

## Weight status and depressive symptoms in 18 year-old Greek adolescents

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### Abstract

Depressive symptoms in adolescence have been a subject of considerable controversy in terms of their nature, severity and identification. The aim of the study was to investigate the possible association between weight status and depressive symptoms among 18 year-old Greek adolescents. A cross-sectional study design was used. The study population consisted of 200 students of the University of Athens who fulfilled the following criteria: age 18 years, absence of clinical depression, no history of hospitalization in a mental institution, no history of alcohol abuse. Weight status was assessed by Body Mass Index (BMI) ( $\text{kg}/\text{m}^2$ ) and calculated from weight and height measurements. Severity of depressive symptoms was assessed by Centre for Epidemiologic Studies-Depression Scale (CES-D). In univariate analysis, CES-D score was significantly associated with adolescents' gender and BMI. The multivariate analysis showed that CES-D score was negatively related to BMI even after controlling the confounding effect of gender ( $P=0.018$ ,  $B=-0.378$ ). Depressive symptoms are related to weight status of adolescents.

### Introduction

Depressive symptoms in adolescence have been a subject of considerable controversy in terms of their nature, severity and identification.<sup>1,2</sup> Depressive symptomatology mainly consists of feelings of discouragement or hopelessness and disappointment, low self-esteem and body-image.<sup>3,6</sup> A series of epidemiological surveys over the previous decades have pointed out that a significant proportion of the

entire population suffers from depressive moods,<sup>7,9</sup> and that the disorder is more common among individuals aged 18-24 years old.<sup>10-12</sup> Other findings suggested that overt suicidal behavior is more often associated with depressive symptoms in both adolescents and adults.<sup>11,13,14</sup> As a matter of fact, it is generally believed that the study of the relevant symptoms may be helpful in the development of preventive measures, focusing on target population groups exposed to risk of manifesting suicidal behavior.<sup>13,15-18</sup>

Many surveys have attempted to identify determinants and predictors of the presence and severity of depressive symptoms.<sup>5,18,19</sup> Nevertheless, only a few have been performed in Greek populations<sup>2,6</sup> and none of these involved adolescents. Furthermore, besides studying the correlation between depressive mood and various sociodemographic characteristics, there are no studies assessing somatometric parameters.

This study attempts to enrich the relevant literature by investigating the association between weight status and depressive symptoms among Greek adolescents.

### Materials and Methods

#### Subjects

In September 2001, 250 first-year students of the University of Athens were invited to participate in the survey by letter and telephone. Of the 250, 212 accepted the invitation. Verbal informed consent was obtained from all participants. The participants fulfilled the following criteria: a) they were 18 years old; b) they had not been previously diagnosed with clinical depression; c) they had never been hospitalized in a mental institution or psychiatric ward of a general hospital; and d) they were not alcohol abusers.

The participants individually visited the examination center of the Medical School of the University of Athens, where specially trained health professionals measured their somatometric characteristics and asked them to answer the Centre for Epidemiologic Studies-Depression Scale (CES-D). Each was also asked to fill in an individual questionnaire, regarding their sociodemographic, economical and educational characteristics. The study design should be considered as cross-sectional since the information about weight status and depressive symptomatology was obtained at a defined time from a sample of normal subjects.

#### Ethics

The study protocol was reviewed and approved by the Greek Committee for the Protection of Personal Data (07/02/2001) and

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Contributions: VM, KH and CB supervised the research paper; PP collected data and wrote the paper; KM collected data; IZ responsible for statistics.

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The research was carried out at the Medical School of the University of Athens.

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the National Hellenic Research Foundation (NHRF) Institute of Biological Research and Biotechnology (IBRB) (6/11/2000).

#### Measures

The body mass Index (BMI), which was calculated from measurements of weight and height, was used as an indicator of weight status. Somatometric characteristics of all participants were measured using the same instruments. Height was measured twice to the nearest centimetre with a direct reading stadiometer. If the two values differed by more than 1 cm, a third measurement was taken and the closest two of the resultant three were averaged. Adolescents' weight was measured in kilograms by a portable digital scale (TANITA model 1632); participants were dressed without shoes, socks and belts. Weight was measured twice to the closest 0.1 kg. A third measurement occurred if the previous two differed by more than 0.5 kg and the closest two of the three were averaged. Finally, height and weight measurements were converted into BMI, which was calculated as weight in kilograms divided by the square of height in meters ( $\text{kg}/\text{m}^2$ ).<sup>20</sup>

#### Instrument

The Centre for Epidemiological Studies Depression Scale (CES-D) was used for the assessment of possible depressive symptoms.

The CES-D is a well-validated and widely used instrument that assesses the presence and severity of depressive symptoms over the week previous to the measurement. It is a self-report scale composed of 20 items following a four-point Likert scale (response range 0-3, total score range 0-60). The 20 items of the scale cover affective, psychological and somatic symptoms. The subject specifies the frequency with which each symptom is experienced (i.e. a little, some, a good part of the time, most of the time). Although it is considered that higher scores of self-rating scales like the CES-D reflect more severe depressive mood, depressive symptoms screened by these scales do not constitute a specific nosological entity within the depressive spectrum of disorders.<sup>21</sup> The assessment of the reliability, validity and psychometric properties of the Greek translation of this scale showed that it is suitable for research use. Chronbach's alpha for the total scale was equal to 0.95 and the test-retest reliability was satisfactory, with Pearson's correlation coefficient for the total CES-D score (CES-Ds) equal to 0.71.<sup>22</sup>

### Statistical analysis

Statistical calculations were performed using the SPSS for Windows (version 10.0.1) statistical software (SPSS Inc., Chicago, IL, USA). First, an analysis was performed to test gender differences. Specifically, a  $\chi^2$  test was used for percentages, followed by a Fischer's exact test if more than 20% of expected values were less than five, or if one or more expected values were less than one. The Mann-Whitney test was used for gender differences in variables not showing a normal distribution.

Second, a two-step procedure was performed to investigate if depressive symptoms were related to certain sociodemographic and somatometric characteristics. Primarily, a univariate analysis was executed using the CES-D scores as the dependent variable and i) "gender"; ii) "having siblings"; iii) "financial problems"; iv) "parents' marital status"; v) "adolescent's BMI"; and vi) "school degree" as the independent variables. Non-parametric statistical procedures were used because CES-Ds did not show a normal distribution. A Mann-Whitney test was used to investigate whether the CES-Ds were related to variables *a*, *b*, *c*, whereas a Kruskal-Wallis test was used for variable *d* and a Spearman's correlation test for variables *e* and *f*.

Characteristics that had been found to be significantly associated with CES-Ds in the first analyses were entered as independent variables in a multivariate linear regression model. A linear regression analysis was used, although CES-Ds did not follow a normal distribution, in order to counteract for the confounding effect of one independent variable (e.g. gender) on the relation between another inde-

pendent variable (e.g. BMI) and the dependent variable (e.g. CES-D score). The results were expressed as medians and interquartile ranges (IR) which better describe a non-normal distribution, but also as means and standard deviations (SD), in order to facilitate comparisons with other studies. The magnitude of the correlation between numeric values was presented using Spearman's correlation coefficient (*r*). The results of multivariate analysis were expressed by the coefficient of determination of regression model ( $R^2$ ), the constant of regression line (*A*), the coefficients of slope of regression line (*B*) and the confidence intervals (CI) of *A* and *B*. The Kolmogorov-Smirnov test was used to investigate if variables followed a normal distribution. A significance level of 0.05 was chosen for all tests.

## Results

Of the 212 adolescents who met the eligibility criteria, data were not retrieved from 12. Data of the remaining 72 male (36%) and 128 female (64%) adolescents are presented in

Table 1 according to their sociodemographic and somatometric characteristics. Most of them lived with both their parents, had siblings, achieved very high school degrees and had no financial problems. Statistically significant differences between sexes were found only for the somatometric characteristics, as expected. Boys had higher mean values for weight, height and BMI than girls. Nevertheless, there was no significant difference in proportions of underweight, overweight and obese individuals between males and females. Underweight was defined as BMI less than 18.5 kg/m<sup>2</sup>, overweight as BMI between 25.0 and 29.9 kg/m<sup>2</sup>, and obesity as BMI of 30.0 kg/m<sup>2</sup> or over.<sup>23</sup>

Table 2 presents the results from the univariate analysis. It shows that the CES-Ds were associated with gender ( $P=0.049$ ) and BMI ( $P=0.002$ ). Specifically, females and adolescents with lower BMI had higher CES-Ds. The multivariate analysis showed that CES-Ds were related to BMI ( $P=0.018$ ) even after controlling for the confounding effect of gender (Table 3). Coefficient *B* shows that the relation was negative and that if a subject's BMI was increased by 1 kg/m<sup>2</sup> then the CES-D would be

**Table 1. Sociodemographic and separate somatometric characteristics of Greek adolescents according to gender.**

|                                 | Male        | Female       | P                   |
|---------------------------------|-------------|--------------|---------------------|
| N. adolescents                  | 72          | 128          |                     |
| Parents' marital status % (n/N) |             |              | 0.592 <sup>a</sup>  |
| Married                         | 90 (47/52)  | 93 (78/84)   |                     |
| Divorced                        | 6 (3/52)    | 6 (5/84)     |                     |
| Widowed                         | 4 (2/52)    | 1 (1/84)     |                     |
| Siblings % (n/N)                |             |              | 0.264 <sup>b</sup>  |
| Yes                             | 96 (9/72)   | 91 (116/128) |                     |
| No                              | 4 (3/72)    | 9 (12/128)   |                     |
| Financial problems % (n/N)      |             |              | 0.333 <sup>b</sup>  |
| Yes                             | 25 (18/71)  | 33 (42/127)  |                     |
| No                              | 75 (53/71)  | 67 (85/127)  |                     |
| School degree <sup>d</sup>      |             |              | 0.875 <sup>c</sup>  |
| Median (IR)                     | 18.1 (3.1)  | 18.2 (2.5)   |                     |
| Mean (SD)                       | 17.6 (2.1)  | 17.6 (2.0)   |                     |
| Weight (kg)                     |             |              | <0.001 <sup>c</sup> |
| Median (IR)                     | 72.0 (9.0)  | 57.0 (13.0)  |                     |
| Mean (SD)                       | 71.8 (9.2)  | 59.0 (9.4)   |                     |
| Height (cm)                     |             |              | <0.001 <sup>c</sup> |
| Median (IR)                     | 176.0 (9.5) | 167.0 (8.0)  |                     |
| Mean (SD)                       | 177.6 (6.7) | 166.4 (6.2)  |                     |
| BMI (kg/m <sup>2</sup> )        |             |              | <0.001 <sup>c</sup> |
| Median (IR)                     | 22.8 (3.5)  | 20.9 (3.6)   |                     |
| Mean (SD)                       | 22.8 (2.6)  | 21.4 (2.9)   |                     |
| BMI category % (n/N)            |             |              | 0.129 <sup>a</sup>  |
| <18.5 kg/m <sup>2</sup>         | 3 (2/68)    | 11 (13/115)  |                     |
| 18.5-24.9 kg/m <sup>2</sup>     | 78 (53/68)  | 76 (87/115)  |                     |
| 25-29.9 kg/m <sup>2</sup>       | 19 (13/68)  | 12 (14/115)  |                     |
| >30 kg/m <sup>2</sup>           | 0 (0/68)    | 1 (1/115)    |                     |

CES-D, Centre for Epidemiologic Studies Depression Scale; n, number of positive cases; N, number of answers; IR, interquartiles range; SD, standard deviation. <sup>a</sup> $\chi^2$  test; <sup>b</sup>Fisher's Exact test; <sup>c</sup>Mann-Whitney test; <sup>d</sup>High-school grades at final report before graduation. Excellent: grades between 18.5 and 20; very good: between 16.5 and 18.49; good: between 10 and 16.49; fail: <10. BMI, body mass index.

decreased by 0.38 units. Coefficient  $R^2$  implies that the association between BMI and CES-Ds could explain only 3.7% of the differences in the adolescents' CES-Ds. This means that BMI is not the only determinant of depressive symptoms.

## Discussion

The aim of this study was to investigate the association between weight status and depressive symptoms among Greek adolescents, counteracting the confounding effect of characteristics that are well known to relate to a depressive mood such as age, gender, clinical depression, hospitalization in mental units, alcohol abuse and economic status.<sup>16,24</sup> Concerning clinical depression, some surveys have found a positive relation between this disorder and weight status.<sup>5,18,25,26</sup> Depressed adolescents were excluded from the study population in order to avoid a confounding effect of clinical depression on the relation between depressive symptoms and weight status. For the same reasons, individuals who had been hospitalized for psychological reasons and alcohol abusers were also excluded. Age effects were controlled by selecting only 18 year-old individuals, whereas gender and economical status were counteracted by statistical analysis.

According to the present results, the severity of depressive symptoms as assessed by the CES-Ds was significantly associated with both gender and BMI only in univariate analysis. The multivariate linear regression analysis showed that only BMI significantly correlated with CES-Ds. However, the relation was not strong, as coefficient B was 0.38. This implies that if CES-Ds is to be decreased by 5 points, then the BMI should be increased by 13 kg/m<sup>2</sup>.

Data from the literature about the correlation between weight status and depression are contradictory.<sup>27</sup> Some of the surveys found an increased risk for depressive symptoms among the obese and the overweight<sup>4,6,15,28</sup> while others indicated a decreased risk ("jolly fat" hypothesis)<sup>29,30</sup> and others have shown no effect of weight status on depressive mood.<sup>31-33</sup> The "jolly fat" hypothesis is also supported by the findings of two community studies which indicate that subgroups within the obese or overweight population, such as individuals asking for clinical weight-loss treatment, show a higher frequency of depressive symptoms.<sup>31,34-36</sup> These discrepancies may be due to differences in the type of the study, the assessment of depressive symptoms or the use of self-report versus direct measures of height and weight. On the other hand, findings from several studies show that characteristics such as parental age over 35 years, divorced or widowed parents, female sex, living in urban areas, lower

**Table 2. Univariate analysis for Centre for Epidemiologic Studies-Depression Scale with sociodemographic and separate anthropometric characteristics as independent variables.**

| Independent variable      | N   | Median (IR) | Mean (SD)  | Rs     | P                  |
|---------------------------|-----|-------------|------------|--------|--------------------|
| Gender                    |     |             |            |        | 0.049 <sup>a</sup> |
| Male                      | 72  | 16.0 (6.0)  | 16.9 (5.6) |        |                    |
| Female                    | 128 | 17.5 (7.8)  | 18.7 (6.2) |        |                    |
| BMI (kg/m <sup>2</sup> )  | 184 |             |            | -0.231 | 0.002 <sup>b</sup> |
| Parents' marital status   |     |             |            |        | 0.529 <sup>c</sup> |
| Married                   | 126 | 17.0 (5.0)  | 17.9 (5.7) |        |                    |
| Divorced                  | 8   | 19.5 (5.3)  | 18.1 (4.9) |        |                    |
| Widowed                   | 3   | 15.0 (0.0)  | 17.0 (5.3) |        |                    |
| Having siblings           |     |             |            |        | 0.589 <sup>a</sup> |
| Yes                       | 186 | 16.0 (7.5)  | 17.2 (5.3) |        |                    |
| No                        | 17  | 17.0 (6.0)  | 17.1 (6.0) |        |                    |
| Financial problems        |     |             |            |        | 0.711 <sup>a</sup> |
| Yes                       | 139 | 17.0 (5.8)  | 18.4 (6.6) |        |                    |
| No                        | 60  | 17.0 (7.0)  | 17.9 (5.8) |        |                    |
| School grade <sup>d</sup> | 195 |             |            | -0.025 | 0.729 <sup>b</sup> |

CES-Ds, Centre for Epidemiologic Studies-Depression Scale score; n, cases included in analysis; IR, interquartiles range; SD: standard deviation; Rs, Spearman's correlation coefficient. <sup>a</sup>Mann-Whitney test; <sup>b</sup>Spearman's correlation test; <sup>c</sup>Fisher's Exact test; <sup>d</sup>High-school grades at final report before graduation; <sup>e</sup>Kruskal Wallis test; Excellent: grades between 18.5 and 20; very good: between 16.5 and 18.49; good: between 10 and 16.49; fail: <10. BMI, body mass index.

socioeconomic status and alcohol abuse are positively correlated with CES-Ds.<sup>24,37</sup> In the present study, none of the sociodemographic variables was identified as a determinant of severity of depressive symptoms, probably due to the small sample size.

As mentioned above, the study sample was carefully selected in order to counteract certain confounders. However, this careful selection had at least one disadvantage: the size of the sample was neither large nor random. Therefore, unknown confounders and certain biases could have been present, whereas the findings could not be generalized to other age groups or settings. On the other hand, the research was based on actual height and weight measurements for the calculation of BMI and not on the height and weight reported by the subjects. It has been shown that overweight or obese participants in self-reported studies tend to underestimate their weight and all participants tend to overestimate their height; true rates of obesity and overweight are likely underestimated in these studies.<sup>27,38,39</sup> Another advantage was the high response rate in the questionnaire items (84.8%).

The hypothesis that weight status and depressive symptoms do not correlate is supported by the results of this study conducted on a sample of Greek adolescents. Further research is required to investigate whether this relation is observed in different settings and age groups. If this hypothesis stands, people with low BMI, as well as people on weight-loss treatment, need psychological support to prevent symptoms of depression, since depressive symptoms are often associated with suicidal behavior.<sup>18,24,31,40</sup>

**Table 3. Multivariate linear regression for Centre for Epidemiologic Studies-Depression Scale with gender and body mass index as independent variables.**

|                               |                      | P      |
|-------------------------------|----------------------|--------|
| N. cases                      | 182                  |        |
| Adjusted R <sup>2</sup>       | 0.037                |        |
| A(CI)                         | 26.82 (23.40, 30.24) | <0.001 |
| B of BMI (CI)                 | -0.38 (-0.44, -0.22) | 0.018  |
| B of gender <sup>a</sup> (CI) | -1.10 (-2.04, -0.16) | 0.241  |

R<sup>2</sup>, coefficient of determination of regression model; A, constant of regression line; CI, confidence interval; B, coefficient of slope of regression line. <sup>a</sup>Reference category was "female gender".

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