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## The relation between anxiety and BMI – is it all in our curves?



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## ABSTRACT

The relation between anxiety and excessive weight is unclear. The aims of the present study were three-fold: First, we examined the association between anxiety and Body Mass Index (BMI). Second, we examined this association separately for female and male participants. Next, we examined both linear and non-linear associations between anxiety and BMI. The BMI was assessed of 92 patients (mean age:  $M=27.52$ ; 57% females) suffering from anxiety disorders. Patients completed the Beck Anxiety Inventory. Both linear and non-linear correlations were computed for the sample as a whole and separately by gender. No gender differences were observed in anxiety scores or BMI. No linear correlation between anxiety scores and BMI was observed. In contrast, a non-linear correlation showed an inverted U-shaped association, with lower anxiety scores both for lower and very high BMI indices, and higher anxiety scores for medium to high BMI indices. Separate computations revealed no differences between males and females. The pattern of results suggests that the association between BMI and anxiety is complex and more accurately captured with non-linear correlations.

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## 1. Introduction

Both obesity and anxiety disorders are prevalent health problems in Western and non-Western countries (Garipey et al., 2010; Ng et al., 2014). Kuczmarski et al. (2000) and Ogden et al. (2014) estimated that about 34% of children and adolescents between six and 19 years are overweight or obese. For adults, Parikh et al. (2007) and the World Health Organization (2015) reported that 34% of adults worldwide are overweight, and 13% are obese, leading to serious health concerns both for individuals and for public authorities.

Whereas obesity or being overweight was once considered an imbalance between energy intake and energy expenditure/inactive lifestyle, in recent years this condition has come to be understood as reflecting a bidirectional interaction, with more complex psychophysiological processes involved. More specifically, a growing body of research shows associations between excess weight in adulthood and adverse events in childhood (Vámosi et al., 2010), between childhood obesity and psychiatric

disorders such as depression (Burke and Storch, 2015), and between adult obesity and psychiatric disorders (Lopresti and Drummond, 2013). Specifically, Lopresti and Drummond (2013) reviewed the possible associations between obesity and psychiatric disorders as both result and cause of dysregulated biological pathways, such as a dysregulated hypothalamic–pituitary–adrenocortical (HPA) axis, dysregulated inflammatory pathways, and increased oxidative stress. As regards psychiatric disorders, anxiety disorders have attracted increasing attention, alongside depression and eating disorders (cf. Garipey et al., 2010).

Anxiety disorder is an umbrella term to describe a group of psychiatric disorders characterized by an exaggerated psychophysiological reaction to internal or external stimuli which are subjectively considered as threatening. Psychological reactions can include excessive worry, fear and apprehension; physiological reactions may include sweating, heart palpitations, tension, increased respiration, and a sensation of cold or shivering. The DSM 5 (American Psychiatric Association, 2013) distinguishes between general anxiety disorder, specific phobias, agoraphobia, panic attacks, and separation anxiety disorder, whereas obsessive–compulsive disorders and post-traumatic stress disorders (PTSD) have been newly classified as separate disorders, as compared to the DSM IV (American Psychiatric Association, 2000).

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Anxiety disorders are the most common psychiatric disorders (Kessler and Wang 2008; Kessler et al., 2010). Onset is typically in childhood or adolescence (Kessler et al., 2010) and they are highly comorbid with mood disorders. Further, given that child and adolescent overweight/obesity occupies the same period in the life course, it is possible that child and adolescent anxiety disorders and excessive weight gain are causally linked (Burke and Storch, 2015). Further, results from meta-analyses and systematic reviews point to a positive association between anxiety disorders and obesity or being overweight (Burke and Storch, 2015; Garipey et al., 2010; Vámosi et al., 2010), though Garipey et al. (2010) note that no clear-cut pattern of results has been observed. In this context, gender seems to be an important factor as some studies reported positive associations between obesity or being overweight and anxiety among adult females but not among males (McLaren et al., 2008; Zhao et al., 2009), while the opposite was observed in a longitudinal study (Bjerkset et al., 2008) in which higher anxiety scores were found to be associated with obesity or excess weight/overweight among males but not females. Puhl and Heuer (2009) argued that obesity, or being overweight, is closely linked to social discrimination and that this is particularly true for women. Accordingly, these authors attribute the higher anxiety scores of women to the greater social discrimination they experience.

In conclusion, from these studies we learn that there may be a positive association between anxiety and obesity or excess weight, that this positive association might be more pronounced among adult females, that all studies have so far been carried out in Western countries and, most importantly, that weight has been treated as the predictor and anxiety the outcome variable. Taking these observations into account, in the present study we assessed a sample in Iran, a non-Western country, and used anxiety as predictor and weight (assessed via BMI) as outcome variable.

The following hypotheses were formulated. First, following Garipey et al. (2010) and Burke and Storch (2015), we anticipated a positive association between anxiety and weight. Second, following Zhao et al. (2009), McLaren et al. (2008), and Puhl and Heuer (2009), we expected a more robust association between anxiety and BMI scores among females than among males. Further, inspections of scatterplots suggested non-linear associations between anxiety scores and BMI. Accordingly, we investigated, if compared to linear correlations, non-linear correlations would more accurately reflect the association between anxiety scores and BMI. To do so, a series of non-linear correlations was performed.

## 2. Method

### 2.1. Procedure

Outpatients at the Farshchian Hospital for Psychiatry in Hamadan (Iran) and reporting symptoms of anxiety were consecutively enrolled in the study during spring and summer 2014. Patients were fully informed about the aims of the study and gave their written informed consent. Thereafter, a thorough psychiatric interview was conducted to diagnose anxiety disorder according to the DSM 5, and patients completed the Beck Anxiety Inventory (see below). BMI was objectively assessed. The Institutional Review Board of the Hamadan University of Medical Sciences (Hamadan, Iran) approved the study, which was carried out in accordance with the ethical standards laid down in the Declaration of Helsinki.

### 2.2. Sample

A total of 92 outpatients (mean age:  $M=27.52$  years,  $SD=9.34$ ; 57.6% females) took part in the study. Outpatients were enrolled in

the study if the following inclusion criteria were met: 1. diagnosis of an anxiety disorder following the DSM 5 (American Psychiatric Association, 2013: generalized anxiety disorder, specific phobia with and without panic disorder; social anxiety disorder, 'others' such as agoraphobia, panic attack), as ascertained by a trained psychiatrist and clinical psychologist; 2. willing and able to participate in the study; 3. age between 18 and 65 years; 4. Beck Anxiety Inventory score of 7 points or higher. Exclusion criteria were: 1. not meeting the inclusion criteria mentioned above; 2. unable or unwilling to complete the questionnaire; 3. suffering from psychiatric disorders other than anxiety disorders (in particular depressive disorders, eating disorders, addiction disorders) or co-morbid psychiatric disorders; 4. a history of diabetes; thyroid dysfunction; any kind of endocrine disease; 5. a history of steroid drugs within the last 6 months.

Of the 130 patients approached, 102 (78.5%) met the inclusion and exclusion criteria, and 92 (70.7%) agreed to participate at the study. The final sample consisted of 53 female (57.6%) and 39 male (42.4%) patients.

### 2.3. Tools

#### 2.3.1. Psychiatric interview

Trained psychiatrists and psychologists performed a structured psychiatric interview (M.I.N.I.; International Neuropsychiatric Interview; Sheehan et al., 1998) to diagnose anxiety disorders according to the DSM 5, and to ensure that only patients meeting the inclusion and exclusion criteria were enrolled in the study.

#### 2.3.2. Beck Anxiety Inventory (BAI, Beck et al., 1988; self-rating instrument)

This questionnaire consists of 21 statements each describing a common symptom of anxiety (mental, physical and stress symptoms). The respondent chooses from among four alternative responses to each statement to describe the severity of his/her anxiety. The alternatives are scored 0–3. Hence total scores for this test can range from 0 to 63, with higher scores reflecting stronger symptoms of anxiety (Cronbach's  $\alpha=0.94$ ). Additionally, following Beck et al. (1988), participants were categorized as follows: 0–7 points, minimal level of anxiety; 8–15 points, mild anxiety; 16–25 points, moderate anxiety; 26–63 points, severe anxiety.

#### 2.3.3. Body Mass Index (BMI)

To calculate BMI, the internationally accepted formula was applied:  $BMI = \text{weight in kg} / \text{height in m squared}$ . Accordingly, the unit is  $\text{kg}/\text{m}^2$ . Patients wore light clothes without shoes for measurement of anthropometric data. To classify BMI, we followed the recommendation of the World Health Organization (WHO, 2006):  $BMI < 15 =$  very severely underweight;  $15 < BMI < 16 =$  severely underweight;  $16 < BMI < 18.5 =$  underweight;  $18.5 < BMI < 25 =$  normal weight;  $25 < BMI < 30 =$  overweight;  $30 < BMI < 35 =$  obese Class I (moderately obese);  $35 < BMI < 40 =$  obese Class II (severely obese);  $40 < BMI =$  obese Class III (very severely obese). In the present sample, the following BMI categories were observed: underweight:  $N=9$  (9.8%), normal weight:  $N=40$  (43.5%); overweight:  $N=21$  (22.8%); obese Class I:  $N=15$  (16%); obese Class II:  $N=7$  (7.6%)

### 2.4. Statistical analysis

First, a series of  $t$ -tests was performed to compare the BMI and anxiety scores of female and male participants. Next, two ANOVAs were performed with the factors Anxiety disorder category (generalized anxiety disorder, social anxiety disorder, specific phobias, and 'others') and Gender (male, female) and with age, BMI, and anxiety as dependent variables. In addition,  $\chi^2$ -tests were performed to calculate the distribution of Gender and Anxiety

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