J. Racial and Ethnic Health Disparities (2015) 2:481–493
DOI 10.1007/s40615-015-0096-9

Gender and Ethnic Differences in the Association Between Obesity and Depression Among Black Adolescents

Shervin Assari[1,2] · **Cleopatra Howard Caldwell**[2,3]

Received: 6 December 2014 / Revised: 31 January 2015 / Accepted: 27 February 2015 / Published online: 19 March 2015

Abstract
Aim This study aimed to investigate the association between obesity and major depression disorder (MDD) in a nationally representative sample of Black adolescents in the USA. The study also tested the effects of ethnicity and gender as possible moderators.
Method Data came from the National Survey of American Life (NSAL)-Adolescents, a representative household mental health survey of Black adolescents in the USA. Participants consisted of 1170 Black adolescents (810 African Americans and 360 Caribbean Blacks). Obesity was defined determined by the cutoff points based on the body mass index (BMI) appropriate for age and gender. Twelve-month MDD was measured using the World Mental Health Composite International Diagnostic Interview (CIDI). In the first step, the association between obesity and MDD in the pooled sample, controlling for the main effects of gender and ethnicity. In the next steps, two interactions were tested: (1) obesity and ethnicity and (2) obesity and gender.
Results Although any associations between obesity and MDD in the pooled sample of Blacks were not found, there was a significant interaction between ethnicity and obesity on MDD. Upon testing the associations across intersections of ethnicity and gender, a positive association was found among Caribbean Black females but not Caribbean Black males, African American males, or African American female.
Conclusion The link between BMI and MDD among Blacks depends on ethnicity and gender, and risk of comorbid depression among Black youth with obesity is highest among Caribbean Black females.

Keyword Obesity · Major depressive disorder · Blacks · Adolescents · Ethnic groups · Gender

✉ Shervin Assari
assari@umich.edu

[1] Department of Psychiatry, School of Medicine, University of Michigan, Ann Arbor, MI, USA

[2] Center for Research on Ethnicity, Culture and Health (CRECH), School of Public Health, University of Michigan, Ann Arbor, MI, USA

[3] Department of Health Behavior and Health Education, School of Public Health, University of Michigan, Ann Arbor, MI, USA

Introduction

Although a considerable body of literature has suggested a link between obesity and depression among adults [1–3], only a few studies have explored the same association among adolescents [4–11]. Less is known about the nature of comorbidity between obesity and depression among Black adolescents [5, 12]. As a general rule, mental health aspect of obesity during adolescence is not well understood [5, 12, 13], possibly due to the historical focus on the physical health aspects of the condition rather than mental health [5].

Although the direction of the association between obesity and depression among adolescents is unknown, research on the link between the two has mostly conceptualized obesity as the cause and depression as the effect. In this view, high stigma and exposure to bullying increases the risk of depression among adolescents with obesity [6]. Despite of the huge burden of obesity on social functioning of the adolescents [7], very little is known about this comorbidity among Blacks. Research in this area will help us better understand the nature of overlap of these two public health challenges. Results of such studies will also help primary care providers address

depression and obesity as two common and comorbid clinical entities in daily clinical practice [4, 5].

A number of third variables have been applied to better understand the complex link between obesity and depression during adolescence. Borrowing from research on adults, gender [14–18] and ethnicity [19] may modify the association between depression and obesity [20]. Among adults, Gavin et al. [19] and Sachs-Ericsson and colleagues [21] have documented Black–White differences in the link between obesity and depression. Ethnicity and gender may also moderate the link between depression and obesity among adolescents [4]. Among adolescents, research has suggested that the association may be under influence of gender [9–12]; however, very little is known on the role of race, ethnicity, or their intersection with gender.

There is growing literature suggesting that not only ethnicity and gender but the intersection of ethnicity and gender may shape the link between obesity and depression [22]. Using the National Survey of American Life (NSAL), Assari showed major differences in the direction and magnitude of the association between obesity and major depression disorder based on the intersection of ethnicity and gender [22, 23]. The study suggested that among African American men, body mass index (BMI)≥35 was negatively associated with depression, while among African American women, BMI≥35 was positively associated with depression. Among Black women, higher BMI tended to accompany a higher risk of depression, while for Black men, higher BMI was associated with lower risk of depression [23]. Despite of a higher prevalence of obesity among racial/ethnic minorities, our understanding of the mental health associates of obesity among minority groups is very limited [19]. The inconsistency in some of the related findings may reflect smaller sample sizes of the ethnic minority populations or invariance across samples in the disorder measures used.

In response to this gap in the literature, the current study was conducted to explore how the association between obesity and 12-month MDD among Blacks depends on ethnicity, gender, and their intersection. Data from a representative sample of African American and Caribbean Black American adolescents was used, so we can generalize our findings to this population of Black youth in the USA. The study was built on a life course approach [24–26] which suggests that the understanding of health of adults requires looking back across an individual's or a cohort's life experiences for clues to current patterns of health and disease, and has an emphasis on recognizing past experiences. A life course epidemiology approach is being used to study the physical health hazards during childhood and adolescence that affect chronic disease risk and health outcomes in later life. In this view, research should identify the underlying processes that operate across the life span and finally develop in the adulthood [24]. A life course approach links early and adolescence and childhood conditions to the later development of adult chronic conditions. Additionally, adolescence is one of the critical periods of growth and development, and health conditions may have long-term health potential and may damage health at other times. In this view, adolescence may be a sensitive developmental stage, and health of adolescence may shape life course trajectories and have important implications for health in later life. In this study, researchers believe that obesity and depression in adolescence may have long-term health consequences and may attenuate or exacerbate long-term risks to depression, obesity, and associated health conditions [26]. Furthurmore, adolescence obesity and depression may have important implications for developing chronic conditions in adulthood [24]. The relationships between adult disease and socioeconomic circumstances at different life stages can thus provide clues to the underlying aetiological processes [26]. A life course approach is being used to investigate how experiences and exposures at different life stages accumulate and create inequalities in morbidity and mortality observed in middle and old age among minority groups [26].

Methods

With a cross-sectional design, this study used data from the National Survey of American Life (NSAL) Adolescents, 2003 [27, 28], the largest mental health survey of Blacks ever conducted in the USA [29–31].

The protocol of the NSAL was approved by the Institute Review Board of the University of Michigan, Ann Arbor. Informed consent was obtained from all adolescent's legal guardian. Assent was also obtained from the adolescent. Respondents received financial compensation for their time (US$50). The study was funded by the National Institute of Mental Health (NIMH), as a part of the Collaborative Psychiatric Epidemiology Surveys (CPES).

Participants

The NSAL included all 1170 Black adolescents, composed of 810 African Americans and 360 Caribbean Blacks. Participants were representative of Black youth between 13 and 17 years who were residing in USA at the time of study. A full description of sampling technique has been published previously [30, 31]. Although African Americans were residents of either large cities or other urban and rural areas, Caribbean Blacks were exclusively sampled from large cities.

Sampling

A national household probability sample of Blacks was sampled for the NSAL-Adolescents. All African American and Caribbean Black households that included a participant in

the NSAL-Adult survey were screened for eligible adolescents living in the household. Adolescents were then randomly selected from the provided list. If more than one eligible adolescent was living in the household, two adolescents were selected based on the gender of the first selected adolescent. This strategy resulted in non-independence for adolescent samples. In response, the adolescent supplement data was weighted to adjust for non-independence in selection probabilities within the households, as well as non-response rates across households and individuals. The weighted data were then post-stratified to represent the national estimates based on gender and age among African American and Caribbean Black youth [27, 28].

Interview

About 82 % of the interviews were conducted face to face, in the homes. In about 18 %, interviews were conducted either entirely or partially by telephone. In-person interviews were performed using computer-assisted personal interviews (CAPIs), which is the preferred method of interview when the questionnaire is long and complex. CAPI is an interviewing technique in which the respondent uses a computer to answer the questions. Interviews lasted an average of 100 min. All the interviews were performed in English. The overall response rate was 80.6 % (80.4 % for African Americans and 83.5 % for Caribbean Blacks).

Measures

The study included sociodemographic correlates including age, gender, ethnicity, household income, and region of the country as control variables. Depression was measured using CIDI [32, 33], while obesity was reported using self-reports of height and weight.

Ethnicity Ethnicity of the adolescents was identified according to the ethnicity of the parents in the household. Parents were self-identified as African Americans if they were Black and did not have ancestral ties to the Caribbean. Parents who identified as Caribbean Black were Blacks and from a country included on a list of Caribbean countries presented by the interviewers or that their parents or grandparents were born in a Caribbean country. The list of Caribbean countries included (1) Cuba, (2) Dominican Republic, (3) Haiti, (4) The Bahamas, (5) Jamaica, (6) Trinidad and Tobago, (7) Dominica, (8) Saint Lucia, (9) Antigua and Barbuda, (10) Barbados, (11) Saint Vincent and the Grenadines, (12) Grenada, and (13) Saint Kitts and Nevis.

Depression Lifetime and 12-month MDD was measured using a modified version of the World Mental Health CIDI, a fully structured diagnostic interview schedule. The CIDI evaluates a wide range of Diagnostic and Statistical Manual, 4th Edition (DSM-IV) mental disorders. This interview schedule was developed for the World Mental Health project initiated in 2000 [32]. The CIDI is developed for use by trained lay interviewers to generate diagnoses of lifetime and recent DSM-IV-TR/ICD-10 disorders [33]. Clinical reappraisal studies among adults have documented generally good concordance of CIDI diagnoses with blinded clinical diagnoses [32, 34]. Among adults, excellent concordance [based on area under the receiver operating characteristic curve (AUC)] has been found between CIDI and DSM-IV/SCID diagnoses of major depressive episode (MDE) and generalized anxiety disorder (GAD). CIDI versus SCID prevalence differences have been shown to be insignificant at the optimal CIDI-SC diagnostic thresholds. Individual-level diagnostic concordance at these thresholds is also substantial, with sensitivity of 68–80 % and of specificity 90–99 %. As a result, CIDI operating characteristics are equivalent for MDE and GAD to those of the best alternative screening scales [35]. This measure provides valid findings for Blacks and ethnic groups of Blacks [36–41].

The CIDI has been previously used for measurement of a wide range of psychiatric disorders and problems among adolescents, including depression [42–47]. Pilot studies of CIDI 3.0 concordance with independent clinical assessments were carried out in clinical and community samples of early adolescents (ages 13–17) in preparation for the National Comorbidity Survey Replication Adolescent Supplement (NCS-A) [48]. Following cognitive interviewing methods, numerous modifications have been implemented to the question wording of CIDI to make the language and characterization of symptoms more appropriate for adolescents. In addition, the instrument has been expanded to include informant reports from a parent or parent surrogate for diagnoses where previous research has shown informant reports to be most valuable [49, 50]. Comparison of CIDI and the Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS) as the gold standard has shown very good aggregate consistency between CIDI and K-SADS prevalence estimates. Strong individual-level CIDI versus K-SADS concordance has been found for depression and most other diagnoses. AUC, a measure of classification accuracy not influenced by prevalence, was .89 for mood disorders [51]. Using descriptors employed for roughly comparable values of κ, 45 individual-level concordance between lifetime CIDI and K-SADS diagnoses can be described as almost perfect (AUC greater than or equal to .9) or substantial (AUC in the range .8–.9) for depression and several other disorders. At the disorder level, CIDI detection of K-SADS cases has been shown to be greater than 80 % for depression and several other disorders [51].

Body Mass Index (BMI) NSAL has collected data on self-reported weights and heights, which were used to measure BMI. BMI based on self-reported measures of weight and height is highly correlated with BMI based on direct measures of height and weight [19]. There is, however, some evidence suggesting that using self-reported weight and height may result in underestimation of BMI [52], as people may tend to underestimate their weight and overestimate their height [53]. Obesity was defined based on BMI appropriate for the age and gender group [54, 55].

Statistical Analysis

Stata 13.0 was used to account for the complex design of the NASL. All analyses used the Taylor expansion approximation technique for calculating the complex design-based estimates of variance. Standard errors reflect the recalculation of variance using the weights due to the study's complex design. Percentages reported in this study are weighted and thus represent proportions to the nation. While in the NSAL the Caribbean Black sample is more clustered than the African American sample, the corrected standard errors are larger for Caribbean Blackthan that for the African American sample. Adjusted odds ratio (OR) and their 95 % confidence interval were reported. *P* values less than 0.05 were considered statistically significant.

Survey logistic regression was used for multivariable analysis, by considering obesity as the predictor, 12-month and lifetime MDD as main outcomes, and age and family income as controls. We fit multiple models to determine role of gender and ethnicity on our association of interest. In the first step, the association between obesity and MDD was tested in the pooled sample, controlling for the main effects of gender and ethnicity. In the next step, one interaction term (between obesity and ethnicity or obesity and gender) was entered to the model. Then, we ran models with both interaction terms in the model. Finally, models specific to ethnicity, gender, and their intersections were ran to interpret significant interactions.

Results

Participants were either between age 13–14 (n=477, 40 % weighted), age 15–16 (n=441, 41 %), and age 17 (n=252, 19 %). Mean age of the participants was 15 (SD=1.42) years. The sample was equally composed of boys (n=563, 48 %) and girls (n=605, 52 %). Almost all (96 %) of the participants were enrolled in high school. Median family income ranged from 0 to US$520,000, with a median of US$28,000. Median income was higher among Caribbean Blacks (US$32,250) than African Americans (US$26,000) ($P$<0.001).

Table 1 presents relative frequency of lifetime and 12-month MDD, and obesity among all participants, and also among subpopulations based on ethnicity, gender, and their intersections. Among all, about 24.5 % had obesity, 6 % met criteria for lifetime MDD, and 4 % met criteria for 12-month MDD.

Table 1 Relative frequency of obesity and major depressive disorder among Blacks

	% (SE)	95 % CI for %
All Blacks		
Obesity	24.69 (0.02)	20.94–28.87
Lifetime MDD	6.28 (0.01)	4.84–8.11
12-month MDD	4.26 (0.01)	3.19–5.67
African Americans		
Obesity	24.92 (0.02)	20.94–29.38
Lifetime MDD	6.25 (0.01)	4.71–8.25
12-month MDD	4.19 (0.01)	3.05–5.73
Caribbean Blacks		
Obesity	21.46 (0.06)	11.58–36.32
Lifetime MDD	6.63 (0.01)	4.75–9.20
12-month MDD	5.20 (0.01)	3.32–8.08
Black girls		
Obesity	24.08 (0.03)	19.38–29.49
Lifetime MDD	5.91 (0.01)	4.11–8.42
12-month MDD	4.31 0.01)	2.88–6.40
Black boys		
Obesity	25.31 (0.02)	20.66–30.61
Lifetime MDD	6.65 (0.01)	4.52–9.69
12-month MDD	4.21 (0.01)	2.74–6.41
African American boys		
Obesity	24.07 (0.03)	19.07–29.90
Lifetime MDD	6.05 (0.01)	4.13–8.79
12-month MDD	4.44 (0.01)	2.91–6.70
African American girls		
Obesity	25.79 (0.03)	20.91–31.35
Lifetime MDD	6.46 (0.01)	4.19–9.82
12-month MDD	3.94 (0.01)	2.42–6.37
Caribbean Black boys		
Obesity	24.21 (0.02)	20.70–28.11
Lifetime MDD	3.57 (0.01)	2.30–5.50
12-month MDD	2.26 (0.00)	1.59–3.21
Caribbean Black girls		
Obesity	19.23 (0.10)	5.77–48.10
Lifetime MDD	9.12 (0.02)	5.67–14.34
12-month MDD	7.59 (0.02)	4.24–13.24

Tables 2 and 3 report summary of regressions in the pooled sample of Blacks. The first model that did not include any interaction term failed to show an association between obesity and MDD. In this model, ethnicity and gender did not have main effects. The next models that included an interaction term between ethnicity and obesity suggested that the effect

Table 2 Adjusted odds ratios for association between obesity and lifetime major depressive disorder

	Odds ratio	Linearized std. err.	*P*	95 % CI for odds ratio
Model with no interaction				
Obesity	1.142	0.421	0.720	0.542–2.404
Caribbean Black	0.999	0.222	0.997	0.638–1.565
Female	1.137	0.333	0.663	0.629–2.057
Age	1.347	0.141	0.007	1.090–1.664
Income	1.000	0.000	0.320	1.000–1.000
Intercept	0.001	0.001	<0.001	0.000–0.017
Model with ethnicity×obesity interaction				
Obesity	1.065	0.429	0.877	0.471–2.406
Caribbean Black	1.926	0.837	0.139	0.800–4.637
Female	1.145	0.334	0.644	0.635–2.065
Age	1.348	0.142	0.007	1.090–1.667
Income	1.000	0.000	0.314	1.000–1.000
Obesity# Caribbean Black				
0#Caribbean	0.393	0.192	0.062	0.147–1.052
Intercept	0.001	0.001	<0.001	0.000–0.018
Model with gender×obesity interaction				
Obesity	1.202	0.464	0.635	0.552–2.621
Caribbean Black	0.996	0.223	0.988	0.634–1.566
Female	1.060	0.642	0.924	0.311–3.608
Age	1.347	0.140	0.006	1.093–1.661
Income	1.000	0.000	0.323	1.000–1.000
Obesity#Females				
0#Female	1.101	0.688	0.879	0.311–3.890
Intercept	0.001	0.001	<0.001	0.000–0.026
Model with both interactions				
Obesity	1.126	0.462	0.774	0.491–2.581
Caribbean Black	1.924	0.841	0.142	0.796–4.653
Female	1.061	0.639	0.922	0.314–3.585
Age	1.349	0.140	0.006	1.093–1.665
Income	1.000	0.000	0.317	1.000–1.000
Obesity# Caribbean Black				
0#Caribbean	0.392	0.194	0.066	0.144–1.066
Obesity#Female				
0#Female	1.110	0.689	0.868	0.316–3.892
Intercept	0.001	0.001	<0.001	0.000–0.026

of obesity on MDD varies based on ethnicity. The next model that included an interaction between gender and obesity suggested that the effect of obesity on MDD does not vary for male and females. The final models that included both interaction terms also suggested that there is an interaction between ethnicity and obesity but not gender and ethnicity on MDD.

Based on Tables 4 and 5 which show summary of regressions fitted to subpopulations based on ethnicity or gender, obesity was only associated with MDD among Caribbean Blacks.

Tables 6 and 7 reveal the results of regressions fitted to subpopulations based on the intersections of ethnicity and gender. Based on this table, obesity was positively associated with MDD only among Caribbean Black females.

Discussion

The current study is the very first nationally representative study of gender and ethnic differences in the association between obesity and depression among Black adolescents. The

Table 3 Adjusted odds ratios for association between obesity and 12-month major depressive disorder among pooled sample of Black youth

	Odds ratio	Linearized std. err.	*P*	95 % CI for odds ratio
Model with no interaction				
Obesity	0.940	0.323	0.858	0.470–1.881
Caribbean Black	1.184	0.326	0.544	0.678–2.066
Female	0.975	0.312	0.937	0.511–1.860
Age	1.405	0.142	0.002	1.145–1.724
Income	1.000	0.000	0.443	1.000–1.000
Intercept	0.000	0.000	<0.001	0.000–0.005
Model with ethnicity×obesity interaction				
Obesity	0.825	0.318	0.621	0.379–1.798
Caribbean Black	3.111	1.475	0.021	1.193–8.110
Female	0.987	0.314	0.967	0.518–1.879
Age	1.408	0.145	0.002	1.144–1.732
Income	1.000	0.000	0.428	1.000–1.000
Obesity# Caribbean Black				
0#Caribbean	0.253	0.140	0.017	0.083–0.774
Intercept	0.000	0.000	<0.001	0.000–0.005
Model with gender×obesity interaction				
Obesity	1.322	0.606	0.547	0.523–3.339
Caribbean Black	1.161	0.340	0.614	0.642–2.097
Female	0.555	0.332	0.331	0.165–1.861
Age	1.409	0.145	0.002	1.145–1.734
Income	1.000	0.000	0.450	1.000–1.000
Obesity#Female				
0#Female	2.076	1.417	0.291	0.523–8.247
Intercept	0.000	0.001	<0.001	0.000–0.011
Model with both interactions				
Obesity	1.170	0.587	0.755	0.425–3.223
Caribbean Black	3.123	1.629	0.035	1.089–8.961
Female	0.552	0.322	0.314	0.170–1.793
Age	1.414	0.147	0.002	1.145–1.746
Income	1.000	0.000	0.441	1.000–1.000
Obesity# Caribbean Black				
0#Caribbean	0.245	0.145	0.022	0.074–0.809
Obesity#Female				
0#Female	2.119	1.412	0.266	0.552–8.145
Intercept	0.000	0.001	<0.001	0.000–0.011

results suggest that the intersection of ethnicity and gender shape the link between obesity and depression among Black youth. Only among Caribbean Black females, obesity is associated with higher risk of MDD. Such an association was not be found among other gender×ethnicity groups (i.e., male or female African Americans or Caribbean Black males).

Most of research on moderators of the link between depression and obesity [12] has focused on moderating effect of gender, while the association has been only found among females [9–12]. Our findings on the positive association between obesity and depression among Caribbean Black females is supported by a meta-analysis that reported an odds ratio of 1.38 for the effect of abdominal obesity on depression. This meta-analysis did not show moderation effects for gender, age, measurement of depression and obesity, and study quality [2]. A study has previously showed that only for girls but not boys, adolescence is a high-risk period for the development of the comorbidity between depression and obesity [9]. Stice et al. also showed that among adolescent girls of age 11–15 years, baseline depressive symptoms predict incident obesity in the next years above and beyond self-reported dietary restraint, radical weight-control behaviors, and

Table 4 Adjusted odds ratios for association between obesity and lifetime major depressive disorder among subpopulations based on ethnicity or gender

	Odds ratio	Linearized std. err.	*P*	95 % CI for odds ratio
African American				
Obesity	1.065	0.429	0.876	0.467–2.432
Female	1.092	0.342	0.782	0.574–2.074
Age	1.338	0.150	0.015	1.064–1.684
Income	1.000	0.000	0.286	1.000–1.000
Intercept	0.001	0.001	<0.001	0.000–0.028
Caribbean Black				
Obesity	2.819	0.694	0.001	1.662–4.780
Female	2.254	0.907	0.063	0.951–5.343
Age	1.423	0.304	0.122	0.899–2.252
Income	1.000	0.000	0.583	1.000–1.000
Intercept	0.000	0.000	0.011	0.000–0.080
Men				
Obesity	1.185	0.461	0.665	0.540–2.599
Caribbean Black	0.639	0.198	0.156	0.342–1.194
Age	1.412	0.217	0.030	1.035–1.925
Income	1.000	0.000	0.027	1.000–1.000
Intercept	0.000	0.001	0.001	0.000–0.028
Women				
Obesity	1.105	0.571	0.848	0.389–3.142
Caribbean Black	1.280	0.410	0.445	0.670–2.444
Age	1.300	0.190	0.079	0.968–1.746
Income	1.000	0.000	0.230	1.000–1.000
Intercept	0.002	0.003	0.006	0.000–0.134

perceived parental obesity. Results of this study provided support for the affect regulation model as an etiologic theory for the link between depression and obesity [11]. In another study, Boutelle and colleagues followed showed that among adolescent girls, obese but not overweight status was associated with future depressive symptoms but not future MDD. As depressive symptoms are considered along the spectrum of depression with clinical depression at the high end, these results suggest that weight status could be considered a factor along the pathway of development of MDD in some adolescent females [10]. In a study of 4175 youths 11–17-year-old community samples, Roberts and Duong showed that body image may be the actual mechanism for the association between obesity and depression [8].

Results of studies among adults are very different from adults' literature, where race, ethnicity, and gender have shown to modify the link between obesity and depression [1, 19, 21, 56]. Among adults, Gariepy and colleagues showed that obesity at baseline may be associated with a lower risk of subsequent major depression episode among men, while it does not predict later MDE among women [57]. Although one study suggested that the association between BMI and depressive symptoms may be greater among African Americans than Whites [21], using the NCS-R data, Simon et al. showed a smaller association between obesity and MDD among Blacks and other minorities than Whites [56]. Gavin and colleagues also reported a positive and significant association between obesity and MDD among White women but not any White men, Black men, and Black women [19]. Most of research on moderators of the link between depression and obesity [12] among adolescents is exclusively focused on moderating effect of gender, suggesting an association among females but not males [9–12].

Despite of our negative findings for male or female African Americans or Caribbean Black males, adolescent depression may have implication for obesity and other chronic medical conditions later in life. One study showed that early adolescent-onset depression is associated with elevated risk of later onset obesity, and obesity, particularly in late adolescence, is associated with increased odds of later depression. Further investigation into the mechanisms of these effects and the reasons for the observed gender and developmental differences is needed [9]. Such studies have recommended design and implementation of prevention programs for early onset depression and obesity as a strategy to reduce risk for this form of comorbidity later in life [9].

Table 5 Adjusted odds ratios for association between obesity and 12-month major depressive disorder among subpopulations based on ethnicity or gender

	Odds ratio	Linearized std. err.	*P*	95 % CI for odds ratio
African American				
Obesity	0.826	0.317	0.622	0.376–1.813
Female	0.907	0.310	0.778	0.451–1.825
Age	1.384	0.150	0.006	1.109–1.726
Income	1.000	0.000	0.373	1.000–1.000
Intercept	0.000	0.001	<0.001	0.000–0.010
Caribbean Black				
Obesity	3.520	1.160	0.002	1.736–7.136
Female	2.647	1.090	0.033	1.094–6.404
Age	1.665	0.458	0.085	0.923–3.005
Income	1.000	0.000	0.372	1.000–1.000
Intercept	0.000	0.000	0.011	0.000–0.037
Men				
Obesity	1.305	0.614	0.575	0.504–3.379
Caribbean Black	0.566	0.157	0.047	0.323–0.992
Age	1.486	0.273	0.037	1.025–2.155
Income	1.000	0.000	0.048	1.000–1.000
Intercept	0.000	0.000	0.002	0.000–0.024
Women				
Obesity	0.637	0.303	0.349	0.244–1.665
Caribbean Black	1.717	0.661	0.168	0.788–3.739
Age	1.347	0.164	0.019	1.053–1.724
Income	1.000	0.000	0.107	1.000–1.000
Intercept	0.001	0.001	0.001	0.000–0.035

Analysis of adult data of the NSAL showed that among African Americans and Black females, there was a negative association between MDD and obesity; however, it was not statistically significant [23]. This result is in line with a previous report that revealed inverse association between obesity and 12-month MDD among Black men [23]. This was consistent with the findings of a longitudinal study conducted by Gariepy and colleagues who analyzed data of the National Population Health Survey with 10,545 adults without depression at baseline. The inverse correlation between obesity and depression in some of the ethnic groups has been explained by the "Jolly Fat" hypothesis [58], which suggests that obesity may reduce psychoneurosis among individuals [59].

There is some evidence regarding the role of ethnicity on the obesity–depression link. A meta-analysis suggested that the association may be more pronounced among Americans than among Europeans and for depressive disorder than for depressive symptoms [1]. A similar study among Black adults suggested that higher BMI tended to accompany a higher risk of depression among women, while higher BMI was associated with lower risk of depression among men. The study also suggested that among African American adults, BMI≥35 was negatively associated with depression among men but positively associated with depression among women [23].

Among Blacks, ethnicity determines the risk of MDD. Lifetime prevalence of MDD is 13 and 10 % among Caribbean Black and African American adults, respectively [60]. Compared to Whites, MDD is more severe and disabling for Blacks [60]. Depression is also less frequently diagnosed and treated properly among Blacks [60]. It has been suggested that health care system and juvenile system have tendency for overdiagnosis and overtreatment of externalizing problems such as conduct disorders among Blacks, while underdiagnose and undertreat emotional and affective problems such as MDD [61, 62]. With a consistent pattern across almost all US states, obesity is 50 % more prevalent among Blacks than Whites [63].

The literature on the moderating effects of race/ethnicity/gender on the link between obesity and depression is extremely limited [64]. While most surveys include predominantly Whites [19], the association between MDD and obesity in minorities is less frequently examined. Due to small sample size of racial/ethnic minority groups, many studies do not report the results for non-Whites. However, even with a low

Table 6 Adjusted odds ratios for association between obesity and lifetime major depressive disorder among subpopulations based on the intersection of ethnicity and gender

	Odds ratio	Linearized std. err.	*P*	95 % CI for odds ratio
African American male				
Obesity	1.416	1.177	0.679	0.258–7.775
Age	1.750	0.568	0.095	0.901–3.402
Income	1.000	0.000	0.051	1.000–1.000
Intercept	0.000	0.000	0.015	0.000–0.069
African American female				
Obesity	0.396	0.477	0.449	0.034–4.673
Age	0.977	0.088	0.797	0.813–1.174
Income	1.000	0.000	0.616	1.000–1.000
Intercept	0.025	0.030	0.005	0.002–0.292
Caribbean Black male				
Obesity	1.000	(omitted)		7.004
Age	2.407	0.265	<0.001	1.901–3.047
Income	1.000	0.000	0.006	1.000–1.000
Intercept	0.000	0.000	<0.001	0.000–0.000
Caribbean Black female				
Obesity	8.901	10.221	0.078	0.758–104.480
Age	3.282	3.533	0.288	0.326–33.030
Income	1.000	0.000	0.191	1.000–1.000
Intercept	0.000	0.000	0.239	0.000–2×10 6

sample size, pattern of the link between obesity and depression among ethnic groups can be informative.

Continuing research is needed to better understanding of ethnic and gender differences on the mental health correlates of obesity in USA. In addition, research should test multiple social, cultural, behavioral, psychological, or biological factors that may explain the role of ethnicity in shaping the mental health correlates of obesity.

The present findings suggest that subpopulations of Black youths differ in the link between obesity and depression. Literature shows that the direction of the association between BMI and MDD may be very different among different parts of the world. Although most studies in the USA have suggested a positive association between obesity and risk of depression, a reverse association has been reported from many Asian countries such as China [65], Korea [58], and Hong Kong [66]. Consistently, even among Asian countries with reverse association between depression and obesity, the magnitude of association seems to be stronger among women than men [58, 67, 68].

Ethnicity and gender may moderate the link between depression and MDD, because ethnicity and gender may determine the nature of changes in life style due to depression or obesity. That is, ethnicity and gender may determine how individuals who are obese or depressed change their social behaviors, perceive stress, express their emotions, or seek help.

Directionality of the association between obesity and MDD is not clear, neither among adolescents nor among adults. Obesity may cause depression, depression may cause obesity, or depression and obesity may be consequence of a common cause, either social factors such as low socioeconomic status, daily stressors, lifestyle factors, or molecular and biological factors such as cortisol [69].

Different mediators should be tested for the ethnic-/gender-specific association between depression and obesity among Black youth. Depression may differentially influence food intake or physical activity among Caribbean Black girls. Such imbalance between energy intake and expenditure may result in obesity among a particular ethnic/gender group. Based on our findings, we hypothesize that how depression or obesity present among Black youth depends on the intersection of their gender and ethnicity. In addition, obesity may differently result in negative body image or stigma among different groups; thus, obesity may be linked to different levels of psychological distress [70].

Future studies should test if body image, intention to reduce weight, smoking, guilt, eating habits, eating disorders, or physical activity can explain at least some of the gender and ethnic differences in the link between obesity and MDD among Black adolescents. Mediating effects of these factors should be tested

Table 7 Adjusted odds ratios for association between obesity and 12-month major depressive disorder among subpopulations based on the intersection of ethnicity and gender

	Odds ratio	Linearized std. err.	*P*	95 % CI
African American male				
Obesity	1.341	0.647	0.548	0.499–3.603
Age	1.473	0.275	0.048	1.004–2.159
Income	1.000	0.000	0.053	1.000–1.000
Intercept	0.000	0.000	0.003	0.000–0.032
African American female				
Obesity	0.413	0.262	0.174	0.112–1.515
Age	1.336	0.179	0.039	1.016–1.757
Income	1.000	0.000	0.188	1.000–1.000
Intercept	0.001	0.002	0.002	0.000–0.064
Caribbean Black male				
Obesity	0.490	0.608	0.574	0.034–7.004
Age	2.159	1.015	0.124	0.788–5.915
Income	1.000	0.000	0.589	1.000–1.000
Intercept	0.000	0.000	0.032	0.000–0.195
Caribbean Black female				
Obesity	5.187	1.906	0.001	2.358–11.410
Age	1.560	0.545	0.224	0.737–3.300
Income	1.000	0.000	0.301	1.000–1.000
Intercept	0.000	0.000	0.118	0.000–16.415

and may increase our knowledge about the complex association between ethnicity, gender, depression, and obesity.

The current study was limited in certain aspects. Sample size was low, as we divided our pooled sample to four groups based on ethnicity and gender. Low statistical power may have contributed to non-significant association in some of the gender–ethnic subpopulations in this study. As a result, future research should use a larger sample size to satisfy enough statistical power. Previous studies have also blamed low sample size for non-significant association of depression and obesity among some ethnic groups. This is especially true in research on ethnic minority groups [21–23]. Low prevalence of depression among males may also contribute to lower statistical power among males. The cross-sectional design of the study limits any causal inference about the associations reported here. Further, BMI was calculated based on self-reported weight and height. However, previous studies show a strong association between self-reported and objective measures of BMI [19].

Findings may have important implication for health promotion of Black youth, especially mental health screening of Caribbean Black females with obesity. Findings may help with design of healthy weight programs and physical activity promotion interventions that emphasize body weight reduction and maintenance among Black youth [21].

Our findings are important as MDD and obesity are considered as two separate public health problems, causing enormous economic burden to the society [68–75]. Depression is the leading cause of disability [5], and obesity is a major cause of mortality [76]. We argue that joint policies and programs may be very beneficial for Caribbean Black females.

Clinicians should screen for depression among Caribbean Black youth with obesity, especially Caribbean Black girls. A full investigation of psychosocial and lifestyle risk factors for individuals who are obese has been previously recommended. However, effective management of obesity requires proper and timely diagnosis and treatment of comorbid depression, if present [3].

To conclude, the association between obesity and depression among Black youth may depend on the intersection of ethnicity and gender. Comorbidity between obesity and depression is not uniformly distributed among Black youth and may be more pronounced among Caribbean Black females than any other group of Blacks. Clinical and public health programs that work on comorbidity of depression and obesity among Black adolescents may benefit from tailoring the program based on ethnicity and gender of the target population.

Acknowledgments The NSAL is mostly supported by the National Institute of Mental Health, with grant U01-MH57716 to Dr. James S. Jackson. Other support came from the Office of Behavioral and Social Science Research at the National Institutes of Health and the University of Michigan.

Ethical Standard Shervin Assari designed the work, analyzed the data, and drafted the manuscript. Cleopatra Caldwell was the co-principle investigator of the NSAL, contributed to the current study design, and designed the NSAL-Adolescents survey. Cleopatra Caldwell also contributed to the preparation and revision of this manuscript.

Parental informed consent and assent were obtained from all adolescent participants included in the study. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of Interest Shervin Assari and Cleopatra Caldwell declare that they have no conflict of interest.

References

1. Luppino FS, de Wit LM, Bouvy PF, Stijnen T, Cuijpers P, Penninx BW, et al. Overweight, obesity, and depression: a systematic review and meta-analysis of longitudinal studies. Arch Gen Psychiatry. 2010;67(3):220–9.
2. Xu Q, Anderson D, Lurie-Beck J. The relationship between abdominal obesity and depression in the general population: a systematic review and meta-analysis. Obes Res Clin Pract. 2011;5(4):e267–78.
3. Atlantis E, Goldney RD, Wittert GA. Obesity and depression or anxiety. BMJ. 2009;339:b3868.
4. Wardle J, Williamson S, Johnson F, Edwards C. Depression in adolescent obesity: cultural moderators of the association between obesity and depressive symptoms. Int J Obes (Lond). 2006;30(4): 634–43.
5. Calamaro CJ. Depression and obesity in adolescents: what can primary care providers do? J Nurse Pract. 2009;5(4):255–61.
6. Reeves GM, Postolache TT, Snitker S. Childhood obesity and depression: connection between these growing problems in growing children. Int J Child Health Hum Dev. 2008;1(2):103–14.
7. Hammerton G, Thapar A, Thapar AK. Association between obesity and depressive disorder in adolescents at high risk for depression. Int J Obes (Lond). 2014;38(4):513–9.
8. Roberts RE, Duong HT. Perceived weight, not obesity, increases risk for major depression among adolescents. J Psychiatr Res. 2013;47(8):1110–7.
9. Marmorstein NR, Iacono WG, Legrand L. Obesity and depression in adolescence and beyond: reciprocal risks. Int J Obes (Lond). 2014;38(7):906–11.
10. Boutelle KN, Hannan P, Fulkerson JA, Crow SJ, Stice E. Obesity as a prospective predictor of depression in adolescent females. Health Psychol. 2010;29(3):293–8.
11. Stice E, Presnell K, Shaw H, Rohde P. Psychological and behavioral risk factors for obesity onset in adolescent girls: a prospective study. J Consult Clin Psychol. 2005;73(2):195–202.
12. Assari S. The link between mental health and obesity: role of individual and contextual factors. Int J Prev Med. 2014;5(3):247–9.
13. Friedman MA, Brownell K. Psychological correlates of obesity: moving to the next research generation. Psychol Bull. 1995;117: 3–20.
14. Ohayon MM, Hong SC. Prevalence of major depression disorder in the general population of South Korea. J Psychiatr Res. 2006;40: 30–6.
15. Carpenter KM, Hasin DS, Allison DB, Faith MS. Relationships between obesity and DSM-IV major depression disorder, suicide ideation, and suicide attempts: results from a general population study. Am J Public Health. 2000;90(2):251–7.
16. 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. Am J Epidemiol. 2003;58:1136–47.
17. McIntyre RS, Konarski JZ, Wilkins K, Soczynska JK, Kennedy SH. Obesity in bipolar disorder and major depression disorder: results from a national community health survey on mental health and well-being. Can J Psychiatry. 2006;51(5):274–80.
18. Scott KM, Bruffaerts R, Simon GE, Alonso J, Angermeyer M, de Girolamo G, et al. Obesity and mental disorders in the general population: results from the world mental health surveys. Int J Obes (Lond). 2008;32(1):192–200.
19. Gavin AR, Rue T, Takeuchi D. Racial/ethnic differences in the association between obesity and major depression disorder: findings from the Comprehensive Psychiatric Epidemiology Surveys. Public Health Rep. 2010;125(5):698–708.
20. Faith AJ, Stunkard MS, Anderson KC. Depression and obesity. Biol Psychiatry. 2003;54:330–7.
21. Sachs-Ericsson N, Burns AB, Gordon KH, Eckel LA, Wonderlich SA, Crosby RD, et al. Body mass index and depressive symptoms in older adults: the moderating roles of race, sex, and socioeconomic status. Am J Geriatr Psychiatry. 2007;15(9):815–25.
22. Assari S. Additive effects of anxiety and depression on body mass index among Blacks: role of ethnicity and gender. Int Cardiovasc Res J. 2014;8(2):44–51.
23. Assari S. Association between obesity and depression among American Blacks: role of ethnicity and gender. J Racial Ethnic Health Dispar. 2014;1(1):36–44.
24. In: Kuh D, Ben-Shlomo Y (eds). A life course approach to chronic disease epidemiology. Oxford: Oxford University Press, 1997, pp.101–20.
25. Lumey LH. Reproductive outcomes in women prenatally exposed to undernutrition: a review of findings from the Dutch famine birth cohort. Proc Nutr Soc. 1998;57(1):129–35.
26. Davey Smith G, Hart C, Blane D, Gillis C, Hawthorne V. Lifetime socioeconomic position and mortality: prospective observational study. BMJ. 1997;314:547–52.
27. Seaton EK, Caldwell CH, Sellers RM, Jackson JS. An intersectional approach for understanding perceived discrimination and psychological well-being among African American and Caribbean Black youth. Dev Psychol. 2010;46(5):1372–9.
28. Seaton EK, Caldwell CH, Sellers RM, Jackson JS. Developmental characteristics of African American and Caribbean Black adolescents' attributions regarding discrimination. J Res Adolesc. 2010;20(3):774–88.
29. Jackson JS, Torres M, Caldwell CH, Neighbors HW, Nesse RM, Taylor RJ, et al. The National Survey of American Life: a study of racial, ethnic, and cultural influences on mental disorders and mental health. Int J Methods Psychiatr Res. 2004;13:196–207.
30. Jackson JS, Neighbors HW, Nesse RM, Trierweiler SJ, Torres M. Methodological innovations in the National Survey of American Life. Int J Methods Psychiatr Res. 2004;13:289–98.
31. Heeringa S, Wagner J, Torres M, Duan N, Adams T, Berglund P. Sample designs and sampling methods for the Collaborative Psychiatric Epidemiology Studies (CPES). Int J Methods Psychiatr Res. 2004;13(4):221–39.
32. Wittchen HU. Reliability and validity studies of the WHO-Composite International Diagnostic Interview (CIDI): a critical review. J Psychiatr Res. 2000;28:57–84.
33. Robins LN, Wing J, Wittchen HU, Helzer JE, Babor TF, Burke J, et al. The Composite International Diagnostic Interview. An epidemiologic instrument suitable for use in conjunction with different diagnostic systems and in different cultures. Arch Gen Psychiatry. 1988;45:1069–77.
34. Kessler RC, Wittchen H-U, Abelson JM, McGonagle KA, Schwarz N, Kendler KS, et al. Methodological studies of the Composite

International Diagnostic Interview (CIDI) in the US National Comorbidity Survey. Int J Methods Psychiatr Res. 1998;7:33–55.
35. Kessler RC, Calabrese JR, Farley PA, Gruber MJ, Jewell MA, Katon W, et al. Composite International Diagnostic Interview screening scales for DSM-IV anxiety and mood disorders. Psychol Med. 2013;43(8):1625–37.
36. Williams DR, Haile R, González HM, Neighbors H, Baser R, Jackson JS. The mental health of Black Caribbean immigrants: results from the National Survey of American Life. Am J Public Health. 2007;97(1):52–9.
37. Jackson JS, Neighbors HW, Torres M, Martin LA, Williams DR, Baser R. Use of mental health services and subjective satisfaction with treatment among Black Caribbean immigrants: results from the National Survey of American Life. Am J Public Health. 2007;97(1):60–7.
38. Neighbors HW, Caldwell C, Williams DR, Nesse R, Taylor RJ, Bullard KM, et al. Race, ethnicity, and the use of services for mental disorders: results from the National Survey of American Life. Arch Gen Psychiatry. 2007;64(4):485–94.
39. Woodward AT, Taylor RJ, Abelson JM, Matusko N. Major depressive disorder among older African Americans, Caribbean blacks, and non-Hispanic whites: secondary analysis of the National Survey of American Life. Depress Anxiety. 2013;30(6):589–97.
40. Assari S, Lankarani MM, Moazen B. Religious beliefs may reduce the negative effect of psychiatric disorders on age of onset of suicidal ideation among Blacks in the United States. Int J Prev Med. 2012;3(5):358–64.
41. Assari S, MoghaniLankarani M, MoghaniLankarani R. Ethnicity modifies the effects of anxiety and drug use on suicidal ideation among Black adults in the United States. Int J Prev Med. 2013;4(11):1151.
42. Green JG, Avenevoli S, Gruber MJ, Kessler RC, Lakoma MD, Merikangas KR, et al. Validation of diagnoses of distress disorders in the US National Comorbidity Survey Replication Adolescent Supplement (NCS-A). Int J Methods Psychiatr Res. 2012;21(1): 41–51.
43. Green JG, Avenevoli S, Finkleman M, Gruber MJ, Kessler RC, Merikangas KR, et al. Validation of the diagnoses of panic disorder and phobic disorders in the US National Comorbidity Survey Replication Adolescent (NCS-A) supplement. Int J Methods Psychiatr Res. 2011;20(2):105–15.
44. Green JG, Avenevoli S, Finkelman M, Gruber MJ, Kessler RC, Merikangas KR, et al. Attention deficit hyperactivity disorder: concordance of the adolescent version of the Composite International Diagnostic Interview version 3.0 (CIDI) with the K-SADS in the US National Comorbidity Survey Replication Adolescent (NCS-A) supplement. Int J Methods Psychiatr Res. 2010;19(1):34–49.
45. Taylor JY, Caldwell CH, Baser RE, Faison N, Jackson JS. Prevalence of eating disorders among Blacks in the National Survey of American Life. Int J Eat Disord. 2007;40(Suppl):S10–4.
46. Joe S, Baser RS, Neighbors HW, Caldwell CH. Jackson JS.12-month and lifetime prevalence of suicide attempts among black adolescents in the National Survey of American Life. J Am Acad Child Adolesc Psychiatry. 2009;48(3):271–82.
47. Ambrosini PJ. Historical development and present status of the schedule for affective disorders and schizophrenia for school-age children (K-SADS). J Am Acad Child Adolesc Psychiatry. 2000;39:49–58.
48. Kessler RC, Avenevoli S, Costello EJ, Green JG, Gruber MJ, Heeringa S, et al. National comorbidity survey replication adolescent supplement (NCS-A): II. Overview and design. J Am Acad Child Adolesc Psychiatry. 2009;48(4):380–5.
49. Grills AE, Ollendick TH. Issues in parent-child agreement: the case of structured diagnostic interviews. Clin Child Fam Psychol Rev. 2002;5:57–83.
50. Johnston C, Murray C. Incremental validity in the psychological assessment of children and adolescents. Psychol Assess. 2003;15: 496–507.
51. Kessler RC, Avenevoli S, Green J, Gruber MJ, Guyer M, He Y, et al. National comorbidity survey replication adolescent supplement (NCS-A): III. Concordance of DSM-IV/CIDI diagnoses with clinical reassessments. J Am Acad Child Adolesc Psychiatry. 2009;48(4):386–99.
52. Simon GE, Von Korff M, Saunders K, Miglioretti DL, Crane PK, van Belle G, et al. Association between obesity and psychiatric disorders in the US adult population. Arch Gen Psychiatry. 2006;63(7):824–30.
53. Taylor AW, Dal Grande E, Gill TK, Chittleborough CR, Wilson DH, Adams RJ, et al. How valid are self-reported height and weight? A comparison between CATI self-report and clinic measurements using a large cohort study. Aust N Z J Public Health. 2006;30(3):238–46.
54. Lang IA, Kipping RR, Jago R, Lawlor DA. Variation in childhood and adolescent obesity prevalence defined by international and country-specific criteria in England and the United States. Eur J Clin Nutr. 2011;65(2):143–50.
55. Dumith SC, FariasJúnior JC. Overweight and obesity in children and adolescents: comparison of three classification criteria based on body mass index. Rev Panam Salud Publica. 2010;28(1):30–5.
56. Simon GE, Von Korff M, Saunders K, Miglioretti DL, Crane PK, van Belle G, et al. Association between obesity and psychiatric disorders in the US adult population. Arch Gen Psychiatry. 2006;63:824–30.
57. Gariepy G, Wang J, Lesage AD, Schmitz N. The longitudinal association from obesity to depression: results from the 12-year National Population Health Survey. Obesity (Silver Spring). 2010;18(5):1033–8.
58. Kim E, Song JH, Hwang JY, Ahn K, Kim J, Koh YH, et al. Obesity and depressive symptoms in elderly Koreans: evidence for the "Jolly Fat" hypothesis from the Ansan Geriatric (AGE) Study. Arch Gerontol Geriatr. 2010;51(2):231–4.
59. Crisp AH, McGuiness B. Jolly fat: relation between obesity and psychoneurosis in general population. Br Med J. 1975;1:7–9.
60. Friedman MA, Brownell KD. 1995 Psychological correlates of obesity: moving to the next generation. Psychol Bull. 1995;117: 3–20.
61. Fabrega H, Ulrich R, Mezzich JE. Do Caucasian and black adolescents differ at psychiatric intake? J Am Acad Child Adolesc Psychiatry. 1993;32:407–13.
62. Assari S, Caldwell CH, Brooks CL, De Loney EH, Campbell T. Primary prevention of aggression and depression among urban African American boys: mechanism of the effect of a family-based intervention with nonresident fathers and sons. Research on Social Work Practice. 2015. In Press.
63. Centers for Disease Control and Prevention (CDC). Differences in prevalence of obesity among black, white, and Hispanic adults—United States, 2006–2008. MMWR Morb Mortal Wkly Rep. 2009;58(27):740–4.
64. Mizell CA. Life course influences on African American men's depression: adolescent parental composition, self-concept, and adult earnings. J Black Stud. 1999;29:467–90.
65. Ho RC, Niti M, Kua EH, Ng TP. Body mass index, waist circumference, waist-hip ratio and depressive symptoms in Chinese elderly: a population-based study. Int J Geriatr Psychiatry. 2008;23(4): 401–8.
66. Kuo SY, Lin KM, Chen CY, Chuang YL, Chen WJ. Depression trajectories and obesity among the elderly in Taiwan. Psychol Med. 2011;41(8):1665–76.
67. Li ZB, Ho SY, Chan WM, Ho KS, Li MP, Leung GM, et al. Obesity and depressive symptoms in Chinese elderly. Int J Geriatr Psychiatry. 2004;19(1):68–74.

68. Kim JY, Chang HM, Cho JJ, Yoo SH, Kim SY. Relationship between obesity and depression in the Korean working population. J Korean Med Sci. 2010;25(11):1560–7.
69. Beydoun MA, Wang Y. Pathways linking socioeconomic status to obesity through depression and lifestyle factors among young US adults. J Affect Disord. 2010;123(1–3):52–63.
70. Ross CE. Overweight and depression. J Health Soc Behav. 1994;35:63–79.
71. 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.
72. WHO, 2006. http://www.euro.who.int/HEN/Syntheses/short/20040908_1.
73. Zanolli DB, Allison R, Narayan KM. The direct health care costs of obesity in the United States. Am J Public Health. 1999;89:1194–9.
74. Rosenheck BG, Druss RA, Sledge WH. Health and disability costs of depressive illness in a major US corporation. Am J Psychiatr. 2000;157:1274–8.
75. de Wit L, Luppino F, van Straten A, Penninx B, Zitman F, Cuijpers P. Depression and obesity: a meta-analysis of community-based studies. Psychiatry Res. 2010;178(2):230–5.
76. Adams KF, Schatzkin A, Harris TB, Kipnis V, Mouw T, Ballard-Barbash R, et al. Overweight, obesity, and mortality in a large prospective cohort of persons 50 to 71 years old. N Engl J Med. 2006;355(8):763–78.