gaal, Overweight, obesity, and blood pressure: the effects of modest weight reduction, *Obes. Res.* 8 (2000) 270–278.
- [34] M. Yilmaz, Gaziantep’te şişmanlık prevalansı ve halkın beslenme alışkanlıkları üzerine bir araştırma, *Gaziantep Tıp Fakültesi Dergisi* 5 (1994) 196–204.