Body image, Anxiety, Depression and DNA damage in Obese Egyptian Women

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Background
Obesity is a worldwide epidemic problem.
Aim
To investigate the role of obesity on body image, frequency of anxiety, depression disorders and DNA damage in a sample of Egyptian women.
Methods
The study included 172 women, 84 were obese and 88 were age-matched nonobese women.
Results
Obese women showed significant higher frequency of abnormal body image (77.4%) as compared with the nonobese (42%) ($P < 0.0001$). Moreover, they had significant higher frequencies of severe anxiety (26.2%) and depression (41.7%) than nonobese women (2.3 and 18.2%, respectively) ($P < 0.001$). Leukocyte DNA damage was evaluated by comet assay and revealed high DNA damage in obese women.
Conclusion
Obesity is a potential risk factor for abnormal body image, anxiety, depression, and DNA damage among Egyptian women. Identifying the psychological problems in obese women is essential to improve quality of life and promote management and prevention.

Keywords:
anxiety, body image, depression, DNA damage, obesity

Introduction

Obesity is a complex heritable trait influenced by the interplay of epigenetics, metagenomics, genetics, and the environment. Numerous genes influencing the phenotype have been identified, especially in early-onset severe obesity with the increasing access to high-accuracy diagnostic tools for genetic investigations (Thaker, 2017). Obesity is one of the major global public health problems. Obese persons face psychological discomfort concerning their physical appearance (Makara-Studzińska and Zaborska, 2009). It is postulated to be a risk factor for anxiety disorders, but the verification of an association between these disorders is not well-defined. In developed countries, disorders of anxiety are the most common mental disorders (Brook and Schmidt, 2008). The consideration of psychological aspects of individuals with morbid obesity is crucial. There is no particular personality form distinctive to the morbidly obese. These patients vary from the general population as their self-esteem and impulse control is worse. Many reports exhibit a positive correlation between obesity and anxiety disorders with fear disorder, mostly in obese women with specific phobia and social phobia. Weight-related discrimination and shame can be troubling to obese persons. Furthermore, the harmful effect of obesity on

quality of life could be traumatic (Gariepy et al., 2010). Obese patients have inactive dependent and passive aggressive personality characteristics, together with a tendency for somatization and problem defiance. Their rational are frequently dichotomous and disastrous. Moreover, obese individuals illustrate low collaboration, and they see themselves as independent and awkward (Lykouras, 2008). It is known that obesity has been associated with depression (Lykouras and Michopoulos, 2011). Body annoyance is recognized as a psychological problem that correlates with obesity and is linked to depression, disorder in eating, and poor self-esteem (Weinberger et al., 2016). One of the effective factors of self-satisfaction with the body image is body weight; hence, individuals with the highest weight usually represent a low level of self-satisfaction (Lipowska and Lipowski, 2015). Women characteristically are far more dissatisfied with their body image than men. Differences also exist across ethnic groups (Sarwer et al., 2005). Oxidative stress is considered one of several unfavorable cellular responses to obesity. It can then impair cellular

structures and generates a low-grade proinflammatory state. This paper aimed to investigate the role of obesity on body image perception and manifestations of anxiety, depression, and oxidative stress.

Patients and methods

The study included 172 women, where 84 were obese and 88 were age-matched nonobese women. They attended the Obesity Clinic, National Research Centre, Egypt. Their mean age was 32.14 ± 3.37.

Written informed consent was obtained from the patients after the explanation of the aim of the study. All the patients' data were confidential, and neither the data nor the collected samples were used in any other research.

The body image, anxiety, and depression were evaluated using an Arabic version questionnaire of body image (Cash and Fleming, 2002), Taylor Manifest Anxiety Scale (Lima *et al.*, 2019), and Zung scales (Schneider *et al.*, 2013), respectively. All provided scales are self-assessment scales for detecting symptoms of self-esteem, anxiety, and depression.

Self-concept (body image)

It is a self-report scale reflecting the attitude of each case toward herself, and it was done through a questionnaire (Cash and Fleming, 2002) applied individually. It contains 26 items, with a cutoff level of 21. Low self-esteem was considered at level of at least 21.

The Taylor Manifest Anxiety Scale originally consisted of 50 true or false questions that are answered by the obese individual to determine their anxiety level. A score less than 17 is considered as no anxiety, a score ranging from 18 to 25 is mild, a score from 26 to 36 is moderate, and a score above 37 is considered severe (Lima *et al.*, 2019).

The Zung Self-Rating Depression Scale (SDS) consists of 20 items with a Likert-type scale after each item. The scores for each item ranged from 1 to 4, and the SDS ranges from a raw score of 20 to a raw score of 80. Some items are reverse scored (i.e. they go from 4 down to 1). SDS scores are classified as normal (<50), mild depression (50–59), moderate to marked major depression (60–69), and severe to extreme major depression (>70) (Schneider *et al.*, 2013).

Assessment of the comet assay

Cell preparation

Peripheral blood leukocytes were isolated by centrifugation (30 min at 1300g) in Ficoll-Paque density gradient (Pharmacia LKB Biotechnology, Piscataway, New Jersey, USA). After centrifugation, leukocytes in the buffy coat were aspirated and washed twice by PBS at pH 7.4.

Preparation of cell microgels on slides

The comet assay was performed according to Singh *et al.* (1988) with modifications according to Blasiak *et al.* (2003). Cell microgels were prepared as layers. The first layer of gel was made by applying 100 µl of normal melting point agarose (0.7%) onto a precleaned microscope charged slides and coverslip gently. The coverslip was removed after the agarose solidified at 4°C. Low-melting-point agarose (0.5%) was prepared in 100 mmol/l PBS and kept at 37°C. Mononuclear cells were mixed with the low-melting-point agarose, and 100 µl of the mixture was applied to the first gel layer. The slides were then covered with a coverslip and placed at 4°C for solidification. After the second layer was solidified, the coverslips were removed from the cell microgels. A final layer of low-melting-point agarose was added followed by coverslips, then left to solidify for 10 min, and then coverslips were removed.

Lysis of cells, DNA unwinding, gel electrophoresis, and DNA staining

The slides were covered with 100 ml of fresh lysis buffer at pH 10 at 4°C for 1 h. Buffer contains 2.5 mol/l NaCl, 100 mmol/l EDTA, 1% sodium hydroxide, 10 mmol/l Tris, 1% Triton X-100, and 10% dimethyl sulfoxide. After draining, microgels slides were treated with DNA unwinding solution (300 mmol/l NaOH, 1 mmol/l EDTA, pH 13) for 30 min at 4°C, and placed directly into a horizontal gel electrophoresis chamber filled with DNA-unwinding solution. Gels were run with constant current (300 mA at 4°C) for 30 min. After electrophoresis, the microgels were neutralized with 0.4 mol/l Trizma base at pH 7.5 for 10 min. The slides were stained with 20-µl ethidium bromide (10 µg/ml).

Visualization and analysis of comet slides

The slides were examined at ×400, magnification using a fluorescence microscope (Model DM 2500, CMS GmbH; Leica Microsystems, Wetzlar, Germany), equipped with an excitation filter of 549 nm and a barrier filter of 590 nm. A damaged cell is visualized as each cell had the appearance of a comet, with a brightly fluorescent head and a tail to one side formed by the DNA containing strand breaks that were drawn away during electrophoresis. Samples were analyzed by counting the damaged cells out of 100 cells per slide to calculate the percent of damage.

Statistical analysis

Data were analyzed using SPSS version 17 (SPSS Inc., Chicago, IL, USA) and were expressed as mean ± SD for quantitative variables, number, and percentage for qualitative ones. Comparisons between groups were done by Student's t-test. P value less than 0.05 was considered to be statistically significant different, and P value less than 0.001 was considered to be statistically highly significant different.

Results

Table 1 represents the clinical findings of the studied cases. The BMI, the mid upper arm circumference, and the waist/hip ratio in the obese women were significantly increased ($P < 0.05$). Furthermore, the waist circumference, the fat mass, and the fat percentage in the obese women versus the nonobese were highly significantly increased ($P < 0.01$).

Table 2 shows the comparison of the body image scale scores, anxiety, and depression between obese and nonobese groups. The obese cases presented with significant higher frequency of abnormal body image (≥21) in 77.4% of cases as compared with 22.6% in nonobese group ($P < 0.0001$).

Furthermore, the nonobese women showed mild anxiety (18–25) in 61.4% of cases compared with 19% in obese women. However, moderate anxiety (26–36) was present in 36.4% of nonobese women and 54.8% in obese women.

The obese women had a higher frequency of symptoms of severe anxiety in 26.2%, whereas it was 2.3% in nonobese women. Depression was significantly higher among obese women (41.7%) compared with the nonobese cases (18.2%) ($P < 0.0001$).

Table 3 shows the mean level of DNA damage in obese women and controls. The mean DNA damage was found to differ significantly between the obese group and controls ($P < 0.01$). The DNA damage in the leukocytes of the patients was higher (Fig. 1a and b) than that of controls (Fig. 1c).

Discussion

Today obesity has become a worldwide problem. The Middle East countries including Qatar, United Arab Emirates, Saudi Arabia, Libya, Oman, Jordan, Egypt, and Kuwait are considered the second highest region regarding obesity. Approximately 75% of its population are obese or overweight (Badran *et al.*, 2011). Egypt

Table 1 The clinical findings of the studied cases

Variables	Nonobese	Obese
Age (years)	30.22±3.30	32.14±3.37
Weight (kg)	57.96±4.87	83.26±16.41
Height (cm)	157.76±5.27	157.13±8.41
BMI (kg/m^2)	22.47±2.36	33.411±6.06*
Mid upper arm circumference (cm)	27.86±2.83	34.14±4.54*
Waist circumference (cm)	77.48±9.85	99.51±12.96**
Waist/hip	0.78±0.08	0.83±0.0.06*
Fat mass (kg)	14.20±5.09	35.39±11.84**
Fat (%)	25.07±7.88	41.55±6.01**

*$P<0.05$. **$P<0.01$, obese versus nonobese.

**Table 2 Comparison of the body image scale scores, anxiety, and depression between obese and nonobese groups**

Variables	Nonobese (n=88) [n (%)]	Obese (n=84) [n (%)]	P
Body image			
>21 (low self-esteem)	37 (42)	65 (77.4)	0.0001
<21	51 (58)	19 (22.6)	
Anxiety			
18-25 (mild)	54 (61.4)	16 (19)	0.0001
26-36 (moderate)	32 (36.4)	46 (54.8)	
>37 (severe)	2 (2.3)	22 (26.2)	
Depression			
<50	72 (81.8)	51 (60.7)	0.001
>50	16 (18.2)	35 (41.7)	

Table 3 The DNA damage in obese women and controls

Obese women (mean±SD)	Control (mean±SD)
30.89±3.1*	14.95±2.0

*$P<0.05$.

Figure 1
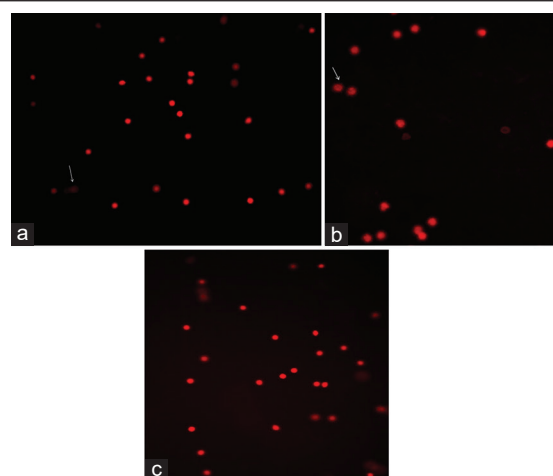
DNA damage in leukocytes of obese and nonobese women: (a) shows the DNA damage pattern in an obese woman showing a highly damaged DNA owing to the migration of damaged DNA fragments throughout electrophoresis leading to a faint look of DNA, whereas (b) shows another obese woman with a moderate DNA damage showing a lesser damaged DNA fragments that leads to more brighter DNA look, and (c) represents the normal DNA pattern showing an intact DNA that appears the brightest.

is one of top 10 most obese countries, occupying the seventh rank of countries in accordance with the

most recent WHO statistics issued for the year 2017 (WHO, 2017). More than 35% of Egyptians are obese, whereas in the USA, the highest percentage of obesity was found in children and young adults.

Overweight and obesity was documented in females more than males (76 and 64.5%, respectively) among Egyptians above the age of 15 years, as reported in WHO statistics. Petry *et al.* (2008) emphasized that extreme obesity is more common in women. Accumulating evidence revealed that the percentage of obesity in Egypt has raised distinctly in the past 30 years. In Egyptian children, 15% are obese according to the Egyptian Medical Association of the Study of obesity in early 2010, whereas during 1990, it was only 6%. In Egypt, increasing obesity is related to junk food and fast food outlets, in addition to sedentary life styles. Moreover, hereditary factors may influence the likelihood of obesity.

This study was conducted among obese and overweight females. Their mean age was 32.14 ± 3.37 years, their mean weight was 83.263 ± 16.41 kg, and their BMI was 33.41 ± 6.06. Obesity is a worldwide epidemic problem that dangers the physical health, in addition to emotional and psychological health. Most studies have shown that obese people experience weight discrimination in both their public and private lives (Puhl and Heuer, 2009). Less confidence, emotionally unstable, and socially inactive are symptoms that are faced by obese people. Many obese individuals feel 'ugly' or unattractive. This seriously has an effect on their self-confidence to interact with people. Accordingly, these individuals have a tendency to be loners and socially isolated. This behavior magnifies the concern of obesity as a result of discouraging these individuals to depart and engage in public interactions. Moreover, it encourages them to stay indoors and engage in uncontrollable eating and sedentary behaviors like watching TV or playing video games, developing a viscous circle (Ogden *et al.*, 2012).

Most obese individuals avoid attention and also keep away from any sports-related activities or other fun stuff to limit social interactions. This might be caused by inability to run fast, sleep apnea, excessive sweating, or other obesity-related health issues. Therefore, these individuals feel less productive and valuable as compared with peers and increase responsibility and low self-esteem (Son and Kim, 2012).

In this study, obese cases showed significant higher frequency of abnormal and poor body image (77.4%) as compared with the nonobese (22.6%) ($P < 0.0001$). Previous studies (Schwartz and Brownell, 2004; Zanardo *et al.*, 2014; Yazdani *et al.*, 2018) have noted that there is a strong indication that poor body image and low self-esteem is linked to obesity, but not all obese persons experience this problem. Other studies reported (Makara-Studzińska and Zaborska, 2009; Weinberger *et al.*, 2016) that obese individuals especially women are irritated with their body and remain dissatisfied even after having lost weight.

The exact association between obesity and anxiety disorder is not clear yet. The studies concerned with this subject are relatively rare, and they follow different methodologies. Most of these studies show a positive relationship with panic disorder, mainly in women, with specific phobia and social phobia. Some authors have found a relationship between obesity and generalized anxiety disorder, but a negative relationship has been also reported. Lo Coco *et al.* (2011) implied that depression or anxiety disorders are complications of low self-esteem in obese individuals.

This study highlighted such relationship. Obese women in our report had higher frequency of symptoms of severe anxiety (26.2%) compared with nonobese ($P < 0.0001$). A strong association between obesity and anxiety disorders was reported in other studies (Muennig, 2008; Scott *et al.*, 2008; Zhao *et al.*, 2009; Brumpton *et al.*, 2013; Grundy *et al.*, 2014; Wang and Menchero, 2014), suggesting the contribution of obesity in the development or maintenance of anxiety disorders.

Depression and obesity are both highly prevalent and are leading public health problems. In this study, obese women had high frequency of symptoms of depression (41.7%) ($P < 0.001$). This coincides with the findings of previous research studies which recognized that obesity in women increases the risk of depression and emphasized that there is an association between depression and obesity, which was stronger in female adolescents (Abou Abbas *et al.*, 2015; Mannan *et al.*, 2016; Vittengl, 2018).

The effect of anxiety and depression on weight change over an 11-year follow-up period in a large population was previously reported (Brumpton *et al.*, 2013). The authors concluded that people who had any anxiety or depression have significantly larger weight change than those without symptoms in both men and women. Moreover, Elena *et al.* (2015) studied the association of increased waist circumference to depression and anxiety tendency in males and females. They found that depression was more dominant in women, whereas in men, both depression and anxiety seem to have an equal frequency. Additionally, they recommended psychotherapy must be added to lifestyle changes in patients with abdominal adiposity.

Furthermore, Adams and Murcia (2016) reported the association between obesity and the incidence of anxiety and depression in Athens-Clarke County in northeast Georgia. They found a relationship between obesity and mental health outcomes, which were similar to the national surveys. They also highlighted that stress might influence both mental health and obesity. The interactions among stress, depression, and anxiety have been formerly reported (Finlay-Jones and Brown, 1981; Hammen, 2005; Luppino et al., 2010). An important pathway comprised the effect of stress on eating habits leading to a preference of foods high in fat and sugar (Torres and Nowson, 2007). Stress-induced eating is considered a link between mental health and obesity. Researchers proved that the individual lean body mass is strongly protective against mood disorders. Poor self-concept and consequent anxiety manifestations and depression cause negative health outcome and decrease quality of life in obese individuals.

Presently, it is established that obesity has a significant effect on the levels of endogenous DNA damage (Anichini et al., 2012; Marta et al., 2019). The comet assay is one of the methods used to evaluate DNA damage in individual cells and is a widely used tool for monitoring genome stability and assessing the role of oxidative stress in human diseases, aging processes, and mutagenesis (Merecz et al., 2015; Grindel Guggenberger et al., 2016). We demonstrated the presence of oxidative stress by estimating the DNA damage in the leukocytes of the patients, which was significantly higher than controls ($P < 0.05$). This coincides with previous studies that demonstrated a relationship between obesity and oxidative stress (Bondia-Pons et al., 2012; Ballesteros-Guzmán et al., 2019). In line with our findings, Włodarczyk et al. (2018) revealed that DNA damage levels in obese women were more than two times as high in comparison with control women. Similarly, Tomasello et al. (2011), using alkaline comet assay, have demonstrated an increase in DNA damage in obese patients in contrast to nonobese ones. The obesity-associated DNA damage may be responsive for disturbances in reproductive capacity of obese patients and their offspring's health (Patro et al., 2013). Additionally, DNA damage in germ cells may be a result of increased reactive oxygen species production, characteristic of obesity (Zwamborn et al., 2017; Lezaja and Altmeyer, 2018;). It is suspected that the appearance of DNA lesions in germ cells can be transmitted to the genome of future generations (Noblanc et al., 2013). Maternal obesity may cause de novo mutations in the embryo, may change the methylation status of the genes in embryo, and through miRNA may affect the expression of embryonic proteins (McPherson et al., 2014). Furthermore, obesity-induced DNA damage

and dysregulation of the DNA repair pathways can lead to increased mutation rate and the transformation of healthy tissues to cancer (Turgeon et al., 2018).

Conclusion

This study delineated that obesity dangers the physical health, in addition to emotional and psychological health. This study showed a highly significant association among abnormal body image, anxiety, depression, oxidative stress, and obesity. Identifying obesity as a potential risk factor for abnormal body image, anxiety, depression, and oxidative stress is crucial for treatment and prevention purposes. The results of our study suggest that particular attention should be paid to the content of antioxidants in the diet of obese people.

Conflicts of interest
There are no conflicts of interest.

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