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Article

# Association Between Obesity and Depressive Symptoms: A Cross-Sectional Study Among Undergraduate and Graduate Students in Bronx, NY

Aditi Puri <sup>1,\*</sup>, Peter C. Nwakeze <sup>1</sup>, Collette M. Brown <sup>2</sup>, Latoya Callender <sup>2</sup>, Chesley Sanchez <sup>3</sup> and William Suarez-Gomez <sup>2</sup>

<sup>1</sup> School of Allied Health Professions, King Graduate School, Monroe University, Bronx, NY 104681, USA

<sup>2</sup> School of Allied Health Sciences, Human Services and Nursing, Lehman College, The City University of New York, NY 10468, USA 2

<sup>3</sup> Department of Epidemiology and Biostatistics, School of Public Health, SUNY Downstate Health Science University, Brooklyn, NY 11203, USA 3

\* Correspondence: apuri@monroeu.edu; Tel. +1 (781)-541-0276

## Abstract

**Background:** Obesity and depression are public health crises in the United States. College students are impacted by both obesity and depression congruently in the US. Purpose: This study analyzed the impact of obesity on depression among 986 undergraduate and graduate students in two colleges located in the Bronx, NY. **Methods:** Data for this cross-sectional study were collected using a subsection (depression) of the Depression, Anxiety and Stress Scale (DASS-21). Body Mass Index was calculated using participant's self-reported height and weight. Data were analyzed using Chi-square test and logistic regression analysis. **Results:** Researchers found an association between obesity and depression. Students who were normal weight were less likely to be depressed compared to obese students after controlling for potential confounders in the logistic regression analysis (Exp(B)=0.698, C.I.=0.493-0.987, p=0.042). Those who were between the ages of 18-24 (Exp(B)=2.463, C.I.=1.602-3.786, p<0.001) and 25-34 (Exp(B)=1.616, C.I.=1.024-2.549, p=.039) were respectively 2.4 and 1.6 times more likely to experience depression compared to those who were 35 years-old or above. **Conclusion:** Institutions should screen students for obesity and depression on college campuses. They should develop programs that treat obesity and depression simultaneously with the goal of improving overall well-being and academic outcomes.

**Keywords:** obesity; depression; BMI; age

## 1. Introduction

Obesity is commonly defined as having excessive body fat. A benchmark for obesity is a body mass index (BMI) of over 30 (weight in kg/height in meter<sup>2</sup>). Obesity is a complex and chronic disease that impacts overall health and quality of life. It is caused by excessive food intake at the most basic level. However, excessive food intake may be influenced by eating habits, certain medications, disability, genetics, lack of sleep, stress, lack of physical activity, and underlying health issues such as metabolic syndrome (Cleveland Clinic, 2024). Obesity increases risk of diseases and conditions such as cancers (esophageal, uterine, breast, pancreatic, colorectal), female infertility, issues with memory/cognition, Alzheimer, dementia, depression and mood disorders, diabetes, high blood pressure, and joint problems (Cleveland Clinic, 2024; Center of Disease Control and Prevention [CDC], 2022).

The prevalence of obesity among adults in the United States between 2021-2023 was 40.3%, with no significant difference between men (39.2%) and women (41.3%) (Emmerich et al., 2024). According

to GBD 2021 US Obesity Forecasting Collaborators (2024) report, the age-standardized obesity among those aged 25 or older was estimated to be 75.9% in males and 72.6% in females. In 2024, 28.7% of college students described themselves as being overweight, while 6.6% considered themselves very obese (Elflin, 2025).

Depression is a mood disorder that causes persistent feeling of sadness and lack of interest. It is a serious disorder that negatively impacts how one thinks, acts and feels. It is also called a major depressive disorder that results in varied emotional and physical problems (Mayo Clinic, 2022). From 2021-2023 depression prevalence among adolescents and adults aged 12 and older, was 13.1%. The depressive symptoms decreased with increasing age in both males and female (CDC, 2025). Nearly 88% of the US population reported difficulty in conducting activity at home, work or social settings due to depression (CDC, 2025). College students are exposed to multiple risk factors that result in depression and suicide. A meta-analysis found 12 risk factors that predict depression and suicide, some of which are sexual harassment, parental depression, mental health problem, childhood adversity and financial difficulty (Sheldon et al., 2021).

### 1.1. Obesity and Depression Effects: College Students

Research illustrates that college students are often simultaneously impacted by obesity and depression globally (Akinyemi et al., 2022; Barr-Poter et al., 2025; Hossain et al., 2022; Kaufman et al., 2020; Luppino, 2010; Odlaug et al., 2015; Sarigiani et al., 2020; Sethi et al., 2021; Zhuang et al., 2025). More specifically, research indicates that obesity is a risk factor for depression (Manan et al., 2016; Zhuang, 2025). A meta-analysis conducted by Manan et al. (2016) found that those who were obese had an 18% increased risk of being depressed (RR: 1.18, 95% CI: 1.04, 1.35). College students are also impacted by obesity and depression. Depression symptoms are common among female undergraduate students. Akinyemi et al. (2022) found that female undergraduate students at the Western Illinois University (WIU) who were either overweight (OR=0.37, 95% CI=1.11-3.31) or obese (OR=2.20, 95% CI=1.30-3.80) had higher odds of being diagnosed with depression compared to students with normal weight. A reciprocal relationship between depression and obesity exists, confirmed by Luppino et al. (2010) in a systematic review and meta-analysis. They found that obesity at baseline increased the risk of depression at follow-up ( $p < 0.001$ ). This association was more prevalent among Americans compared to Europeans ( $p = 0.05$ ).

Obesity impacts psychological functions, and body image. A desire to obtain ideal body weight as determined by the society can also lead to mood disorders. Sarigiani et al. (2020) found a statistically significant difference in body image and depressive symptoms. Obese women had significantly lower body image and higher depressive symptoms (35.5%,  $p < 0.05$ ) compared to non-obese women. Obese women with high depressive symptoms reported low body image and more eating problems (Sarigiani et al., 2020). The prevalence of mood disorders noted as "severe" and "very severe depression" was 91.2% among 950 university students in Istanbul. In addition, 23.8% of students who misjudged their body weight reported higher levels of depression ( $p = 0.008$ ) (Hamurcu, 2023). In a large mid-western university overweight and obesity were found to be significantly associated with greater depressive symptoms, low academic achievement, and use of diet pills (Odlaug et al., 2015). A systematic review from Gulf Cooperating Countries (GCC) also found a significant association between depression and mood disorders among students. Prevalence of overweight and obesity was alarmingly high in these countries, with a mean rate of 29.4% (Joma et al., 2024). A study from Bangladesh found greater odds of obesity among those with severe and extremely severe levels of Depression Anxiety and Stress (DAS) disorders compared to normal and mild levels (Hossain et al., 2022).

College students often experience academic burn-out. Zhunag et al. (2025) found academic burn-out and internet addiction were mediators of overweight/obesity and depression ( $b = .452$ ,  $p < .001$ ). Overweight/obese medical students were more likely to experience academic burnout and internet addiction, which increased their risk for depression.

Food security also impacts the relationship between obesity and depression. A study conducted by Barr-Poter et al., (2025) found that students from two universities in the US who were food insecure (36.7%) reported experiencing depression (39.1%). Female students who were more likely to report very low food security status (FSS) and high BMI were at greater odds for the prevalence of depression ( $p < .001$ ). A reciprocal relationship between food insecurity and depression was found among students enrolled in two different campuses in Bronx, NY. Students who were stressed experienced food insecurity ( $p < 0.022$ ), whereas those who were food insecure were more likely to report stress ( $p = 0.007$ ) and depression ( $p < 0.021$ ) (Brown et al., 2025).

Despite evident correlation between obesity and mental health comorbidities, there is a scarcity of interventions that are targeted towards the youth on college campuses. Weight management interventions are particularly fragmented on college campuses (Sethi et al., 2015). Kauffman et al. (2020) found that engaging in exercise in past 30 days ( $B = .16$ ,  $p < .05$ ) and greater body positivity ( $B = -.36$ ,  $p < .001$ ) were associated with lower depressive symptoms.

### 1.2. School Level and Depression: Undergraduate and Graduate Students

The beginning of a college degree whether undergraduate or graduate, can be stressful. In addition to coping with academic pressure, some students find separation from family stressful while others may still have multiple work and family responsibilities, especially if they live in urban areas. This results in first onset of mental health or substance abuse problems or exacerbation of their symptoms, which can lead to depression (Pedrelli et al., 2015). Depression is common among graduate and undergraduate students across the globe (Adams et al., 2021; Beiter et al., 2015; Charles et al., 2022; Duffy et al., 2020; Eisenberg et al., 2025; Li et al., 2023; Liu et al., 2019; Pedrelli et al., 2015; Sheldon et al., 2021; Senthilkumar et al., 2023). Data from the 2024-2025 Healthy Minds Study (HMS) (2025) reveals that 36% of college students had severe (17%) and moderate (19%) depression, and 32% had a lifetime diagnosis of a depression or a mood disorder (major depressive disorder and persistent depressive disorders). Data for the HMS study were collected from 84,735 students attending 135 colleges/universities in the US (Eisenberg et al., 2025). The researchers reported that the psychological health of students varies by degree level. Another study conducted in China by Liu et al., (2019) reported that the highest level of depression was found among first- or second-year Chinese full-time undergraduate students enrolled in 15 different universities in China. Thirty five percent of students reported above normal levels of depression. Daily stress can further exacerbate the situation, daily stress was positively correlated to depression and anxiety ( $p < 0.001$ ) among professional degree graduate students in Chinese traditional medicine universities (Li et al., 2023). Also, a recent study conducted by Brown et al., (2025) among undergraduate students who attended urban institutions reported that 47.4% of the students experienced high depression. Thus, effective interventions are required to reorganize as well as strengthen existing mental health services and develop new resources for students on campus (Duffy, Keown et al., 2019; Duffy, Saunders et al., 2019).

### 1.3. Obesity and Depression: Impact on Students' Well-Being

Multiple studies have examined the association between obesity and Major Depressive Disorders (MDD), which is now seen as a public health problem that impact the overall well-being of the populations (Badillo et al., 2021; Darimont et al., 2020; de Wit et al., 2022; Herhaus et al., 2020; Wang, 2024; Wang et al., 2022). Collectively, these studies indicate a positive relationship between BMI and depression, where higher levels of BMI correspond to higher levels of depression. For example, de Wit et al. (2022) used data from Netherlands Mental Health Survey Study-2 (NEMESIS-2) to examine the incidence of mood disorders (major depression, dysthymia and bipolar disorder) by BMI levels among adult in general population. Those who were obese at baseline had a significantly increased risk of any mood-or-anxiety disorder compared to those with normal body weight ( $OR = 1.71$ , 95% CI: 1.11-2.62). Similarly, a meta-analysis and a systematic review by Luppino et al. (2010) also found that those who were obese had an increased risk of developing depression over a period (55%). A U-shaped relationship between BMI and depression was found by Cui et al.

(2024) in Longgann District of Shenzhen City. Both obesity and underweight increased the risk of depression, especially among those who were young, single, employed and highly educated. Another study found a significant association between depression and BMI classes: underweight, overweight, normal weight and obesity. Obese individuals had higher values of depression as compared to other BMI classes (Herhaus et al., 2020). Similarly, a systematic review by Pereria-Miranda et al. (2017) found that those who were obese were 32% more likely to have depression (PR=1.32, 95% CI=1.26-1.38). Obesity was specifically associated with multiple episodes of major depression (MDD-R, OR=1.32, 95% CI=0.89-1.07) in a longitudinal study, however, a reverse association was not found during a 2-year follow-up (Nigatu et al., 2015).

The risk of depression is highest among those who have Metabolically Unhealthy Obesity (MUO) (OR-1.442; 95% CI=1.432) (Wang et al., 2022). Metabolically unhealthy obesity is characterized by inflammation, increased adipose visceral tissue, hyperglycemia, hypertension, and insulin resistance (Cho et al., 2022). BMI and depression also affect men and women differently; however, results are mixed. Using NHANES data from 2017–2020, Wang et al. (2024) found that women exhibited more pronounced symptoms of depression compared to men (B=0.07, p<.005). Depression, feeling down or hopeless everyday was associated with overweight among men (61.5%) and women (50.9%) in a study conducted by Badillo et al. (2021) using the National Health and Nutrition Examination Survey (NHANES) data. Darimont et al. (2020), found that women who perceived themselves as overweight or reported a high BMI (obese) had significantly higher odds of depression (OR -1.48 95% CI – 1.17 – 1.72) compared to women who reported normal weight (CI - 1.29, 1.04-1.60).

A systematic review by Tzenois et al. (2023) revealed a bidirectional relationship between obesity and depression upon review of both epidemiological and experimental evidence. Studies show that depression is a predictor for obesity, especially among women and individuals who experience recurrent depressive disorders (Blasco et al., 2020).

The obesity rates have doubled in the US from 1990-2022, both obesity and depression are associated with comorbidities such as sleep apnea, type II diabetes, metabolic dysfunction-associated steatotic liver disease, metabolic syndrome, and cardiovascular disease. Due to neurobiological, hormonal and inflammatory pathways underlying both diseases physicians should consider screening patients who present with obesity for depression. Treatment options such as lifestyle and behavior modification, pharmacotherapy for both depression and obesity, and bariatric surgery for obesity are critical to manage both conditions simultaneously (Kushner, 2025). Interventions targeted at reducing obesity may reduce risk of depression by decreasing inflammation. At the same time, interventions that target depression may also treat obesity by promoting healthier lifestyle and improving self-regulation.

#### 1.4. Study Purpose

Globally, college campuses are adversely impacted by the increasing prevalence of obesity and depression. Literature establishes that those who are obese often suffer from depression (Barr-Porter et al., 2025; Hossain et al., 2022; Joma et al., 2024; Sethi et al., 2015). Moreover, mental health issues have a propensity to impact student success (Bieter, 2015). To our knowledge no studies have examined the association between BMI and depression at the undergraduate and graduate levels in the same population. Thus, the purpose of this study was to explore the impact of obesity on depression among undergraduate and graduate students enrolled in a private university and public college in the Bronx, NY.

This study investigates the question: What is the association between obesity and depression among undergraduate and graduate students at a private university and public college in Bronx, NY?

## 2. Materials and Methods

### 2.1. Study Design, Settings and Participants

Students from a private university and public college located in Bronx, NY were recruited for this cross-sectional study. Student population represented undergraduate and graduate students. Nine hundred and eight-seven (987) students aged 18 years and older participated in this study.

Data were collected from students enrolled during the spring 2024 semester using Survey Monkey. A written approval was obtained from professors before approaching students in their classes.

To recruit students, researchers described the study purpose, inclusion criteria, and consent procedure. Students who matched the inclusion criteria were given access to a QR code that led them to the survey. Students reviewed the informed consent before proceeding to answer the survey questions. Students were not compensated for participation.

### 2.2. Measures

#### 2.2.1. Depression, Anxiety and Stress Scale (DASS) 21

The depression section of DASS-21 scale was used to collect data from eligible participants. DASS-21 is a widely used screening measure used for assessing symptoms of depression, anxiety and stress in community settings (Lovibond et al., 1995). The depression scale measures low self-esteem, low-positive effect and hopelessness. The Cronbach's alpha for each sub-scale was high (Dass 21-D subscale 0.72). The overall score which includes all items was also high (Cronbach's alpha=0.88). A few questions from the depression scale were: *I couldn't seem to experience any positive feelings at all, I felt that the life was meaningless, I felt downhearted and blue*. The scoring of the depression scale ranged from 0-42 – Normal depression (0-9), Mild Depression (10-12), Moderate (13-20), Severe (21-27), Extremely Severe (28-42) (Lovibond et al., 2013; Tran et al., 2013).

#### 2.2.2. Body Mass Index

The body mass index was calculated using participant's self-reported height and weight. According to the CDC (2024), BMI is calculated by dividing a person's body weight (in kilograms) by square of their height (in meters). The BMI categories are underweight (<18.5), healthy weight (18.5-24.9), overweight (25-29.9), obese ( $\geq 30$ ).

#### 2.2.3. Covariates

Demographic data were collected on age, race/ethnicity, gender, level of education, and income. Another variable collected was self-reported Grade Point Averages (GPAs).

### 2.3. Ethical Considerations

An Institutional Review Board (IRB) approval was attained from both colleges in Bronx, NY (Monroe University (IRB No: FAC-2023-04) and Lehman College (IRB No. 2024-0087). All participants who met the eligibility criteria read the informed consent, thereafter, responded "yes" to the question "Do you want to participate in the study?" After consenting, they proceeded to answer the survey questions. The study data were stored in password protected laptops of the researchers.

### 2.4. Data Analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS), version 29 statistical software (IBM Corp, 2025). Frequencies were used to analyze the descriptive data. Bivariate analysis using Chi-Square test was used to analyze the association between independent (BMI, School Level, Age, Gender, Income, GPA) and dependent (Depression) variables. Significant variables from the bivariate analysis were entered in a logistic regression model to control for potential confounders.

### 3. Results

#### 3.1. Demographic Variables and Depression

Data were collected from 986 students from a private university and public college located in Bronx, NY. Majority of the students were female (70.2%) and aged 18-24 (56.5%). Minorities were highly represented in this sample, 38.2% of the students were Black/African American followed by Hispanics (32.2%). Most of the students (32.3%) had an annual family income below \$20,000, while 26% had an income between \$20,000 - \$40,000 and 16.9% between \$40,001 and \$60,000. Maximum number of students were in the 1<sup>st</sup> year (29.3%), followed by graduate (26.6%), 4<sup>th</sup> year (15%) and 3<sup>rd</sup> year (13.8%). Majority of the students were undergraduates (73%), and only 27% were graduates.

Approximately 51.3% of the students were either overweight (26.2%) or obese (25.1%). The prevalence of depression was high among this population, where 30.2% of students experienced extremely severe depression and 14.3% reported severe depression.

**Table 1.** Frequency Distribution of Demographic Variables and Depression.

Variable	Number (n)	Percent (%)
<b>Age (n=986)</b>		
18-24	557	56.5
25-34	294	29.5
35-44	97	10.0
45+	38	4.0
<b>Race (n=978)</b>		
American Indian/Alaska Natives – Non Hispanic	27	2.8
Asian – Non-Hispanic	194	19.8
Black or African American, Non-Hispanic	374	38.2
Native Hawaiian/Pacific Islander – Non-Hispanic	5	0.5
Hispanic	314	32.2
White – Non-Hispanic	64	6.5
<b>Income (n=954)</b>		
<\$20,000	306	32.3
\$20,000-\$40,000	244	26.0
\$40,001-\$60,000	161	16.9
\$60,001-\$80,000	113	11.8
\$80,0001+	130	13.0
<b>Gender (n=987)</b>		
Male	287	29.1
Female	693	70.2
Non-Binary	2	0.2
Other	5	0.5
<b>GPA (n=900)</b>		
<3	179	19.9
3.0-3.49	255	28.3
3.5-4.0	466	11.9
<b>Degree Level (n=983)</b>		
Associate Degree-Freshman-1 <sup>st</sup> year	288	29.3
Associate Degree-Sophomore – 2 <sup>nd</sup> year	150	15.3
Bachelor Degree-Junior-3 <sup>rd</sup> Year	136	13.8
Bachelor Degree-Senior-4 <sup>th</sup> Year	148	15.0
Graduate School	261	26.6
<b>School Level (n=983)</b>		
Undergraduate	722	73.0
Graduate	261	27.0

<b>BMI (n=924)</b>		
Underweight	68	7.4
Normal	382	41.3
Overweight	242	26.2
Obese	232	25.1
<b>Depression (n=967)</b>		
Normal	7	0.7
Mild	3	0.3
Moderate	527	54.5
Severe	138	14.3
Extremely Severe	292	30.2

### 3.2. Bivariate Association Between Demographic Variable, BMI and Depression

A Chi-square test was conducted to understand the relationship between independent variables (age, gender, income, degree level, GPA, school level, BMI) and dependent variable (depression). The association between age and depression was significant ( $X^2=28$ ,  $df=9$ ,  $p<0.001$ ). Depression among the student population was inversely related to age, where students who reported severe or extremely severe depression were younger. For example, students who reported severe (15.3%) and extremely severe depression (35.7%) were highly represented in the younger age group (18-24 year) compared to students who were 45 years and older and reported severe (7.9%) and extremely severe (15.8%) depression.

The results indicate that there was an association between degree level and depression ( $X^2=26.10$ ,  $df=12$ ,  $p=0.010$ ). Severe depression was highest among 4<sup>th</sup> year students (18.4%), followed by 1<sup>st</sup> year (13.9%), graduate (12.8%) and 3<sup>rd</sup> year students (12.5%). Approximately 70% of students in first- (38.8%) and fourth (31.3%) year experienced extremely severe depression. The association remained significant when undergraduate and graduate students ( $X^2=14.853$ ,  $df=4$ ,  $p=0.005$ ) were separated in the analysis. It is worth noting that the prevalence of severe to extremely severe depression among undergraduate students was 47.6%, while the same among graduate students was 35.2%.

The association between GPA and depression was significant ( $X^2=14.583$ ,  $df=6$ ,  $p=0.024$ ). Severe depression (16.1%) was highest among those who had a GPA between 3.0-3.49, followed by 14.3% of those with GPA between 3.5-4.0. Twenty-nine percent of those who had a GPA between 3-3.49 experienced extremely severe depression, while 26.8% of those with extremely severe depression had a GPA between 3.5-4.0. Highest rate of extremely severe depression (40%) was experienced by those who had GPA <3.0.

The association between BMI and depression was significant ( $X^2=21.08$ ,  $df=9$ ,  $p=0.012$ ). Increased BMI was positively related to extremely severe depression. Students who were obese reported extremely severe depression (34.1%) compared to those who had a normal BMI (27.2%).

**Table 2.** Bivariate Association Demographic Variable, BMI and Depression.

Variable	Mild Depression n (%)	Moderate Depression n (%)	Severe Depression n (%)	Extremely Severe Depression n (%)	Chi-Square	df	p-value
<b>Age</b>							
18-24	5 (0.9%)	262 (48.2%)	83 (15.3%)	194 (35.7%)	28.11	9	<0.001*
25-34	3 (1%)	172 (59.7%)	39 (13.5%)	74 (25.7%)			
35-44	2 (2.1%)	63 (65.6%)	13 (13.5%)	18 (18.8%)			
45+	0 (0%)	29 (76.3%)	3 (7.9%)	6 (15.8%)			
<b>Gender</b>							
Male	3 (1.1%)	163 (59.1%)	46 (16.7%)	64 (23.2%)	15.65	9	0.074
Female	7 (1%)	362 (52.9%)	92 (13.5%)	223 (32.6%)			

Non-Binary	0 (0)	0 (0)	0 (0)	2 (100%)			
Other	0 (0)	2 (40%)	0 (0)	3 (60%)			
<b>Income</b>							
<\$20,000	4 (1.4%)	151 (51%)	40 (13.5%)	101 (34.1%)	21.213	18	0.269
\$20,000-40,000	1 (0.4%)	138 (57.3%)	39 (16.2%)	63 (26.1%)			
\$40,001-60,000	2 (1.3%)	82 (51.6%)	26 (16.4%)	49 (30.8%)			
\$60,0001-80,000	1 (.9%)	58 (52.3%)	16 (14.4%)	36 (32.4%)			
80,001-100,000	1 (1.5%)	47 (70.1%)	8 (11.9%)	11 (16.4%)			
100,0001-120,000	0 (0%)	20 (66.7%)	1 (3.3%)	9 (30%)			
120,000+	0 (0%)	15 (46.9%)	8 (25%)	9 (28%)			
<b>Degree Level</b>							
Ass Degree-1 <sup>st</sup> Yr	2 (0.7%)	131 (46.6%)	39 (13.9%)	109 (38.8%)	26.10	12	0.010*
Ass Degree-2 <sup>nd</sup> Yr	1 (0.7%)	82 (55.8%)	22 (15%)	42 (28.6%)			
Bach Degree-3 <sup>rd</sup> Yr	1 (0.7%)	82 (60.3%)	17 (12.5%)	36 (26.5%)			
Bach Degree-4 <sup>th</sup> Yr	1 (0.7%)	73 (49.3%)	27 (18.4%)	46 (31.3%)			
Grad School	5 (2%)	157 (62.8%)	32 (12.8%)	56 (22.4%)			
<b>School Level</b>							
Graduate	5 (2%)	157 (62.8%)	32 (12.8%)	56 (22.4%)	14.853	4	0.005*
Under-graduate	5 (0.5%)	368 (51.8%)	105 (14.8%)	233 (32.8%)			
<b>GPA</b>							
<3	2 (1.1%)	81 (46.3%)	22 (12.6%)	70 (40.0%)	14.582	6	0.024*
3.0-3.49	4 (1.6%)	133 (53.6%)	40 (16.1%)	71 (28.6%)			
3.5-4.0	2 (.4%)	270 (58.4%)	66 (14.3%)	124 (26.8%)			
<b>BMI</b>							
Underweight	3 (4.5%)	39 (59.1%)	8 (12.1%)	16 (24.2%)	21.08	9	0.012*
Normal	1 (0.3%)	221 (58.3%)	54 (14.2%)	103 (27.2%)			
Overweight	1 (0.4%)	118 (49.6%)	42 (17.6%)	77 (32.4%)			
Obese	3 (1.3%)	118 (51.5%)	30 (13.1%)	78 (34.1%)			

### 3.3. Logistic Regression Model: Factors Effecting Depression

A logistic regression model was used to predict the association between age, school level, BMI and depression after controlling for potential confounders. The odds of depression were highest among 18–24-year-olds compared to those who were 35 years or older. Those who were between the ages of 18-24 years were 2 times more likely ( $\text{Exp}(B)=2.463$ ,  $\text{C.I.}=1.602-3.786$ ) to be depressed ( $p<0.001$ ). The odds of depression were nearly 2 times ( $\text{Exp}(B)=1.616$ ,  $\text{C.I.}=1.024-2.549$ ) higher among 25–34-year-olds ( $p=0.039$ ). Students in the normal weight range were less likely to be depressed compared to those who were obese ( $\text{Exp}(B)=0.698$ ,  $\text{C.I.}=0.493-0.987$ ,  $p=0.042$ ). The association between school level and depression was not significant ( $\text{Exp}(B)=1.179$ ,  $\text{C.I.}=0.832-1.672$ ,  $p=0.355$ ), but it is important to note that 47.6% of undergraduates were either severely or very severely depressed compared to graduate students (35.2%) in this study.

**Table 3.** Logistic Regression Model: Factors Effecting Depression.

Variable	B	SE	Wald	df	Sig	Exp (B)	95% C.I	
							Lower	Upper
Age								

18-24	0.901	0.219	16.886	1	<0.001*	2.463	1.602	3.786
25-34	0.480	0.233	4.255	1	0.039*	1.616	1.024	2.549
<b>BMI</b>								
Under Weight	-0.432	0.305	2.007	1	0.157	0.649	0.357	1.180
Normal Weight	-0.360	0.177	4.127	1	0.042*	0.698	0.493	0.987
Over weight	0.133	0.190	0.486	1	0.486	1.142	0.786	1.659
<b>School Level</b>								
Undergraduate	0.165	0.178	0.857	1	0.355	1.179	0.832	1.672
Constant	-0.849	0.258	10.856	1	<0.001	0.482		

## 4. Discussion

### 4.1. Obesity and Depression

Authors found an association between obesity and depression, students who were normal weight were less likely to be depressed compared to obese after controlling for confounders in the logistic regression analysis (Exp(B)=0.698, C.I.=0.493-0.987,  $p=0.042$ ). Research elucidates that college students are simultaneously impacted by obesity and depression globally (Akinyemi et al., 2022; Barr-Porter et al., 2025; Hossain et al., 2022; Kaufman et al.; 2020; Odlaug et al., 2015; Sarigiani et al., 2020; Sethi et al., 2015; Zhuang et al., 2025). Increased BMI was directly related to extremely severe depression. Obese students reported extremely severe depression (34.1%) compared to those who had a normal BMI (27.2%) in the Chi-Square analysis ( $X^2=21.08$ ,  $df=9$ ,  $p=0.012$ ). Moreover, majority of the students in this study were either overweight (26.2%) or obese (25.1%). A similar study from Bangladesh found greater odds of obesity among those with severe and extremely severe levels of depression compared to normal and mild levels (Hossain et al., 2022). Hamurcu et al. (2023) noted that 91.2% of 950 university students in Istanbul had “severe and “very severe” depression whereas in our study 47.2% of the obese students reported severe (13.1%) and very severe (34.1%) depression. A systematic review by Pereria-Miranda et al. (2017) also confirmed that those who were obese were 32% more likely to have depression (PR=1.32, 95% CI=1.26-1.38). Our study results corroborate with findings in the literature; that obesity is a predictor of depression among college students. Age was another significant predictor of depression where the prevalence of depression was higher among younger students than older students. More than one-half of the students in our study were between 18-24 years old. Younger students may have higher rates of depression because they are navigating the challenges of being a young adult, navigating a new college environment, and they might not know how to properly manage their time. These challenges, if not properly managed can create stress, which can further escalate to depression.

### 4.2. School Level and Depression

Depression is common among graduate and undergraduate students across the globe (Adams et al., 2021; Beiter et al., 2015; Charles et al., 2021, Duffy et al., 2019; Eisenberg et al., 2025; Li et al., 2023; Liu et al., 2019; Pedrelli et al., 2015; Sheldon et al., 2021; Senthilkumar et al., 2023). In this study a significant association was found between degree levels and depression ( $X^2=26.10$ ,  $df=12$ ,  $p=0.010$ ). Students in the first-year experienced highest levels of severe and extremely severe depression (52.7%) followed closely by fourth year students (49.7%). Liu et al. (2019) reported that depression levels were 35% above normal among undergraduate students, highest score of depression was found among first- or second-year students. In another study Ebert et al. (2019) noted that the incidence of Major Depressive Disorders (MDD) was 6.9% among first-year students. Our findings were much higher among our first-year students than other studies.

Upon separation of the analysis by school level the association remained significant ( $X^2=14.853$ ,  $df=4$ ,  $p=0.005$ ), 47.6% of the undergraduate students experienced severe and extremely severe depression. This association was not significant in the multivariate analysis. Master’s and PhD

students (n=2,161) across 142 universities in the US reported high levels of moderate (49%) and severe depression (23%) (Busch et al., 2024).

In a similar study, Senthilkumar et al. (2023) noted that 50% of graduate students report symptoms related to depression and burn-out, in fact mental well-being is an important factor in a student's decision to leave academia. In this study 35.2% of graduate students experienced severe or extremely severe depression compared to 23% who experienced severe depression in a study by Busch et al. (2024). Thus, mental health interventions should be implemented by the institutions to retain undergraduate and graduate students experiencing mental health problems.

#### 4.3. Age and Depression

Age was a significant predictor of depression in our study. Those between the ages of 18-24 (Exp(B)=2.463, C.I.=1.602-3.786,  $p<0.001$ ) and 25-34 (Exp(B)=1.616, C.I.=1.024-2.549,  $p=0.039$ ) were two times more likely to experience depression after controlling for confounders in the logistic regression analysis. This relationship was also significant in the bivariate analysis ( $X^2=28.11$ ,  $df=9$ ,  $p\text{-value}<0.001$ ).

Pedrelli et al. (2015) noted that traditional college students are at an age where they experience numerous stressors such as first-time work, relationship with a significant other or roommates from a different culture or belief system. Non-traditional students also face multiple stressors associated with financial responsibilities, multiple roles and demands (Pedrelli et al., 2015). In this study, various factors led to higher levels of depression among our first-year students, such as less experience with stress management, limited coping skills, heightened academic and career uncertainty, first time independence, limited help-seeking behavior, new environment, and off-campus commute. Moreover, mental health problems often occur in young adulthood by age 25. Median age for onset of mood disorders is between 25-45 years (Kessler et al., 2007). Stressors experienced by our students were like the ones described by Pedrelli et al. (2015). Majority of our 18-24-year-olds were severely or extremely severely depressed (51%) followed by 25-34-year-olds (39.2%). However, the age of onset is not known. Therefore, institutions should periodically screen for mental health problems along with providing comprehensive services to improve health, well-being and academic outcomes such as graduation (Pedrelli et al., 2015).

#### 4.4. Implications

To reduce the growing rates of obesity and depressive disorders, colleges should implement health policies aimed at prevention, detection and treatment of psychiatric disorders (Liu, 2019) and obesity. In this study obesity and young age (18-34 years) were significant predictors of depression among undergraduate and graduate students. Students at-risk of developing both obesity and depression should be screened upon entry, especially younger students (18-24-year-olds) as they had highest levels of severe and extremely severe depression in this study. In fact, screening for obesity and depression should be periodically conducted on college campuses. Behavior and lifestyle modification are the first line of treatment to manage mood-related disorders and obesity. Behavior modification interventions such as dietary changes, increased exercise and goal-oriented counselling can positively impact treatment outcomes for obesity and depression (Kushner et al., 2025). The American Psychology Association (2019) recommends treating clinical depression using seven psychotherapy interventions (behavioral therapy, cognitive therapy, cognitive behavioral therapy, interpersonal psychotherapy, mindfulness-based-cognitive therapy, psychodynamic therapy, and supportive therapy) and second generation antidepressants (Serotonin-norepinephrine-reuptake-inhibitors [SNRIs], Serotonin reuptake inhibitors [SSRI], norepinephrine/dopamine reuptake inhibitors [NDRIs]) (American Psychology Association, 2019), if needed.

University administrators are developing creative solutions to address mental health crisis on college campuses. Innovative approaches such as group therapy, peer counseling and telehealth are embraced to address an increase in demand for mental health services. Many schools are relying on faculty as first responders, who can assist institutions in identifying students in distress. University

of North Carolina trained 900 faculty and staff to provide Mental Health First Aid, which includes providing basic skills for supporting students with mental health and substance abuse issues. At Penn State Faculty are trained to respond and refer by recognizing signs of struggle, such as drop in attendance, assignment submission failure or disheveled appearance (Abrams, 2022).

Integrated therapies that target both obesity and depression can address both crises simultaneously. Ma et al. (2019) enrolled 409 adults who were obese and depressed in their Rainbow Randomized Clinical Trial. The participants received intervention that integrated problem-solving therapy for depression with Diabetes Prevention Program based behavioral weight loss treatment. They also received antidepressants, if indicated. After 12 months, the intervention group had significantly improved weight loss and depressive symptoms. Such integrated therapies should be offered to overweight/obese and depressed students on college campuses to improve overall well-being and academic outcomes. Anti-obesity medications are FDA approved first-line treatment for obesity, some examples include NB-ER Phentermine-Topiramates-ER, GLP-1R agonist, Liraglutide Semaglutide and Tirzepatide (Kushner et al., 2025). A meta-analysis by Chen et al. (2024) indicated that depression rating scale scores decreased significantly compared to baseline when patients received GLP-1RA treatment. Therefore, anti-obesity medications should be considered a first-line treatment option for overweight and obese college students.

In addition, public health initiatives are critical for addressing obesity and depression on college campuses. Our institutions can collaborate with programs such as The Bronx Health Reach to address obesity. The Bronx Health Reach has implemented several successful initiatives such as elimination of whole milk in public school to address obesity, diabetes and cardiovascular diseases in Bronx. Reach is focused on reducing health disparities among racial and ethnic populations at highest risk of chronic diseases. The fruit and vegetable voucher as well as safe and accessible physical activity initiatives offered by Reach can resolve obesity and related chronic diseases on our campuses (Society for Public Health Education [SOPHE], 2025).

In academia the current focus is to either treat mental health issues or implement wellness strategies, however, the training environment or the academic culture that adversely impacts well-being continues to persist, especially in graduate schools (Senthilkumar et al., 2023). An academic environment that promotes physical and mental well-being is critical for overall success of students. Future research can explore the influence of academic environment on obesity and depression outcomes. In addition, studies can also investigate the effects of obesity, academic performance, healthcare access on major depressive disorders among college students.

## 5. Conclusions

The contribution of our study to public health is significant as it explored an important association between obesity and a Major Depressive Disorder – depression. Obesity and young age were significant predictors of depression among undergraduate and graduate students. Students in Bronx, NY were simultaneously impacted by obesity and depression, younger students between the ages of 18-34 reported higher levels of severe or extremely severe depression compared to those above the age of 35. Periodic screening for obesity and depression on college campuses is critical for providing timely access to services. Colleges should invest in programs and policies that simultaneously address obesity and depression among students, some examples include group therapy, peer counseling, training faculty as first responders, promoting physical activity and healthy eating, encouraging body positivity, subsidizing health meals, providing food vouchers, and increasing access to antidepressants or anti-obesity medications, if needed. Most importantly colleges should create an academic environment that promotes health and well-being among students.

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## Abbreviations

The following abbreviations are used in this manuscript:

BMI            Body Mass Index  
DASS-21      Depression, Anxiety and Stress Scale

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