# The association of total and abdominal obesity with health-related quality of life in a sample of Greek healthy adults

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## ABSTRACT

**BACKGROUND:** in the Greek population, the association between obesity and Health-Related Quality of Life (HRQoL) has not been examined so far. Thus, the purpose of the present study is to explore obesity-related predictors of HRQoL in a sample of Greek healthy adults.

**METHODS:** a cross-sectional design was used. The sample consisted of three hundred twenty seven healthy men (N=105) and women (N=222), between the ages of 30 and 50 years (mean age=39.57 ± 6.68) who lived in Athens. Body mass index (BMI), waist to hip ratio (WHR), and body fat (BF) were assessed. HRQoL was evaluated using the short-form 36 (SF-36) health survey, which consists of eight subscales and two health factors (physical and psychological health). Socio-demographic variables and health-related behaviours were assessed by questionnaires. Separate hierarchical regression analyses were conducted to examine the associations between BMI, WHR, BF and SF-36 health survey subscales and factors.

**RESULTS:** socio-demographic and health-related variables were moderately associated with the HRQoL subscales and factors. Furthermore, after controlling the socio-demographic variables and health-related behaviours, (a) BMI negatively predicted the physical functioning, physical role, bodily pain, and social functioning subscales, as well as the physical health factor and (b) WHR and BF negatively predicted the physical functioning subscale. However, the obesity indexes did not predict other psychological health subscales.

**CONCLUSIONS:** the results indicated negative associations of BMI, WHR, BF with physical functioning and health in a sample of Greek healthy adults. Such data relating total and abdominal obesity to HRQoL, as assessed by BMI, WHR, and BF, have not been reported until now in the literature. One limitation of this study was that the sample size was relatively small and the results could not be generalized to the entire Greek population.

*Key words: Health-Related Quality of Life; Obesity; Abdominal obesity; Body fat*

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## INTRODUCTION

Data from recent studies suggest that obesity levels are rising in the United States [1], as well as in the European Union [2]. More specifically, the prevalence of obesity was 32.2% among adult men and 35.5% among adult women from the United States [1]. In line with this, the prevalence of obesity was 26% in men and 18.2% in women from Greece [3]. This rising prevalence of obesity can result in increased risk factor for metabolic syndrome, cardiovascular diseases, musculoskeletal and endocrine problems, cancers, and mortality [4, 5]. Furthermore, abdominal obesity is an independent risk factor for metabolic syndrome and cardiovascular diseases [5, 6]. Finally, obesity has a substantial impact on a person's functional capacity and Health-Related Quality of Life (HRQoL) [7, 8], which has been defined as an individual's perceived physical and psychological health and social well-being over time [9].

In particular, several studies have indicated a negative relationship between obesity and HRQoL [7, 8, 10-15]. However, the impact of obesity has been shown to be more pronounced on physical than on psychological health [7, 8, 10, 12, 13, 15]. Much of the research examining the association between obesity and HRQoL has been restricted to estimating obesity levels from self-reported information on body mass index (BMI) [10, 11, 13, 15]. Previous studies, however, have shown that weight tends to be underestimated and height tends to be overestimated [16, 17] and this could have affected the association between BMI and HRQoL. Also, only a few studies have estimated the obesity levels using additional obesity indexes, such as waist circumference, waist to hip ratio (WHR) or body fat (BF) [18-20].

In the Greek population, what has been examined so far is the relationship between various diseases and HRQoL [21, 22], as well as the validity and reliability of questionnaires for the HRQoL assessment [23-25]. No study has investigated the association between obesity and HRQoL in the Greek population. Moreover, no data which relate total and abdominal obesity to HRQoL measuring BMI, WHR, and BF in healthy adults have been reported until now in literature. Thus, the purpose of the present study is to examine the hypothesis that BMI, WHR, and BF are significant predictors of HRQoL in a sample of Greek healthy adults, while controlling various socio-demographic and health-related behaviours.

## METHODS

### Participants' description

A request form for the study was sent to 28 private and public companies and 12 major fitness centers from Prefecture of Athens in Greece. The application explained the study's purpose requesting for healthy men and women, between the ages of 30 and 50 years. Fifteen business managers (from 12 companies and 3 fitness centers) allowed the conduction of the study in their workplaces and sports facilities and informed their employees and trainee. In total, 523 volunteers, men and women between the ages of 30 and 50 years, accepted to participate in the study and signed a consent form.

The sample's selection criteria were the following: (a) good health condition, (b) participants not underweight (BMI > 18.50 kg/m$^2$) [26] and (c) women not pregnant. Persons with diseases, like diabetes, asthma, hypertension, cardiovascular and lung diseases, arthritis, depression, cancer, as well as persons with physical dysfunction or disability were excluded from the final sample, due to the consequences of diseases on HRQoL [27]. Based on the above criteria, from the 523 volunteers the following were excluded: (a) 139 participants with diseases, (b) 24 persons with BMI ≤ 18.50 kg/m$^2$, (c) 10 pregnant women, and (d) 23 persons that did not complete all the questionnaires. Thus, the final sample consisted of 327 participants.

### HRQoL assessment

HRQoL was estimated using the short form 36 (SF-36) health survey. The SF-36 is a valid and reliable generic questionnaire for the HRQoL assessment, which can be used in healthy population, for various diseases, as well as for comparisons between different groups of diseases and patients [28-30]. The SF-36 health survey consists of 36 questions that assess eight subscales: physical functioning, role disability due to physical problems (physical role), bodily

pain, general health perceptions (general health), vitality, social functioning, role disability due to emotional problems (emotional role), and mental health. The eight subscales estimate two health factors: physical health (PCS) and psychological health (MCS). In particular, the first four subscales are referred to PCS factor, whereas the latter four subscales are referred to MCS factor. Subscales scores were transformed into a scale ranging from 0 to 100, while PCS and MCS factors were scored using standardization and norm-based methods with a mean of 50 and a standard deviation of 10 [29]. Higher values represent better HRQoL. Furthermore, as far as the Greek version of the SF-36 health survey is concerned, recent research has shown high validity and reliability values for the Greek general adult population [23-25].

### Anthropometric measurements

All anthropometric measurements were carried out by trained personnel in accordance with Heyward and Stolarczyk recommendations [26]. The participants were wearing light clothes during measurements: body weight was measured to the nearest 100 gr by a calibrated scale and standing height in bare feet to the nearest cm by a stadiometer. BMI was calculated as weight (kg) divided by height (m) squared. Furthermore, waist circumference was measured at the level between the lowest rib margin and iliac crest, whereas hip circumference at the widest trochanters to the nearest cm. WHR was calculated as waist circumference (cm) divided by hip circumference (cm). In addition, biceps, triceps, suprailiac, and abdominal skinfolds were measured with high quality metal calibrated calliper. BF was estimated by Durnin and Womersley [31] and Siri equations, whereas for the obese men and women BF was calculated using Weltman et al equations [26].

### Health problems assessment

The following diseases were evaluated with related-questions: diabetes mellitus, cardiovascular and lung diseases, joint and neck problems, arthritis, allergies, depression, epilepsy, headaches, migraines, disability and mobility problems, case of cancer over the past five years, and problems due to accidents [15].

### Socio-demographic variables assessment

The following self-reported socio-demographic variables were recorded: age, gender, educational level, marital status, number of children, type of job, and income. Specifically, according to educational level, the participants were categorized to six groups: elementary school, secondary school, pre-university studies, professional school, bachelor studies, master/PhD studies. Based on marital status, the participants were stratified into four groups: single, married, divorced, widowed. According to the number of children, the participants were categorized to four groups: no children, 1-2 children, 3-4 children, > 4 children. Also, based on the type of job, the participants were stratified into five groups: unemployed, no job (household, etc.), job in private sector, job in public sector, independent job. Finally, according to monthly income, the participants were categorized to four groups: <1 000 €, 1 000-2 000 €, 2 000-3 000 €, > 4000 €.

### Health-related behaviours assessment

Physical activity (PA) was assessed with the PA at sport index and the PA during leisure-time index of the Baecke PA questionnaire [32]. Previous studies indicated high validity and reliability values for the Baecke PA questionnaire [33]. Smoking status and alcohol consumption were assessed with four questions. Especially, based on smoking status, the participants were stratified into three groups: no smoking, smoking (few days/month), and smoking (all days/month). According to alcohol consumption, the participants were categorized to four groups: no consumption, low consumption, moderate consumption, and high consumption.

### Data collection

The first stage of the study included anthropometric measurements for the obesity assessment, whereas the second stage included self-reported information for the personal and socio-demographic characteristics, as well as the HRQoL and health-related behaviours. The HRQoL questionnaire was administered via interview in order to enhance participants'

understanding of the questions and reduce the number of missing values [25, 29], whereas the other questionnaires were completed by the participants.

### Study design and sample size and power calculations

The study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement [34]. A cross-sectional non-experimental design was used to examine associations of total and abdominal obesity with HRQoL in healthy adults living in Athens. The study was carried out at May and June of 2007.

The sample size was calculated by the Fleiss formula for cross-sectional studies using the statistical program EPI INFO, version 7 (http://cdc.gov/epiinfo). The sample size was calculated based on the following parameters: (a) a power of 80%, (b) a confidence interval of 95% and, (c) the 22.5% prevalence of obesity in the Greek adult population (3). Considering that the prevalence of obesity in the sample studied is 12% (less than 10% in comparison to the general population), the number of participants should be 459. In an attempt to equalize the hypothesized exclusion of participants due to the sample's selection criteria, 523 men and women participated in the study. Specifically, according to the sample's selection criteria, participants with diseases were excluded due to the consequences of diseases on HRQoL [27]. Similarly, underweight persons, pregnant women and participants with missing data were excluded from the sample. Thus, the final sample included 327 healthy men (N=105) and women (N=222). Given the size of the eligible sample, a power analysis for cross-sectional studies was conducted. Specifically, assuming that the obese (exposed) participants were 38 (11.6%) and the normal weight and overweight (unexposed) participants were 289 (88.4%), the analysis showed that the sample size had more than adequate power (0.90) to detect a difference at the significant level of $p<0.05$ (95% confidence interval).

### Statistical Analysis

Initial analysis indicated non-normal distributions for the values of the SF-36 subscales and factors, as well as the PA indices values. For this reason, the values were transformed with logarithmic functions to solve the problem of non-normal distributions. Means, medians, standard deviations, frequencies, sums and rates x100 were used in order to describe the sampled population. For the description of the sample's obesity levels, the participants were stratified into three BMI groups according to Heyward and Stolarczyk recommendations [30].

Separate hierarchical regression analyses were conducted to examine the effect of the three obesity indexes on the HRQoL subscales and factors, while controlling the effect of the socio-demographic variables and health-related behaviours. Specifically, two regression models were included in the analyses. In the first one, age, gender, educational level, marital status, number of children, type of job, income, PA at sport index, PA during leisure-time index, smoking status, and alcohol consumption were entered as predictors. In the second one, BMI, WHR, and BF were entered as predictors. The HRQoL subscales and factors were the dependent variables. To assess the fit of the models, the R square change coefficient was used. The R square change coefficient is the improvement in R square when a second predictor is added. To assess significant predictors of HRQoL subscales and factors, $\beta$ and $t$ coefficients were used. A $p$ value of $<0.05$ was considered statistically significant. Statistical analyses were performed with the SPSS Version 17.0 software.

## RESULTS

The sample size of 327 was used for the statistical power analysis (with 14 predictors) and the alpha level was set at $p<0.05$. The analysis was performed using the software package G*Power 3.1 (35) and the results showed that the sample size of 327 had more than adequate power (0.80), at the moderate to large effect size level. Descriptive statistics of the 327 participants (mean age ± SD in years=39.57 ± 6.68) are presented in Table 1.

### Exploration of the variables predicting HRQoL

Hierarchical regression analysis was applied to examine the effect of the obesity indexes

TABLE 1

PARTICIPANTS' SOCIO-DEMOGRAPHIC CHARACTERISTICS, OBESITY LEVELS AND HEALTH-RELATED BEHAVIOURS

| CHARACTERISTICS | PARTICIPANTS' GROUPS | N | % |
|---|---|---|---|
| GENDER | Men | 105 | 32.1 |
| | Women | 222 | 67.9 |
| BMI * | Normal weight (18.50 ≤ BMI ≤ 24.99 kg/m²) | 171 | 52.3 |
| | Overweight (25.00 ≤ BMI ≤ 29.99 kg/m²) | 118 | 36.1 |
| | Obese (30 ≤ BMI kg/m²)* | 38 | 11.6 |
| EDUCATIONAL LEVEL | Elementary school | 7 | 2.1 |
| | Secondary school | 9 | 2.8 |
| | Pre-university studies | 64 | 19.6 |
| | Professional school | 53 | 16.2 |
| | Bachelor-University studies | 147 | 45.0 |
| | Master/PhD studies (post-graduate) | 47 | 14.4 |
| MARITAL STATUS | Single | 95 | 29.1 |
| | Married | 207 | 63.3 |
| | Divorced | 21 | 6.4 |
| | Widowed | 4 | 1.2 |
| NUMBER OF CHILDREN | None | 124 | 37.9 |
| | 1-2 | 188 | 57.5 |
| | 3-4 | 14 | 4.3 |
| | > 4 | 1 | 0.3 |
| TYPE OF JOB | Unemployed | 4 | 1.2 |
| | No job (household, etc.) | 13 | 4.0 |
| | Job in private sector | 126 | 38.5 |
| | Job in public sector | 158 | 48.3 |
| | Independent job | 26 | 8.0 |
| INCOME (EUROS) | <1 000 | 35 | 10.7 |
| | 1 000-2 000 | 124 | 37.9 |
| | 2 000-3 000 | 117 | 35.8 |
| | >4 000 | 51 | 15.6 |
| SMOKING STATUS | No | 168 | 51.4 |
| | Few days/month | 36 | 11.0 |
| | All days/month | 123 | 37.6 |
| ALCOHOL CONSUMPTION | None | 137 | 41.9 |
| | Low | 115 | 35.2 |
| | Moderate | 40 | 12.2 |
| | High | 35 | 10.7 |

* For the description of the sample's obesity levels, the participants were stratified into three BMI groups according to Heyward and Stolarczyk recommendations [30], whereas for the hierarchical regression analysis, the absolute values of BMI were used

on HRQoL, while controlling various socio-demographic and health-related behaviours. The socio-demographic and health-related behaviours were entered in the first regression model, whereas the three obesity indexes were entered together in the second regression model. Table 2 presents the coefficients and significant statistics for all the socio-demographic and health-related behaviours at the first regression model. In the first model, age ($\beta$=-0.26, $p<0.01$),

marital status (β=0.17, p<0.05), number of children (β=-0.14, p<0.05), educational level (β=0.20, p<0.01), and PA at sport index (β=0.30, p<0.01) were significant predictors of the physical functioning subscale ($R^2$ *change*=0.28, p<0.01). Gender (β=-0.13, p<0.05), marital status (β=0.18, p<0.05), and number of children (β=-0.21, p<0.05) significantly predicted the physical role subscale ($R^2$ *change*=0.10, p< 0.01). Gender (β=-0.15, p<0.05), and type of job (β=0.14, p<0.05) were significant predictors of the bodily pain subscale ($R^2$ *change*=0.09, p<0.01). Smoking status (β=-0.12, p<0.05), and PA at sport index (β=0.17, p<0.01) significantly predicted the general health subscale ($R^2$ *change*=0.08, p<0.01). Age (β=-0.22, p<0.01), type of job (β=0.15, p<0.01), marital status (β=0.20, p<0.01), number of children (β=-0.15, p<0.05), and PA at sport index (β=0.18, p<0.01) were significant predictors of the physical health factor ($R^2$ *change* = 0.18, p<0.01). Gender (β=-0.12, p<0.05), marital status (β=0.18, p<0.05), PA at sport index (β=0.12, p<0.04), and PA during leisure-time index (β=0.18, p<0.01) significantly predicted the vitality subscale ($R^2$ *change*=0.13, p<0.01). Gender was a significant predictor of the social functioning (β=-0.16, $R^2$ *change*=0.10, p<0.05), and role emotional subscales (β=-0.18, $R^2$ *change*=0.09, p<0.01). Finally, gender (β=-0.17, p<0.05), and alcohol consumption (β=-0.13, p<0.05) significantly predicted the mental health subscale ($R^2$ *change* = 0.18, p<0.01).

Table 3 presents the coefficients and significant statistics for all the obesity indexes at the second regression model. As shown in Table 3, by adding the second block

TABLE 2

1ST REGRESSION MODEL'S RESULTS OF HIERARCHICAL MULTIPLE REGRESSION PREDICTING HRQOL

| INDEPENDENT VARIABLES | HRQOL (DEPENDENT VARIABLES) | COEFFICIENTS | | |
|---|---|---|---|---|
| | | β | t | p |
| AGE | Physical functioning | -0.26 | -4.32 | 0.00 |
| | Physical health factor | -0.22 | -3.31 | 0.00 |
| GENDER | Physical role | -0.13 | -2.19 | 0.03 |
| | Bodily pain | -0.15 | -2.47 | 0.01 |
| | Vitality | -0.12 | -2.02 | 0.05 |
| | Social functioning | -0.16 | -2.71 | 0.01 |
| | Role emotional | -0.18 | -3.03 | 0.00 |
| | Mental health | -0.17 | -2.85 | 0.01 |
| TYPE OF WORK | Bodily pain | 0.14 | 2.48 | 0.01 |
| | Physical health factor | 0.15 | 2.93 | 0.00 |
| MARITAL STATUS | Physical functioning | 0.17 | 2.77 | 0.01 |
| | Physical role | 0.18 | 2.60 | 0.01 |
| | Physical health factor | 0.20 | 2.95 | 0.00 |
| | Vitality | 0.18 | 2.57 | 0.01 |
| NUMBER OF CHILDREN | Physical functioning | -0.14 | -2.19 | 0.03 |
| | Physical role | -0.21 | -2.81 | 0.01 |
| | Physical health factor | -0.15 | -2.06 | 0.04 |
| EDUCATIONAL LEVEL | Physical functioning | 0.20 | 3.70 | 0.00 |
| SMOKING | General health | -0.12 | -2.06 | 0.04 |
| ALCOHOL | Mental health | -0.13 | -2.31 | 0.02 |
| SPORT PA INDEX | Physical functioning | 0.30 | 5.96 | 0.00 |
| | General health | 0.17 | 2.88 | 0.00 |
| | Physical health factor | 0.18 | 3.59 | 0.00 |
| | Vitality | 0.12 | 2.10 | 0.04 |
| LEISURE PA INDEX | Vitality | 0.18 | 3.18 | 0.00 |

of variables to the equation, BMI (β=-0.36, p<0.01), WHR (β=-0.24, p<0.01), and BF (β=-0.16, p<0.05) were significant negative predictors of the physical functioning subscale ($R^2$ *change*=0.25, p<0.01), after controlling the socio-demographic variables and health-related behaviours. Furthermore, as shown in Table 3, results in model 2 showed that BMI was significant negative predictor of the following HRQoL subscales: (a) physical role (β=-0.24, p<0.03; $R^2$ *change*=0.02, p<0.01), (b) bodily pain (β=-0.23, p<0.03; $R^2$ *change*=0.03, p<0.01), (c) physical health factor (β=-0.26, p<0.01; $R^2$ *change*=0.10, p<0.01), and (d) social functioning (β=-0.21, p<0.05; $R^2$ *change*=0.02, p<0.01).

However, none of the obesity indexes significantly predicted the general health, vitality, physical role, and mental health subscales, as well as the psychological health factor, while controlling the socio-demographic variables and health-related behaviours.

## DISCUSSION

In this paper, the association between obesity and HRQoL in a sample of Greek healthy adults was reported. To our knowledge, this study constituted the first attempt of examining this relationship in Greek population, using the BMI, WHR, and BF indexes to assess obesity levels. Such data, which relate total and abdominal obesity to HRQoL examining the three obesity indexes in healthy adults, have not been reported so far in the literature. In the present study, BMI negatively predicted the physical functioning, physical role and bodily pain subscales as well as the physical health factor. These findings are consistent with the results provided by other studies [7, 8, 10-13]. However, many of the above studies have been restricted to estimating obesity levels from self-reported information on BMI [10, 11, 13]. Also, one interesting finding in the present study is that abdominal and total obesity, as assessed by WHR and BF, was negatively associated with the physical functioning subscale. Such associations have been confirmed only using waist circumference as an obesity index [19, 20]. As far as the psychological health is concerned, it was found that BMI negatively predicted the social functioning subscale. In contrast, associations between obesity and other psychological health subscales were non-significant. In consistency with these results, many studies showed neither the effect nor the association between obesity and psychological health [7, 8, 12-15, 19].

The results also indicated moderate associations among the socio-demographic and health-related variables and the HRQoL subscales and factors. Specifically, the socio-demographic variables were significantly related to physical functioning and other HRQoL subscales. Considering the health-related behaviours, PA at sport index showed moderate associations with the physical functioning, general health and vitality subscales and the physical health factor. Similarly, significant correlations were found between the following variables: (a) PA during leisure-time index and vitality subscale, (b) smoking status and general health subscale, and (c) alcohol consumption and mental health subscale. After controlling the aforementioned associations, the obesity indexes negatively predicted physical functioning and health,

TABLE 3

2ND REGRESSION MODEL'S RESULTS OF HIERARCHICAL MULTIPLE REGRESSION PREDICTING HRQOL

| OBESITY INDEXES (INDEPENDENT VARIABLES) | HRQOL (DEPENDENT VARIABLES) | COEFFICIENTS | | |
|---|---|---|---|---|
| | | *β* | *t* | *p* |
| BMI | Physical functioning | -0.36 | -4.53 | 0.00 |
| | Physical role | -0.24 | -2.22 | 0.03 |
| | Bodily pain | -0.23 | -2.15 | 0.03 |
| | Physical health factor | -0.26 | -2.66 | 0.01 |
| | Social functioning | -0.21 | -1.94 | 0.05 |
| WHR | Physical functioning | -0.24 | -3.00 | 0.00 |
| BF | Physical functioning | -0.16 | -2.01 | 0.05 |

Adjusted for: age, gender, marital status, number of children, educational level, kind of work, income, PA at sport index, PA during leisure-time index, smoking status, and alcohol consumption

confirming the results of previous studies [7, 10, 12, 19, 20]. These studies indicated a strong association between obesity and HRQoL, after adjusting for socio-demographic and health-related variables. In line with this, low to moderate associations were found among socio-demographic variables, health-related behaviours, and HRQoL [7, 10, 12, 19, 20]. Contrary to other studies [7, 8, 10, 12, 15, 19], the present study focused on the relationship between obesity and HRQoL among healthy adults in an attempt to control the consequences of diseases on HRQoL [27]. In this way, it can be claimed that, although all participants were healthy, obesity was negatively associated with physical functioning and health.

However, this study had several limitations. More specifically, due to the cross-sectional nature of the study, it is impossible to draw definitive conclusions about the causal relationship between obesity and HRQoL. Moreover, the sample was relatively small and not representative and thus, the results could not be generalized to the entire Greek population. Despite the above mentioned limitations, this study had some advantages that need to be reported. First, the measurements of the BMI, WHR, and BF indexes are a proof of the accurate and complete obesity assessment giving the opportunity to examine the relationship of total and abdominal adiposity with HRQoL. Second, compared to the self-report method, which most of researchers used for the BMI estimation [10, 11, 13, 15], the method used in the present study for the BMI assessment can resolve the problems of weight underestimation and height overestimation. Third, a key feature of this study is the use of the SF-36 health survey, which is one of the most valid and reliable instruments for the HRQoL assessment [28-30].

In conclusion, the present paper confirmed the negative associations of BMI with physical functioning and health in a sample of Greek healthy adults. Also, the results indicated that abdominal and total obesity, as assessed by WHR and BF, was negatively related to physical functioning. Considering the limitations of the present study, we propose future studies in larger and more representative samples including larger age groups. Particularly, a study in a representative sample of the Greek adult population would be of considerable value for a better and more accurate examination of the association between obesity and HRQoL in this country.

***ETHICAL APPROVAL:*** *the study was approved by the University's ethical committee.*

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