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**Original Article**
CLINICAL TRIALS AND INVESTIGATIONS

Obesity

# From Socioeconomic Disadvantage to Obesity: The Mediating Role of Psychological Distress and Emotional Eating

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**Objective:** Lower socioeconomic status is robustly associated with obesity; however, the underpinning psychological mechanisms remain unclear. The current study sought to determine whether the relationship between lower socioeconomic status and obesity is explained by psychological distress and subsequent emotional eating as a coping strategy. It also examined whether psychological resilience plays a protective role in this pathway.

**Methods:** Participants ($N = 150$) from a range of socioeconomic backgrounds completed questionnaire measures of psychological distress, emotional eating, and resilience. They reported their income and education level as an indicator of socioeconomic status and their height and weight in order to calculate BMI.

**Results:** There was a significant indirect effect of socioeconomic status on BMI via psychological distress and emotional eating; specifically, lower socioeconomic status was associated with higher distress, higher distress was associated with higher emotional eating, and higher emotional eating was associated with higher BMI ($b$ [SE] = −0.02 [0.01]; 95% CI: −0.04 to −0.01). However, resilience was not a significant moderator of this association.

**Conclusions:** Psychological distress and subsequent emotional eating represent a serial pathway that links lower socioeconomic status with obesity. Targeting these maladaptive coping behaviors may be one strategy to reduce obesity in low-income populations.

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## Introduction

The increasing prevalence of obesity in many countries worldwide has been labeled as an "epidemic." Globally, the number of individuals with overweight and obesity increased by 27.5% for adults and 47.1% for children between 1980 and 2013 (1). In the United Kingdom, around two-thirds of adults have overweight or obesity, and obesity prevalence almost doubled between 1993 and 2015 (2). Costs to the National Health Service associated with having obesity or overweight are projected to reach £10 billion by 2050, with wider economic costs (such as days of employment missed) expected to reach £50 billion per year (3). Current weight-management strategies primarily focus on improving the quality of dietary intake and reducing sedentary lifestyles. However, their success has been limited, especially regarding longer-term maintenance of weight loss (4).

The causes of obesity are complex and vary between individuals. However, one factor that has been reliably associated with obesity is socioeconomic status (SES). In developed countries, obesity disproportionally affects individuals from lower social classes, and this is particularly the case for women (5-9). Recent research (10) showed how socioeconomic disparities in child and adolescent body weight have reversed over time; in the 1940s through to the 1970s, low SES was associated with lower weight; however, in 2001, low SES was associated with higher weight. The reason for this socioeconomic disparity is not well understood, but it is often attributed to the greater availability of low-cost, calorie-dense foods in more deprived areas relative to more affluent neighborhoods (11). However, there is limited evidence for an association between local food environments and obesity (12), indicating that other factors also play a role.

To date, there has been relatively little consideration of the underlying psychological mechanisms that may explain why individuals from lower socioeconomic groups are vulnerable to developing obesity. In view of this, Hemmingsson (13) proposed a theoretical model that emphasizes the role of psychological, emotional, and social

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factors. According to this model, socioeconomic disadvantage causes psychological and emotional distress. This distress is transferred from parents to children, thus creating a disharmonious family environment. Ultimately, the adult and/or child experiences psychological and emotional overload, which leads to maladaptive coping strategies, such as eating energy-dense foods to alleviate negative emotions and stress. These maladaptive eating behaviors, coupled with stress-induced disturbances to metabolic signals, are thought to promote weight gain and obesity over time. The negative social, psychological, emotional, and behavioral consequences of obesity exacerbate psychological distress and maladaptive eating behaviors, thus creating a cyclic mechanism that perpetuates the difficulties.

Though Hemmingsson's model (13) is yet to be empirically tested in its entirety, there is considerable support for some of the proposed relationships. For example, numerous studies have shown a link between socioeconomic disadvantage (e.g., income inequality, lower social status) and psychological distress, such as higher rates of depression and lower mental well-being in lower socioeconomic groups relative to more affluent groups (14-17). Poverty and poor mental health are interrelated such that poverty can be both a cause and consequence of mental health problems (18). Regarding obesity, in an experimental study, participants who were experimentally induced to feel poor consumed significantly more calories from snack foods compared with participants who were induced to feel wealthy (19). Notably, this study also found that higher social anxiety was directly associated with increased consumption, and this was particularly true for participants who had a strong need to belong (19). There is also a body of evidence linking emotional or stress-induced eating with higher BMI and consumption of energy-dense sweet and/or fatty foods in adults (20,21) and in children and adolescents (22,23). Furthermore, the tendency to eat palatable foods as a coping strategy predicted increases in BMI over 2 years in young adults (24). Therefore, while there is general support for direct relationships between these key variables, to the authors' knowledge, no studies have directly examined whether psychological distress and emotional eating mediate the association between SES and BMI.

Hemmingsson's model (13) also proposed that there are protective factors that can act as buffers, thus preventing the link between socioeconomic disadvantage and psychological distress. Resilience refers to an individual's capacity to cope with stressors and to withstand the potential depressive consequences of such stressors (25). In previous studies, lower levels of resilience have been associated with higher incidences of depression (26,27). Low resilience also was found to independently predict higher BMI and waist circumference (28). This suggests that individuals who are high in resilience may cope better with socioeconomic disadvantage and thus be protected from increased psychological distress and subsequent maladaptive eating.

The current study aimed to elucidate the associations between SES, psychological distress, emotional eating, and BMI. It was predicted that lower SES would be indirectly associated with (higher) BMI via psychological distress and emotional eating (i.e., whereby lower SES is associated with higher psychological distress, higher psychological distress is associated with higher emotional eating, and higher emotional eating is associated with higher BMI). It was also predicted that resilience would moderate the association between lower SES and psychological distress such that this association would be most pronounced in individuals with lower relative to higher levels of resilience.

# Methods

## Participants

Participants were recruited using online advertisements (via internal university websites and externally using social media) and through an Urban Community and Neighbourhood Centre (UCAN) situated in the town of Bolton in North West England. UCANs provide support and advice to local residents within an identified geographical area of socioeconomic deprivation, and Bolton is one of the most deprived local authorities in England (29). Inclusion criteria for the study were being aged between 18 and 65 years with a good level of English language skills. A total of 194 participants were recruited and commenced the study. Complete data were obtained for 150 of these participants. Ethical approval for the study was obtained through the University of Liverpool's Research Ethics Committee.

All participants were provided with written information outlining the nature and purpose of the study. Written informed consent was obtained prior to study commencement. As compensation for their time, participants were given the option to be entered into a prize drawing upon completion of the study.

## Measures

*Demographic information.* Each participant was asked to provide their age (in years), gender, and ethnicity.

*SES.* Consistent with previous approaches (30,31), participants reported their employment status (employed full-time, employed part-time, unemployed looking for work, unemployed not looking for work, retired, student, unable to work due to health or disability, housewife/husband, voluntary employment), their total annual household income (9-point scale: 1 ≤ £5,200; 2 = £5,200-£10,399; 3 = £10,400-£15,599; 4 = £15,600-£20,799; 5 = £20,800-£25,999; 6 = £26,000-£36,399; 7 = £36,400-£51,999; 8 = £52,000-£77,999; 9 ≥ £78,000), and their level of education (8-point scale: 1 = none; 2 = General Certificate of Secondary Education (GCSE) grade D or below; 3 = GCSE grade C or above; 4 = A-level or equivalent; 5 = university degree or equivalent; 6 = postgraduate qualification or equivalent; 7 = master's degree or equivalent; 8 = PhD or equivalent).

*Psychological distress.* The 21-item Depression Anxiety Stress Scale (DASS) (32) was used to measure the following three related states of psychological distress: depression, anxiety, and stress. Participants responded to each item (e.g., "I found it hard to wind down") using a 4-point scale (0 = never; 1 = sometimes; 2 = often; 3 = almost always). Cronbach α values for the current study were as follows: depression $\alpha = 0.92$; anxiety $\alpha = 0.83$; stress $\alpha = 0.86$; and total distress scale $\alpha = 0.94$.

*Emotional eating.* The 13-item emotional eating subscale from the Dutch Eating Behavior Questionnaire (DEBQ) was used (33). Participants responded to each item (e.g., "Do you have a desire to eat when you are emotionally upset?") on a 5-point scale (1 = never; 2 = seldom; 3 = sometimes; 4 = often; 5 = very often). The total subscale score was calculated as the mean of responses to the items. Cronbach α for the current data was $\alpha = 0.95$.

*BMI.* Participants reported their current weight (in kilograms or in stones and pounds) and height (in centimeters or in feet and inches). Data were converted to metric units, if necessary, to calculate BMI

using the formula weight in kilograms divided by height in meters squared. Previous research has indicated that self-reported and objectively measured weight data are highly correlated (34,35).

*Resilience.* The 6-item Brief Resilience Scale was used (36). Participants responded to each item (e.g. "I tend to bounce back quickly after hard times") on a 5-point scale (1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree). The total scale score was calculated as the mean of responses to the items, with higher scores indicating higher levels of resilience. Cronbach α for the current data was α = 0.86.

*Life events.* The Life Events Scale measures the occurrence of stressful life events (37). Participants are asked to indicate how many times in the past 5 years they have experienced 14 events (e.g., death of child/partner/relative/friend, end of intense relationship, serious or long-lasting financial problems, serious or long-standing work problem). The frequencies for each event are totaled to provide the total scale score, with higher scores indicating a greater frequency of stressful life events.

## Procedure

The questionnaires were hosted online using Qualtrics (Qualtrics International, Inc., Provo, Utah). Participants recruited using online advertisements could access the questionnaires via a Web link. Participants at the UCAN were recruited using paper-based advertisements posted within the center, which provided them with the Web link to the online survey. Alternatively, participants at the UCAN were given the opportunity to meet with the researcher and were then given access to the online survey at a computer in the center, or, depending on their personal preference, they completed paper-based copies of the questionnaires ($n = 20$ opted to complete paper-based copies, 13% of the total sample). We took a flexible approach to recruitment to ensure that participants without Internet access were not precluded from taking part.

Upon commencing the study, participants first viewed the Participant Information Sheet and provided their consent to participate in the subsequent consent form. They then completed the demographic (including height and weight) and SES information followed by the four questionnaires in the following order: DASS, Brief Resilience Scale, DEBQ, and Life Events Scale. Upon completion of the study, participants were provided with a debrief information sheet.

## Statistical analysis

According to guidance on sample size for mediation analyses (38), a minimum of 71 participants was needed to detect the hypothesised associations between the key variables (80% power with medium effect sizes). Data were checked for outliers alongside tests of multicollinearity, homogeneity, and homoscedasticity to ensure assumptions for further analysis were met. Because of the variation in measurement scales used, all variables were log transformed to standardize the data prior to running further analyses. Data sets for four participants had missing data for a single item within either the DEBQ or DASS. Missing data points were handled using valid mean substitution. The validation mean substitution uses the average of participants' other responses to generate a value for the missing data. It has been shown to be a valid method when the measure in question employs multiple items to gauge a single construct and participants have answered all remaining questions related to that construct (39). A composite score was generated for SES using the two measures with numerical scales, total household income (9-point scale; higher scores indicate higher income) and level of education (8-point scale; higher scores indicate higher levels of education), which have been used as indicators of SES in previous studies (30,31). The DASS provides subscores for depression, anxiety, and stress while also providing a total score as a more general dimension of psychological distress. Initial correlations indicated a high level of association across the three subscores ($r \geq 0.68$); therefore, the DASS total score was used in the analysis.

The primary hypothesis predicted that lower SES would be indirectly associated with (higher) BMI via psychological distress and emotional eating. This was tested by a serial multiple mediation analysis in PROCESS (40); the independent variable (IV) was SES, the dependent variable (DV) was BMI, and the serial mediators were psychological distress (first mediator) and emotional eating (second mediator) (Figure 1). PROCESS compares the magnitude of the direct effect

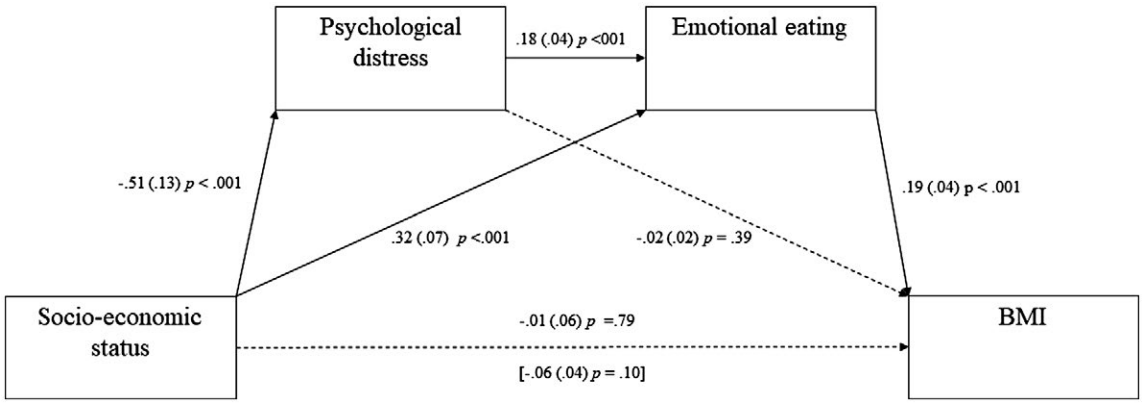


**Figure 1** Serial multiple mediation analysis with socioeconomic as the independent variable, BMI as the dependent variable, and psychological distress and emotional eating as the first and second mediators. Values are unstandardized regression coefficients (SE in parentheses) and associated *P* values. Bracketed association = direct effect (controlling for indirect effects). Solid lines indicate significant pathways, and dashed lines indicate nonsignificant pathways.

(IV-DV; controlling for the mediators) with the total effect of the IV on the DV including the indirect pathway via the mediators. It produces bias-corrected bootstrapped confidence intervals (CI) for indirect effects via individual mediators and for the serial effect of the two mediators in the serial mediation model. A significant indirect effect is inferred by upper and lower CIs that do not include zero.

Exploratory analyses were conducted to determine whether lower SES was associated with higher psychological distress because of greater frequency of negative life events (measured using the Life Events Scale). This was tested by a serial multiple mediation analysis; the IV was SES, the DV was BMI, and the serial mediators were negative life events (first mediator), psychological distress (second mediator), and emotional eating (third mediator).

It was also predicted that resilience would moderate the association between lower SES and psychological distress. This was tested using a moderated mediation analysis in PROCESS in which the indirect effect of SES on emotional eating via psychological distress was examined at three levels of the moderator (resilience scores; −1 SD, mean, +1 SD).

All models controlled for age and gender as covariates.

## Results

Descriptive characteristics of the study participants are shown in Table 1 ($N=150$). Box plots illustrating the spread of the data for highest education level and yearly household income can be found in Supporting Information Figure S1. Most of the sample were female (83%) and white (93%). Regarding employment status, 52% of the participants were employed full-time, 16% were employed part-time, 16% were students, 9% were unemployed and/or looking for work, 3% were unable to work because of health or disability, 3% reported being a housewife/husband, < 1% were retired, and < 1% were in voluntary employment. The mean BMI of the sample was 26.3 kg/m$^2$ (scores > 25 indicative of being overweight; 4% of participants had underweight, 44% were of healthy weight, 32% had overweight, and 20% had obesity. The correlations between the variables are shown in Table 2.

**TABLE 1** Sample descriptives and questionnaire scores ($N=150$)

| | Mean | SD | Range |
|---|---|---|---|
| Age, y | 35.35 | 10.90 | 18-65 |
| BMI, kg/m$^2$ | 26.31 | 6.00 | 16.3-45.2 |
| DASS | 15.06 | 11.42 | 0-56 |
| LES | 6.14 | 6.39 | 0-38 |
| DEBQ | 2.58 | 1.02 | 1-5 |
| Resilience | 3.25 | 0.80 | 1-5 |
| Highest education level[a] | 5.15 | 1.87 | 1-8 |
| Yearly household income[b] | 5.67 | 2.46 | 1-9 |

[a]8-point scale: 1 = none; 2 = GCSE grade D or below; 3 = GCSE grade C or above; 4 = A-level or equivalent; 5 = university degree or equivalent; 6 = postgraduate qualification or equivalent; 7 = master's degree or equivalent; and 8 = PhD or equivalent.
[b]9-point scale: 1 ≤ £5,200; 2 = £5,200 to £10,399; 3 = £10,400 to £15,599; 4 = £15,600 to £20,799; 5 = £20,800 to £25,999; 6 = £26,000 to £36,399; 7 = £36,400 to £51,999; 8 = £52,000 to £77,999; and 9 ≥ £78,000.
DASS, Depression Anxiety Stress Scale; LES, Life Events Scale; DEBQ, Dutch Eating Behavior Questionnaire (emotional eating subscale).

**TABLE 2** Pearson correlation coefficients ($r$) between SES, questionnaire measures, and BMI

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. SES | – | | | | | |
| 2. DASS | −0.34* | – | | | | |
| 3. DEBQ | 0.18** | 0.26* | – | | | |
| 4. Resilience | 0.14 | −0.49* | −0.13 | – | | |
| 5. BMI | −0.06 | 0.04 | 0.33* | 0.05 | – | |
| 6. LES | −0.16 | 0.21[1] | 0.07 | −0.16 | 0.20** | – |

Higher scores on DASS indicate higher emotional distress, higher scores on DEBQ indicate higher levels of emotional eating, higher scores on Brief Resilience Scale indicate higher levels of resilience, and higher scores on LES indicate a greater number of stressful life events.
*$P<0.01$.
**$P<0.05$.
SES, socioeconomic status composite score; DASS, Depression Anxiety Stress Scale; DEBQ, Dutch Eating Behavior Questionnaire (emotional eating subscale); LES, Life Events Scale.

### Effect of SES on BMI via psychological distress and emotional eating

In the serial multiple mediation model, there was no significant total effect of SES on BMI ($b$ [SE] = −0.01 [0.06]; $P=0.79$). However, as predicted, there was a significant indirect effect of SES on BMI via psychological distress and emotional eating ($b$ [SE] = −0.02 [0.01]; 95% CI: −0.04 to −0.01) (Figure 1). That is, lower SES predicted higher psychological distress, which predicted higher emotional eating, which, in turn, predicted higher BMI. There was also a significant simple indirect effect of SES on BMI via emotional eating ($b$ [SE] = 0.06 [0.02]; 95% CI: 0.03 to 0.10). However, contrary to prediction, this pathway indicated that higher SES predicted higher emotional eating. The simple indirect effect of SES on BMI via psychological distress was not significant ($b$ [SE] = 0.01 [0.01]; 95% CI: −0.01 to 0.04). Taken together, the effect of SES on BMI in the model accounting for all mediators explained 15% of the variance ($R^2=0.15$; $P=0.0003$).

The exploratory analysis with the inclusion of negative life events as an additional serial mediator found no evidence of a significant indirect effect via the three-mediator serial pathway (i.e., SES → negative life events → distress → emotional eating → BMI; $b$ [SE] = −0.001 [0.001]; 95% CI: −0.01 to 0.00). Supporting Information Figure S2 provides additional detail on this analysis.

### Resilience as a moderator of the indirect effect of SES on emotional eating via psychological distress

Resilience was found to be an independent predictor of psychological distress, whereby higher resilience was associated with lower psychological distress ($b$ [SE] = −1.21 [0.20]; $P<0.001$). However, the significant indirect effect of SES on emotional eating via psychological distress remained evident at all three levels of the moderator (low, medium, and high resilience) (Table 3). The total index

**TABLE 3** Moderated mediation by resilience of indirect effect of SES on emotional eating via psychological distress

| | Effect (SE) | 95% CI |
|---|---|---|
| Low resilience | −0.08 (0.04) | −0.18 to −0.03 |
| Medium resilience | −0.10 (0.04) | −0.19 to −0.04 |
| High resilience | −0.11 (0.04) | −0.22 to −0.04 |

Resilience scores: low = −1 SD; medium = mean; high = +1 SD.

of moderated mediation indicated that no significant moderation occurred (*b* [*SE*] = −0.122 [0.18]; 95% CI: −0.51 to 0.19).

## Discussion

The current study aimed to elucidate the associations between SES, psychological distress, emotional eating, and BMI. As predicted, there was a significant indirect effect of SES on BMI via psychological distress and emotional eating; namely, lower SES was predictive of higher psychological distress, and higher psychological distress predicted higher emotional eating, which, in turn, predicted higher BMI. This finding directly supports components of the theoretical model proposed by Hemmingsson (13), which emphasizes the key role of psychological distress and maladaptive coping strategies in explaining the association between socioeconomic disadvantage and obesity.

In the current study, the simple indirect effect of SES on BMI via psychological distress was not significant. This indicates that psychological distress did not significantly mediate the (cross-sectional) relationship between SES and BMI; the pathway required the addition of emotional eating as a coping strategy for distress. This finding suggests that it is not distress *per se* but people's coping strategies for dealing with distress that may be critical in explaining the link between socioeconomic disadvantage and body weight. Consistent with this, a recent study (41) found that although lower SES was associated with both greater psychosocial stress and weight gain over a 9-year period, stress did not mediate the higher weight gain associated with lower SES.

Higher resilience was an independent predictor of lower psychological distress, in line with previous research (26,27). However, contrary to our hypothesis, resilience did not moderate the relationship between SES and psychological distress. This indicates that being high on trait resilience alone was not sufficient to protect those with lower SES from experiencing greater levels of psychological distress. Hemmingsson's theoretical model emphasizes a process whereby multiple factors create a cumulative protective effect (i.e., resilience, social support, self-esteem, and functional coping). It is possible, therefore, that resilience alone in the current study, without other additional protective mechanisms, was not sufficient to moderate the relationship between SES and psychological distress. Future studies in this area should seek to measure a range of potential protective factors.

The current study also revealed an unexpected finding in which higher SES was predictive of higher emotional eating in the simple indirect pathway, independent of psychological distress. Previous research found that male participants with degree-level qualifications (indicative of higher SES) had significant levels of stress-related eating (21). The positive direct association between SES and emotional eating contrasts with the previously discussed negative indirect association between SES and emotional eating via psychological distress; this phenomenon of opposing directions of direct and indirect effects in a mediation analysis is known as a suppression effect. This finding suggests that for individuals in higher socioeconomic positions, emotional eating is also prevalent; however, critically, this is not in response to significant psychological distress. In addition, the DEBQ emotional eating measure used in the current study assesses the tendency to eat in response to a variety of emotions, some of which imply coping (e.g., in response to low mood), while others do not (e.g., boredom). It is, therefore, possible that participants with higher SES may be eating in response to other emotions not directly related to coping with distress.

The exploratory analyses failed to find a significant association between lower SES and greater frequency of negative life events. This suggests that it is not an increased likelihood of negative life events per se that makes individuals with lower SES more vulnerable to experiencing greater psychological distress. Other studies have suggested that individuals who experience socioeconomic disadvantage may have more limited access to resources (e.g., material, interpersonal, intrapersonal) (42). It is possible that this, rather than negative life events themselves, may make these individuals more vulnerable to experiencing psychological distress and subsequent maladaptive coping behaviors. Other psychological experiences, such as feeling lower in social rank or feeling deprived, may also underpin some of the vulnerability posed by socioeconomic disadvantage and should be explored further.

We had a relatively small sample size and a limited number of participants with obesity (20% of our sample) based on BMI. However, the average BMI was in the overweight range and is in line with average BMI in the United Kingdom, as reported elsewhere (27 kg/m$^2$ for women, 27.4 kg/m$^2$ for men) (43). BMI was self-reported within the current study, and though previous research has indicated that self-reported and objectively measured weight data are highly correlated (34,35), it is possible that discrepancies may have occurred. Future research would benefit from using objective measures of body weight. The sample recruited was a predominantly female, white population, and further research is needed to explore the role of gender and ethnicity. However, our findings are relevant, as previous studies have indicated that socioeconomic disparities in obesity are most pronounced in women (5). In addition, the propensity to use increased consumption of food as a coping strategy may be more prevalent in women than men (22). An examination of economic circumstances and population weight in 67 countries found that while lower SES was associated with higher BMI in more economically developed nations, the opposite was found in less developed countries (i.e., higher SES associated with higher BMI) (44). Future research would benefit from the comparison of studies conducted in economically developed and less developed countries to consider the generalizability of the current findings. Furthermore, the data from the current study are cross-sectional. Though the results provide evidence for association, it is not possible to make causal inferences about the relationships reported. Notably, Hemmingsson's model predicts that the consequences of obesity exacerbate psychological distress and maladaptive eating behaviors, thus creating a vicious circle of negative affect and weight gain. Longitudinal studies that measure a range of socioeconomic, psychological, behavioral, social, and environmental factors are needed to test the model in full to determine the temporal sequence of the variables of interest.

The high prevalence of obesity in many countries worldwide is a major concern, and the development of effective intervention and preventive approaches is at the forefront of health agendas. The present study

suggests an important role for psychological and emotional factors in eating behavior and body weight regulation, particularly for those of lower SES. Therefore, weight-management initiatives should encompass psychological factors alongside existing strategies, such as the promotion of healthy eating messages and exercise promotion. Initiatives and interventions that target psychological distress and teach people to develop more positive coping strategies (e.g., problem solving, positive help seeking, relaxation techniques) may be particularly effective. This is consistent with recent recommendations for tailored approaches that meet the needs of the local population and consider the impact of wider socioeconomic and community factors on obesity prevalence (45).

The present study shows that the relationship between SES and obesity may be partly explained by psychological distress and subsequent emotional eating as a coping strategy. Resilience was not found to be a protective factor in this relationship. Overall, these findings suggest that psychological interventions may play an important role in public health and weight-management strategies, particularly in lower SES populations.O

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