

## Risk factors of obesity in a cohort of 1001 Cypriot adults: An epidemiological study

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### Abstract

**Background and Aims:** To measure the prevalence of overweight and obesity in adults in the Republic of Cyprus, and to evaluate and relate possible obesity risk factors of the adult Cypriot population.

**Methods:** This is an epidemiological cross-sectional study on a stratified random sample of 1001 (48.5% males-51.5% females) subjects, aged 18-80 years old. Anthropometric, biochemical, and dietary/lifestyle characteristics included in the study.

**Results:** The prevalence of overweight (Ow) and obesity (Ob) was 46.9% and 28.8% for males and 26% and 27% for females, respectively. Overweight and obese subjects were found to have statistically significant higher levels of Body Mass Index ( $p<0.001$ ), Waist circumference ( $p<0.001$ ), Total serum cholesterol ( $p<0.001$ ), Low density lipoprotein ( $p<0.005$ ), Glucose ( $p<0.007$ ) and Triglycerides ( $p<0.001$ ) compared to normal peers. In addition, Ow and Ob participants consumed significantly lower levels of fruits and vegetables ( $p<0.001$ ), exercised less time/d ( $p<0.001$ ) and smoke more cigarettes/d ( $p<0.001$ ), compared to normal subjects, respectively. In multiple regression analysis of factors associated with overweight and obesity, Waist Circumference (beta: 1.132,  $p<0.001$ ), Glucose (beta: 0.892,  $p<0.045$ ), alcohol consumption (beta: 0.563,  $p<0.001$ ), and exercise levels (beta: -0.444,  $p<0.001$ ), were the most significant ones.

**Conclusion:** The prevalence of overweight and obesity is very high in Cypriot adults. The current study also revealed a significant positive relation of Ow and Ob with waist circumference, high blood glucose levels and increased consumption of alcohol and a negative one with decreased levels of exercise. Hippokratia 2012; 16 (3): 256-260

**Keywords:** obesity, overweight, Cyprus, nutrition, risk factors

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Overweight and obesity are becoming increasingly prevalent in both developed and developing countries<sup>1</sup>. The occurrence of adult obesity is causing worldwide concern, and the World Health Organization (WHO) has estimated that the number of overweight is close to one billion internationally, whereas the number of obese individuals is close to 300 million<sup>2</sup>.

In relatively affluent countries like Cyprus, the phenomenon is increasingly widespread among children, as a recent local study has shown<sup>3</sup>. WHO also estimated that the 1989/1990 levels of obesity in Cyprus were 19% and 24% for men and women, respectively, in the age range 35-64 years<sup>3</sup>.

In neighboring Greece, which shares a common ethnic background and way of life with the majority of the population of the Republic of Cyprus, the combined per-

centages of overweight and obese were determined to be 72% and 74% for men and women, respectively<sup>4</sup>.

In addition, heart disease is the leading cause of deaths in adults in Greece<sup>5</sup> which may also negatively affect Cypriot population. Well-known risk factors such as obesity, hyperlipidemia, abdominal body fat, lack of exercise, smoking and bad dietary factors may lead to cardiovascular disease (CVD)<sup>6</sup>.

The aim of the present work is to report the results of the first comprehensive epidemiological study on overweight and obesity in the adult Cypriot population as well as to determine possible risk factors such as anthropometrical, biochemical and dietary/lifestyle.

### Subjects and methods

The current study was conducted during 2005-2009,

**Table 1:** Population Distribution.

	Men	Women	Total (%)
Nicosia	19.7± 1.81	20.7 ± 1.85	40.40 ± 2.41
Limassol	14.9 ± 1.51	14.8 ± 1.54	29.70± 2.05
Larnaca	7.40 ± 1.19	7.70 ± 1.21	15.10 ± 1.71
Paphos	4.65 ± 1.17	4.25 ± 1.18	8.90 ± 1.30
Famagusta	2.66 ± 0.51	3.24 ± 0.51	5.90 ± 0.71

Data presented as % of population ±SE

**Table 2:** Prevalence rates of overweight and obese adults.

	Males (n=485) (%)	Females (n=516) (%)	Total (n=1001) (%)
Normal	117 (24.3)	242 (47)	359 (35.8)
Overweight	227 (46.9)	134 (26)	361 (36.0)
Obese	151 (28.8)	140 (27)	291 (28.2)
Chi-square test for differences between gender $\chi^2$ , $p = 0.507$			

and included 1001 Cypriot adults in the age range 18 to 80y (48.5% males/51.5% females). The population of Cyprus is about 600.000 thousand people. The figures of the subjects were the most valid at the time of the beginning of the study as those were adopted by the Cyprus Ministry of Health. For the sample size the statistical error was 3%. The sample was representative from all main cities and suburbs in Cyprus (Nicosia, Limassol, Pafos, Larnaca and Famagusta). The selection of the subjects was performed randomly using the 2005 telephone directory, and the total final sample was stratified and in full compliance with the demographics of the Republic of Cyprus (table 1). Detail information of the whole procedure and any possible health risks was given to the subjects prior to any intervention and a consent form was signed by all subjects willing to participate. All subjects were free of any condition or disease such as diabetes, hyperlipidemia, hypertension or taking any medication. The study was also approved by the Cyprus National Bioethics Committee.

Body weight (Bw) was measured using a scale (Seca 700) with an accuracy of ±100 gr. Subjects were weighed wearing light clothes and without shoes. Height (Ht) was measured using a seca stadiometer. BMI was calculated by dividing weight (kg) by height squared ( $m^2$ ). The categorization of the weight situation of the subjects according to the BMI was taken as follows: BMI 20-25 normal weight, BMI 25-30 overweight, and BMI > 30 obese. Waist circumference (WC) was measured to the nearest 0.1cm using a regular tape.

Laboratory examinations were obtained for all subjects (n=1001) participated in the study after an overnight fast. The fasting plasma glucose, total cholesterol

(TC), triglyceride(TG), low-density lipoprotein cholesterol (LDL-C) and high density lipoprotein cholesterol (HDL-C) concentrations were measured using Bayer Reagent Packs on an automated chemistry analyzer (Advia 1650 Autoanalyzer; Bayer Diagnostics, Leverkusen, Germany). Classification of the results was reported based on the above three groups (Normal, Overweight Obese).

The 24-h recall technique was used to collect dietary intake information for a total of 3 days (2 weekdays and 1 weekend day). Study participants together were asked to describe the type and amount of food consumed after a detailed explanation and guidance provided by a registered dietician. To improve the accuracy of food description, food models were used to describe the portion sizes. The dietary record was analyzed using a software program which included Greek and Cypriot food database. Questionnaires were used to ascertain information regarding exercise, smoking and the amount of alcohol consumed.

#### Statistical Analysis

We performed statistical analysis with SPSS 13.5 software. Variables which have been found non-normally distributed were log-transformed. Chi-square test was used to detect significant differences between two independent groups. Data was presented as mean ± S.E. Analysis of variance (ANOVA) was used to calculate the significant differences of variations in the three groups. For post hoc comparisons of means, Bonferroni test was used. Multiple regression analysis was used to estimate the relationship of different parameters to overweight and obesity. Values with  $p < 0.05$  were considered statistically significant.

**Table 3:** Anthropometric characteristics of all subjects (n=1001).

	Normal (n=361)	Overweight (n=362)	Obese (n=279)	p value
Age (y)	36.2 ± 11.07	44.8 ± 12.6	43.6 ± 14.7	0.277
Height (cm)	163 ± 70	164 ± 13.7	162 ± 11.9	0.548
Weight (kg)	60.2 ± 8.3	76 ± 8.2*	94 ± 13.6*	0.001
BMI (kg/m <sup>2</sup> )	21.2 ± 1.5	26.3 ± 1.7*	34.7 ± 3.2*	0.001
WC (cm)	74 ± 7.8	91 ± 8.5*	105 ± 12*	0.001

Data presented as mean± S.E

Statistically significant (P < 0.05)

\*Statistically significant difference between normal and overweight and normal and obese group.

Abbr: BMI=body mass index, WC=waist circumference

**Table 4:** Biochemical characteristics of participated subjects (n=1001).

Parameters**	Normal (n=361)	Overweight (n=362)	Obese (n= 279)	p value
TC (mg/dl)	201 ± 41	229 ± 44*	223 ± 43*	0.001
HDL (mg/dl)	58.4 ± 13.5	51 ± 12	50 ± 11.5	0.188
LDL (mg/dl)	90.7 ± 34.2	91 ± 36.2*	93.9 ± 34*	0.005
TC/HDL (ratio)	3.4	4.49	4.46	0.067
Glucose (mg/dl)	84.6 ± 22.2	92.3 ± 19.6*	93 ± 17*	0.007
Triglycerides (mg/dl)	78.2 ± 45.4	121 ± 96*	141 ± 83*	0.001

Data presented as mean± S.E

Statistically significant (P < 0.05)

\*Statistically significant difference between normal and overweight and normal and obese group.

\*\*Adjusted for age and gender

Abbr: TC=total cholesterol, HDL=high density lipoprotein, LDL= low density lipoprotein

## Results

The prevalence of overweight and obesity was 46.9% and 28.8 % for males and 26% and 27 % for females, respectively (Table 2). Overweight and obesity in combination reaches to 75.2% for males and 53% for females.

Table 3 illustrates the anthropometric characteristics of N, OW and OB subjects. Obese and overweight subjects were found to have statistically significant higher levels of Ht, Wt, BMI and WC compared to normal ones.

Obese and overweight subjects were also found to have statistically significant increased levels of TC (p<0.001), LDL (p<0.005), TG (p<0.001) and Glucose (p<0.007) compared to normal peers. No significant difference were found between the three groups and in HDL levels and TC/HDL ratio (Table 4).

Table 5 reveals dietary and lifestyle information. Ow and Ob subjects were found to consume significantly lower levels of fruits and vegetables (p<0.001). In addition, Ow and Ob groups were having significantly less physical activity levels (p<0.001) and smoke more cigarettes than normal subjects (p<0.001). No statistically significant differences were observed for red meat and fish consumption between all three groups.

In multiple regression analysis of factors associated

with overweight and obesity, WC, glucose, alcohol and exercise were the most significant ones (Table 6).

## Discussion

This study was the first comprehensive epidemiological study in Cyprus that tried to investigate the prevalence of Ow and Ob as well as risk factors parameters related to that. Even though the geographic characteristics may play an important role in the prevalence rates, however our data shows a very high prevalence rate (Ow+Ob, 75.2% M and 53% F) compared with others studies in the world.

Data from the WHO-MONICA study revealed markedly different prevalence patterns within Europe, ranging from 7% in Swedish men to 45% in women from Lithuania<sup>7</sup>. In the United States, prevalence's comparable to those seen in Europe today were already observed in data from the NHANES III survey, conducted 15 years ago. In a recent NHANES survey, which includes data from 2004, prevalences in the US ranged from 29% in white men to 50% in black women<sup>8</sup>. Data from the US show that the prevalence of obesity is rising continuously, and similar trends have been reported recently for the Chinese population, in which the prevalence of obesity has doubled over the past decade<sup>9</sup>. With these worldwide

**Table 5:** Dietary and lifestyle characteristics of subjects.

Parameters**	Normal (n=361)	Overweight (n=362)	Obese (n=279)	p value
Red meat (servings/d)	0.8 ± 0.7	2.2 ± 0.9	4.4 ± 1.1	0.391
Fish (servings/d)	0.47 ± 0.1	0.5 ± 0.2	0.4 ± 0.2	0.437
Vegetables (servings/d)	4.2 ± 1.5	1.1 ± 1.1*	0.7 ± 0.8 *	0.003
Fruits (servings/d)	3.2 ± 1.6	1.2 ± 1.2*	0.5 ± 0.9 *	0.001
Alcohol (g/d)	29 ± 5.1	55 ± 4.9*	54 ± 4.8 *	0.001
Smoking (cig/d)	5 ± 2.7	12 ± 2.6*	15 ± 3 *	0.001
Exercise (Met x h/d)	6 ± 0.7	3.8 ± 0.7*	3.5 ± 0.6 *	0.001

Data presented as mean± S.E

Statistically significant (P < 0.05)

\*Statistically significant difference between normal and overweight and normal and obese group.

\*\*Adjusted for age, gender and energy intake

**Table 6:** Parameters associating with overweight and obesity by multiple regression analysis\*\*

	Beta	95% CI	p value
WC (cm)	1.132	(1.009-1.837)	0.001*
TC (mg/dl)	0.876	(0.746-1.193)	0.887
LDL (mg/dl)	1.007	(0.917-1.085)	0.512
Glucose (mg/dl)	0.892	(0.643-1.542)	0.045*
TG (mg/dl)	1.009	(0.821-1.182)	0.098
Fruits (g)	1.032	(0.778-0.352)	0.668
Vegetables (g)	0.852	(0.549-1.031)	0.877
Alcohol (g)	0.563	(0.247-0.788)	0.001*
Smoking (cig)	0.712	(0.211-0.989)	0.479
Exercise (Met)	-0.444	(-0.211-0.712)	0.001*

\*Statistically significant (P < 0.05)

\*\*Adjusted for age, gender and energy intake

Abbr: WC=waist circumference, TC=total cholesterol, LDL=low density lipoprotein, TG=triglycerides

trends in mind, and based on the data currently available for Europe, it would appear safe to assume that obesity in Europe is approaching, if it has not already reached, epidemic proportions.

Overall, in the central, eastern, and southern regions of Europe, prevalence rates are higher than in the western or northern regions. This geographic pattern can be explained, at least in part, by different socioeconomic conditions, as well as by lifestyle and nutritional factors. The prevalence of obesity in Spain and Italy, in particular, is high, and there has been recent discussion in the literature about urbanization and the globalization of certain lifestyle factors that have had a negative impact on the traditional Mediterranean diet<sup>10</sup>. Greece, which shares a common ethnic background and way of life with the majority of the population of the Republic of Cyprus, has also very high combined percentages of overweight and obesity rates, 72% and 74% for men and women, respectively<sup>4</sup>.

Increased visceral or abdominal adipose tissue in particular has been shown to be more strongly associated with meta-

bolic and cardiovascular disease risk and a variety of chronic diseases<sup>11</sup>. (WC) is a convenient measure of abdominal adipose tissue<sup>11</sup> and is unrelated to height, correlates closely with BMI<sup>12</sup> and total body fat<sup>13</sup>, and is associated with cardiovascular disease risk factors independent of BMI<sup>14</sup>. In our study, the obese subjects we found to have significantly higher levels of WC compared with the normal ones.

The results of serum lipid profiles and blood pressure levels in our study confirmed that obesity is associated with an increased future risk of dyslipidemia and possible metabolic syndrome. Obese subjects had significantly higher total cholesterol, LDL cholesterol, triglycerides, than normal subjects. Although the obese group's averages were within normal ranges, it is clear that obesity is associated with abnormal lipid metabolism and a higher risk of metabolic syndrome<sup>15</sup>.

Nutrient intake of fruits, vegetables from food frequency questionnaire and 3-day dietary record showed strong differences between the normal and obese groups. Diets rich in fruits and vegetables are associated with a decreased risk of many chronic diseases as well as obesity<sup>16,17</sup>.

Physical activity is an important factor in the regulation of energy balance and prevention of the development of obesity. Sedentary lifestyles have been associated with obesity<sup>18</sup>. In this study, the frequency and duration of exercise did differ significantly between obese and normal weight subjects. Therefore, a sedentary lifestyle does seem to be a major determinant of obesity in these subjects.

In this study, the amount of alcohol consumed per drinking episode was significantly higher in the obese group. Conflicting results exist on the relationship between alcohol consumption and the development of obesity<sup>19,20</sup>. However, Yoon et al<sup>21</sup>, using 1998 KNHANES data, reported that abdominal obesity was positively associated with alcohol consumption in Korean adults with average ages of 44.2 (men) and 45.1 (women).

Our study has several limitations: we did not take in account all dietary patterns and we did not collect information about genetic predisposition and socioeconomic status of the subjects.

Nevertheless, we present for first time important information about prevalence rates of overweight and obesity in a large sample of adult Cypriot population as well anthropometric, biochemical and dietary/lifestyle data.

## Conclusion

The prevalence of overweight and obesity is very high in Cypriot adults. The current study also revealed a significant positive relation of Ow and Ob waist circumference, high blood glucose levels and increased consumption of alcohol and a negative one with decreased levels of physical activity. More studies are necessary to elucidate additional factors that possibly have an effect on Ow and Ob in Cypriot population.

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## Conflict of Interest

The study was funded by research grant-HEALTH/1104/21 by Cyprus Research Promotion Foundation and also from external sponsors, Flora Pro-Active, Zorpas Bakery, Lanitis Ltd., Costas Papaellinas, and Nestlé Ltd.

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