

BMI Correlation with Psychiatric Problems Among 10-18 Years Iranian Students

Marjan Zakeri, Mojtaba Sedaghat, Mohammad Esmacil Motlagh, Reza Tayari Ashtiani, and Glayol Ardalan

Department of Community Medicine, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

Received: 20 Feb. 2011; Received in revised form: 29 Oct. 2011; Accepted: 14 Dec. 2011

Abstract- Obesity and its related emotional and physical consequences are a worldwide problem. Obese individuals are usually stigmatized. This study is proposed to assess the correlation between body mass index, gender and age with psychiatric symptoms among Iranian students. A number of 9172 students aged 10-18 years (53.5% girls and 46.5% boys) from all provinces of Iran participated in this study. Data was collected using the global school based health survey questionnaire of the World Health Organization (GSHS-WHO). Overall, prevalence of predictors of having emotional problems, depression and anxiety were 27.8%, 29.7% and 11.5% respectively. Girls had significantly higher prevalence of predictors of psychiatric symptoms. Overall obesity was a protective factor against emotional problems OR (CI95%):0.79(0.65-0.98), but it was attributable to obese boys OR (CI95%):0.72(0.55-0.95). Depression and anxiety symptoms were higher in intermediate school girls and high school girls and boys. More attention should be paid to girls' psychological problems. Besides, obesity had an indirect relation with predictors of having psychiatric problems in Iranian boys and it might be due to: (1) parents' beliefs about heaviness as a predictor of healthiness, (2) boys' lower vulnerability to psychological consequences of obesity and (3) lower pressure from parents on their obese sons to lose weight.

© 2012 Tehran University of Medical Sciences. All rights reserved.

Acta Medica Iranica, 2012; 50(3): 177-184.

Keywords: Child; Body mass index; Depression; Anxiety; Emotion; Iran

Introduction

Increasing evidence suggests a rise in children's mental health problems (1-3); moreover, undeniably obesity is increasing among children worldwide (4-7). It has been shown that, the prevalence of obesity and overweight are 5-8% and 12.3% respectively in a sample of Iranian students (8). In addition, according to another study in Iranian students the prevalence of underweight, overweight and obesity were 16.2%, 8.6% and 1.5% respectively (9). It seems that the prevalence of underweight, overweight and obesity among Iranian students has a different pattern from most of the other countries. On the other hand, studies have shown that obesity correlates with physical (5-7,10-13) and emotional health problems (17-21). Major depression, panic disorder and agoraphobia are more frequent among obese individuals and they are usually stigmatized (22-24). According to our knowledge, no survey has been carried out to evaluate the presence of this correlation among Iranian students. Moreover, we

think that because of the cultural differences, it is essential to assess the correlation between genders, age and body mass index with having psychiatric problems among Iranian adolescents.

Materials and Methods

Data of our study come from the Global School-based Health Survey (GSHS) questionnaire about health related behaviors among school children aged 10-18 years living in all provinces of Iran. The GSHS questionnaire is designed by the World Health Organization (WHO) to assess the student's condition in different areas; the data related to many other countries have been reported previously (<http://www.who.int/chp/gshs/datasets/en/index.htm>). The questionnaires validity was evaluated by specialists after translation; then in order to assess the quality of questions 2 pilot studies were carried out on 120 urban and rural students in one of the regions around Tehran (Islamshahr). After each pilot study, the questions with any difficulty in

Correspondent Author: Mojtaba Sedaghat

Department of Community Medicine, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran
Tel/Fax: +98 21 88962357, E-mail: sedaghat.dr@gmail.com

BMI correlation with psychiatric problems

understanding were modified. In the next step, the questionnaire validation was assessed divided by each group of questions related to a specific item (ex. mental health) (the Cronbach's reliability coefficient >0.7).

To collect the data, according to children population in each region of Iran also the population of children attending each grade, appropriate number of schools was randomly selected. In the next step, the schools were chosen to use table of random numbers to enter the survey; In each school, two classes were selected from each level randomly and in order to randomize the students in each class, we decided to enter only the students sitting in the first and the last row tables in the study. The demographic variables include participants' gender and grade (Primary (10-11years), Intermediate (12-14years) and High (15-18years) school). Students' height and weight were measured by accurate balance after answering the questions. Respondents' BMI (Body Mass Index: measured weight in kilograms divided by the square of measured height in meters) was categorized according to growth charts developed by Center for Disease Control (CDC) (1).

Participants' emotional status was assessed by questions shown in table 2. If the answer to at least 3 out of the first 5 questions was C or D, or the answer to 3 or more questions was B, it would count on as a predictor of having *Emotional Problems*. A positive answer to the 6th question was of value as a predictor of having *depressive problem*. In the last question the answers D or E was taken as a predictor of having *anxiety problem*. Logistic regression carried out for 3 outcomes to elicit their correlation with BMI, gender and grade.

Statistical analysis

Overall, 9172 Iranian students participated in the GSHS survey (2006-7). After excluding questionnaires not properly filled, we analyzed data from 8460 participants. Data was analyzed using SPSS software. Logistic regression was carried out to compare the prevalence of predictors of having emotional, depressive and anxiety problems among different subcategories. Odd ratios (OR) evolved from the regression model with confidence interval (CI)>95% count on showing significant difference.

Table 1. List of questions to screen psychiatric problem.

1.	During the past 6 months how often have you felt worthless?
2.	During the past 6 months how often have you got angry too soon?
3.	During the past 6 months how often have you felt anxious?
4.	During the past 6 months how often have you had a bad sleep?
5.	During the past 6 months how often have you felt dizzy or confused?
A.	Never or rarely
B.	Once in a week
C.	More than once in a week
D.	Nearly every day
6.	During the past 12 months, have you had 2 complete weeks of sadness preventing from your routine activities?
A.	Yes
B.	No
7.	During the past 12 months, how often have you been so worried about something that you could not sleep at nights?
A.	Never
B.	Rarely
C.	Sometimes
D.	Most of the time
E.	Always

Table 2. Demographic characteristics.

		n (%)	n (%)	
Gender	Boys	4524(53.5)		
	Girls	3936(46.5)		
School level	Primary	1534(18.1)	Boys	778(50.7)
			Girls	756(49.3)
	Intermediate	3664(43.3)	Boys	2099(57.3)
			Girls	1565(42.7)
	High	3262(38.6)	Boys	1647(50.5)
			Girls	1615(49.5)

Human subjects' approval statement: Participation was voluntary, refusal to participate involved no penalty or loss of benefits to which the subject was otherwise entitled, and the subject may discontinue participation at any time without penalty or loss of benefits.

Results

Demographic characteristics of students are presented in table 2 and body mass index distribution is shown in table 3.

Descriptive features of predictors of having emotional, depressive and anxiety problems are shown in table 4.

Unadjusted odd ratio of predictors of having emotional, depressive and anxiety problems among subjects in subcategories of BMI, gender and school level are exhibited in table 4.

Having psychiatric problems and BMI subcategories

Prevalence of predictors of having emotional problems among obese students is significantly less frequent [OR: 0.79 (0.65-0.98)] than students with normal BMI while predictors of having depressive or anxiety problems, respectively, had no significance among obese students versus normal weight students [OR: 1.03(0.85-1.25)], [OR: 0.79(0.58-1.06)]; according to table 5, this significance is attributable to obese boys.

Table 3. Body mass index distribution.

	n (%)		n (%)		n (%)		
Underweight	789(9.5)	Boys	468 (10.5)				
		Girls	321 (8.3)				
		Primary	193 (12.7)	Boys	111(14.3)		
				Girls	82(11)		
			Intermediate	348 (9.6)	Boys	214(10.3)	
				Girls	134(8.6)		
		High		248 (7.8)	Boys	143(8.9)	
				Girls	105(6.7)		
			Normal weight	6154(73.8)	Boys	3222 (72.1)	
		Girls			2932 (75.7)		
		Primary			1087 (71.4)	Boys	544(70.2)
						Girls	543(72.7)
Intermediate	2670 (73.4)				Boys	1511(72.4)	
		Girls			1159(74.7)		
	High	2397 (75.4)			Boys	1167(72.6)	
		Girls			1230(78.2)		
Overweight		858(10.3)			Boys	445 (10)	
	Girls				413 (10.7)		
	Primary				149 (9.8)	Boys	71(9.2)
						Girls	78(10.4)
			Intermediate	388 (10.7)	Boys	217(10.4)	
				Girls	171(11)		
	High			321 (10.1)	Boys	157(9.8)	
				Girls	164(10.4)		
			Obese	538(6.5)	Boys	333 (7.5)	
	Girls				205 (5.3)		
	Primary				93 (6.1)	Boys	49(6.3)
						Girls	44(5.9)
Intermediate		231 (6.4)			Boys	144(6.9)	
		Girls			87(5.6)		
	High	214 (6.7)			Boys	140(8.7)	
		Girls			74(4.7)		

Table 4. Descriptive features and unadjusted odd ratios (ORs).

		Emotional problems n (%) OR (CI95%)	Depressive problems n (%) OR (CI95%)	Anxiety problems n (%) OR (CI95%)
BMI	Underweight	209(26.5) 0.91(0.77-1.07)	197(25) 0.77(0.65-0.91)	74(9.4) 0.76(0.59-0.98)
	Normal weight	1742(28.3)	1853(30.1)	732(11.9)
	Overweight	238(27.7) 0.97(0.82-1.14)	259(30.2) 1.00(0.85-1.17)	106(12.4) 1.04(0.84-1.29)
	Obese	129(24) 0.79(0.65-0.98)	166(30.9) 1.03(0.85-1.25)	52(9.7) 0.79(0.58-1.06)
Gender	Boy	1210(26.7)	1243(27.5)	382(8.4)
	Girl	1140(29) 1.11(1.01-1.22)	1267(32.2) 1.25(1.14-1.37)	593(15.1) 1.92(1.67-2.2)
School level	Primary	448(29.2)	332(21.6)	112(7.3)
	Intermediate	983(26.8) 0.88(0.77-1.01)	998(27.2) 1.35(1.17-1.56)	401(10.9) 1.56(1.25-1.94)
	High	919(28.2) 0.95(0.83-1.08)	1180(36.2) 2.05(1.78-2.36)	462(14.2) 2.09(1.68-2.60)
total		6110(27.8)	2510(29.7)	975(11.5)

On the other hand, predictors of having depressive and anxiety problems were significantly less frequent among underweight students versus normal weight students [OR: 0.77(0.65-0.91)], [OR: 0.76(0.59-0.98)]; this significance in predictor of having depressive problems is attributable to underweight girls in comparison with normal weight girls also to underweight intermediate and high school students versus normal weight intermediate and high school students; however, the significance in predictor of having anxiety in underweight students versus normal weight students was not attributable to a particular subgroup.

As shown in table 5, underweight girls in comparison with normal weight girls have significantly lower predictor of having depressive problems [OR: 0.72(0.56-0.94)]; moreover, underweight intermediate and high school students in comparison with normal weight intermediate and high school students, significantly have fewer predictor of depressive symptoms [OR: 0.76(0.58-0.99)], [OR: 0.74(0.56-0.99)]. Besides, the prevalence of predictors of having anxiety problems is higher in an expressive way in overweight primary school students [OR: 1.91(1.12-3.27)] in comparison with normal weight primary school students.

Table 5. Adjusted odds ratios(ORs) to other individuals in the same gender or grade but with normal BMI.

		Emotional problems OR (CI95%)	Depressive problems OR (CI95%)	Anxiety problems OR (CI95%)
Underweight	Boy	0.96(0.77-1.20)	0.82(0.66-1.03)	0.84(0.58-1.22)
	Girl	0.85(0.66-1.11)	0.72(0.56-0.94)	0.76(0.54-1.08)
	Primary school	0.97(0.69-1.36)	1.08(0.74-1.56)	0.79(0.41-1.52)
	Intermediate school	0.91(0.71-1.18)	0.76(0.58-0.99)	0.73(0.49-1.08)
	High school	0.85(0.63-1.15)	0.74(0.56-0.99)	0.89(0.61-1.31)
Overweight	Boy	1.01(0.81-1.26)	0.89(0.71-1.12)	1.24(0.89-1.73)
	Girl	0.92(0.73-1.16)	1.11(0.90-1.38)	0.91(0.68-1.22)
	Primary school	1.16(0.80-1.67)	1.24(0.83-1.85)	1.91(1.12-3.27)
	Intermediate school	0.90(0.70-1.14)	1.07(0.84-1.35)	0.86(0.61-1.23)
	High school	0.97(0.75-1.26)	0.88(0.69-1.12)	1.02(0.74-1.42)
Obese	Boy	0.72(0.55-0.95)	1.00(0.78-1.29)	0.87(0.57-1.34)
	Girl	0.93(0.68-1.28)	1.13(0.84-1.52)	0.81(0.53-1.24)
	Primary school	0.65(0.39-1.08)	1.16(0.70-1.92)	0.59(0.21-1.64)
	Intermediate school	0.76(0.55-1.05)	1.07(0.80-1.45)	0.89(0.58-1.39)
	High school	0.90(0.66-1.24)	0.95(0.71-1.27)	0.73(0.47-1.14)

Table 6. Adjusted odds ratios(ORs) to other individuals with the same gender but in primary school.

		Emotional problems OR (CI95%)	Depressive problems OR (CI95%)	Anxiety problems OR (CI95%)
Boy	Primary school			
	Intermediate school	0.73(0.61-0.88)	1.06(0.87-1.29)	1.30(0.94-1.79)
	High school	0.80(0.66-0.96)	1.59(1.31-1.93)	1.40(1.01-1.95)
Girl	Primary school			
	Intermediate school	1.10(0.91-1.34)	1.80(1.46-2.22)	1.91(1.42-2.58)
	High school	1.13(0.93-1.37)	2.66(2.16-3.26)	2.76(2.06-3.70)

According to table 5, obese boys show lower prevalence of predictors of having emotional problems in comparison with boys of normal BMI group [OR: 0.72(0.55-0.95)]. According to table 8, intermediate and high school boys have significantly lower prevalence of predictors of having emotional problems [OR: 0.73(0.61-0.88)], [0.80(0.66-0.96)] while, girls from the same school grade showed no significance in comparison with primary school girls [OR: 1.10(0.91-1.34)], [OR: 1.13(0.93-1.37)].

Having psychiatric problems and gender subcategory

According to table 4, prevalence of predictors of having emotional, depressive and anxiety problems are significantly higher among girls in comparison with boys [OR: 1.11(1.01-1.22)], [OR: 1.25(1.14-1.37)], [OR: 1.92(1.67-2.2)]; as shown in table 5, this significance was not attributable to a particular BMI group of girls, but considering table 6, it was attributable to intermediate and high school girls versus primary school girls.

Having psychiatric problems and grade subcategories

Table 4 also shows that predictors of having depressive and anxiety problems are higher among intermediate and high school students in comparison with primary school students, while predictor of having emotional problems showed no significance in intermediate and high school students in comparison with primary school students. The significance in predictors of having depressive and anxiety problems is not attributable to a particular BMI subcategory among intermediate and high school students (Table 5), but according to table 6, higher prevalence of depressive and anxiety problems is attributable to intermediate and high school girls and high school boys respectively versus primary school girls and boys.

Discussion

According to our knowledge, it is the first population-based study assessing the relationship between BMI and psychiatric symptoms in Iranian students. In our study, the prevalence of overweight/obesity is higher than Chinese (26) and Pakistani (28) students as two developing countries; while, it is lower than Canadian (28) and Texas (29) children and adolescents as two developed countries. We propose that these findings might be in relation with less than recommended standard fat intake that was seen in Pakistani students (30). On the other hand, the dietary trends in the United States as an example of a developed country are more complicated than those found in the developing world (31) and might be another reason for this difference. In the United States, daily caloric intake appears to be increasing primarily from high-energy, low-nutrient foods and an increase in snacks (32-37). More meals are being consumed in restaurants (32-34,36) and restaurants offer increased portion sizes (32,38); fast foods are usually more energy dense and might be linked to obesity (39-44).

The present study shows that students' BMI, gender and school level are related to their emotional problems. These findings reveal that predictors of having emotional problems is particularly lower among obese children that are attributable to boys; besides, predictors of having depressive/anxiety problems are not higher in this group; on the other hand, predictors of having depressive/anxiety problems are significantly lower among underweight students and it is attributable to underweight girls. There is no data on the prevalence of psychiatric problems categorized by BMI in Iran but studies in developing countries show that awareness of weight problems is particularly low in preschool children (45) and, unfortunately, heaviness may be considered as an indicator of good health for children (46); we propose that it might be the reason for the lower prevalence of predictors of having emotional

BMI correlation with psychiatric problems

problems among obese students. Moreover, possible effect of obesity in reduction of predictors of having emotional problems is statically attributable to boys and seems to have some underlying reasons in families to put lower pressure on their overweight/obese sons to lose weight rather than their overweight/obese daughters, so that, in a study in Iranian children, it has been reported that overweight/obese boys engaged in weight loss programs, one fourth of the girls (47). Studies in developed countries also exhibited higher acceptance among mothers for higher weight among their sons rather than their daughters (48). Additionally, it seems that boys are less vulnerable to psychological consequences of obesity, and there is lower social pressure on them to be thin (49).

The relationship between anxiety and depression with elevated BMI has been evaluated in a few studies with various methods (50-53); in the Pine *et al.*, study depression during childhood was positively associated with elevated BMI during adulthood (50); the reason for this diversity in the results might be the method of Pine *et al.*, study which was a prospective study carried out during a 10-15 years period (50); in the Crisp and McGuinness study, A significant positive relation was found between substantial obesity and low levels of anxiety and depression; the reason of this diversity might be the higher age of subjects and living in suburban regions (51). Anderson *et al.*, study had results against our study which might be the result of the different method (a 20 years prospective study) (52). Erickson *et al.*, found a positive relationship between higher BMI and depressive symptoms only among preadolescent girls but not preadolescent boys; their study was a cross sectional one that might be the reason for this diversity (53). Studies suggest higher BMI as a risk factor for anxiety (52-53). In our study, the overall prevalence of anxiety symptoms was much lower than other studies (50-52) and did not show any differences in the obese group's predictors of having depressive or anxiety problem in comparison with normal weight group. In our study, being underweight seems as a protective factor against anxiety symptoms that is attributable to underweight girls. Discrepancy may be due to the measurement method and being self reported but it might be a result of girls being more vulnerable to psychological consequences of obesity, and more social pressure on them to be thin (49).

In addition, predictors of having psychiatric problems (emotional problems, depression, anxiety) are more frequent among girls and these problems are significantly more frequent among intermediate (12-

14years) and high school (15-18years) students (it is essential to mention that there was no significant correlation between gender and school grade). About the impact of school grade, this study is a match with other studies (5,16). Girls in the puberty period with any BMI have reported higher undesirability in comparison with boys (55); according to another study (56), diversity in monoamine transmitter function and processing between male and female, may contribute to higher prevalence of psychiatric problems among girls. Moreover, another study have shown that the overall rate of 5-HT synthesis is 48% lower in females in comparison with males (57) increasing the susceptibility for experiencing depression in females. Higher prevalence of psychiatric problems among 12-18 years girls versus 10-11 years girls might be a result of hormonal changes due to puberty which happens in older ages for boys (58) so that in Deecher's article, depression is less frequent in 15-19 years boys in comparison with girls in the same age and even less than 10-14 years girls; our data support Deecher's findings since higher prevalence of predictors of having psychiatric problems were seen in 10-18 years girls but it was only seen in 15-18 years boys and not in younger boys.

This study is a widespread survey in Iran with the purpose of evaluating the anthropometric characteristics on psychological symptoms of adolescents. In conclusion, this study indicates that psychiatric problems are more frequent among girls also among intermediate and high school students; but in our study, having psychiatric problems was not more frequent in obese students. These findings reveal the necessity for paying more attention to this issue in adolescents and it seems essential to pay more attention to inform students and parents about consequences of obesity and the benefits of fitness.

References

1. Syed EU, Hussein SA, Haidry SE. Prevalence of emotional and behavioural problems among primary school children in Karachi, Pakistan: multi informant survey. *Indian J Pediatr* 2009;76(6):623-7.
2. Maughan B, Collishaw S, Meltzer H, Goodman R. Recent trends in UK child and adolescent mental health. *Soc Psychiatry Psychiatr Epidemiol* 2008;43(4):305-10.
3. Tick NT, van der Ende J, Verhulst FC. Twenty-year trends in emotional and behavioral problems in Dutch children in a changing society. *Acta Psychiatr Scand* 2007;116(6):473-82.

4. Office of Surveillance, Epidemiology, and Laboratory Services. Behavioral Risk Factor Surveillance System. Prevalence and Trends Data. Overweight and Obesity (BMI). [Internet] 2009 May 15 [cited 2012 Feb 15]; Available from: <http://apps.nccd.cdc.gov/brfss/list.asp?cat=OB&yr=2009&qkey=4409&state=All>
5. Freedman DS, Khan LK, Serdula MK, Galuska DA, Dietz WH. Trends and correlates of class 3 obesity in the United States from 1990 through 2000. *JAMA* 2002;288(14):1758-61.
6. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA* 2006;295(13):1549-55.
7. Lee IM, Manson JE, Hennekens CH, Paffenbarger RS Jr. Body weight and mortality. A 27-year follow-up of middle-aged men. *JAMA* 1993;270(23):2823-8.
8. Hajian-Tilaki KO, Sajjadi P, Razavi A. Prevalence of overweight and obesity and associated risk factors in urban primary-school children in Babol, Islamic Republic of Iran. *East Mediterr Health J* 2011;17(2):109-14.
9. Montazerifar F, Karajibani M, Rakhshani F, Hashemi M. Prevalence of underweight, overweight and obesity among high-school girls in Sistan va Baluchistan. *East Mediterr Health J* 2009;15(5):1293-300.
10. Anderson SE, Cohen P, Naumova EN, Must A. Association of depression and anxiety disorders with weight change in a prospective community-based study of children followed up into adulthood. *Arch Pediatr Adolesc Med* 2006;160(3):285-91.
11. Dixon JB, Dixon ME, O'Brien PE. Depression in association with severe obesity: changes with weight loss. *Arch Intern Med* 2003;163(17):2058-65.
12. Simon GE, Von Korff M, Saunders K, Miglioretti DL, Crane PK, van Belle G, Kessler RC. Association between obesity and psychiatric disorders in the US adult population. *Arch Gen Psychiatry* 2006;63(7):824-30.
13. Baumeister H, Härter M. Mental disorders in patients with obesity in comparison with healthy probands. *Int J Obes (Lond)* 2007;31(7):1155-64.
14. Bjerkeset O, Romundstad P, Evans J, Gunnell D. Association of adult body mass index and height with anxiety, depression, and suicide in the general population: the HUNT study. *Am J Epidemiol* 2008;167(2):193-202.
15. Carpenter KM, Hasin DS, Allison DB, Faith MS. Relationships between obesity and DSM-IV major depressive disorder, suicide ideation, and suicide attempts: results from a general population study. *Am J Public Health* 2000;90(2):251-7.
16. Sotoudeh G, Mirdamadi SR, Siassi F, Khosravi S, Chamari M. Relationships of overweight and obesity with hormonal and metabolic parameters in hirsute women. *Acta Med Iran* 2003;41(1):37-44.
17. Pabst SR, Negriff S, Dorn LD, Susman EJ, Huang B. Depression and anxiety in adolescent females: the impact of sleep preference and body mass index. *J Adolesc Health* 2009;44(6):554-60.
18. Peralta RL. Thinking sociologically about sources of obesity in the United States. *Gender Issues* 2003;21(3):5-16.
19. Eisenberg ME, Neumark-Sztainer D, Story M. Associations of weight-based teasing and emotional well-being among adolescents. *Arch Pediatr Adolesc Med* 2003;157(8):733-8.
20. Spiotta RT, Luma GB. Evaluating obesity and cardiovascular risk factors in children and adolescents. *Am Fam Physician* 2008;78(9):1052-8.
21. Malhotra A, Hillman D. Obesity and the lung: 3. Obesity, respiration and intensive care. *Thorax* 2008;63(10):925-31.
22. Moayeri H, Rabbani A, Keihanidoust ZT, Bidad K, Anari S. Overweight adolescents: a group at risk for metabolic syndrome (Tehran adolescent obesity study). *Arch Iran Med* 2008;11(1):10-5.
23. Pang W, Sun Z, Zheng L, Li J, Zhang X, Liu S, Xu C, Li J, Hu D, Sun Y. Body mass index and the prevalence of prehypertension and hypertension in a Chinese rural population. *Intern Med* 2008;47(10):893-7.
24. Herva A, Laitinen J, Miettunen J, Veijola J, Karvonen JT, Läksy K, Joukamaa M. Obesity and depression: results from the longitudinal Northern Finland 1966 Birth Cohort Study. *Int J Obes (Lond)* 2006;30(3):520-7.
25. Tang J, Yu Y, Du Y, Ma Y, Zhu H, Liu Z. Association between actual weight status, perceived weight and depressive, anxious symptoms in Chinese adolescents: a cross-sectional study. *BMC Public Health* 2010;10:594.
26. Warraich HJ, Javed F, Faraz-Ul-Haq M, Khawaja FB, Saleem S. Prevalence of obesity in school-going children of Karachi. *PLoS One* 2009;4(3):e4816.
27. Shields M, Tremblay MS. Canadian childhood obesity estimates based on WHO, IOTF and CDC cut-points. *Int J Pediatr Obes* 2010;5(3):265-73.
28. Orsi CM, Hale DE, Lynch JL. Pediatric obesity epidemiology. *Curr Opin Endocrinol Diabetes Obes* 2011;18(1):14-22.
29. Aziz S, Umm-e-Rubab, Noorulain W, Majid R, Hosain K, Siddiqui IA, Manzoor S. Dietary pattern, height, weight centile and BMI of affluent school children and adolescents from three major cities of Pakistan. *J Coll Physicians Surg Pak* 2010;20(1):10-6.
30. Zhai F, Wang H, Du S, He Y, Wang Z, Ge K, Popkin BM. Lifespan nutrition and changing socio-economic conditions in China. *Asia Pac J Clin Nutr* 2007;16 Suppl 1:374-82.

BMI correlation with psychiatric problems

31. French SA, Story M, Neumark-Sztainer D, Fulkerson JA, Hannan P. Fast food restaurant use among adolescents: associations with nutrient intake, food choices and behavioral and psychosocial variables. *Int J Obes Relat Metab Disord* 2001;25(12):1823-33.
32. Nielsen SJ, Siega-Riz AM, Popkin BM. Trends in energy intake in U.S. between 1977 and 1996: similar shifts seen across age groups. *Obes Res* 2002;10(5):370-8.
33. Nielsen SJ, Siega-Riz AM, Popkin BM. Trends in food locations and sources among adolescents and young adults. *Prev Med* 2002;35(2):107-13.
34. Haines PS, Hama MY, Guilkey DK, Popkin BM. Weekend eating in the United States is linked with greater energy, fat, and alcohol intake. *Obes Res* 2003;11(8):945-9.
35. Jeffery RW, Utter J. The changing environment and population obesity in the United States. *Obes Res* 2003;11 Suppl:12S-22S.
36. Nielsen SJ, Popkin BM. Patterns and trends in food portion sizes, 1977-1998. *JAMA* 2003;289(4):450-3.
37. Young LR, Nestle M. The contribution of expanding portion sizes to the US obesity epidemic. *Am J Public Health* 2002;92(2):246-9.
38. Bowman SA, Gortmaker SL, Ebbeling CB, Pereira MA, Ludwig DS. Effects of fast-food consumption on energy intake and diet quality among children in a national household survey. *Pediatrics* 2004;113(1 Pt 1):112-8.
39. McCrory MA, Fuss PJ, Hays NP, Vinken AG, Greenberg AS, Roberts SB. Overeating in America: association between restaurant food consumption and body fatness in healthy adult men and women ages 19 to 80. *Obes Res* 1999;7(6):564-71.
40. French SA, Harnack L, Jeffery RW. Fast food restaurant use among women in the Pound of Prevention study: dietary, behavioral and demographic correlates. *Int J Obes Relat Metab Disord* 2000;24(10):1353-9.
41. Ma Y, Bertone ER, Stanek EJ 3rd, Reed GW, Hebert JR, Cohen NL, Merriam PA, Ockene IS. Association between eating patterns and obesity in a free-living US adult population. *Am J Epidemiol* 2003;158(1):85-92.
42. Nicklas TA, Yang SJ, Baranowski T, Zakeri I, Berenson G. Eating patterns and obesity in children. The Bogalusa Heart Study. *Am J Prev Med* 2003;25(1):9-16.
43. Thompson OM, Ballew C, Resnicow K, Must A, Bandini LG, Cyr H, Dietz WH. Food purchased away from home as a predictor of change in BMI z-score among girls. *Int J Obes Relat Metab Disord* 2004;28(2):282-9.
44. Maddah M. Childhood obesity and early prevention of cardiovascular disease: Iranian families act too late. *Int J Cardiol* 2008;126(2):292-4.
45. Jain A, Sherman SN, Chamberlin LA, Carter Y, Powers SW, Whitaker RC. Why don't low-income mothers worry about their preschoolers being overweight? *Pediatrics* 2001;107(5):1138-46.
46. Maddah M, Solhpour A. Obesity in relation to gender, educational levels and living area in adult population in Rasht, northern Iran. *Int J Cardiol* 2010;145(2):310-1.
47. Karasalihoğlu S, Oner N, Ekuklu G, Vatansever U, Pala O. Body mass index percentiles among adolescent girls living in Edirne, Turkey. *Pediatr Int* 2003;45(4):452-7.
48. Flynn MA. Fear of fatness and adolescent girls: implications for obesity prevention. *Proc Nutr Soc* 1997;56(1B):305-17.
49. Richardson LP, Davis R, Poulton R, McCauley E, Moffitt TE, Caspi A, Connell F. A longitudinal evaluation of adolescent depression and adult obesity. *Arch Pediatr Adolesc Med* 2003;157(8):739-45.
50. Pine DS, Goldstein RB, Wolk S, Weissman MM. The association between childhood depression and adulthood body mass index. *Pediatrics* 2001;107(5):1049-56.
51. Crisp AH, McGuiness B. Jolly fat: relation between obesity and psychoneurosis in general population. *Br Med J* 1976;1(6000):7-9.
52. Anderson SE, Cohen P, Naumova EN, Jacques PF, Must A. Adolescent obesity and risk for subsequent major depressive disorder and anxiety disorder: prospective evidence. *Psychosom Med* 2007;69(8):740-7.
53. Erickson SJ, Robinson TN, Haydel KF, Killen JD. Are overweight children unhappy?: Body mass index, depressive symptoms, and overweight concerns in elementary school children. *Arch Pediatr Adolesc Med* 2000;154(9):931-5.
54. Neumark-Sztainer D, Story M, French SA, Resnick MD. Psychosocial correlates of health compromising behaviors among adolescents. *Health Educ Res* 1997;12(1):37-52.
55. Moreno FA, McGahuey CA, Freeman MP, Delgado PL. Sex differences in depressive response during monoamine depletions in remitted depressive subjects. *J Clin Psychiatry* 2006;67(10):1618-23.
56. Nishizawa S, Benkelfat C, Young SN, Leyton M, Mzengeza S, de Montigny C, Blier P, Diksic M. Differences between males and females in rates of serotonin synthesis in human brain. *Proc Natl Acad Sci U S A* 1997;94(10):5308-13.
57. Deecher D, Andree TH, Sloan D, Schechter LE. From menarche to menopause: exploring the underlying biology of depression in women experiencing hormonal changes. *Psychoneuroendocrinology* 2008;33(1):3-17.