Body mass index and psychological distress among Lebanese University students: examining the moderating effect of gender

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Introduction

Psychological distress (PD) is widely defined as ‘a state of emotional suffering’ (Ridner, 2004) characterised by a mixture of symptoms that include depression (e.g. lost interest; sadness; hopelessness), general anxiety (e.g. restlessness; feeling tense) (Mirowsky & Ross, 2002), personality traits, functional disabilities and behavioural problems (e.g. increased substance abuse, sleep disruption, poor work perform) (Drapeau, Marchand, & Beaulieu-Prévost, 2012) These subjective states can reduce the emotional resilience of individuals and impact their social functioning (Wheaton, 2007) and ability to cope with a particular set of circumstances (Sellick & Edwardson, 2007). PD is increasingly becoming a significant global concern, especially in younger populations (Sandanger, Nygard, Ingebrigtsen, Sorensen, & Dalgard, 1999). In fact, in western societies, PD has been found to be more prevalent and severe among university students compared to the general population (Adlaf, Gliksman, Demers, & Newton-Taylor, 2001).

Studies evaluating the association between PD with body mass index (BMI) have shown contradictory results. Whilst no such association existed in some studies (Arbour-Nicitopoulos, Faulkner, & Irving, 2015)
(Ainsworth et al., 2000). The resulting MET-min products were summed to

Methods

Design and data collection process

A cross-sectional study was conducted among university students aged 17–35 using a proportionate cluster sampling between October 2010 and July 2011. Since the study is observational and respects participants’ anonymity and confidentiality, the Internal Review Board (IRB) of the Lebanese university waived the need for an official approval. Students were informed through a written and oral consent form that their participation was voluntary and they had the right to refuse to participate. Pregnant female students were not included in the study sample. Out of 4900 distributed questionnaires, 3384 (69.1%) were returned to the field worker. Students with missing information about BDS-22, weight or height were excluded from the analysis (566 of 3384 eligible students). A total sample of 2818 students was used. Additional study details have been previously described (Salameh et al., 2012).

Questionnaire

The questionnaire used for data collection was composed of several parts:

- Socio-demographic characteristics include: age, gender, place of residence (Beirut, Mount Lebanon, North, South and Bekaa), type of University (private or public university), marital status (single, married, divorced or widowed), and income-per-family-member (IPFM). IPFM, a measure defined as the household monthly income of a family divided by number of its members. Subsequently, the IPFM was classified into four categories (low, medium low, medium high and highest income).
- Information about health behaviours includes questions about cigarette or waterpipe smoking. Physical activity was assessed by a range of daily activities and habitual leisure time sports or recreational activities. An overall energy expenditure, expressed in Metabolic Equivalent Total (MET) units, was computed by calculating activity × frequency of the activity × MET intensity for each recorded activity (Ainsworth et al., 2000). The resulting MET-min products were summed to
produce an index of daily physical activity, expressing the amount of energy per kg body weight expended during the week (Kimm et al., 2000). The quantitative variables for physical activity (MET) were subsequently divided into tertiles (low, moderate and high).

- Questions about health indicators: Students were asked to rate their health (‘How would you describe your current health status’) on a 10-point scale. Students were also questioned about the presence or absence of chronic diseases.

- PD measurement: PD was assessed using the Beirut Distress Scale (BDS-22) (Barbour, Saadeh, & Salameh, 2012). Respondents were asked to rate how often, in the past few weeks, they experienced several PD symptoms. Items are answerable on a Likert scale from ‘0’ to ‘3’ indicating the experience of the symptoms (0 – never, 1 – sometimes, 2 – often, and 3 – always). The BDS-22, a measure created by adding all the items of the score, ranged from 0 to 66 with higher scores indicating greater risk of PD. Provided that the lifetime prevalence of any DSM-IV (Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition) disorder was 25.8% of the adult population (Karam et al., 2008), the BDS-22 was dichotomized at the 75th percentile, with a score of 25 or more being indicative for high risk of PD.

- Anthropometric measures: The weight and height measures of the total students were self-reported. For a randomly selected subsample of 507 students, the weight and height were measured by interviewers using a calibrated balance and a stadiometer (without shoes). These subsample anthropometric measurements were used to validate and correct the self-reported height and weight of the total sample. Accordingly, BMI, calculated as weight in kilograms divided by height in metres squared, was used as categorical variable. Consistent with the definitions set forth by the WHO, students were grouped into four categories: ‘underweight’ (BMI <18.5 kg/m²), ‘normal weight’ (BMI 18.5–24.9 kg/m²) as a reference group, ‘overweight’ (BMI 25.0–29.9 kg/m²) and ‘obese’ (BMI ≥30 kg/m²) (‘Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults–The Evidence Report. National Institutes of Health,’ 1998; Obesity: preventing and managing the global epidemic. Report of a WHO consultation).

**Statistical analyses**

The data entry and analyses were performed using the statistical software SPSS version 20.0. All analyses were conducted on a weighted sample using the distribution of students in private and public Lebanese universities, provided by the Centre for Educational Research & Development. To generate the corrected weight and height measures for the total sample, four simple regression equations were obtained for females and males, separately, using both the measured and self-reported weight and height of the subsample (n = 507 students). The corrected weight and height were then used in the analyses. Means with their standard deviation and percentages were used to describe continuous and categorical variables, respectively. Statistical bivariate analysis was performed. The student T-test was used for the continuous variables to compare their means. The Pearson chi-square ($\chi^2$) test was used for categorical variables. A p-value < .05 was considered statistically significant. A multivariate analysis using logistic regression was carried out with the higher risk for PD as the dependent variable. Adjusted odds ratios and their 95% confidence intervals were reported. The final logistic regression model was reached after ensuring the adequacy of our data using the Hosmer and Lemeshow test. The generated final model was tested for the effect modification by gender as it is believed that women and men may express PD differently (Jorm et al., 2005) and have different BMI levels (Flegal, 2006).

**Results**

**Characteristics of the study sample**

Table 1 describes the baseline characteristics of the entire study sample by gender. The total number of students was 2818 of which 61.2% were females. Their overall mean age (SD) was 20.66 (1.89).
The categories of BMI varied widely across the entire sample with 8% were underweight, 71% were normal weight, 17.3% were overweight and 3.7% were obese. The proportion of overweight or obese was higher in males than females (overweight: 29.9 and 9.3; obese: 6.4 and 1.9). The overall mean BDS-22 score (SD) was 16.93 (13.06). The mean BDS-22 score was significantly higher among female students (18.30) than males (15.20) with \( p < .001 \).

**Association between BDS-22 score and selected characteristics of the study sample**

The results of the bivariate analysis of the BDS-22 score with selected characteristics of the Lebanese university students are presented in Table 2. Females had significantly higher risk of PD than males (OR: 1.38; 95% CI: 1.15–1.65; \( p \)-value < .001). Students who are current cigarette smokers were 1.5 times more at risk of PD than their non-smoker counterparts. There was no significant association between...
the BDS-22 score and waterpipe smoking. This score was significantly associated with the place of residence, the presence of chronic diseases and self-rated global health with \( p \)-value < .05.

**Association between BDS-22 score and BMI for all students and stratified by gender**

Overall, being overweight was found to be a protective factor against high risk of PD when compared to normal weight (reference category) (OR: .7; 95% CI: .5–.9) (Table 3). Upon stratifying the entire sample of the Lebanese university students by gender, no association was found between these two categorical variables. In Table 4, the BDS-22 score was significantly inversely associated with overweight category when compared to the normal weight after controlling for the socio-demographic characteristics (age, place of residence, and income-per-family member), health indicators (presence of chronic disease and self-rated global health), gender and cigarette smoking status in the total sample (OR .7, 95% CI: .5–.9, \( p \)-value .02). The association between the BDS-22 score and BMI differed by gender (\( p \)-value for interaction: .02). In fact, the inverse association between BDS-22 score and being overweight was significantly pronounced for females, but not for males (OR: .5, 95% CI: .4–.8, \( p \)-value .02).

### Table 2. Bivariate analysis of BDS-22 score among Lebanese university students.

| Characteristics                      | Low to medium BDS22 | High BDS22 | OR (95% CI) | \( p \)-value |
|--------------------------------------|---------------------|------------|-------------|--------------|
| Gender                               |                     |            |             | <.001*       |
| Male                                 | 859 (40.6)          | 234 (33.2) | 1.00        |              |
| Female                               | 1255 (59.4)         | 470 (66.8) | 1.38 (1.15–1.65) |              |
| Age category (in years)              |                     |            |             | .13          |
| 17–19                                | 588 (27.9)          | 189 (26.9) | 1.00        |              |
| 20–21                                | 901 (42.7)          | 329 (46.8) | 1.14 (0.92–1.39) |              |
| 22 and above                         | 620 (29.4)          | 185 (26.3) | 0.93 (0.73–1.17) |              |
| Marital status                       |                     |            |             | .52          |
| Single                               | 2034 (96.4)         | 674 (95.9) | 1.00        |              |
| Other                                | 76 (3.6)            | 29 (4.1)  | 1.16 (0.75–1.79) |              |
| Place of residence                   |                     |            |             | .02*         |
| Beirut                               | 283 (13.5)          | 92 (13.1)  | 1.00        |              |
| Mount Lebanon                        | 1019 (48.6)         | 322 (45.8) | 0.97 (.74–1.27) |              |
| North Lebanon                        | 327 (15.6)          | 140 (19.9) | 1.32 (.97–1.79) |              |
| South Lebanon                        | 323 (15.4)          | 88 (12.5)  | 0.84 (.60–1.17) |              |
| Bekaa                                | 146 (7.0)           | 61 (8.7)  | 1.28 (.88–1.88) |              |
| Income-per-family-member (IPFM)      |                     |            |             | .09          |
| Low                                  | 530 (26.7)          | 181 (27.0) | 1.00        |              |
| Medium low                           | 573 (28.9)          | 219 (32.7) | 1.12 (.89–1.41) |              |
| Medium high                          | 349 (17.6)          | 120 (17.9) | 1.01 (.77–1.32) |              |
| Highest                              | 532 (26.8)          | 150 (22.4) | .83 (.65–1.06) |              |
| Type of university                   |                     |            |             | .57          |
| Public                               | 1150 (54.4)         | 391 (55.6) | 1.00        |              |
| Private                              | 1193 (55.6)         | 312 (44.4) | 1.16 (.75–1.79) |              |
| Cigarette smoking                    |                     |            |             | <.001*       |
| Non smoker                           | 1752 (83.0)         | 537 (76.3) | 1.00        |              |
| Current smoker                       | 359 (17.0)          | 167 (23.7) | 1.51 (1.23–1.86) |              |
| Waterpipe smoking                    |                     |            |             | .29          |
| Non Smoker                           | 1641 (77.7)         | 533 (75.8) | 1.00        |              |
| Current smoker                       | 470 (22.3)          | 170 (24.2) | 1.11 (.91–1.36) |              |
| Physical activity                    |                     |            |             | .15          |
| Low                                  | 707 (35.5)          | 252 (38.7) | 1.00        |              |
| Moderate                             | 598 (30.1)          | 201 (30.9) | 0.94 (.76–1.17) |              |
| High                                 | 684 (34.4)          | 198 (30.4) | 0.81 (.65–1.01) |              |
| Presence of chronic diseases         |                     |            |             | .01*         |
| No                                   | 1992 (94.6)         | 643 (92.1) | 1.00        |              |
| Yes                                  | 113 (5.4)           | 55 (7.9)  | 1.50 (1.07–2.10) |              |
| Self-rated global health (mean ± SD) |                     |            |             | .001*        |
| 7.9 (1.4)                            | 7.4 (1.6)           | .77 (.72–.82) |              |

\*\( p \)-value < .05 statistically significant.
Discussion

This is, to our knowledge, the first epidemiological cross-sectional study conducted on a large sample of Lebanese young adults to evaluate the association between BMI and PD and to examine the potential moderator effect of gender on this association. The study results showed gender to have a significant modification effect on the association between PD and BMI categories.

Indeed, a number of published studies have highlighted the role of gender in moderating the association between BMI and PD (Barry et al., 2008; Brandheim et al., 2013; Sachs-Ericsson et al., 2007; Schieman et al., 2007). The observed gender difference in our study results might be due to the fact that males and females, under the influence of socio-cultural norms and pressures, tend to perceive the standards for beauty and physical appearance differently. These comparison standards are emphasized by strength and muscularity for males (Raevuori et al., 2006) and thinness body image for females (Saraceni & Russell-Mayhew, 2007). The results of our study showed no evidence of association between PD and any of the BMI categories among male students when stratifying our sample of students by gender. These findings come in accordance with those from other studies (Atlantis & Ball, 2008; Istvan, Zavela, & Weidner, 1992). In fact, previously published literature have indicated that muscle dissatisfaction among males is associated with PD (Raevuori et al., 2006) and that abdominal adiposity for adult men,
rather than BMI, is associated with symptoms of depression and anxiety disorders (Ahlberg et al., 2002). Unlike males, female students who are overweight in our study were less likely to have high PD symptoms than their normal weight participants. These results are consistent with the Australian study on a large adult population of 30,214 persons which reported significantly lower PD in overweight female participants compared to normal weight counterparts (Goldney, Dunn, Air, Dal Grande, & Taylor, 2009). A possible explanation is that, so as to relieve their stress, females, who reach overweight stages, tend to consume high-caloric or palatable foods (Nogueiras et al., 2012) and they eventually give up their struggle to get rid of their excess weight.

In fact, a biological mechanism relating psychological stress with elevated body weight has been frequently addressed in published literature. Following the exposure of individuals to stress, the activation of hypothalamic-pituitary-adrenal axis (Drolet et al., 2001) and the production of stress hormone cortisol (Epel, Lapidus, McEwen, & Brownell, 2001) and endogenous opioids (Drolet et al., 2001) can motivate those individuals to increase their food intake, particularly high-fat, calorie-dense foods (Nogueiras et al., 2012), as a means to manage their stress and make them feel better, which contributes to body fat accumulation.

Our study also shows that obesity in young Lebanese university students was not associated with having PD symptoms. In fact, it is well known that mental health risks increase considerably among the obese (Marcus & Wildes, 2009), particularly the severe cases (class III) (Onyike, Crum, Lee, Lyketsos, & Eaton, 2003). Knowing that, the inadequate number of severe cases of obesity (class I: 91 students ~ 2.7%; class II: 15 students ~ .4%; class III: 9 students ~ .3% ‘results not shown’) of the 103 obese students (~3.7%) in our sample, might partly explain the lack of the association between obesity and PD in this study.

The major strengths of our study are, in addition to the consistency of our findings with other studies, the use of a relatively large sample and a well-validated and reliable instrument to screen for PD among Lebanese young adults. Our study has, however, several limitations. Despite that a weighting procedure has been performed on our sample of university students, the representativeness of the total population of Lebanese university students might be affected. This is probably due to a selection bias as the participants in our study were not randomly selected. Since our results are based on a population of Lebanese university students, it is merely impractical to extrapolate these findings to other young Lebanese adults with different demographic characteristics. Moreover, the reliance on self-reported information may subject the study to response bias which could eventually underestimate the associations our study has shown. Another major limitation of this study is that the BDS-22 questionnaire provides information about PD only within the past few weeks and may fail to detect others beyond this period. Thus, long-term diagnosis of PD symptoms would help researchers to better understand the variation of these symptoms with body weight. Also, there is a greater need to consider in similar studies a broader range of body fat measures and indicators other than BMI such as waist-hip ratio, waist circumference and muscularity when studying the association with PD symptoms. Finally, because of the cross-sectional nature of the study, it is not possible to ascertain the reverse causality or temporal relationship concerning the pathways of association between PD and various BMI categories which is likely to be bidirectional.

In conclusion, our findings highlight the importance of gender in the interpretation of the relationship between BMI and PD. Being overweight is a protective factor against having PD symptoms among female. The inverse relationship as revealed in our study raises several questions about the protective effect of psychiatric conditions on young adults. Further studies need to take other PD-related factors such as weight perception, body image and self-esteem into account when evaluating the association between body weight and PD among young adults.

**Disclosure statement**

No potential conflict of interest was reported by the authors.

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Notes of contributions

Linda Abou Abbas is a PhD candidate in Public Health at the Free University of Brussels. She is currently working as an epidemiologist at the Ministry of Public health, epidemiological surveillance unit. She is also a participant member of the Clinical and Epidemiological research team of the Lebanese University, Doctoral School of Sciences & technologies. She is interested in public health and epidemiological research in the fields of obesity and psychological distress in Lebanon. Pascale Salameh PharmD, MPH, PhD is a Doctor of Pharmacy, with a Master in Public Health, a Diploma in Biostatistics and a PhD in Epidemiology. The author is a full professor at the Lebanese American University and an associate dean at the School of Pharmacy. The author is an expert in research direction (Ability to Direct Research), and has long-teaching experience in academic institutions, published 127 international peer-reviewed papers and hundreds of communications in medical epidemiology, clinical pharmacy and public health. Wissam Nasser is an epidemiologist at the Ministry of Public health, epidemiological surveillance unit. He is currently working in the National Cancer Registry Program. He is interested in Public health and Epidemiological research. Zeina Nasser is a PhD candidate in Public Health at the Free University of Brussels. She is currently working as an epidemiologist at the Ministry of Public health, Epidemiological surveillance unit. She is also a participant member of the Clinical and Epidemiological research team of the Lebanese University, Doctoral School of Sciences & technologies. She is interested in public health and epidemiological research, in the fields of pollution and cardiovascular diseases in Lebanon. Isabelle Godin has a PhD in Public health. She is a professor at the Free University of Brussels, school of Public Health. She is also a director of the Research Center "Social approaches to Health" and director of the SIPEs service (Service of Information, Health Promotion and Education) of the Free University of Brussels. Her research interests include: socio-economic and psycho-social determinants of health, stress, health and well-being at work, in a gender and social perspective, health Information System, social inequalities in health, international comparisons of health indicators, methods and methodology in public health and social sciences research, social representations of health, health representations, health indicators in mother and child health, children and adolescents.

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