

### Contributing factors of obesity among stressed adolescents

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#### Abstract

**Background:** Many adolescents suffer from common mental disorders such as stress, which affects health through the psychosocial process, eating behavior, food choices and physical activity. During adolescence, dietary patterns are formed and can affect the occurrence of diseases in later life. This is a review of the results in the pertinent literature, from 1989 until November 2013, concerning stress and the contributing factors that lead to obesity among adolescents. The aim of this review is to identify obesity among stressed adolescents as well as the contributing factors.

**Methods:** A descriptive design was used for both quantitative and qualitative studies while, in addition, psychological theories were used for the qualitative studies. The articles were screened to ensure their quality and included in this review accordingly. Ten articles were included in the review comprising cross-sectional, cohort, review and meta-analysis. Interviews and questionnaires were used for data collection.

**Results:** The literature provided obvious information focusing on emotional stress and obesity for both boys and girls. This review revealed that stress results in overweight and obesity among adolescents through changes in lifestyle including decreased physical activity and increased food intake. Gender and economic status are the main components that affect obesity in stressed adolescents.

**Conclusion:** Obesity is a consequence of stress among adolescents and is exacerbated by the wrong eating attitude. Developing proper food choices among adolescents can help prevent obesity and other complications in adulthood.

**Keywords:** Stress, Obesity, Adolescent, Eating, Body Mass Index

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## 1. Introduction

### 1.1. Background

Stress is a disorder and disturbance in the dynamic balance of all organisms. It is defined as “the non-specific response of the body to any factor that overwhelms or threatens to overwhelm the body’s ability to maintain

homeostasis". (1) Stress can make adolescents developing vulnerable to reach a biological and psychology maturity; (2) however, a stress-free life is not suitable for people, as it would lead to the inability to cope with life's challenges; and (3) an optimal level of stress is good provided it is not transformed into distress. The stress system interacts with other systems in an organism that regulate the metabolism as well as a variety of behavioral, immune, endocrine and cardiovascular functions. Therefore, developing adolescents are susceptible to chronic stress, which might result in various psychopathologic conditions; for instance, depression, anxiety, osteoporosis, impaired immune functions as well as obesity and increasing Body Mass Index (BMI) (4).

Chronic stress (distress) can result in the development of obesity, which can activate the hypothalamic-pituitary-adrenal axis and the sympathetic nervous system. During stress, some hormones can induce appetite, such as cortisol. Cortisol injection or an increasing level of cortisol in the body is associated with improved appetite, especially for foods high in sugar and fat (5). It is assumed that food consumption can be stimulated by cortisol, which can bind to the hypothalamus receptors. Moreover, leptin, corticotrophin and neuropeptide can be regulated by cortisol to stimulate appetite (6). Obesity, as a result of caloric imbalance during childhood or adolescence, is a major focus of public health attempts worldwide according to the World Health Organization (2013) (7). Obesity carries a short-term and long-term risk among adolescents, which can lead to consequences in adulthood (8, 9).

### **1.2. Statement of the problem**

The level of response to stress (chronic or acute) can affect physiological changes, such as gastric emptying, heart rate and blood pressure (10). The outcome of stress can seriously affect the well-being of adolescents (11, 12). Since the prevalence of obesity is growing, the consideration of the burden of stress on adolescent health is crucial. Studies have shown the prevalence of stress among adolescents in various countries including the US, which was 22.2% (13), China 13.2% (14), and in Saudi Arabia 52.5% and 35.5% among female and male adolescents (15). Obesity among children and adolescents is one of the main predictors of adulthood obesity. Obesity among adolescents has risen over the last two decades causing increased concern about psychosocial and physical consequences (16). Based on a report in 2010, over 30% of U.S. adolescents were overweight and obese (17). The percentage of obese adolescents (12-19 years old) in the U.S. has increased from 5% in 1980 to 18% in 2010 (17, 18). Not only is obesity one of the main outcomes of stress, obesity itself can lead to serious diseases in adolescence, and, consequently, in adulthood, such as high blood pressure, type 2 diabetes, orthopedic complications, atherosclerosis and also emotional disorders (19-21). Since obesity is a preventable disease, with efficient interventions and appropriate strategies it can be improved. Hence, stress reduction strategies, coping with stress, and consideration of contributing factors that can decrease obesity among stressed adolescents can be useful. Obesity among stressed adolescents is important for researchers and policy makers. However, while some previous studies found that stress among adolescents may lead to obesity (2, 22, and 23), others did not (24, 25). The studies are sporadic, and, individually, they show that there are various factors that can affect the relationship between stress and obesity. Stressed adolescents with factors including gender and economic status as well as BMI are more likely to get obesity (26-28). Further studies are needed to reveal the role of the main factors that lead to obesity and cause chronic diseases among stressed adolescents.

### **1.3. Objective of research**

This review aims to provide an overview of obesity among stressed adolescents as well as the contributing factors based on the findings of previously published papers. First, we describe how stress can change both eating behavior and food choices. Second, we discuss the main contributory factors for stress leading to obesity.

## **2. Material and Methods**

English language databases including PubMed, Science Direct, Scopus, Springer and Google Scholar were searched from 1980 until November 2013. Publications were searched in two steps according to specific keywords. The keywords for the first step included stress, obesity, adolescents, diet and food pattern. The following MeSH terms were used 'stress AND obesity AND adolescents AND diet OR food pattern'. At the next step, based on the previous searching level, more specific keywords including stressed adolescent, BMI, gender, economic status were performed. MeSH terms for this step included 'stressed adolescent AND gender AND economic status'. The titles and abstracts of all searched articles were evaluated for relevance according to the main point of the review, as well as the inclusion and exclusion criteria. Additional studies in the reference list of full studies were searched manually to find more relevant studies.

### 2.1. Inclusion and exclusion criteria

As inclusion criteria, English language studies, cross-sectional studies, cohort studies, randomized control trial, meta-analyses as well as reviews were analyzed. All relevant studies were evaluated on the basis of the titles and abstracts. Irrelevant studies as well as studies on adolescents with severe psychological problems, using drugs that cause obesity, and studies on smoking and addiction were excluded. Studies on children (less than 10 years old) and the elderly were not considered.

### 2.2. Quality assessment

For the identification and the assessment of the quality of each article, sections, including the title, abstract, introduction, methods, results, discussion, conclusion and other information were employed together with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement checklist (29). Based on the STROBE checklist, with 22 items, the strength quality of the articles was checked. Studies scoring over 70% were included. In addition, the sampling method, existence of valid instruments and presence of inclusion and exclusion criteria were also checked. The data were based on the search results, which identified 25 articles; however, 16 studies were excluded from the review leaving 9 articles for further analysis.

### 3. Results

This review indicates that the presence of stress among adolescents may lead to the development of obesity, which is a worldwide public health problem in adulthood. Several factors were reported as contributing significantly to the development of obesity among stressed adolescents of which the most important were gender and economic status. However, BMI as a moderating variable is controversial as it is not a significant factor among stressed adolescents in terms of developing obesity. Among the studies that qualified, only five were conducted on stressed adolescents and developing obesity, and four on contributing factors of stress to obesity. The results of the previous studies were classified into research studies on obesity among stressed adolescents and two moderating variables – gender and economic status.

#### 3.1. Obesity among stressed adolescents

In contrast with depressed mood, which leads to decreased food intake and body weight loss among adolescents, stress results in increased food intake and body weight gain (30). Low physical activity is a co-existing factor that leads to the development of obesity among stressed adolescents (30). Eating is one of the behaviors that may be affected as a result of the response to acute or chronic stress, especially in adolescence (31, 32). In addition, the severity of stress is a factor that explains food consumption as a response to stress. Table 1 shows the summary of the following results based on stress severity and food consumption.

**Table 1.** Stress severity and more food consumption

Athour (year)	Stress severity	More frequent food consumption
Jaarsveld et al. (2009)	Moderate-Severe	Sweet and high fat
Michaud et al. (1990)	Mild-Severe	High fat
Cartwright et al. (2003)	Severe	High fat and snacks but Low fruits and vegetables
Sproesser et al. (2013)	Not reported	Ice-cream
Oliver et al. (2000)	Not reported	Sweet and high fat and snacks

Jaarsveld et al. (33) showed the association between stress and BMI, and waist circumferences among 4,065 adolescents (mean age of 11-16 years old). Adolescents under moderate or severe stress levels had significantly higher BMI, waist circumference ( $P < 0.05$ ) and they consumed more sweet and high fat foods compared to adolescents with a mild stress level. Michaud et al. (34) conducted a study to assess the eating behavior changes during stress among 225 male and female adolescents with stress levels from mild to severe. The stress was school exam week and the energy intake of the students was determined. They showed that energy intake among stressed adolescents was significantly higher than others ( $2,225 \pm 49$  kcal versus  $2,074 \pm 48$  kcal, respectively,  $P \leq 0.01$ ). In addition, they had a higher consumption of high fat foods. They concluded that higher stress levels might significantly change the eating habits of students. Moreover, Cartwright et al. (35) indicated that unhealthy food choices among stressed adolescents might result in long-term diseases.

Cartwright et al. (35) investigated dietary practices among 4,320 adolescents (mean age of 11.83 years). Students who were stressed had a higher intake of fatty food and snacks but a lower consumption of breakfast and intake of fruits and vegetables compared to students without stress. They stated that the effect of stress on food intake was independent of gender, body weight and socioeconomic status. Sproesser et al. (36) reported that ice cream was a popular food choice among 152 stressed males and females ( $P = 0.01$ ). They showed that participants suffering stress lost their normal eating pattern, and demonstrated that the body's response to stress for increasing or decreasing weight is based on the positive or negative situation that a person faces. Another study (37) revealed the effect of stress in respect to the eating behavior of 212 adolescents. Stress affected both eating and health through increasing the intake of sweet and high fat foods. The participants had a higher intake of snacks ( $t = 2.66$ ,  $P < 0.05$ ) compared to normal adolescents.

### 3.2. Gender

Gender differences in developing obesity among stressed adolescents were reported differently in some studies, in that some studies reported that being female is a risk factor to develop obesity due to stress, while some reported that there is no difference between genders (16, 38). Oliver and Wardle (39) showed that gender among adolescents (63 men and 149 women) is a factor in developing weight gain due to stress. The factor that can make gender an influencing item is food choice. Oliver and Wardle revealed that increasing snacks in males and females did not show a significant difference, while stressed female students had a higher intake of sweets and chocolates compared to males ( $X^2 = 10.9$ ,  $P < 0.01$ ). Another study, by Young-Hyman et al. (40), assessed the overweight or obesity among adolescents ( $11.9 \pm 2.5$  years old) with the status of chronic stress. Their results showed that female adolescents were more likely than male adolescents to become obese ( $P < 0.01$ ). In addition, girls had more body dissatisfaction and higher weight-related distress than boys ( $P < 0.001$ ). Weinstein et al. (41) performed a cross-sectional study among 101 men and women with the aim of assessing the relationship between stress and changes in food intake. They indicated that stressed females overate than males ( $r=0.51$ ,  $P < 0.001$ ) and that stress led them to eating disorder behaviors. Women showed a high score for disinhibition, which correlated with eating more than usual ( $r=0.51$ ,  $P < 0.001$ ).

### 3.3. Economic status

Income is a psychological stressor among adolescents in low-income families but not for those who are not (42). Obviously, household economic status influences eating behavior. However, economic status itself is a risk factor for stress, inasmuch as stressed adolescents cannot have a similar eating behavior to adolescents with high-level economic status. In a cohort study by Gortmaker et al. (43) among adolescents and young adults, stress situation in poor family or in low economic status had a significant inverse association with obesity. In this longitudinal nation survey, ethnicity was a significant factor for eating behavior. On the other hand, students with low socioeconomic status did not have an adequate food intake. Gortmaker showed that eating behavior when stressed and being overweight or obese was affected by economic status.

## 4. Discussion

This review indicated that stressed adolescents are at risk of developing obesity. The eating behavior is mainly prevalent among those adolescents who are stressed. The biological pathway from stress to obesity may affect the eating pattern of adolescents. The response of adolescents to stress is a biological as well as a behavioral response that includes overeating and low physical activity. Oliver et al. (37) explained that stress can affect eating and health through mechanisms, such as reducing food intake in the short-term but increasing the intake of sweet and high fat foods, slow gastric emptying, increasing blood pressure and activation of adrenaline in the long-term. Moreover, Sinha and Jastreboff (44) believed that stress is a common risk factor for obesity and can induce appetite. They indicated that stress could lead to obesity not only by increasing food intake but also through different food choices. In contrast, Grunberg and Straub (45) reported that stressed men demonstrated less food consumption while stressed women had significantly increased food consumption. They concluded that the relation between stress and overeating depended on the gender of the participants.

The influence of stress on behavior and the biological pathways in adolescents can increase body weight, since stress influences health behavior (46). Impaired biological and behavioral pathways can result in the selection of special foods (high calorie, high fat and high sugar), emotional eating and lack of sleep. However, the strategies to cope with stress are different and lead to different eating behavior (47, 48). A Finnish study among 45,810 men and women revealed that stress-related eating was significantly associated with obesity. They reported that eating and

drinking made women feel better in a stressful situation (49). Therefore, obese people usually consume more foods in stressful situations compared to normal persons.

Stress can affect dietary behavior, which may lead to weight changes in the long-term and short-term; however, this process is less clear (50). A healthy diet is a factor that is negatively associated with a stressful status, especially in female adolescents or adults. Females with higher stress eat a less healthy diet and gain more weight (51). Moreover, Coccia et al. (52) showed increasing weight among stressed adolescents (15-16 years old). They indicated that stress in adolescents could lead to unhealthy eating behavior. Stress induces eating, especially of nutrient-dense foods and foods with high sugar and fat (53).

The response to stress is different between genders (47). Although Ogden et al. (38) indicated that there are no differences in gender for obesity rates among adolescents, in a cross-sectional study, Zeigler-Johnson et al. (54) showed that among different ethnicities in the U.S., gender was a risk factor for obesity. In line with the results of the current study, Zellner et al. (55) revealed that the eating pattern during stress is significantly different for women and men ( $X^2 = 10.85$ ,  $P < 0.01$ ). They reported that stressed women increased their food consumption more than men. Ptacek et al. (56) showed that in controlled laboratory conditions, despite the similar cognitive status, women and men did not use the same method to cope with stress. Females tried to have an emotion-focused coping, while men used problem-focused coping. In addition, oral or eating response to cope with stress is significantly different between genders. Women prefer to eat more food, particularly high caloric foods, while the strategies to cope with stress for men are smoking or the consumption of alcohol as an oral behavior (48, 57). Economic status can affect body weight status due to food intake insecurity. The accessibility to sufficient food among adolescents in a poor family is not adequately facilitated. This relationship between economic status, stress and obesity is global; however, this association is not completely clear (12). Sobal et al. (58) reported a strong association between obesity and socio-economic status among 44 published studies. In contrast, in a study by Janssen et al. (59), among 6,684 adolescents, socio-economic status was inversely associated with obesity. Adolescents in low wealth families had a poorer diet and less physical activity (59, 60).

The findings of this review are in line with the findings of previous studies. Since most of the studies were based on the self-report of weight and height, the findings need to be interpreted cautiously to decrease the bias. Furthermore, laboratory studies are needed to measure the stress level in acute or chronic stress to demonstrate significant overeating. Moreover, physical activity should be given proper consideration in studies on obesity. When determining the increasing body weight among stressed adolescents, it is important to consider both energy intake as well as energy expenditure. One of the strengths of this study is the interpretation of the contributing factors among stressed adolescents to become obese. In addition, the current study demonstrates eating behavior in stress mood.

One of the strengths of this review was highlighting the dietary changes and obesity as well as stress in adolescence. Adolescents are usually ignored while the fundamental changes (psychological, behavioral and or dietary intakes) take place during this phase. Moreover, this review pays attention to the role of stress in causing changes among adolescents. Furthermore, studies should be performed on the role of other contributing factors, such as increasing age, using drugs and being overweight or underweight at the time of facing stress in correlation to stress and obesity.

## 5. Conclusion

According to previous research, stress can lead to developing obesity among adolescents. This means that stress due to biological changes can increase body weight and lead to obesity among adolescents. The highlighted outcome of stress among adolescents is lower physical activity and higher body weight, which is more obvious among female adolescents. The reason for this gender difference is not clear. Gender and socioeconomic status are two important factors among adolescents that can affect the concept of stress during this time.

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## Conflict of Interest:

There is no conflict of interest to be declared.

## Authors' contributions:

All of authors contributed to this project and article equally. All authors read and approved the final manuscript.

## References

1. Sherwood L. Human physiology from cells to systems.(4th ed.)Brooks/Cole, California; 2001.
2. Pervanidou P, Chrousos GP. Stress and obesity/metabolic syndrome in childhood and adolescence. *Int J PediatrObes.* 2011;6Suppl 1:21-8. doi: 10.3109/17477166.2011.615996
3. Jones TL. Definition of stress. In J.J. Robert-McComb (Ed.), *Eating Disorders in Women and Children: Prevention, Stress Management, and Treatment.* Boca Raton, FL: CRS Press. 2001:89-100.
4. Vriendt T, Moreno LA, De Henauw S. Chronic stress and obesity in adolescents: Scientific evidence and methodological issues for epidemiological research. *Nutrition, Metabolism and Cardiovascular Diseases.* 2009;19(7):511–519.
5. Epel E, Lapidus R, McEwen B, et al. Stress may add bite to appetite in women: a laboratory study of stress-induced cortisol and eating behavior. *Psychoneuroendocrinology.* 2001;26:37-49.
6. Cavagnini F, Croci M, Putignano P, et al. Glucocorticoids and neuroendocrine function. *International Journal of Obesity.* 2000;24: S77-S79.
7. World Health Organization. Childhood overweight and obesity. *Global Strategy on Diet, Physical Activity and Health;* 2013. <http://www.who.int/dietphysicalactivity/childhood/en/>
8. Freedman DS, Mei Z, Srinivasan SR, Berenson GS, Dietz WH. Cardiovascular risk factors and excess adiposity among overweight children and adolescents: the Bogalusa Heart Study. *J Pediatr.* 2007;150(1):12-17.
9. Singh AS, Mulder C, Twisk JW, van Mechelen W, Chinapaw MJ. Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obes Rev.* 2008;9(5):474-488.
10. Bhatia V, Tandon RK. Stress and the gastrointestinal tract. *J GastroenterolHepatol.* 2005;20:332–339.
11. Hammer M, Stamatakis E. Inflammation as an intermediate pathway in the association between psychosocial stress and obesity. *PhysiolBehav.* 2008; 94:536–539.
12. Gundersen C, Mahatmya D, Garasky S, Lohman B. Linking psychosocial stressors and childhood obesity. *Obesity Reviews.* 2011;12(5):54–e63.
13. Merikangas KR, He JP, Burstein M, et al. Lifetime Prevalence of Mental Disorders in U.S. Adolescents: Results from the National Comorbidity Survey Replication–Adolescent Supplement (NCS-A). *Journal of the American Academy of Child & Adolescent Psychiatry.* 2010;49(10):980–989.
14. Fan F, Zhang Y, Yang Y, Mo L, Liu X. Symptoms of posttraumatic stress disorder, depression, and anxiety among adolescents following the 2008 Wenchuan earthquake in China. *Journal of Traumatic Stress.* 2011;24(1):44–53
15. Al-Gelban KS, Al-Amri HS, Mostafa OA. Prevalence of Depression, Anxiety and Stress as Measured by the Depression, Anxiety, and Stress Scale (DASS-42) among Secondary School Girls in Abha, Saudi Arabia. *Sultan Qaboos Univ Med J.* 2009;9(2):140–147.
16. Swallen KC, Reither EN, Haas SA, Meier AM. Overweight, obesity, and health-related quality of life among adolescents: the National Longitudinal Study of Adolescent Health. *Pediatrics.* 2005;115:340–347. doi:10.1542/peds.2004-0678
17. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of Obesity and Trends in Body Mass Index Among US Children and Adolescents, 1999-2010. *JAMA.* 2012;307(5):483-490. doi:10.1001/jama.2012.40
18. National Center for Health Statistics. *Health, United States, 2011: With Special Features on Socioeconomic Status and Health.* Hyattsville, MD; U.S. Department of Health and Human Services; 2012.
19. Ogden CL, Carroll MD, Curtin LR, et al. Prevalence of high body mass index in US children and adolescents, 2007–2008. *JAMA.* 2010;303:242–249. doi:10.1001/jama.2009.2012
20. Sorof JM, Lai D, Turner J, Poffenbarger T, Portman RJ. Overweight, ethnicity, and the prevalence of hypertension in school-aged children. *Pediatrics.* 2004;113:475–482.
21. Goran MI, Ball GD, Cruz ML. Obesity and Risk of Type 2 Diabetes and Cardiovascular Disease in Children and Adolescents. *J ClinEndocrinolMetab.* 2003;88:1417–1427.
22. Onyike CU, Crum RM, Lee HB, Lyketsos CG, Eaton WW. Is Obesity Associated with Major Depression? Results from the Third National, Health and Nutrition Examination Survey. *American Journal of Epidemiology,* 2003;158(12):1139-1147.
23. Roberts RE, Kaplan GA, Shema SJ, et al. Are the obese at greater risk for depression? *Am J Epidemiol.* 2000;152:163–70.
24. Faubel M. Body image and depression in women with early and late onset obesity. *J Psychol.* 1989;123:385–95.
25. Hammerton G, Thapar A, Thapar AK. Association between obesity and depressive disorder in adolescents at high risk for depression. *Int J Obes (Lond);* 2013.doi: 10.1038/ijo.2013.133

26. Wardle J, Cooke L. The impact of obesity on psychological well-being. *Best Pract Res ClinEndocrinolMetab.* 2005;19(3):421-440.
27. Stunkard AJ, Faith MS, Allison KC. Depression and obesity. *Biol Psychiatry.* 2003;54:330-337. doi:10.1016/S0006-3223(03)00608-5
28. Faith MS, Matz PE, Jorge MA. Obesity-depression associations in the population. *J Psychosom Res.* 2002;53:935-942. doi:10.1016/S0022-3999(02)00308-2
29. da Costa, B. R., M. Cevallos, D. G. Altman, A. W. S. Rutjes and M. Egger (2011). "Uses and misuses of the STROBE statement: bibliographic study." *BMJ Open* 1(1).
30. Dallman MF, Pecoraro N, Akana SF, et al. Chronic stress and obesity: A new view of "comfort food". *Proceeding of the National Academy of Sciences of the United States of America.* 2003;100(20):11696-11701.
31. Wardle J, Gibson EL. Impact of stress on diet: process and implications. In S. Stansfield, M. Marmot (Eds.), *Stress and the heart. Psychosocial pathways to coronary heart disease*, BMJ Publishing Group, London. 2002:124-149.
32. Takeda E, Terao J, Nakaya Y, et al. Stress control and human nutrition. *J Med Invest.* 2004;51:139-145.
33. Jaarsveld CHM, Fidler JA, Steptoe A, Boniface D, Wardle J. Perceived Stress and Weight Gain in Adolescence: A Longitudinal Analysis. *Obesity.* 2009;17(12):2155-2161.
34. Michaud C, Kahn JP, Musse N, Bulet C, Nicolas JP, Mejean L. Relationships between a critical life event and eating behaviour in high-school students. *Stress Medicine.* 1990;6(1):57-64
35. Cartwright M, Wardle J, Steggle N, Simon AE, Croker H, Jarvis MJ. Stress and dietary practices in adolescents. *Health Psychology.* 2003;22(4):362-369.
36. Sproesser G, Schupp HT, Renner B. The Bright Side of Stress-Induced Eating: Eating More When Stressed but Less When Pleased. *Psychological Science*, Published online,28, 2013, doi:10.1177/0956797613494849
37. Oliver G, Wardle J, Gibson EL. Stress and Food Choice: A Laboratory Study. *Psychosomatic Medicine.* 2000;62(6):853-865.
38. Erickson SJ, Robinson TN, Haydel KF, Kil-len JD. Are overweight children unhappy? Body mass index, depressive symptoms, and overweight concerns in elementary school children. *Arch PediatrAdolesc Med.* 2000; 154(9):931-935.
39. Oliver G, Wardle J. Perceived Effects of Stress on Food Choice. *Physiology & Behavior.* 1999; 66(3):511-515.
40. Young-Hyman D, Tanofsky-Kraff M, Yanovski SZ, et al. Psychological status and weight-related distress in overweight or at-risk-for-overweight children. *Obesity.* 2006;14 (12):2249-2258.
41. Weinstein SE, Shide DJ, Rolls BJ. Changes in Food Intake in Response to Stress in Men and Women: Psychological Factors. *Appetite.* 1997;28:7-18.
42. Taylor SJC, Viner R, Booy R, et al. Ethnicity, socio-economic status, overweight and underweight in east London adolescents. *Ethnicity and Health*, 2005;10(2):113-128.
43. GortmakerSL, Must A, Perrin JM, Sobol AM, Dietz WH. Social and economic consequences of overweight in adolescents and young adulthood. *The New England Journal of Medicine.*1993;329(14):1008-1012.
44. Sinha R, JastreboffAM. Stress as a Common Risk Factor for Obesity and Addiction. *Biological Psychiatry.* 2013;73(9):827-83.
45. Grunberg NE, Straub RO. The role of gender and taste class in the effects of stress on eating. *Health Psychology.* 1992;11(2):97-100.
46. Kumar S, Mahabalaraju KD, Anuroopa MS. Prevalence of obesity and its influencing factor among affluent school children of Devanagere City. *Indian Journal of Community Medicine.* 2007;32:15-7.
47. Matud MP. Gender differences in stress and coping styles. *Personality and Individual Differences.* 2004;37(7):1401-1415.
48. Mehlum L. Alcohol and stress in Norwegian United Nations peacekeepers. *Mil Med.* 1999;164:720-724.
49. Kouvonen A, Kivimaki M, Cox SJ, Cox T, Vahtera J. Relationship between work stress and body mass index among 45,810 female and male employees. *Psychosom Med.* 2005;67:577-583.
50. Block JP, He Y, Zaslavsky AM, Ding L, Ayanian JZ. Psychosocial stress and change in weight among US adults. *American Journal of Epidemiology.* 2009;170(2):181-192.
51. Moore CJ, Cunningham SA. Social Position, Psychological Stress, and Obesity: A Systematic Review. *Journal of the Academy of Nutrition and Dietetics.* 2012;112(4):518-526.
52. Coccia C, Darling CA, Cui MRM, Sath SK. Adolescent Health, Stress and Life Satisfaction: The Paradox of Indulgent Parenting. *Stress and Health.* 2012;28(3):211-221.

53. Torres SJ, Nowson CA. Relationship between stress, eating behavior, and obesity. *Nutrition*. 2007;23(11-12):887-894.
54. Zeigler-Johnson C, Weber A, Glanz K, Spangler E, Rebbeck TR. Gender- and ethnic-specific associations with obesity: individual and neighborhood-level factors. *J Natl Med Assoc*. 2013;105(2):173-82.
55. Zellner DA, Loaiza S, Gonzalez Z, Pita J, Morales J, Pecora D, Wolf A. Food selection changes under stress. *Physiology & Behavior*. 2006;87(4):789-793.
56. Ptacek JT, Smith RE, Dodge KL. Gender Differences in Coping with Stress: When Stressor and Appraisals Do Not Differ. *Pers Soc Psychol Bull*. 1994;20(4):421-430.
57. Gentry LA, Chung JJ, Aung N, Keller S, Heinrich KM, Maddock JE. Gender Differences in Stress and Coping among Adults living in Hawai'i. *Californian Journal of Health Promotion*. 2007;75(2):89-102
58. Sobal J, Stunkard AJ. Socioeconomic status and obesity: A review of the literature. *Psychological Bulletin*. 1989;105(2):260-275.
59. Janssen I, Boyce T, Simpson K, Pickett W. Influence of individual- and area-level measures of socioeconomic status on obesity, unhealthy eating, and physical inactivity in Canadian adolescents. *American Journal of Clinical Nutrition*. 2006;83:139-145.
60. Hanson MD, Chen E. Socioeconomic status and health behaviors in adolescence: a review of the literature. *J Behav Med*. 2007;30(3):263-85..