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PREVALENCE OF DEPRESSION SYMPTOMS AMONG ADOLESCENTS AGED 12–17 YEARS IN CALIFORNIA AND THE ROLE OF OVERWEIGHT AS A RISK FACTOR

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Background: Literature documentation of the health consequences of obesity among adolescents continues to grow and includes the psychosocial consequences of obesity on this population.

Objective: The specific aim of this study was to identify prevalence of depression in adolescents, aged 12 to 17 years, and to identify the role of overweight as a risk factor for depression.

Methods: Secondary data analysis of the adolescent version of the 2005 California Health Interview Survey. Symptoms of depression were measured with a reduced version of the Center for Epidemiologic Studies Depression Scale. Weight status was determined using the Centers for Disease Control definitions and those recommended by the American Academy of Pediatrics.

Results: The sample was nearly half male (50.6%). The majority of the adolescents in the sample were White (47.2%) followed by Latino (33.5%). Approximately 10% of the adolescents reported more than 10 depression symptoms. Based on BMI, 16.5% of the sample were at-risk of being overweight, and 14.7% were overweight. However, 24.4% of sample thought they were 'slightly overweight or very overweight. We did not find any statistically significant association between weight status and symptoms of depression, but at the bivariate level we did find a statistically significant association between perception of one's weight and depression, $P<.001$. We also found that sex (OR 3.10; CI 2.07–4.51), perceived health (OR 2.25; CI 1.53–3.31), smoking (OR 1.8; CI 1.30–2.69), and alcohol use (OR 2.06; CI 1.44–2.95) were independently associated with depression symptoms.

Conclusion: Even though we were unable to prove the proposed association, our findings are noteworthy given that the association between these variables are less clear in the literature. Future studies that attempt to examine the relationship between these two variables may benefit from longitudinal design, inclusion of multi-item risk and protective predictors, inclusion of social-context related variables, perceived weight, and family history of obesity. (*Ethn Dis.* 2010;20[Suppl 1]:S1-107–S1-115)

Key Words: Depression, Adolescents, Overweight

INTRODUCTION

Depressive disorder has an estimated annual prevalence of 4%–8% among adolescents, with ~20% of American youth experiencing an episode of depression before age 18.[1] National data show that the prevalence of depression among adolescents is increasing.[2] This may be due to the existence of reliable screening tools that allow research investigators and clinicians to identify moderate forms of depressions with no psychometric and physical symptoms.[3] Nevertheless, depression has been a risk factor for: report of poor quality of life in adolescent population,[4] suicide for people aged ≥ 15 years,[5] poor school functioning,[6] poor psychosocial functioning,[7] increased physical illness,[8] and increased risk of substance abuse.[9]

Prevalence of overweight (ie, according to body mass index [BMI] for age and sex) and obesity among youth in 2003–2004 was reported at 17.1%, and it continues to grow.[10] A national study has shown that between 1980 and 2002, the prevalence of overweight among adolescents tripled from 5% to 16%.[11,12] Epidemiological research documents that overweight adolescents are at increased risks for hypertension, dyslipidemia, metabolic syndrome, diabetes,[13,14] cardiovascular diseases,[15,16] and mental health.[12,17]

Obese youth are at considerable risk of continued and mounting psychosocial impairment and poor developmental adaptation.[18] Regardless of race or sex, increasing weight has been associated with emotional and weight-related distress in children.[19] It has been shown that being overweight reduces overall quality of life (QOL) among children,[4,20,21] even when it does not directly influence physical functioning,[1] and may also be linked to suicidal behavior.[5,22,23] Schwimmer and others[24] found that severely obese children and adolescents have health-related QOL issues similar to children who had been diagnosed with cancer. In youth with extreme obesity, health-related QOL was found to be severely impaired with 30%–45% meeting criteria for clinically significant depressive symptoms. However, only 21% of youth at the time of study were in some form of psychological treatment (eg, medication or therapy).[18]

Regardless of the existing evidence, the association between weight status and mental health outcomes, specifically depression-related outcomes, are less clear due to mixed results. [5,13,25] Some

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researchers have obtained enough evidence to make the contention that obesity and depression are related in older adults[5,26] and in young adults,[27–29] yet, others have asserted otherwise.[30,31] Nevertheless, the evidence of mixed results has created more interest among researchers to further examine the links between these two constructs.[32] Some investigators have studied it using cross-sectional design[28,33] and others have used longitudinal design.[27,34,35]

To explain the association between weight status and depression, researchers have supported the notion that depression exerts an effect on weight through emotional eating, eating calorie-dense food, (''jolly fat'' effect) and decreased physical activities.[28,32] Therefore, this group of investigators argue that depressive symptoms appear to be predictive of obesity and elevated BMI in adult[36] and adolescent populations.[29,35,37,38]

Another group of investigators assert that obesity, or weight status, exerts an effect on depression.[5,25,26,39,40] This alternative reflects a self-appraisal hypothesis based on Cooley's concept of looking-glass self, which asserts that individuals see themselves through the eyes of others, therefore, their opinion of themselves are the reflection of how others see them.[41] Therefore, this approach posits that being overweight is considered a stigmatizing attribute, especially among adolescents who are more likely to form opinions about themselves that are undifferentiated from others in their social group.[42] If one's social group views overweight as a negative attribute, this view can contribute to stereotyping and, in turn, discrimination of the obese individual,[43] thus leading to depression.[30] The next alternative looks for the third underlying factor that may moderate or mediate the association between depression and weight status, such as sociodemographic factors.[13,44]

Irrespective of mechanism of association between obesity and depression, existing evidence suggests a link between these two constructs. However, the variability in the results across studies may be due to the variability in methodology, measurements and epidemiological sample, as well as inconsistent control of covariates.[25] These findings suggest that more studies are needed to clarify the role of weight status as a risk factor for depression. Early identification and understanding of the relationships between obesity and depression in adolescents can provide important clinical information to help: 1) tailor treatments for depressed youth in hopes of preventing future development of obesity; 2) tailor treatment for severely obese youth who may suffer from unrecognized depressive symptoms in hopes of motivating them to receive obesity treatment; and 3) develop reliable screening tools for pediatrician to use when an adolescent presents with specific risk factors for obesity and depression.

In this study, we attempted: 1) to report the prevalence of depression symptoms among adolescents aged 12–17 years in California; and 2) to examine association among this sample of weight status and report of depression symptoms based on the self-appraisal hypothesis. We hypothesized that adolescents in higher weight groups would report a higher number of depression symptoms compared to normal weight adolescents. Given the known association between depression, perception of being overweight,[45] cigarette smoking,[30,46,47] and drinking,[30,48] we also examined the association of these variables with the symptoms of depression among our sample of adolescents. Therefore, we hypothesized that adolescents who ever smoked cigarettes, ever had more than a few sips of alcohol, and who perceived their weight to be of a problem, would be more likely to report symptoms of depression than their counterparts who reported otherwise on these characteristics.

METHODS

Study Design and Sample

This was a cross-sectional, secondary data analysis using the adolescent version of the California Health Interview Survey (CHIS)[49] for 2005. The CHIS, a statewide, population-based, telephone survey, is the largest state health survey ever undertaken in the United States. It was modeled after the National Health Interview Survey and was designed to provide population-based estimates for most California counties' non-institutionalized civilians.[49] Based on a multi-stage sampling design, the state of California was divided into 41 geographic sampling strata (primarily counties) and within each geographic stratum, households were selected through random-digit dialing. Within each household, one adult (aged ≥18 years) and, for those households with adolescents (aged 12–17 years), one adolescent, after approval was obtained from their guardian, were randomly selected for interview. The survey captures information on health status, health behaviors, cancer history, perceived mental health, prevention, access to and utilization of healthcare services, and health insurance coverage. The CHIS collected data from all races and ethnicities and was conducted in 5 different languages, including English and Spanish. Response rate for the most recent CHIS survey was reported at 33.5 percent.[49]

The CHIS 2005 database included a total of 4029 adolescents. For the current study, we included adolescents (aged 12–17 years), of all ethnicities and both sexes, whose body mass index (BMI) for their age and sex, was: normal, at-risk for being overweight, and/or overweight. Underweight adolescents (based on the BMI-specific for age and sex) were excluded from the study. The study sample included 3892 adolescents who met these inclusion criteria.

Measures

Depression Symptoms

Self-reported, past seven days depression symptoms were assessed with the reduced version of the Center for Epidemiologic Studies Depression Scale (CES-D)[50] for children/adolescents. Eight items cover depressed affect (felt depressed, lonely, sad, could not shake off feeling sad and unhappy, felt life was a failure), happiness (were happy, enjoyed life), and retarded activity (did not want to do the things you usually do). Using a four point answer scale (never = 0, sometimes = 1, a lot of the time = 2, most of the time = 3), a sum score was calculated ranging between 0–24 with higher scores indicating more symptoms. For the original 20- item CES-D adult version, the cutoff score of ≥ 16 has been suggested[50]; however, for the 8-item version that has been used by CHIS, we were not able to find any established cutoff point. Cutoff score of ≥ 8 and ≥ 10 for the 10-item CES-D has been used before in adult samples.[51] For the current study, we followed Mikolajczyk et al.[52] Using CHIS data, adolescents who had a cutoff score of >10 for an 8-item CES-D were classified as having symptoms of depression.

Weight Status

Adolescents' weight status was calculated based on BMI (kg/m^2) and grouped into three categories as outlined by the Centers for Disease Control (CDC) and the American Academy of Pediatrics (AAP) where sex- and age-specific BMI is considered normal if BMI is $>5^{th}$ percentile but $<85^{th}$ percentile, at-risk for being overweight if it is $>85^{th}$ percentile but $<95^{th}$ percentile, and is considered as overweight if $>95^{th}$ percentile.

Covariates

Other variables considered in the analysis were: age (12–13, 14–15, 16–17); sex; race (White, Latino, African American, Asian/other); family type (married parents, single parents); poverty level ($\geq$ 200%, $<$ 200%); perceived health (good to excellent, fair to poor); usual source of care (no, yes); health insurance (no, yes); ever had more than a few sips of alcohol (alcohol use) (no, yes); ever smoked cigarettes (cigarette smoking) (no, yes); perception of one's weight (very underweight, slightly underweight, normal weight, slightly overweight, very overweight); trying to do anything about the weight (no, yes); parent's report of child needing emotional counseling (no, yes); and child's report of history of receiving emotional counseling (no, yes).

Data Analysis

All analyses were conducted with STATA, which uses replicate weights to account for the complex survey design (Stata Corporation, College Station, Tex., 2005). Descriptive statistics were used to present overall sociodemographic characteristics of the sample. Pearson chi-square test and adjusted regressions were use to determine the bivariate association, as well as independent associations between weight status and other covariates with depressive symptoms. $P \leq .05$ was considered statistically significant for tested associations.

RESULTS

Description of the Sample

The overall characteristics of the study sample are presented in Table 1. The sample was nearly half male (50.6%). The majority of the adolescents in the sample were White (47.2%) followed by Latino (33.5%). Many in the sample had health insurance (93.5%) and regular source of care (75.1%). Those who felt 'good to excellent' about their health comprised 87.8% of the sample, 17.2% reported 'ever smoking', and 36.0% reported 'ever had more than a few sips of alcohol drink.'

Approximately 10%, of the adolescents reported >10 depression symptoms and almost 14% of the parents thought teens needed help with emotional problems. However, only slightly more than 11% of the adolescents reported receiving psychological or emotional counseling. In regard to weight status, 68.8% of adolescents were at normal weight, 16.5% were at-risk of being overweight and 14.7% were overweight. In reference to perception of one's weight, 14.6% of the sample perceived their weight as very underweight or slightly underweight. About one fourth of the adolescents (24.4%) thought they were slightly overweight or very overweight, and 60.9% thought they were the right weight. Thirty percent of the adolescents reported that they were trying to do something about their weight (data not shown).

Association between Weight Status and Depression Symptoms: Unadjusted

The results of the bivariate analysis between weight status, covariates, and depression symptoms are summarized in Table 2. No statistically significant association was found between weight status and report of depression symptoms, and the same result was found for race, family type, health insurance, and having a regular source of care. However, we found a statistically significant association between perception of one's weight ($P<.001$), sex ($P<.001$), age ($P=.0221$), poverty level ($P=.0107$), perceived health (good to excellent 8.7%, fair to poor 19.2%; $P<.001$), alcohol use ($P<.001$), and smoking ($P<.001$) and report of depression symptoms. As expected, there was also a significant association between the depression symptoms and parent's report of child needing emotional counseling ($P<.001$) and history of receiving emotional counseling ($P<.001$). Interestingly, we also detected a significant

Table 1. Overall sociodemographics of adolescents in the study (*N*=3892)

Variable	Category	Frequency	Percent (%)
Sex	Male	1970	50.6
	Female	1922	49.4
Race	White	1836	47.2
	Latino	1302	33.5
	African-American	185	4.7
	Asian	299	7.6
	Other race	270	6.9
Age	12–13	1315	32.8
	14–15	1388	35.5
	16–17	1189	31.7
Depression			
≤ 10		3508	90.1
> 10		384	9.9
Parent thinks teen needed help with emotional problem	No	3467	86.1
	Yes	562	13.9
Received psychological/emotional counseling	No	3575	88.7
	Yes	454	11.3
Weight status	Normal	2814	68.8
	At-risk of overweight	613	16.5
	Overweight	465	14.7
Perception of weight	Very underweight	42	1.0
	Slightly underweight	548	13.6
	About the right weight	2455	60.9
	Slightly overweight	868	21.5
	Very overweight	116	2.9
Family type	Married parents	2980	70.1
	Single parents	912	29.9
Parental education	College	1390	27.6
	High School	1870	49.2
	Less than high school	603	21.4
	No formal	29	1.8
Poverty level	≥ 200% FPL	2631	58.3
	< 200% FPL	1261	41.7
Perceived health	Good-excellent	3500	87.8
	Fair-poor	392	12.2
Usual source of care	Yes	2610	75.1
	No	679	24.9
Health insurance	Yes	3655	93.5
	No	237	6.5
Ever smoked cigarettes	No	3336	82.8
	Yes	693	17.2
Ever had more than few sips of alcohol drink	No	2466	64.0
	Yes	1426	36.0

association between perception of weight and report of depression symptoms ($P<.001$), as well as trying to do anything about the weight ($P<.001$) and depression symptoms. Furthermore, a higher percentage of adolescents who were trying to lose weight (14.4%) reported symptoms of depression, compared to the group who were trying to stay at their current weight (7.6%), or gain weight (8.5).

Association between Weight Status and Depression Symptoms: Adjusted

In the multivariate logistic regression analysis (Table 3), after controlling for the study main covariates and those which were significant at the bivariate level, we did not detect any statistically significant association between weight status and report of depressive symptoms. Only sex (OR 3.10; CI 2.07–4.51), perceived health (OR 2.25; CI 1.53–3.31), smoking (OR 1.8; CI 1.30–2.69), and alcohol use (OR 2.06; CI 1.44–2.95) were independently associated with depression symptoms. All the other variables that were significant at the bivariate level lost their significance at this stage of analysis, including perception of weight.

DISCUSSION

Nearly 10% of this sample of adolescents in California reported depression symptoms compared to population-based data showing between 10%–15% of the child and adolescent population at any one time has some symptoms of depression.[53] Mikolajczyk et al,[52] using CHIS 2003 adolescent data and CES-D cutoff score of >10, reported that 7.3% of the sample had scores >10. Therefore, our findings show a trend toward an increase in report of depression symptoms among adolescent residing in California. This could be a warning sign for primary care physicians and pediatricians to screen adolescents for symptoms of depression to make adequate referral or interventions.

Our findings show that 14.7% of adolescents in the sample were overweight (ie, BMI >95th percentile). Although this is slightly lower than the national prevalence of 16%,[11] it is high enough to be a public health issue causing economic burden. We did not detect any association between weight status and depression symptoms in this study. It could be that overweight adolescents in this sample, by virtue of being young, were protected from the stigma associated with being overweight. Thus, they may have had a better image of themselves, and therefore, not depressed. It also could be that these adolescents were protected by their immediate social context (for example, supportive family and peers),[30] providing them with a positive reflection of

Table 2. Bivariate analysis: depression (reduced version CES-D score >10), sociodemographic and sociopsychological parameters

Variable	Category	Non-Depressed ≤ 10 % (*n*)	Depressed > 10 % (*n*)	*P* value
Sex	Male	94.5 (1852)	5.5 (118)	<.001
	Female	85.5 (1656)	14.5 (266)	
Race	White	89.9 (1662)	10.1 (174)	.4499
	Latino	89.8 (1169)	10.2 (133)	
	African American	88.0 (160)	12.0 (25)	
	Asian/Other	92.3 (517)	7.7 (52)	
Age	12–13	92.4 (1224)	7.6 (91)	.0221
	14–15	90.0 (1246)	10.0 (142)	
	16–17	87.7 (1038)	12.3 (151)	
Family type	Married parents	90.8 (2716)	9.2 (264)	.0886
	Single parents	88.3 (792)	11.7 (120)	
Poverty level	≥ 200%	91.5 (2411)	8.5 (220)	.0107
	< 200%	88.0 (1097)	12.0 (164)	
Weight status	Normal	89.7 (2544)	10.3 (270)	.6600
	At risk	90.7 (553)	9.3 (60)	
	Overweight	91.2 (411)	8.8 (54)	
Perception of weight	Very underweight	78.1 (25)	21.9 (7)	<.001
	Slightly underweight	88.2 (425)	11.8 (57)	
	Normal weight	92.2 (2214)	7.8 (188)	
	Slightly overweight	86.9 (748)	13.1 (113)	
	Very overweight	83.5 (96)	16.5 (19)	
Trying to do anything about weight	Lose	85.6 (1026)	14.4 (173)	<.001
	Stay	92.4 (931)	7.6 (77)	
	Gain	91.5 (301)	8.5 (28)	
	None	92.2 (1250)	7.8 (106)	
Access to health care	No usual source of care	87.4 (590)	12.7 (89)	.0871
	Uninsured	91.7 (218)	8.4 (19)	.5411
Perceived health	Good to excellent	91.4 (3201)	8.7 (299)	<.001
	Fair to poor	80.8 (307)	19.2 (85)	
Ever had more than few sips of alcohol drink	No	93.0 (2299)	6.9 (167)	<.001
	Yes	84.7 (1209)	15.3 (217)	
Ever smoked cigarettes	No	91.9 (2988)	8.1 (227)	<.001
	Yes	81.5 (520)	18.5 (157)	
Parent thinks teen needed help with emotional problem	Parent thought child needed emotional help	69.0 (377)	31.0 (169)	<.001
Received psychological/emotional counseling	Received psychological emotional counseling	70.5 (311)	29.5 (130)	<.001

their body image. We did not have data to assess the attitude of people who made up the social context of the adolescents toward being overweight. We also could not explore the extent to which adolescents cared about what members of their social context think about them being overweight (subjective norms). The experience of depression could also be different for adolescents who come from a ''thin'' family, or an ''overweight'' family. More context-specific data would help to explore these possibilities.[30]

The prevalence of overweight based on BMI in our sample was 8.8% but 13.1% and 16.5% considered themselves as slightly overweight or very overweight. We detected an association between perception of weight and depression symptoms in the bivariate model; however, this association lost its significance in the multivariate, adjusted model. A closer look at the distribution of these variables in the data showed that adolescents who perceived their weight as very underweight, slightly overweight or very overweight were more likely to report higher symptoms of depression: 21.9%, 13.1%, and 16.5%, respectively. However, symptoms of depression reached a plateau for the slightly underweight (11.8%), and for the about the right weight group (7.8%, $P<.001$), therefore, providing partial support, ie, only in the bivariate model, for the U-curve association between overweight and depression. The underlying assumption for the U-curve hypothesis is that both being underweight and overweight is associated with depression. This is because according to DSM-IV both over-eating and under-eating are core symptoms of major depressive disorders.[54] This hypothesis is understudied but those who tested it have provided partial [22] or full support.[54,55] De Sousa showed that, among a sample of adolescents in Portugal, lack of satisfaction with their body image led to psychological malad-

Table 3. Characteristics associated with depressive symptoms in multivariate analysis

Variable	Category	Odds Ratio	95% Confidence Interval
Weight status	Normal	Reference	
	At-risk of overweight	0.91	0.54–1.52
	Overweight	0.71	0.42–1.19
Sex	Male	Reference	
	Female	3.10	**2.07–4.51**
Age	12–13	Reference	
	14–15	1.00	0.70–1.44
	16–17	0.96	0.60–1.52
Race	White	Reference	
	African American	1.34	0.70–2.56
	Latino	0.84	0.59–1.19
	Asian/Other	0.81	0.51–1.26
Perceived health	Excellent to good	Reference	
	Fair to poor	2.25	**1.53–3.31**
Family type	Married parents	Reference	
	Single parents	1.04	0.73–1.50
Poverty level	≥ 200%	Reference	
	< 200%	1.40	0.96–2.05
Ever smoked cigarettes	No	Reference	
	Yes	1.8	**1.30–2.69**
Ever had more than few sips of alcohol drink	No	Reference	
	Yes	2.06	**1.44–2.95**

Note: Bold indicates independent association with depression symptoms.

justment, and nutritional disorders.[56] Further studies are needed to look at perception of body weight as a risk factor for depression compared to actual BMI. Results of these studies could have implications for programs that target obesity control among adolescents.

In our study, we were also able to demonstrate some putative correlations of depression, such as sex, smoking, alcohol use, and perceived health. Females were three times (OR 3.1) more likely to report depression symptoms than males [$P<.001$)]. This finding is consistent with the literature.[57] Positive cross-sectional correlation between being female and depression has been supported by many other investigators through three main theories: 1) biological basis of depression that implicates sex differences in depression is the function of how differently male and female process their emotions.[58] According to this theory, females are more likely to experience dysregulation of emotion-processing and are, therefore, more at-risk for depression;[59] 2) low self-esteem, experience of certain stressful events, coping style, and sensitivity to lack of social support, turns inward in females and becomes risk factors for depression[60,61]; and 3) sex frames access to social resources, influencing the prevalence of poverty and economic dependence among women leading to anxiety and depression.[62] Programs for adolescent females at-risk of depression are needed to offer self-help materials, counseling services, and support group so that they would be well equipped to manage biological, psychological, and social risk factors for depression.

Adolescents who reported ever had more than a few sips of alcohol comprised 36% of our sample. Alcoholic beverages have been one of the most widely used substances by youth in the United States for a long time.[63] In 2008, youth who admitted drinking alcohol in the 30-days prior to the survey were: 16% 8th graders, 29% 10th graders, and 43% 12th graders.[63] In our sample, those who ever used alcohol were two times (OR 2.06) more likely to report depression symptoms than those who did not drink ($P<.001$). This finding, in general, supports earlier findings pertaining to the role of alcohol in presentation of some level of depression among adolescents[64] and adults.[48,65] In general, three mechanisms have been used to describe the relationship between depressive symptoms and alcohol use: 1) alcohol misuse leads to higher levels of depression and contributes to the inception, duration or recurrence of depressive disorders[66–68]; 2) depression leads to alcohol misuse and the persistence of alcohol dependence as a form of self-medication[69,70]; and 3) there are common determinants for alcohol dependence and depression, including environmental or genetic ones.[71,72] The majority of the epidemiological and correlational studies that investigate the physical and mental health consequences of alcohol misuse rely on the first mechanism.[73,74]

In our study, 17% of the adolescents reported ever smoking. National data show 14.6% of adolescent were current smokers (smoking in the past 30 days) in 2000.[75] Eaton and others, using national data, reported that during 2005, 23% of high school students had smoked cigarettes during the 30 days preceding the survey.[76] We found that youth who reported ever smoking were nearly two times (OR 1.8) more likely to report depression symptoms compared to non-smokers ($P<.001$). This finding supports the claim of other investigators that smoking is a risk factor for depression.[77,78] However, the temporal relationship between adolescent smoking and depression is still unsettled. Some research findings support that depression predicts smoking,[79] yet another group provides evidence for a bidirectional relationship between these two variables; in other words, depression contributes to the initiation of smoking and smoking progression contributes to dampening of depression symptoms.[46]

More longitudinal data are needed to resolve some of these issues.

Slightly more than 12% of the adolescents in the sample reported fair to poor perceived health. Furthermore, adolescents who reported fair to poor perceived health were two times more likely to report depression symptoms (OR 2.3) compared to those reporting good to excellent health ($P<.001$). Self-rated health is an important indicator of quality of life and a good predictor of future mental health but less studied in adolescents.[80] Our finding suggests that asking adolescents to self-report their health (one-item) can be used for the screening and identification of those who are at-risk for depression. This could be a valuable tool for clinicians who serve this segment of the population.

In general, our findings, in respect to the association between health and compromising behaviors such as smoking and alcohol use, poor perception of health, and symptoms of depression, point to predisposing attributes, which could have less favorable health outcomes for this segment of the population.[75] Clinicians can play a critical role to screen adolescents for risky behaviors and early signs of depression, and set the stage for early counseling and intervention.

Limitations

This study has several limitations that should be considered when interpreting our findings. First, data for this study were cross-sectional; therefore, we were unable to make any causal inferences about the role of variables that were statistically significant (sex, alcohol use, smoking, and health status) and depression symptoms. Second, data for this study were self-reported; therefore, reported measures of weight and height could be inaccurate. Danubio et al[81] argue that both men and women overestimate their height and underestimate their weight, leading to a misclassification of the prevalence of overweight.[81] However, a population-based study of adolescents found a high correlation between self-reported weight and height with actual weight and height. These researchers correctly classified weight status of 94% of the adolescents in the study.[82] Third, our measures of cigarette smoking and alcohol use are limited by a single-item question not letting us to guard against measurement error.

This study, however, offers several important findings. This is the first study using a large group of adolescents from the CHIS 2005 survey to test the association between BMI and depression based on the self-appraisal and social consequences hypothesis. Even though we were unable to prove the proposed association, our findings are noteworthy given that the association between these variables are still unclear in the literature and small bivariate associations are all some investigators have been able to present.[13,30] Our demonstration of an association of being female, smoking, alcohol use, and self-perceived health with depression is consistent with the previous research, which suggests intervening in any of these factors has the potential to prevent the development of depression symptoms in this population. Future studies, which attempt to study the relationship between these two variables, may benefit from longitudinal design, inclusion of multi-item risk and protective predictors, inclusion of social-context related variables, perceived weight, and family history of obesity.

REFERENCES

1. Arif AA, Rohrer JE. The relationship between obesity, hyperglycemia symptoms, and health-related quality of life among Hispanic and non-Hispanic white children and adolescents. *BMC Fam Pract*. 2006;7:3.
2. Cross-National Collaborative Group. The changing rate of major depression. Cross-national comparisons. *JAMA*. 1992;268(21): 3098–3105.
3. Birmaher BRN, Williamson DE, Brent DA, et al. Childhood and adolescent depression. a review of the past 10 years (Part I). *J Am Acad Child Adolesc Psychiatry*. 1996;35(11): 1427–1439.
4. Hughes AR, Farewell K, Harris D, Reilly JJ. Quality of life in a clinical sample of obese children. *Int J Obes (Lond)*. 2007;31(1):39–44.
5. Mather AA, Cox BJ, Enns MW, Sareen J. Associations of obesity with psychiatric disorders and suicidal behaviors in a nationally representative sample. *J Psychosom Res*. 2009;66(4):277–285.
6. Logan DE, Simons LE, Kaczynski KJ. School functioning in adolescents with chronic pain: the role of depressive symptoms in school impairment. *J Pediatr Psychol*. 2009[in press].
7. Purper-Ouakil D, Michel G, Mouren-Simeoni MC. Vulnerability to depression in children and adolescents: update and perspectives. *Encephale*. 2002;28(3 Pt 1):234–240.
8. Himmerich H, Fulda S, Linseisen J, et al. Depression, comorbidities and the TNF-[alpha] system. *European Psychiatry*. 2008; 23(6):421–429.
9. Crum RMSC, Ialongo N, Anthony JC. Is depressed mood in childhood associated with an increased risk for initiation of alcohol use during early adolescence? *Addict Behav*. 2008;33(1):24–40.
10. 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):1549–1555.
11. Centers for Disease Control and Prevention. Available at: www.cdc.gov/HealthyYouth. Last accessed December 8, 2005.
12. Waring ME, Lapane KL. Overweight in Children and Adolescents in Relation to Attention-Deficit/Hyperactivity Disorder: Results From a National Sample. *Pediatrics*. 2008;122(1):e1–6.
13. Faith MSMP, Jorge MA. Obesity-depression associations in the population. *J Psychosom Res*. 2002;53(4):935–942.
14. Duncan GE, Li SM, Zhou XH. Prevalence and trends of a metabolic syndrome phenotype among US adolescents, 1999–2000. *Diabetes Care*. 2004;27(10):2438–2443.
15. Freedman DS, Khan LK, Dietz WH, Srinivasan SR, Berenson GS. Relationship of childhood obesity to coronary heart disease risk factors in adulthood: the Bogalusa Heart Study. *Pediatrics*. 2001;108(3):712–718.
16. Weiss JW, Mouttapa M, Chou CP, et al. Hostility, depressive symptoms, and smoking in early adolescence. *J Adolesc*. 2005;28(1): 49–62.
17. Wang G, Dietz WH. Economic burden of obesity in youths aged 6 to 17 years: 1979–1999. *Pediatrics*. 2002;109(5):E81–81.
18. Zeller MH, Modi AC. Predictors of health-related quality of life in obese youth. *Obesity (Silver Spring)*. 2006;14(1):122–130.

19. Young-Hyman D, Tanofsky-Kraff M, Yanovski SZ, Keil M, Cohen ML, Peyrot M, Yanovski JA. Psychological status and weight-related distress in overweight or at-risk-for-overweight children. *Obesity (Silver Spring)*. 2006;14(12):2249–2258.
20. Williams J, Wake M, Hesketh K, Maher E, Waters E. Health-related quality of life of overweight and obese children. *JAMA*. 2005;293(1):70–76.
21. de Beer M, Hofsteenge GH, Koot HM, Hirasing RA, Delemarre-van de Waal HA, Gemke RJ. Health-related-quality-of-life in obese adolescents is decreased and inversely related to BMI. *Acta Paediatr*. 2007;96(5): 710–714.
22. 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):251–257.
23. Dong C, Li WD, Li D, Price RA. Extreme obesity is associated with attempted suicides: results from a family study. *Int J Obes (Lond)*. 2006;30(2):388–390.
24. Schwimmer JB, Burwinkle TM, Varni JW. Health-related quality of life of severely obese children and adolescents. *JAMA*. 2003; 289(14):1813–1819.
25. Dong C, Sanchez LE, Price RA. Relationship of obesity to depression: a family-based study. *Int J Obes Relat Metab Disord*. 2004;28(6): 790–795.
26. Roberts RE, Deleger S, Strawbridge WJ, Kaplan GA. Prospective association between obesity and depression: evidence from the Alameda County Study. *Int J Obes Relat Metab Disord*. 2003;27(4):514–521.
27. Hasler G, Pine DS, Gamma A, Milos G, Ajdacic V, Eich D, Rossler W, Angst J. The associations between psychopathology and being overweight: a 20-year prospective study. *Psychol Med*. 2004;34(6):1047–1057.
28. Becker ES, Margraf J, Turke V, Soeder U, Neumer S. Obesity and mental illness in a representative sample of young women. *Int J Obes Relat Metab Disord*. 2001;25 Suppl 1:S5–9.
29. Goodman E, Whitaker RC. A prospective study of the role of depression in the development and persistence of adolescent obesity. *Pediatrics*. 2002;110(3):497–504.
30. Needham BL, Crosnoe R. Overweight status and depressive symptoms during adolescence. *J Adolesc Health*. 2005;36(1):48–55.
31. Statistics NCfH. *Data file Documentation, National Health Interview Survey, 2005 (machine readable data file and documentation)*. Hyattsville, MD: National Center for Health Statistics, Centers for Disease Control and Prevention; 2006.
32. Blaine B. Does Depression Cause Obesity?: A Meta-analysis of Longitudinal Studies of Depression and Weight Control. *J Health Psychol*. 2008;13(8):1190–1197.
33. John U, Meyer C, Rumpf HJ, Hapke U. Relationships of psychiatric disorders with overweight and obesity in an adult general population. *Obes Res*. 2005;13(1):101–109.
34. Hasler G, Pine DS, Kleinbaum DG, Gamma A, Luckenbaugh D, Ajdacic V, Eich D, Rossler W, Angst J. Depressive symptoms during childhood and adult obesity: the Zurich Cohort Study. *Mol Psychiatry*. 2005;10(9):842–850.
35. 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):285–291.
36. Hasler G, Lissek S, Ajdacic V, Milos G, Gamma A, Eich D, Rossler W, Angst J. Major depression predicts an increase in long-term body weight variability in young adults. *Obes Res*. 2005;13(11):1991–1998.
37. 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):739–745.
38. Lynch FL, Clarke GN. Estimating the economic burden of depression in children and adolescents. *Am J Prev Med*. 2006;31(6 Suppl 1):S143–151.
39. McIntyre RS, Konarski JZ, Wilkins K, Soczynska JK, Kennedy SH. Obesity in bipolar disorder and major depressive disorder: results from a national community health survey on mental health and well-being. *Can J Psychiatry*. 2006;51(5):274–280.
40. Scott KM, Bruffaerts R, Simon GE, 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.
41. Cooley CH. *Human Nature and the Social Order*. New York: Transaction Publishers; 1964.
42. Ross CE. Overweight and depression. *J Health Soc Behav*. 1994;35:63–79.
43. Carr D, Friedman MA. Is obesity stigmatizing? Body weight, perceived discrimination, and psychological well-being in the United States. *J Health Soc Behav*. 2005;46(3):244–259.
44. Friedman MA, Brownell KD. Psychological correlates of obesity: moving to the next research generation. *Psychol Bull*. 1995;117(1): 3–20.
45. Pimenta AM, Sanchez-Villegas A, Bes-Rastrollo M, Lopez CN, Martinez-Gonzalez MA. Relationship between body image disturbance and incidence of depression: the SUN prospective cohort. *BMC Public Health*. 2009;9:1.
46. Audrain-McGovern J, Rodriguez D, Kassel JD. Adolescent smoking and depression: evidence for self-medication and peer smoking mediation. *Addiction*. 2009.
47. Fergusson DM, Goodwin RD, Horwood LJ. Major depression and cigarette smoking: results of a 21-year longitudinal study. *Psychol Med*. 2003;33(8):1357–1367.
48. Paljarvi T, Koskenvuo M, Poikolainen K, Kauhanen J, Sillanmaki L, Makela P. Binge drinking and depressive symptoms: a 5-year population-based cohort study. *Addiction*. 2009;104(7):1168–1178.
49. California Health Interview Survey C. Dataset public use file. 2003. Available at www.chis.ucla.edu. Last accessed November 27, 2009.
50. Radloff L. The CES-D scale: a self-report depression scale for research in the general population. *Applied Psychological Measurement*. 1977;1(3):385–401.
51. Andresen EM, Malmgren JA, Carter WB, Patrick DL. Screening for depression in well older adults: evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale). *Am J Prev Med*. 1994; 10(2):77–84.
52. Mikolajczyk RT, Bredehorst M, Khelaifat N, Maier C, Maxwell AE. Correlates of depressive symptoms among Latino and Non-Latino White adolescents: findings from the 2003 California Health Interview Survey. *BMC Public Health*. 2007;7:21.
53. *Mental Health, A Report of the Surgeon General*. Rockville: US. Department of Health & Human Services; 1999.
54. de Wit LM, van Straten A, van Herten M, Penninx BW, Cuijpers P. Depression and body mass index, a u-shaped association. *BMC Public Health*. 2009;9:14.
55. Johnston E, Johnson S, McLeod P, Johnston M. The relation of body mass index to depressive symptoms. *Can J Public Health*. 2004;95(3):179–183.
56. de Sousa SM. Body-image and obesity in adolescence: a comparative study of social-demographic, psychological, and behavioral aspects. *Span J Psychol*. 2008;11(2):551–563.
57. Li CE, DiGiuseppe R, Froh J. The roles of sex, gender, and coping in adolescent depression. *Adolescence*. 2006;41(163):409–415.
58. Patton GC, Olsson C, Bond L, Toumbourou JW, Carlin JB, Hemphill SA, Catalano RF. Predicting female depression across puberty: a two-nation longitudinal study. *J Am Acad Child Adolesc Psychiatry*. 2008;47(12): 1424–1432.
59. Wright SL, Langenecker SA, Deldin PJ, Rapport LJ, Nielson KA, Kade AM, Own LS, Akil H, Young EA, Zubieta JK. Gender-specific disruptions in emotion processing in younger adults with depression. *Depress Anxiety*. 2009;26(2):182–189.

60. Charbonneau AM, Mezulis AH, Hyde JS. Stress and emotional reactivity as explanations for gender differences in adolescents' depressive symptoms. *J Youth Adolesc*. 2009;38(8): 1050–1058.
61. Nummer G, Seiffge-Krenke I. Can differences in stress perception and coping explain sex differences in depressive symptoms in adolescents? *Z Kinder Jugendpsychiatr Psychother*. 2001;29(2):89–97.
62. Matheson FI, Moineddin R, Dunn JR, Creatore MI, Gozdyra P, Glazier RH. Urban neighborhoods, chronic stress, gender and depression. *Soc Sci Med*. 2006;63(10): 2604–2616.
63. Johnston LDOMP, Bachman JG, Schulenberg JE. *Monitoring the Future National Results on Adolescent Drug Use: Overview of Key Findings, 2008*. Bethesda, MD: National Institute on Drug Abuse; 2009.
64. Maag JW, Irvin DM. Alcohol use and depression among African-American and Caucasian adolescents. *Adolescence*. 2005;40(157): 87–101.
65. Bazargan-Hejazi SBM, Gaines T, Jemanez M. Alcohol misuse and report of recent depressive symptoms among ED patients. *Am J Emerg Med*. 2008;26(5):537–544.
66. Aneshensel CSH, Depression GJ. alcohol use, and smoking over one year: a four-wave longitudinal causal model. *J Abnorm Psychol*. 1983;92:134–150.
67. Hansell S, Sherman G, Mechanic D. Body awareness and medical care utilization among older adults in an HMO. *J Gerontol*. 1991;46(3):S151–S159.
68. Schuckit MAH, V. Alcohol dependence and anxiety disorders : what is the relationship? *Am J Psychiat*. 1994;151:1723–1734.
69. Kwok RK, Yankaskas BC. The use of census data for determining race and education as SES indicators: a validation study. *Annals of Epidemiol*. 2001;11(3):171–177.
70. Kessler RC, Nelson CB, McGonagle KA, Edlund MJ, Frank RG, Leaf PJ. The epidemiology of co-occurring addictive and mental disorders : implications for prevention and service utilization. *Am J Orthopsychiatry*. 1996;66:17–31.
71. Kendler KS, Heath AC, Neale MC, Kessler RC, Eaves LJ. Alcoholism and major depression in women. A twin study of the causes of comorbidity. *Arch Gen Psychiatry*. 1993;50.
72. Tambs K, Harris JR, Magnus P. Genetic and environmental contributions to the correlation between alcohol consumption and symptoms of anxiety and depression. Results from a bivariate analysis of Norwegian twin data. *Behavior Genetics*. 1997;27:241–250.
73. Green CAPN, Polen MR. Gender differences in the relationships between multiple measures of alcohol consumption and physical and mental health. *Alcohol Clin Exp Res*. 2004; 28(5):754–764.
74. Haynes JCFM, Singleton N, Meltzer H, Araya R, Lewis G, Wiles NJ. Alcohol consumption as a risk factor for anxiety and depression: results from the longitudinal follow-up of the National Psychiatric Morbidity Survey. *Br J Psychiatry*. 2005;Dec;187:544–551.
75. Pasch KE, Nelson MC, Lytle LA, Moe SG, Perry CL. Adoption of risk-related factors through early adolescence: associations with weight status and implications for causal mechanisms. *J Adolesc Health*. 2008;43(4): 387–393.
76. Eaton DK, Kann L, Kinchen S, Ross J, Hawkins J, Harris WA, Lowry R, McManus T, Chyen D, Shanklin S, Lim C, Grunbaum JA, Wechsler H. Youth risk behavior surveillance–United States, 2005. *MMWR*. 2006; 55(5):1–108.
77. Steuber TL, Danner F. Adolescent smoking and depression: which comes first? *Addict Behav*. 2006;31(1):133–136.
78. Goodman E, Capitman J. Depressive symptoms and cigarette smoking among teens. *Pediatrics*. 2000;106(4):748–755.
79. Rohde P, Kahler CW, Lewinsohn PM, Brown RA. Psychiatric disorders, familial factors, and cigarette smoking: III. Associations with cessation by young adulthood among daily smokers. *Nicotine Tob Res*. 2004;6(3):509–522.
80. Breidablik H-J, Meland E, Lydersen S. Self-rated health during adolescence: stability and predictors of change (Young-HUNT study, Norway). *Eur J Public Health*. 2009;19(1): 73–78.
81. Danubio ME, Miranda G, Vinciguerra MG, Vecchi E, Rufo F. Comparison of self-reported and measured height and weight: implications for obesity research among young adults. *Econ Hum Biol*. 2008;6(1):181–190.
82. Strauss RS. Comparison of measured and self-reported weight and height in a cross-sectional sample of young adolescents. *Int J Obes Relat Metab Disord*. 1999;23(8):904–908.