

## Correlation between educational status and cardiovascular risk factors in an overweight and obese Turkish female population

*Fazla kilolu ve şişman bir grup Türk kadınında eğitim düzeyi ve kardiyovasküler risk faktörleri ilişkisi*

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### ABSTRACT

**Objective:** The prevalence of obesity is rapidly increasing in Turkey as well as all over the world. Educational inequalities play an important role in the development of obesity. In this study, our aim is to evaluate how educational status affects obesity and cardiovascular risk factors in the overweight and obese Turkish female population.

**Methods:** In this study, 3080 overweight (n=633) and obese (n=2447) Turkish women who applied to İstanbul Faculty of Medicine Obesity Outpatient Clinic were evaluated retrospectively. Educational status was classified according to the subjects' latest term of education. Subjects were evaluated in terms of anthropometric and biochemical parameters. The association of educational level with cardiovascular risk factors and metabolic syndrome were analyzed using logistic regression analysis.

**Results:** Educational levels after adjusted continuous variables (age and body mass index) showed significant correlation with waist circumference, total and high-density lipoprotein cholesterol, triglycerides, low-density lipoprotein cholesterol and glucose. Low educated class (LEC) had a 1.93 (95% CI - 1.56-2.39, p=0.001) fold increased risk than high educated subjects for cardiovascular risk factors. Metabolic syndrome prevalence was more prevalent and significant risk increase was observed in LEC (OR = 2.02, 95% CI -1.53-2.67, p=0.001).

**Conclusions:** Low educational status is a contributing factor for development of obesity and increased risk for obesity related disorders in the Turkish overweight and obese female population. Population based information and educational policies might prevent obesity related disorders and decrease cardiovascular mortality. (*Anadolu Kardiyol Derg 2008; 8: 336-41*)

**Key words:** Education levels, obesity, cardiovascular risk factors, metabolic syndrome, Turkish population, logistic regression analysis

### ÖZET

**Amaç:** Obezite prevalansı tüm dünyada ve ülkemizde hızla artmaktadır. Eğitim düzeyleri arasındaki farklılıklar bu artışta önemli rol oynamaktadır. Bu çalışmamızda eğitim düzeyinin fazla kilolu ve şişman Türk kadınlarında şişmanlık ve kardiyovasküler risk faktörleri üzerindeki etkisi değerlendirilmiştir.

**Yöntemler:** Bu çalışmada İstanbul Tıp Fakültesi obezite polikliniğine başvurmuş 3080 fazla kilolu (n= 633) ve şişman kadın (n= 2447) retrospektif olarak değerlendirildi. Eğitim düzeyi kişilerin en son mezun oldukları dereceye göre sınıflandırıldı. Hastaların biyolojik ve antropometrik parametreleri değerlendirildi. Eğitim düzeyleri ile kardiyovasküler risk faktörleri arasında ilişki lojistik regresyon analiz ile değerlendirildi.

**Bulgular:** Eğitim düzeyi sürekli değişkenler (yaş ve vücut kitle indeksi) ile kontrol edildikten sonra, bel çevresi, total ve yüksek-yoğunluklu lipoprotein (HDL) kolesterol, trigliserid, düşük-yoğunluklu lipoprotein (LDL)-kolesterol ve glukoz değerleri ile anlamlı korelasyon göstermektedir. Düşük eğitim düzeyli hastalarda yüksek okul mezunu hastalara oranla kardiyovasküler risk faktörlerine 1.93 (%95 GA -1.56-2.39, p=0.001) kat daha fazla rastlanmıştır. Metabolik sendrom prevalansı ve kardiyovasküler risk faktörleri düşük eğitim düzeyindeki hastalarda daha yüksek bulunmuştur [OR=2.02, (%95GA 1.53-2.67, p=0.001).

**Sonuç:** Düşük eğitim düzeyi fazla kilolu ve şişman Türk kadınlarında şişmanlık gelişimi ve şişmanlıkla ilgili hastalıkların gelişmesinde önemli bir problemdir. Toplumsal tabanlı bilgilendirme ve eğitim politikaları şişmanlık ile ilgili hastalıkların ve kalp-damar hastalıklarına bağlı ölümleri önleyecektir. (*Anadolu Kardiyol Derg 2008; 8: 336-41*)

**Anahtar kelimeler:** Eğitim düzeyi, şişmanlık, kardiyovasküler risk faktörleri, metabolik sendrom, Türk toplumu, lojistik regresyon analiz

## Introduction

The prevalence of obesity is rapidly increasing in both developed and developing countries (1, 2). Dietary habits, life-style factors such as low physical activity, socioeconomic status and genetic factors contribute to the development of obesity all over the world as well as in Turkey.

It has been shown in several populations that low socioeconomic status is associated with both obesity and cardiovascular diseases (3-6). There is an inverse relationship between educational level and income status with hypertension, smoking, serum lipid levels and obesity. Based on US National Longitudinal Mortality Study data, there was a steady drop in the standardized mortality ratio as educational level increased (7). However, the relationship between educational inequalities and biological mechanism of metabolic syndrome, obesity and cardiovascular mortality remains unclear.

Studies on the Turkish population have revealed that Turks have high cardiovascular risk factors such as high smoking prevalence, high carbohydrate consumption in the diet, high total cholesterol/ high-density lipoprotein cholesterol (HDL-C) ratio and low HDL-C levels (8, 9). A recently published cross-sectional observational survey regarding the prevalence of metabolic syndrome in Turkish population showed that more than one-third (35.8%) of Turks are obese (10). The prevalence of obesity in the adult Turkish population is higher than in most of Western European countries, where the prevalence of obesity varies between 10-25% (11). A similar rate, however, has been encountered in Eastern European and Mediterranean populations in the range of 25- 35% (12).

Although several studies related to obesity, metabolic syndrome and socioeconomic status from different regions in Turkey have been published (13-15), the relationship of metabolic syndrome and educational level in obese women is not known.

In this present study, we examined how educational inequalities have an affect on obese and overweight subjects using our hospital-based records in İstanbul.

## Methods

### Study population

Overall, 3080 overweight and obese women who applied to the İstanbul Faculty of Medicine Obesity Outpatient clinic between the years 1998-2005 were evaluated retrospectively. The data used in this study were collected the patients first visit.

### Anthropometry

Parameters were measured during fasting period. Their weights in light clothes were recorded to the nearest 0.1 kg and their heights to the nearest 0.5 cm. Body mass index (BMI) was calculated as weight (kg) divided by height (m<sup>2</sup>). Waist and hip circumferences were measured in the standing position. Waist circumference (WC) was measured midway between the *arcus costalis* and *processus spina iliaca anterior superior*, hip circumference was measured at the largest level of *symphysis pubis* and *gluteus maximus*.

Blood pressure was measured in sitting position with a random zero sphygmomanometer - small (9 x 18 cm), medium (12x23 cm), and large (15x33 cm) cuffs were used when appropriate. Systolic (Korotkoff phase I) and diastolic (Korotkoff phase V) blood pressure were measured twice on the left upper arm and the average was used for analysis.

### Biochemistry

Blood samples were drawn after 12 hours of fasting. Glucose, cholesterol, triglyceride, HDL-cholesterol levels were determined by an automated analyzer with a quality control of ISO 9001.

### Education

Subjects were asked by means of a questionnaire their latest terms of education. Classification of education was divided into 5 categories: illiterate, primary school (1-5 years), secondary school (6-9 years), high school (10-12 years) and university (more than 12 years). Based on the International Standard Classification of Education (16), illiterate, primary and secondary school were pooled as the low educated class (LEC).

### Statistical analyses

Data was analyzed using SPSS for Windows version 10.0 (SPSS Inc., Chicago, IL, USA), Microsoft Access, and Microsoft Excel 6.0 (Microsoft Corporation). Association between educational levels and anthropometric and biochemical levels were analyzed. Biochemical levels are expressed in mmol/L and all values are reported as means±SD. Mean values were compared with ANOVA test. Bonferroni post hoc test was used for pairwise comparisons and p <0.05 was considered significant. Partial correlation analysis was performed to determine variable correlation after controlling with age and BMI. Logistic regression analysis (LRA) was carried out in order to establish the association of each cardiovascular risk factor and educational level with calculation of odds ratio (OR). Age was included as covariate in this model. Cardiovascular risk factors were defined as high blood pressure (those taking pharmacological antihypertensive treatment or those with systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥85mmHg according to Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-VII) (17), high blood glucose (fasting plasma glucose level ≥6.1 mmol/L), high total cholesterol (plasma total cholesterol level ≥5.2mmol/L), high triglycerides level (plasma triglycerides level ≥1.65mmol/L) and low HDL-Cholesterol level (plasma HDL-cholesterol level ≤1.29mmol/L). The independent variables in the LRA were education levels and the dependent variables included in this model dichotomously; having any of the cardiovascular risk factors that mentioned above.

Subjects were classified according to modified definitions of metabolic syndrome from the World Health Organization (WHO) (18-20) and the National Cholesterol Education Program 2001 (NCEP). Modified WHO definition classifies a subject as having the metabolic syndrome whether she had hyperinsulinemia or impaired glucose tolerance (fasting plasma glucose level ≥5.2mmol/L) or diabetes and at least two of the following metabolic abnormalities: BMI ≥30kg/m<sup>2</sup> or waist-to-hip ratio (WHR) ≥0.85, dyslipidemia (plasma triglycerides levels ≥1.65mmol/L and HDL-C levels ≤1.03 mmol/L) and high blood pressure (systolic blood pressure ≥130mmHg and diastolic blood

pressure  $\geq 85$  mmHg or self-reported antihypertensive medication). Microalbuminuria criteria from the original WHO definition was omitted. We believed that this omission would not have strongly affected educational disparities in the metabolic syndrome. The NCEP definition classifies a subject as having the metabolic syndrome if she has at least three of the following five metabolic abnormalities: High blood pressure (systolic blood pressure  $\geq 130$  mmHg and diastolic blood pressure  $\geq 85$  mmHg or self-reported antihypertensive medication), dyslipidemia (plasma triglycerides levels  $\geq 1.65$  mmol/L and HDL-C levels  $< 1.29$  mmol/L), abdominal obesity ( $WC \geq 88$  cm) and impaired fasting glucose (fasting plasma glucose  $\geq 5.2$  mmol/L).

The main difference between these two definitions of metabolic syndrome is that WHO definition suggests using plasma insulin levels and HDL-C cut-off levels lower than NCEP HDL-C cut-off levels. There is no common consensus established which definition is being used yet. However, it was shown that WHO criteria has better sensitivity for predicting CHD and type 2 diabetes compared with the NCEP criteria which has better specificity (21).

## Results

Table 1 summarizes the anthropometric and biochemical characteristics of studied populations. Body mass index, WC,

WHR, blood pressure, triglycerides and glucose were lowest in the younger population with an increasing trend with age, whereas total cholesterol and HDL-C did not significantly change with age.

There were significant differences in BMI, WC, WHR, blood pressure, triglycerides and glucose levels (all  $p < 0.0001$ ) and HDL-C level ( $p = 0.001$ ) among groups with different educational levels. Post-hoc analysis showed that mean BMI in LEC was higher than in other groups (mean  $38.3 \pm 7.2$  kg/m<sup>2</sup> vs.  $34.2 \pm 6.0$  kg/m<sup>2</sup> in high school group and  $33.6 \pm 6.3$  kg/m<sup>2</sup> in university group,  $p < 0.0001$  and  $p < 0.0001$ ). Waist circumference and WHR in LEC group were larger than in other educational groups ( $p < 0.0001$  for both). Systolic and diastolic blood pressures were similar in the high school group and the university group; however, significant differences were found in subjects in the LEC ( $p < 0.0001$  for both). Mean triglycerides levels were higher in LEC than in high school and university groups ( $1.69 \pm 0.95$  mmol/L vs.  $1.44 \pm 0.84$  mmol/L and  $1.42 \pm 0.89$  mmol/L, respectively,  $p < 0.0001$  and  $p < 0.0001$ ), while HDL-C levels were lower ( $1.17 \pm 0.28$  mmol/L vs.  $1.22 \pm 0.28$  mmol/L and  $1.24 \pm 0.29$  mmol/L, respectively,  $p = 0.046$  and  $p < 0.0001$ ). Biochemical analysis showed that glucose level was higher in the LEC group than in high school and university groups ( $5.62 \pm 1.64$  mmol/L vs.  $5.27 \pm 1.74$  mmol/L and  $5.18 \pm 1.08$  mmol/L, respectively,  $p < 0.0001$ ).

**Table 1. Clinical, anthropometric and biochemical characteristics of study population**

| Variables  | Low educated (n=1224) | High school (n=951) | University (n=905) | F*      | p*      |
|--|-----------------------|---------------------|--------------------|---------|---------|
| Age, years   | 42.1±12.5             | 35.1±12.6           | 37.9±11.4          | 85.256  | <0.0001 |
| Body mass index, kg/m <sup>2</sup>   | 38.3±7.2              | **34.2±6.0          | **33.6±6.3         | 192.052 | <0.0001 |
| Waist circumference, cm  | 104.0±12.8            | **96.6±12.4         | **96.1±13.4        | 169.008 | <0.0001 |
| Waist-to-hip ratio   | 0.83±0.06             | **0.81±0.07         | **0.81±0.07        | 28.484  | <0.0001 |
| Blood pressure, mmHg   |                       |                     |                    |         |         |
| Systolic   | 132.1±25.2            | **123.8±21.4        | **124.2±21.9       | 46.691  | <0.0001 |
| Diastolic  | 84.1±14.2             | **79.5±12.8         | **79.4±12.9        | 28.795  | <0.0001 |
| Total cholesterol, mmol/L  | 5.32±1.15             | 5.14±1.12           | 5.24±1.06          | 5.886   | NS      |
| HDL-cholesterol, mmol/L  | 1.17±0.28             | **1.22±0.28         | *1.24±0.29         | 7.332   | <0.001  |
| Triglycerides, mmol/L  | 1.69±0.95             | **1.44±0.84         | **1.42±0.89        | 20.268  | <0.0001 |
| LDL-cholesterol, mmol/L  | 3.31±1.01             | 3.2±1.01            | 3.27±1.00          | 3.453   | NS      |
| Glucose, mmol/L  | 5.63±1.64             | **5.27±1.74         | **5.18±1.08        | 19.829  | <0.0001 |
| Data are represented as Mean±Standard Deviation<br>* - one way ANOVA test for comparison of 3 groups -<br>Bonferroni post hoc test for pairwise comparisons - * - $p = 0.046$ and ** - $p < 0.0001$ - differences are significant in comparison with LEC group<br>HDL - high-density lipoprotein, LDL - low-density lipoprotein, LEC - low education class, NS - non-significant |                       |                     |                    |         |         |

**Table 2. Correlation analysis of educational levels and anthropometric and biochemical parameters in study group after controlling with age and BMI (n=3080)**

|   |   | WC    | WHR   | SBP   | DBP   | TC    | HDL    | TG    | LDL   | GLU    |
|---|---|-------|-------|-------|-------|-------|--------|-------|-------|--------|
| Education Levels  | r | -0.03 | -0.03 | -0.01 | -0.02 | -0.04 | -0.06  | -0.05 | -0.04 | -0.06  |
|   | p | 0.048 | 0.059 | NS    | NS    | 0.025 | <0.001 | 0.005 | 0.02  | <0.001 |
| DBP- diastolic blood pressure, GLU- glucose, HDL- high density lipoprotein, LDL- low density lipoprotein, NS- non-significant, SBP- systolic blood pressure, TC- total cholesterol, TG- triglycerides, WC- waist circumference, WHR- waist-to-hip ratio |   |       |       |       |       |       |        |       |       |        |

### Correlation of educational levels and anthropometric and biochemical parameters in Turkish overweight and obese women

In univariate analysis, the partial correlation coefficients and significances for educational levels and anthropometric and biochemical parameters after included continuous variables (age and BMI) are presented in Table 2. We found significant correlation between educational levels and WC, TC levels, HDL-C levels, triglycerides levels, low-density lipoprotein cholesterol (LDL-C) levels and glucose ( $p < 0.05$  for all). However, no significant correlation was found between education levels and blood pressure, while there was a borderline association ( $p < 0.059$ ) between educational level and WHR.

### Relationship of educational levels and cardiovascular risk factors

Logistic regression analysis was performed to determine relationship between educational levels and cardiovascular risk factors. Odds ratios and 95% confidence interval values are presented in Table 3. The women in the LEC group had 1.93 fold (95% CI 1.56-2.39,  $p = 0.001$ ) and women in the high school group had a 1.44 fold (95%CI 1.17-1.77,  $p = 0.001$ ) increase in cardiovascular risk. Significant risk increases were found in women of LEC group - for high blood pressure levels (1.55 fold), high glucose (1.90 fold), high triglycerides levels (1.69 fold) and low HDL-C levels (1.65 fold) (all  $p = 0.001$ ). The high school group had a significantly high risk for total cardiovascular risk factors, whereas there was no a significant risk for higher blood pressure, higher glucose, higher triglycerides and lower HDL-C levels for high school and university groups.

**Table 3. Logistic regression analysis in study population according to educational levels**

|                        | OR   | 95%CI     | p     |
|------------------------|------|-----------|-------|
| CV Risk                |      |           |       |
| LEC                    | 1.93 | 1.56-2.39 | 0.001 |
| High School            | 1.44 | 1.17-1.77 | 0.001 |
| High BP                |      |           |       |
| LEC                    | 1.55 | 1.29-1.89 | 0.001 |
| High School            | 1.12 | 0.92-1.37 | NS    |
| High Glucose           |      |           |       |
| LEC                    | 1.90 | 1.47-2.45 | 0.001 |
| High School            | 1.29 | 0.96-1.74 | NS    |
| High Total Cholesterol |      |           |       |
| LEC                    | 0.93 | 0.78-1.11 | NS    |
| High School            | 0.93 | 0.77-1.12 | NS    |
| Low HDL-C              |      |           |       |
| LEC                    | 1.65 | 0.36-2.00 | 0.001 |
| High School            | 1.15 | 0.94-1.42 | NS    |
| High Triglycerides     |      |           |       |
| LEC                    | 1.69 | 1.41-2.02 | 0.001 |
| High School            | 1.19 | 0.98-1.45 | NS    |

BP- blood pressure, CI- confidence interval, CV- cardiovascular, LEC- low education class, NS- non-significant, OR- odds ratio

### Prevalence of metabolic syndrome among different educational levels

The prevalence of metabolic syndrome using modified WHO metabolic syndrome criteria in our study population was 11.5%. Educational differences in the prevalence of metabolic syndrome were of similar magnitude in the high school group (2.45%,  $n = 77$ ) and the university group (2.5%,  $n = 80$ ), however, with significantly higher in LEC group (6.7%  $n = 219$ ), ( $p < 0.001$ ). Metabolic syndrome subjects' mean age was  $46.1 \pm 11.5$  years ( $n = 2874$ ) and subjects who did not have metabolic syndrome were younger than subjects with metabolic syndrome [ $37.2 \pm 12.3$  years,  $n = 376$ ,  $p < 0.001$ ]. In the logistic regression model adjusted with age, the OR for the metabolic syndrome was 2.02 (95% C.I. 1.53-2.67,  $p = 0.001$ ) higher for the LEC group than for the university level group. There was no significant risk increase in the high school level (OR=1.16, 95% CI 0.86-1.67) when compared to the LEC group.

The prevalence of metabolic syndrome using NCEP metabolic syndrome criteria was 43.6% in the study population. Overall, 21.8% of subjects in the LEC group had metabolic syndrome and ~11% of subjects had metabolic syndrome in the other education level groups.

### Discussion

In this study, we evaluated educational status and its relationship with obesity using our hospital based database. Our results indicated that there are educational correlated effects on obese female subjects. Higher prevalence of metabolic abnormalities was encountered in the LEC group, especially, when the subjects in this group were analyzed separately; in the illiterate subgroup, the prevalence of abnormalities reached the highest values (data not shown). Obesity and related traits regarding the prevalence of metabolic abnormalities showed consistency with other studies investigated educational attainment in different populations (22, 23). Matthews et al. (24) investigated the association between educational level and biological parameters and behavioral risk factors for coronary heart disease among 2138 middle-aged women in Allegheny County, Pa, USA. It was reported that less educated women were more obese, had higher prevalence of coronary risk factors such as, high triglyceride, low HDL-C, high LDL-C levels and lesser physical activity. Drewnowski and Specter (25) reviewed obesity and related disorders with respect to poverty in the US, and they also concluded that lesser education and lesser income are associated with higher obesity and metabolic syndrome prevalence among women.

A recently published study regarding educational inequalities in the metabolic syndrome and coronary heart disease among middle-aged Finnish population indicated that the prevalence of metabolic syndrome, as defined by the NCEP criteria, was lower in the university group than in the less educated group (26). As discussed above, educational attainment and its obesity relationship are not only seen in Western populations, but are also encountered in Mediterranean populations. Mataix et al. (27) also investigated the educational attainment and cardiovascular risk factor

relationships in random populations from Southern Spain. They showed that major cardiovascular risk factors prevalence are 3 times more frequent in non-schooled women than in the university group after age-adjustment.

Our results also showed that age is an important risk factor for obesity development in the Turkish female population. Obesity prevalence was at the highest rate (87.6%) in the oldest quartile in our study group. This finding might bring a question to mind; do obese older patients apply more frequently to obesity outpatient clinics than younger patients? However, obesity is more prominent in older age due to a lack of exercise, as well as behavioral and social changes (28). Meanwhile, other studies in random Turkish population have shown that obesity prevalence increases with aging in the Marmara region (29, 30).

As for lipid parameters, our results showed that there was an inverse relationship between educational levels and lipid parameters. Even though the mean values of total cholesterol (TC) were not significantly different in each group, a slight inverse correlation was seen in this study. Interestingly, TC shows less consistency with education and cardiovascular risk factors. Some studies (31, 32), like in this study, have found a negative correlation, whereas opposite results have also been published (33). It might be speculated that the Turkish population has been well characterized with low HDL-C levels and high TC/HDL-C ratios. Besides dietary variability, income status and smoking habits, other regulatory mechanisms can also affect the variable. On the other hand, in a recently published study regarding impacts of educational levels on plasma lipid parameters and BMI in random Turkish populations, 3 different random cohorts between the years 1993-2003 were analyzed. It was shown that TC levels were not significantly different between higher educated and lower educated women. Nevertheless higher educated women tended to exercise more, smoke less, and have higher income and a higher HDL-C than LEC subjects. The authors in that study have concluded that educational levels have a major impact on weight status and plasma lipid parameters in Turkish women (34).

Another interesting finding in this study is that the prevalence of metabolic syndrome had variations when WHO and NCEP criteria were performed on the study population. The prevalence of metabolic syndrome using WHO criteria was 11.5% whereas, it reached 43.6% using NCEP criteria. We concluded that the different cut-off levels for HDL-C in the two definitions resulted in this large variation. Another question might be asked to determine which criteria are most appropriate for determining metabolic syndrome in the Turkish population. Onat et al. (35) suggested that HDL-C threshold should be modified from 1.29 mmol/L to 1.16 mmol/L because of the genetically low level of HDL-C in the Turkish female population and that the WC threshold to be raised from 88 cm to 91 cm according to Turkish Adult Risk Factor Study. However, there has not been a common consensus of which metabolic syndrome criteria should be used in order to represent most appropriately the Turkish population. We therefore, think that further large, longitudinal population based studies are required to answer this question in the Turkish population.

### Study limitations

It is worth noting that this study was done by retrospective analysis of hospital based records. It is not able to represent all Turkish population. Since this study has a large patient number, it might give us enough clues about general characteristics of overweight and obese Turkish women. It is well known that obese populations have special metabolic characteristics and their relationship between body fat and cardiovascular risk factors are different from random populations. In addition, we did not adjust our study group with respect to income level and occupational status. Even with these limitations, several previous studies had found that educational status was the most detrimental variable in cardiovascular risk and thus as a result for mortality (36).

### Conclusions

This the largest study on association of educational status with anthropometric and biochemical parameters for cardiovascular risk factors in overweight and obese Turkish women showed that low educational status is a serious problem for developing obesity and increasing risk for obesity related disorders in the overweight and obese Turkish female population in İstanbul. Preventive cautions such as more information about healthy diets; low saturated fat, foods contain low glycemic index, as well as encouragement for more exercise should be put in practice. We believe that these efforts will prevent the development of obesity in the Turkish female population.

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