ANTHROPOLOGICAL SCIENCE
Vol. 116(3), 191–199, 2008

Secular trend in body height and weight of Turkish adults

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Received 13 December 2006; accepted 18 December 2007

Abstract The secular change in body size across generations provides information about public health changes and living conditions over time. In this study, secular height and weight changes in the adult Turkish population for the years between 1884 and 2006 were analyzed. The study was based on a contemporary cross-sectional survey conducted in Ankara, Turkey, on 1215 (703 males and 512 females) healthy adults. Historical data sets were obtained from previous surveys. Between 1884 and 2006, the mean height of Turkish males increased by 11.94 cm (0.98 cm/decade). The height increase was 6.59 cm (0.96 cm/decade) for females between 1937 and 2006: the mean weight increase was 15.78 kg for males and 14.12 kg for females during this same 69-year period. Although the mean height of Turkish males was within the range of the variations in European countries during the 1880s, Turkish males and females today are shorter and lighter than people in the United States and several European countries. In the first half of the 20th century, periods of sudden decreases, and subsequent recoveries, were identified. However, in the last three decades the positive secular change has accelerated rapidly due to modest improvements in the socio-economic prosperity of Turkey, and it can be concluded that further positive changes may be expected in the near future.

Key words: secular change, height, weight, Turkish adults

Introduction

The term secular change is used to define marked changes in adult body size and growth processes of successive generations in a given population (Malina, 1990; Ulijaszek, 1998; Dittmar, 1998; Bogin, 1999). It is a good determinator of public health and indicates how environmental conditions affect human body size over a long period of time (Tanner, 1992; Cole, 2003).

The body size and growth characteristics of a population can change across generations either positively or negatively (Ulijaszek, 1998; Roche and Sun, 2003). It has been reported that human biological characteristics are influenced not only by genetic factors, but also by the natural and socio-economic environment (Komlos, 1999). Since human growth and body size respond with considerable sensitivity to environment, the positive secular trend in populations within the developing world has largely been attributed to improved nutrition and health conditions (Ulijaszek, 1998; Komlos, 1999). This phenomenon has been well documented during the last two centuries in many industrialized countries (Eveleth and Tanner, 1990; Kouchi, 1996; Susanne and Bodzsar, 1998; Bogin, 1999; Arcaleni, 2006). Negative secular change in a population's height is taken to be a response to environmental deterioration and has been observed in historical sequences as well as in contemporary populations (Ulijaszek, 1998).

Initial determinants of secular increase are generally accepted to be increased availability of public health services and improved nutrition, while other factors have been proposed by various authors (Ulijaszek, 1998; Bogin, 1999; Komlos, 1999). These include cumulative socio-economic circumstances such as migration, improved hygiene, reduction in child labor, access to education, and higher income (Ulijaszek, 1998; Komlos, 1999).

While secular changes in height and weight have been a focus of attention in an anthropological context in various populations, little attention has been devoted to Turkish populations. Anthropometric data on Turkish adults are relatively limited, and there is little information available regarding the occurrence of secular change. The first anthropometric data related to adult height for this population was reported by Weisbach in 1884 (as cited by İnan, 1947), followed by pioneering studies which focused mainly on adult male height. Concerning historical anthropometry in Turkey, two nationwide anthropometry data sets referred to the whole country. The first nationwide survey on both male and female adults which focused on various anthropometric traits was conducted in 1937 (İstatistik Umum Müdürlüğü, 1937). The second nationwide survey was conducted by Çiner (1960) only on female subjects. In addition to these nationwide surveys, anthropometric studies on conscripts may represent national means as well as the country's regional averages. In Turkey, military service is compulsory for all males when they reach the age of 19 years. Therefore, a random sample of military conscripts can be considered as a true national representation of males from all regions and all social

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Published online 21 May 2008
in J-STAGE (www.jstage.jst.go.jp) DOI: 10.1537/ase.061213

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strata. Hertzberg et al. (1963) were the first to collect data from Turkish conscripts, as a part of the North Atlantic Treaty Organization (NATO) anthropometric survey which was conducted in 1960–1961. Data on the Turkish conscripts were also collected and published in 1971 (Emekli, 1971), 1989 (Kayış and Özok, 1989), and 1997 (Kır, 1997).

As Turkey is a developing country, an analysis of height and weight data will provide important information about the impact of socio-economic fluctuations on long-term changes in nutritional and other public health conditions. The aim of this study is to present anthropometric data on the contemporary adult Turkish population and to focus on the secular changes since 1884.

Materials and Methods

The present study is based on two data sets: contemporary data and comparative former data. To determine the contemporary anthropometric measurements, a cross-sectional survey was conducted in Ankara, Turkey. The survey was performed between January 2004 and December 2006. The subjects of the contemporary data set are 1215 healthy adults (703 males and 512 females) aged between 18 and 59 years. Dates of birth (day–month–year) were recorded, and ages were calculated based upon the recorded date. A questionnaire was completed to assess socioeconomic status (SES) indicators: education level, occupation, place of birth, and number of children (Table 1).

Height (cm) and weight (kg) were measured by the author and three trained technicians according to the methods specified by the International Biological Programme (Weiner and Lourie, 1969), while the participants were in light clothes and without shoes. Height was measured to the nearest millimeter by a Martin-type anthropometer, and weight was measured to the nearest 100 g using a digital scale.

A *t*-test was used to evaluate the sex differences for each age group using SPSS 13.0 software. Selected percentiles (3rd, 10th, 25th, 50th, 75th, 90th, and 97th) for males and females were constructed using the LMS method (Cole and Green, 1992; Cole, 2002) by the LMS Chartmaker program (Medical Research Council, UK) (www.health-for-all-children.co.uk). The LMS method summarizes age-related data distribution by using a power transformation, which normalizes data distribution and takes into account the skewness present in anthropometric measurements. The three letters L, M and S represent the Box–Cox power which transforms the data distribution to the normal (L), the median (M), and the coefficient of variation (S). Each quantity has corresponding smooth curves plotted against age by natural cubic splines which were estimated using maximum likelihoods. By using the LMS method one can construct any required percentile using the following formula: percentile = $M(1 + LSZ_{\acute{\alpha}})^{(1/L)}$, where $Z_{\acute{\alpha}}$ is the normal equivalent deviate of the required centile and calculated as $Z = [(\text{measurement}/M)^{(L)} - 1]/LS$ (Cole and Green, 1992; Cole et al., 1998; Cole, 2000; Cole, 2002). The goodness-of-fit was estimated by means of quantile–quantile (QQ) tests (Pan and Cole, 2004). The QQ plot is often used to assess whether the data follow a particular distribution, e.g. for the normality of the data after conversion to *z*–scores (SDS). Graphs were plotted using Kaleidagraph 3.5 software.

Table 1. Socio-economic indicators of the subjects

A. Education level	*n*	%
Illiterate	5	0.4
Primary school	175	14.4
Secondary school	91	7.5
High school	688	56.6
University	256	21.1
Total	1,215	100.0

B. Occupation	*n*	%
Professional, administrative, self employment	82	6.7
Government employee, Military and Police Forces	584	48.1
Sales and technicians	28	2.3
Retired	74	6.1
Handlers, helpers, laborers	197	16.2
Student	88	7.2
Housewife	161	13.3
Unemployment	1	0.1
Total	1,215	100.0

C. Number of children	*n*	%
0	449	37.0
1	285	23.5
2	336	27.7
3	107	8.8
4+	38	3.1
Total	1,215	100.0

D. Place of birth by region	*n*	%
Marmara	51	4.2
Aegean Sea	41	3.4
Mediterranean	95	7.8
Central Anatolia	690	56.8
Black Sea	171	14.1
East Anatolia	122	10.0
South East Anatolia	37	3.0
Abroad	8	0.7
Total	1,215	100.0

The second data set consists of historical data obtained from former survey reports (Table 2). Secular change was expressed as increase per decade obtained by multiplying the average annual increase of each measurement by 10.

The body mass index (BMI), weight/height^2 (kg/m^2), and the prevalence of overweight and obesity were calculated. International Obesity Task Force (IOTF) BMI cut-off criteria were used to define overweight (25 kg/m^2) and obesity (30 kg/m^2) (Cole and Rolland-Cachera, 2002; Lobstein et al., 2004).

Results

Contemporary mean height was found to be 174.0 cm (SD 6.9) for males and 158.9 cm (SD 6.4) for females. Contemporary mean weight was found to be 77.8 kg (SD 10.8) for males and 67.0 kg (SD 11.9) for females. Table 3 reports the sample size and mean values of height, weight and BMI by

Table 2. Historical comparative data of adults

Survey year	*Subjects: number of subjects (age)*	*Source of Data*
1884	Males: 44	Weisbach (İnan, 1947)
1891	Males: 86	Bassanovitch (İnan, 1947)
1891	Males: 300	Pittard (İnan, 1947)
1931–32	Males: 797	Kansu (İnan, 1947)
1937	Males: 39,465, Females: 20,263 (age: 20+)	İstatistik Umum Müdürlüğü (1937)
1960	Females: 661 (age: 20–40)	Çiner (1960)
1960–61	Males: 915 (age: 19–45) (conscripts)	Hertzberg et al. (1963)
1966–68	Males: 1,865 (age: 20) (conscripts)	Emekli (1969–70)
1975	Males: 568, Female: 556 (age: 20–45)	Saatçioğlu (1975)
1989	Males: 5,109 (age: 20–26) (conscripts)	Kayış and Özok (1989)
1995	Females: 676 (mean age: 22.18 ± 7.28)	Yorulmaz et al. (1995)
1997	Males: 1,159 (age: 19+) (conscripts)	Kır (1997)
1997	Females: 271 (age: 16–57)	Örmeci et al. (1997)
1999	Males: 250 (age: 20–60)	Akın (1999)

Table 3. Mean values of height, weight and BMI by sex and age group

Age group (years)	Height (cm)						Weight (kg)				BMI			
	Males			Females			Males		Females		Males		Females	
	n	Mean	SD	*n*	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
18–29	390	176.1**	6.3	163	162.0	7.0	77.5**	10.6	59.3	9.8	25.0**	3.0	22.9	3.6
30–39	191	172.9**	6.6	112	158.4	5.6	78.1**	10.7	67.3	11.6	26.1**	3.3	26.8	4.5
40–49	102	169.1**	6.9	177	157.1	5.5	75.9**	12.2	70.1	11.5	26.5**	3.7	28.5	4.8
50–59	20	169.7**	5.0	60	156.4	5.2	82.4**	9.7	72.1	11.3	28.4*	3.4	29.7	4.3
Total	703	174.1**	6.9	512	158.9	6.4	77.8**	10.8	67.0	11.9	25.7**	3.3	26.7	5.0

* $P < 0.05$, ** $P < 0.001$, sex difference was tested by a *t*-test.

age group for both sexes. In every age group, height and weight exhibited statistically significant ($P < 0.001$) sex differences. Tables 4 and 5 present height and weight percentile values by sex and age group, respectively. QQ tests revealed overall satisfactory goodness-of-fit for both parameters by sex and age groups (95% confidence interval).

Table 6 demonstrates the prevalence of overweight and obesity for both sexes. Based on IOTF 8.8% of males and 21.5% of females were obese. The prevalence of overweight was found to be higher in males (47.5%) than in females (35.5%).

Figure 1 presents data on the mean height of adult males

Table 4. Percentile values of height (cm) by sex and age group calculated by the LMS method

Age group	Males							Females						
	3rd	10th	25th	50th	75th	90th	97th	3rd	10th	25th	50th	75th	90th	97th
18–29	160.1	164.2	168.6	173.9	179.7	185.3	191.2	150.8	155.6	160.0	164.5	168.8	172.3	175.6
30–39	157.9	161.9	166.0	170.5	174.9	178.8	182.6	147.6	150.8	153.9	157.4	160.8	163.8	166.8
40–49	157.8	161.4	165.0	169.2	173.4	177.4	181.4	147.3	150.3	153.5	157.0	160.6	164.0	167.3
50–59	157.4	161.2	164.1	168.4	172.0	173.8	176.5	145.6	150.2	152.2	156.7	159.8	162.7	166.3
Total	157.4	161.5	165.5	169.7	173.9	177.5	181.0	147.6	150.6	153.8	157.5	161.3	164.9	168.6

Table 5. Percentile values of weight (kg) by sex and age group calculated by the LMS method

Age group	Males							Females						
	3rd	10th	25th	50th	75th	90th	97th	3rd	10th	25th	50th	75th	90th	97th
18–29	54.5	58.5	63.1	68.9	75.7	82.9	91.0	43.6	47.5	51.9	57.4	63.8	70.2	77.5
30–39	60.5	65.4	70.8	77.3	84.4	91.5	99.1	47.4	53.2	59.6	67.3	75.8	84.1	92.9
40–49	55.6	62.1	69.0	77.1	85.7	93.8	102.1	50.1	55.3	61.3	68.8	77.3	86.1	95.8
50–59	52.5	69.0	77.4	83.8	88.7	92.3	95.5	56.1	60.0	64.8	70.7	78.5	89.2	105.4
Total	56.8	62.8	69.0	76.4	84.0	91.1	98.3	50.4	55.2	60.7	67.6	75.6	83.9	93.2

Table 6. Percentage of overweight and obesity in Turkish adults by age and sex group based on the IOTF reference criteria (Lobstein et al., 2004)

Age Group (years)	Males		Females	
	Overweight 25 < BMI ≤ 30	Obese 30 < BMI	Overweight 25 < BMI ≤ 30	Obese 30 < BMI
18–29	44.9	4.4	18.4	3.7
30–39	52.9	10.5	32.2	20.5
40–49	49.0	16.7	65.0	48.7
50–59	40.0	40.0	42.9	40.0
Total	47.5	8.8	35.5	21.4

Table 7. Mean height (cm) of Turkish males and females between 1884 and 2006

Survey year	Males			Females		
	n	Mean	SD	*n*	Mean	SD
1884	44	162.2				
1891	300	164.2				
1931–32	797	166.3				
1937	39,465	165.3		20,263	152.3	
1960–61	915	169.3	5.7	661	155.4	5.4
1966–68	1,865	166.6				
1975	568	167.9		556	154.4	
1989	5,109	170.2	6.1			
1997	1,159	170.6	6.2	271	157.0	6.4
1999	250	172.0	7.5			
Present study	703	174.1	6.9	512	158.9	6.4

and females during the past 122 years as reported in several studies (Table 7). Comparative data from Turkey demonstrate a general increase in male height between 1884 and 2006. Overall, male height increased from 162.2 cm to 174.0 cm, a rate of increase of 0.98 cm/decade (Figure 1). The mean height of females increased from 152.3 cm to 158.9 cm, and the rate of secular increase was 0.96 cm/decade between 1937 and 2006. The observed rate of secular increase in height between 1937 and 2006 was greater in males (1.19 cm/decade) than in females (0.96 cm/decade). The sex difference in mean height was 13.0 cm in 1937, 13.9 cm in 1960–1961 ($t = 48.90$, $P < 0.001$), 13.5 cm in 1975, and 15.3 cm today ($t = 39.66$, $P < 0.001$).

The secular trend is not completely linear. Figure 2 presents the differences in mean height between survey years. Periods of steady increase are followed by sudden decreases and subsequent recoveries. In the mid-1930s there was a slight decrease in mean male height. Anthropological studies performed after World War I (WWI) and the Independence War (1918–1923) showed a decrease in mean male height, while studies in the 1950s and 1960s indicate that mean height increased again. Survey results from the mid-1960s once again indicate a decrease in the mean height for males who were born during World War II (WWII) and the post-war depression. Increases in male height have been observed since the 1970s up to the present. The same pattern is evident for females, although both increases and decreases were smaller than those for males.

Table 8 presents the increase in height between 1937 and 2006 for males and females according to different age groups. The rate of secular increase varied with age and the increment was greatest in the 20–29 year age group for both sexes.

Figure 3 presents the changes in the mean weight of the Turkish population during the 69-year period from 1937 to 2006 (Table 9). Comparative data demonstrate that the mean weight of both sexes increased during this period. Overall, mean weight increased from 62.0 kg to 77.8 kg in males and from 52.9 kg to 67.0 kg in females. The rate of the secular increase was 2.29 kg/decade and 2.05 kg/decade for males and females, respectively (also see Figure 4). The secular gain in height showed a similar pattern in both sexes for this time period.

The increments in mean weight by age group for males and females are presented in Table 10. The overall trends are similar to those of height: the increments are positive and the amount varies with age group. However, in contrast to the patterns of height increments, weight increments were greater later in life. For weight, the increment was greatest in the 50–59 year age group.

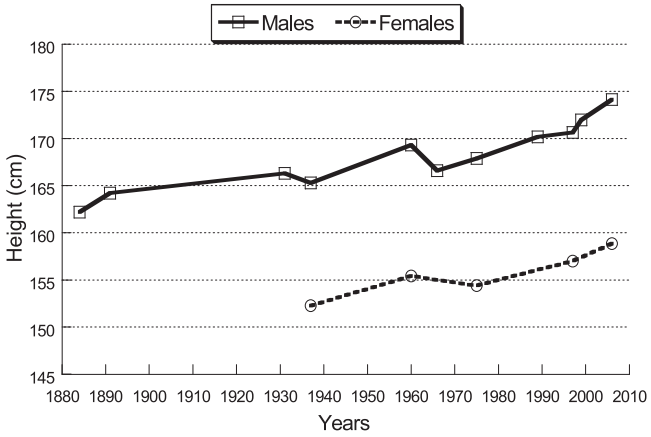


Figure 1. Secular change in the mean height (cm) of Turkish males and females between 1884 and 2006.

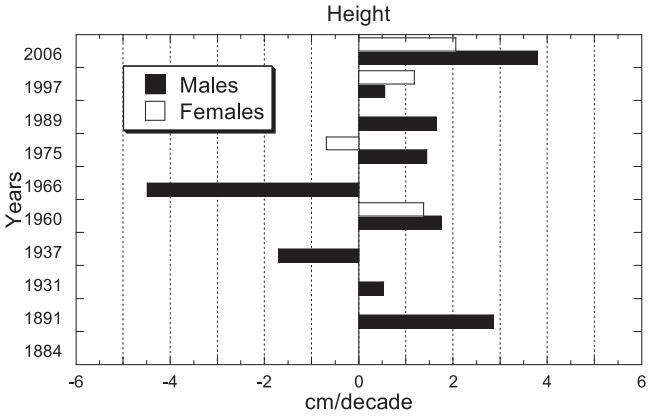


Figure 2. Secular increment in the mean height (cm/decade) for Turkish males and females between 1884 and 2006.

Table 8. Mean height (cm) of Turkish males and females in 1884 and 2006 and the rate of secular change (cm/decade)

Age group (years)	Males					Females				
	1937†		2006‡	1937–2006		1937		2006	1937–2006	
	n	Mean	Mean	Increment (cm)	Change per decade	n	Mean	Mean	Increment (cm)	Change per decade
20–29	13,397	165.4	176.1*	10.7	+1.56	5,941	152.2	162.0*	9.7	+1.41
30–39	13,314	165.3	172.9	7.6	+1.10	5,814	152.3	158.4	6.1	+0.88
40–49	6,293	165.7	169.1	3.5	+0.50	4,295	152.5	157.1	4.6	+0.67
50–59	3,854	165.2	169.7	5.0	+0.73	2,914	152.8	156.4	3.5	+0.51

† İstatistik Umum Müdürlüğü (1937)
‡ Present study.
* 2006 study included the 18–29 year age group.

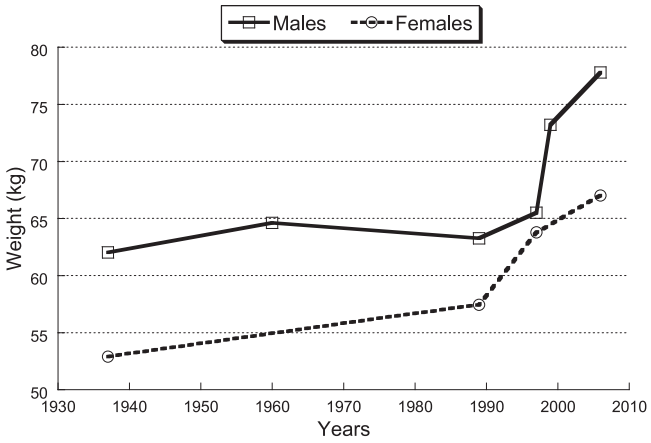


Figure 3. Secular change in the mean weight (kg) of Turkish males and females between 1884 and 2006.

Table 9. Mean weight (kg) of Turkish males and females between 1937 and 2006

Survey year	Males			Females		
	n	Mean	SD	*n*	Mean	SD
1937	39,465	62.0		20,263	52.9	
1960	661	64.6	4.6			
1989	5,109	63.3	7.4			
1995				676	57.4	8.8
1997	1,159	65.5	10.0	271	63.8	11.7
1999	250	73.2	10.9			
Present study	703	77.8	10.8	512	67.0	11.9

Discussion

Secular change since 1884

Comparison of data on Turkish adults since 1884 demonstrated a prominent secular increase in height and weight. The rate of secular change in the mean height (1884–2006) and mean weight (1937–2006) of males was 0.98 cm/decade and 2.29 kg/decade, respectively. The rate of the secular change in the mean height and mean weight (1937–2006) of females was 0.96 cm/decade and 2.05 kg/decade, respectively. Moreover, the trend is not always linear and not even unidirectional for height. Besides the steady increase, decreases and subsequent recoveries also occurred. In the mid-1930s and in the period between the 1960s and 1970s, negative secular change was prominent.

Since the 18th century, data on the height and nutritional status in European nations have been based mainly on studies of military recruits (Floud et al., 1990). In 1761, Norwegian recruits aged 18.5 had an average height of 159.5 cm, and the Historical Statistics of Italy (1861–1975) showed that the mean height of 20-year-old recruits born in 1854 was 162.4 cm. The mean height of Spanish recruits was 163.4 cm in 1913 (Floud et al., 1990). The mean height of Turkish males during the Ottoman Empire was similar to that of their European counterparts. According to İnan (1947), the reported mean height for Ottoman Turkish males varied from Weisbach's 162.2 cm in 1884, to Bassanovitch's 164.2 cm or Pittard's 167.9 cm (both in 1891).

Since 1860s, mean adult height in Western European countries has increased at a rate of 1 cm/decade, reaching 175 cm by the time baby–boomers reached adulthood. In the Netherlands, the rate was greater, i.e. about 1.6 cm/decade. Consequently, the Dutch, along with the Scandinavians, became the tallest people in the world. In 1860 they were approximately equal to the European norm, which is 7 cm shorter than that of Americans (European descendants living in the United States), but today their mean height is around 180–183 cm, about 3–5 cm taller than the average American (Komlos, 1999). The most pronounced secular increase reported so far is the increase observed in the whole population of Japan which occurred after WWII (Kouchi, 1986, 1996). In 1960, the height of Japanese young adult males was about 162 cm, while it was about 172 cm in 1995. The most rapid change, about 7 cm was observed between 1960 and 1980. On the other hand, the rate of secular increase in Sweden and Norway between 1952 and 1985 was only 0.3 cm/decade (Bogin, 1999).

During the WWI and WWII, a negative secular trend or lack of a positive secular trend was observed in developed countries. Europe during WWI and WWII and Japan during WWII experienced this situation (Malina, 1990). Furthermore, people living under deteriorating conditions demonstrate negative secular trends in height and weight (Bogin, 1999; Cole, 2003). In India and other non-industrialized countries, a secular decrease has been documented in height (Jurgens, 1990; Pheasant, 2002). These trends are similar to those that occurred in Europe in former times (Cole, 2000).

Table 10. Mean weight (kg) of Turkish males and females in 1937 and 2006 and the rate of secular change (kg/decade)

Age group (years)	Males				Females			
	1937†	2006‡	1937–2006		1937	2006	1937–2006	
	Mean	Mean	Increment (kg)	Change per decade	Mean	Mean	Increment (kg)	Change per decade
20–29	62.5	77.5*	14.9	+2.16	52.6	59.3*	6.7	+0.97
30–39	62.9	78.0	15.2	+2.20	53.6	67.3	13.7	+1.98
40–49	63.2	75.9	12.7	+1.84	53.2	70.1	16.9	+2.45
50–59	62.6	82.4	19.7	+2.86	52.2	72.7	20.5	+2.97

† İstatistik Umum Müdürlüğü (1937).
‡ Present study.
* 2006 study included the 18–29 year age group.

Anthropological studies on Turkish adults performed after WWI and the Independence War (1918–1923), showed a decrease in mean male height. Between the survey years 1931–1932 and 1937, male height decreased by 1 cm (İstatistik Umum Müdürlüğü, 1937; İnan, 1947). Between the 1937 nationwide survey (İstatistik Umum Müdürlüğü, 1937) and the 1960–1961 NATO anthropometric survey (Hertzberg et al., 1963), a positive increase (1.74 cm/decade) is evident. However, studies in 1966 (Emekli, 1971) and in 1975 (Saatçioğlu, 1975) indicate that mean male height had decreased since the 1960–1961 NATO survey. This trend may be linked with the WWII and post-war depression. Neyzi et al. (1996) pointed out a negative secular trend in the growth of Turkish children during the same period. Thus, the secular trends in the mean height of children are similar to those of adults, though vary somewhat according to the age of the children. It has been reported that this negative trend in the growth of Turkish children is possibly due to the conditions created by WWII. Although Turkey did not take part in this war, socioeconomic conditions were considerably affected by the war (Neyzi et al., 1996). A similar pattern is evident for the secular change in the height of Turkish females. Between survey years 1937 (İstatistik Umum Müdürlüğü, 1937) and 1960 (Çiner, 1960), a positive secular change was evident, indicating a rate of 1.37 cm/decade. However, according to a survey conducted in 1975 (Saatçioğlu, 1975), a negative change was observed (–0.69 cm/decade).

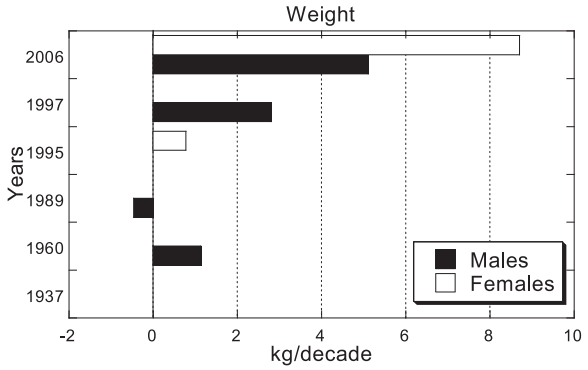


Figure 4. Secular increment in the mean weight (kg/decade) for Turkish males and females between 1937 to 2006.

Since the 1970s, mean height has been increasing in both sexes. Compared to the CDC 2000 US reference, the median of Turkish contemporary data falls between the 25th and 50th percentile of the US data (50th percentile of height data for 20-year-old males and females were 177 cm and 164 cm, respectively) (Kuczmarski et al., 2002; Cole, 2003). It must be noted that the US height data currently lags behind that of the Northern Europe (e.g. almost 7 cm smaller than the Netherlands) (Cole, 2003).

Overweight and obesity

According to the IOTF, an epidemic of obesity has been affecting both developed and developing countries (IOTF, 2003). The present data demonstrate that the secular increase in adult weight for the Turkish population brings the overweight (47.5% of males and 35.5% of females) and obesity (8.8% of males and 21.5% of females) epidemic together. Results from the 1990 and 2000 Turkish Adult Risk Factor Study (TEKHARF) (Şansoy, 2003) showed that the prevalence of obesity increased in males and females from 9% and 28.5% to 11.4% and 32.6%, respectively. It must be noted that age is strongly associated with obesity, and that both TEKHARF surveys were carried out on adults over 30 years of age. In the present day among Turkish adults aged 30 years or older, the prevalence of overweight is alarming for males and obesity for females, but the prevelance of obesity is still lower than that in Western and Middle Eastern countries. Today, women's obesity prevalence rates are over 20% in countries such as the UK, Germany, Finland and Greece. The United States has been facing extreme obesity rates since the 1980s (IOTF, 2003). In the Middle East high levels of obesity exist, particularly in females, though also in males as well in Egypt and Saudi Arabia. In Kuwait, the United Arab Emirates, and Bahrain, obesity rates for females are 20–30%. In Iran the obesity rate varies between rural and urban populations; among females in Tehran it is 30% (IOTF, 2003). The observed sex difference in the obesity rate is probably related to the fact that a large proportion of the women in Middle Eastern countries are sedentary, particularly in the cities (Bahrami et al., 2006). There are physical and cultural barriers against the physical activity of women such as a lack of physical education in schools and an absence of women's participation in sports in general (Galal, 2002).

Factors contributing to the secular change

There is a debate over the relative importance of different environmental factors that have influenced the final adult size at different periods of time. In this context, the present findings raise questions about the factors that might be responsible for the observed negative and positive secular changes in Turkish adults' height and weight during the survey years. When compared with developed countries that have experienced a high degree of secular increase, Turkish adults exhibit a slower rate of secular increase.

(1) Nutrition and public health

National nutrition surveys conducted during the last four decades indicate that the average diet has been adequate to meet the recommended daily intake of calories and most of the required nutrients. However, intakes of animal protein, calcium, vitamin A, and riboflavin are lower than recommended (Pekcan and Karaağaoğlu, 2000; FAOSTAT, 2001). The proportions of protein, fat, and carbohydrates in the dietary energy supplies (DES) have changed between 1965 and 1997 by –0.9%, +3.2%, and –2.2%, respectively. The proportions of protein, fat and carbohydrates in the Turkish diet are approximately 12%, 25%, and 63%, respectively (FAOSTAT, 2001). No significant change was observed in average per capita food consumption within the last four decades. However, there are differences among families and sub-groups in terms of energy and nutrient intakes. The most important factors affecting food consumption patterns are income level and lack of knowledge. Low–income families consume more bread, while high–income families consume more meat, meat products, fresh fruits, and vegetables (Pekcan and Karaağaoğlu, 2000; HUIPS, 2004; Pekcan, 2006; Akbay et al., 2007).

On the other hand, Turkey has achieved progress in controlling major infectious diseases, and thus the occurrence of these declined dramatically between the late 1960s and 1990s (MoH, 2004). Infant mortality rate was considerably reduced from 120 per 1,000 live births in 1980, through 55 per 1,000 live births in 1992 and to 23.6 per 1,000 live births in 2005 (TURKSTAT, 2004, 2005) though it is still higher than the European Union average (8 per 1,000 live births) (MoH, 2004). Infant mortality rate is strongly associated with overall living conditions and it is one of the single most meaningful indicators of socioeconomic improvement (Bogin, 1999).

Although inequality in the amount and quality of food between different socio-economic groups still exists, improvements in public hygiene, and access to improved water supplies and medical care, as indicated by the reduced infant motality rate, may have played a part in the secular change in adult height seen in the last decades.

(2) Socioeconomic environment

Concerning socioeconomic status, Turkey has experienced gradual changes in respect to community size, scale of urbanization, education level, and income. According to the 1927 census, the population was 13 million, whereas the 2000 census recorded a population of 67 million. The high population growth rate now stands at over 12.6‰ for 2005 (TURKSTAT, 2004, 2005). The illiteracy rate within the adult population was 81.3% in 1935, 61.9% in 1960, 34.4% in 1980, and 13.5% in 2000 (5.6% among males and 21.5% among females) (TURKSTAT, 2004).

After WWI and the Independence War (1918–1923), the Turkish economy recovered remarkably. Between 1923 and 1930, industrial and service sectors grew by more than 9% per year and agricultural output rose by 87%. Between 1930 and 1950, influenced by worldwide depression, the Turkish economy sharply declined. In the late 1950s, the country experienced economic disruptions, and again during the 1970s. After 1980, development continued and Turkey exhibited a markedly improved economic performance, although some crises and deficits did occur. Furthermore, the gross domestic product (GDP) and other growth and industrial production indices have been rising while real wages remain low (Metz, 1996).

Increasing urbanization and urban–rural disparity have become top-priority issues in Turkey (SPO, 2006). Urbanization represents the overall trend in social changes and acts through biological factors (Kouchi, 1996). In Turkey the urban population has increased sharply since the 1950s: the population living in cities was around 25% in 1950 and 65% in 2000 (HUIPS, 2004).

Consequently, economic growth and urbanization of the Turkish population over the last decades have had a major impact on the health status and disease patterns throughout the country. Investments in health and education, as well as in poverty alleviation, have led to an improvement in overall health in Turkey, and these phenomena could be linked to the positive secular increase. On the other hand, at the end of the 20th century, income inequality and regional differences in Turkey were still greater than those in Western Europe (Komlos and Baur, 2004), and this could explain the slower rate of secular increase in Turkey.

Conclusions

The secular trends of height and weight seem to reflect the impact of long-term changes in nutrition and health conditions related to economic, social, and demographic changes. In Turkey, the direction of secular changes has been similar to that in other European countries, but on a smaller scale. With regards to its socioeconomic status, Turkey has experienced gradual changes in community size, sanitation, urbanization, as well as education and income level, although regional and urban–rural disparities still exist. During the 122-year study period, remarkable secular increases in height and weight were observed in Turkish adults, especially during the last three decades, although negative secular changes were also observed during the periods of hardship.

Secular change in adult height has ceased in several European countries, but it is still continuing in others (Kouchi, 1996). It is difficult to predict future trends concerning secular changes in Turkish adult anthropometric characteristics. However, the secular increase in adult height and weight seem to be due to the increase in growth rates in early childhood, and in Turkish children this trend is still continuing (Özer, 2007). It is therefore expected that the secular increase in height and weight will continue in the near future.

Acknowledgments

This study has been undertaken at Kyoto University, under the Japanese Government Ministry of Education, Culture, Sports, Science and Technology (Monbukagakusho) Scholarship. The author wishes to thank the individuals who participated in this study for their patience and friendly cooperation. The author would like to thank Professor Kazumichi Katayama (Kyoto University), Professor Makiko Kouchi (National Institute of Advanced Industrial Science and Technology), Professor Erksin Güleç (Ankara University) and Professor Galip Akın (Ankara University), and the reviewers for their constructive comments during the preparation of this manuscript. Thanks are also due to Lee Ai Ling for language support, and Dr. Timur Gültekin and Yener Bektaş for their contribution during the data collection.

References

Akbay C., Boz İ., and Chern W.S. (2007) Houshold food consumption in Turkey. European Review of Agricultural Economics, 34: 209–231.

Akın G. (1999) Ergonomics and anthropometrics in front of screen study. Ankara Üniversitesi Dil ve Tarih-Coğrafya Fakültesi Dergisi, 39: 87–101 (in Turkish).

Arcaleni E. (2006) Secular trend and regional differences in the stature of Italians, 1854–1980. Economics and Human Biology, 4: 24–38.

Bahrami H., Sadatsafavi M., Pourshams A., Kamangar F., Nouraei M., Semnani S., Brennan P., Boffetta P., and Malekzadeh R. (2006) Obesity and hypertension in an Iranian cohort study; Iranian women experience higher rates of obesity and hypertension than American women. BMC Public Health, 6: 158–167.

Bogin B. (1999) Patterns of human growth. Cambridge University Press, Cambridge.

Çiner R. (1960) Anthropometry of Turkish females. Ankara Üniversitesi Dil ve Tarih-Coğrafya Fakültesi Dergisi, 18: 161–199 (in Turkish).

Cole T.J. (2000) Secular trends in growth. Proceedings of the Nutrition Society, 59: 317–324.

Cole T.J. (2002) Growth references and standards. In: Cameron N. (eds.), Human growth and development. Academic Press: St Louis, pp. 383–414.

Cole T.J. (2003) The secular trend in human physical growth: a biological view. Economics and Human Biology, 1: 161–168.

Cole T.J. and Green P.J. (1992) Smoothing reference centile curves: the LMS method and penalized likelihood. Statistics in Medicine, 10: 1305–1319.

Cole T.J. and Rolland-Cachera M.F. (2002) Measurement and Definition. In: Burniat W., Cole T., and Lissau I. (eds.), Childhood and Adolescent Obesity: Causes and Consequences, Prevention and Management. Cambridge University Press, Cambridge, pp. 3–27.

Cole T.J., Freeman J.V., and Preece M.A. (1998) British 1990 growth reference centiles for weight, height, body mass index and head circumference fitted by maximum penalized likelihood. Statistics in Medicine, 17: 407–429.

Dittmar M. (1998) Secular growth changes in the stature and weight of Amerindian schoolchildren and adults in the Chilean Andes, 1972–1987. American Journal of Human Biology, 10: 607–617.

Emekli Y. (1971) The average height, head and skelique indices of 20 years of aged Turkish males. Antropoloji, 5: 203–228 (in Turkish).

Eveleth P.B. and Tanner J.M. (1990) World Variation in Human Growth, 2nd edn. Cambridge University Press, Cambridge.

FAO Food and Agriculture Organization (FAOSTAT) (2001) Nutrition Country Profiles-Turkey, FAO, Rome.

Floud R., Wachter K., and Gregory A. (1990) Height, health and history. Cambridge University Press, Cambridge.

Galal O. (2002) The nutrition transition in Egypt: obesity, undernutrition and the food consumption context. Public Health Nutrition, 5: 141–148.

Hacettepe University Institute of Population Studies (HUIPS), Ministry of Health, State Planning Organization, and European Union (2004) 2003 Turkey Demographic and Health Survey. HUIPS, Ankara.

Hertzberg T.H.E., Churchill E., Dupertuis C.W., White R.M., and Damon A. (1963) Anthropometric survey of Turkey, Greece and Italy. Macmillan, New York.

International Obesity Task Force (IOTF) (2003) International Obesity Task force Statement, London.

İnan A. (1947) Anthropological characteristics of Turkish population and history of Turkey. Turk Tarih Kurumu Basimevi, VII. Seri-No. 15, Ankara (in Turkish).

İstatistik Umum Müdürlüğü (1937) 1937 Turkish Anthropometry Survey. Basbakanlik Istatistik Umum Mudurlugu, Publication No. 151, Ankara (in Turkish and French).

Jurgens H.W., Aune I.A., and Pieper U. (1990) International Data on Anthropometry. Occupational and Health Series, vol. 65 International Labor Office, Geneva.

Kayış B. and Özok A.F. (1989) Anthropometric data of Turkish male population. The Scientific and Technological Research Council of Turkey (TUBITAK), YAE a71, Ankara (in Turkish).

Kır T. (1997) The determination of anthropometric measures of candidate officers, non-commissioned officers and recruits in military training in Etimesgut Garrison. PhD. Thesis, Gulhane Military Medical Academy, Ankara (in Turkish).

Komlos J. (1999) On the biological standard living in Russia and the Soviet Union. Slavic Review, 58: 71–79.

Komlos J. and Baur M. (2004) From the tallest to (one of) the fattest: the enigmatic fate of the American population in the 20th century. Economics and Human Biology, 2: 57–74.

Kouchi M. (1986) Geographic variations in modern Japanese somatometric data: a secular change hypothesis. The University Museum, University of Tokyo Bulletin, 27: 93–106.

Kouchi M. (1996) Secular change and socioeconomic difference in height in Japan. Anthropological Science, 104: 325–340.

Kuczmarski R.J., Ogden C.L., Guo S.S., Grummer-Strawn L.M., Flegal K.M., Mei Z., Wei R., Curtin L.R., Roche A.F., and Johnson C.L. (2002) 2000 CDC growth charts for the United States: Methods and development. National Center for Health Statistics, Atlanta, GA.

Lobstein T., Bauru L., and Unau R. (2004) Obesity in children and young people: a crisis in public health. Obesity Reviews, 5: 4–104.

Malina R.M. (1990) Research on secular trend on auxology. Antropologischer Anzeiger, 48: 209–218.

Metz H.C. (1996) Turkey: A Country Study. GPO for the Library of Congress, Washington.

Ministry of Health of Turkey (MoH) (2004) Turkey Health Report, Publication No. SB-HM-2004/01, Ankara.

Neyzi O., Bundak R., Günöz H., Darendeliler F., and Saka N. (1996) Social class differences and secular trend in height in Turkish schoolchildren. In Bodzar B.E. and Susanne C. (eds.), Studies in Human Biology. Eotvos University Press: Budapest, pp. 139–146.

Örmeci A.R., Gürbüz H., Ayata A., and Çetin H. (1997) Adult head circumferences and centiles. Journal of Turgut Ozal Medical Center, 4: 261–264 (in Turkish).

Özer B.K. (2007) Growth reference centiles and secular changes in Turkish children and adolescents, Economics and Human Biology, 5: 280–301.

Pan H. and Cole T.J. (2004) A comparison of goodness of fit tests for age-related reference ranges. Statistics in Medicine, 23:

1749–1965.
Pekcan G. (2006) Food and nutrition policies: what's being done in Turkey. Public Health Nutrition, 9: 158–162.
Pekcan G. and Karaağaoğlu N. (2000) State of nutrition in Turkey. Nutritional Health, 14: 41–52.
Pheasant S. (2002) Body space Anthropometry, ergonomics and the design of work. Taylor and Francis, London.
Roche A. and Sun S. (2003) Human growth, assessment and interpretation. Cambridge University Press, Cambridge.
Saatçioğlu A. (1975) A biometrical investigation on the three anthropometric characters and their changes according to the socio-economic groups in Turkey, Antropoloji, 7: 175–199 (in Turkish).
Şansoy V. (2003) Obesity, abdominal obesity and their relation with other risk factors in Turkish adults. In Onat A. (eds.), TEKHARF, MAS, Istanbul, pp. 64–69 (in Turkish).
State Planning Organization (SPO) (2006) National Rural development Strategy. Republic of Turkey Prime Ministry State Planning Organization, Ankara.
Susanne C. and Bodzar E.B. (1998) Patterns of secular change of growth and development. In Bodzar B.E. and Susanne C. (eds.), Secular Growth Changes in Europe, Eotvos University Press, Budapest, pp. 5–26.
Tanner J.M. (1992) Growth as a measure of nutritional and hygienic status of a population. Hormone Research, 38 (Suppl. 1): 106–115.
Turkish Statistical Institute (TURKSTAT). (2004) Statistical Indicators 1923–2004. Publication No. 535, Ankara.
Turkish Statistical Institute (TURKSTAT). (2005) Statistical yearbook 2005. Publication no: 3009, Ankara.
Ulijaszek S.J. (1998) The secular trend. In: Ulijaszek S.J., Johnston F.E., and Preece M.A. (eds.), Cambridge Encyclopaedia of Human Growth and Development, Cambridge University Press, Cambridge, pp. 395–403.
Yorulmaz F., Taşkınalp O., Türüt M., and Kutoğlu T. (1995) Some body indexes in 1445 Turkish adults. Trakya Üniversitesi Tip Fakültesi Dergisi, 12p: 57–59 (in Turkish).
Weiner J.E.S. and Lourie J.A. (1969) Human Biology: A Guide to Field Methods. IBP Handbook, No. 9, Blackwell, Oxford.