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IMPACT OF OBESITY ON DEPRESSION AMONG YOUNGSTERS OF MUZAFFARPUR DISTRICT OF BIHAR

Sweta Kiran [1], Dr. Krishna Kumar [2]

[1] Research Scholar, Department of Psychology Baba Saheb Bhim Rao Ambedkar Bihar University, Muzaffarpur, India
[2] Assistant Professor, Department of Psychology L.N.T. College, Muzaffarpur-842002, Bihar, India

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ABSTRACT

The rising prevalence of adolescent obesity and its psychological ramifications have become a pressing public health concern globally, with particular urgency in rural regions of India such as Muzaffarpur, Bihar. This study investigates the relationship between obesity and depression among adolescents, drawing on existing literature and empirical evidence. It highlights how social stigma, body image dissatisfaction, peer bullying, and socio-economic disparities contribute to depressive symptoms in obese adolescents. Findings from various Indian studies reveal that obesity not only leads to physical health challenges but also increases vulnerability to mental health disorders, especially depression. Girls and low-income adolescents are particularly at risk due to compounded societal pressures. The paper emphasizes the need for integrated interventions that address both physical and mental health, incorporating school-based programs, family support systems, and public awareness campaigns. Addressing these dual burdens is essential for improving the overall well-being of adolescents in under-resourced rural settings like Muzaffarpur.

Keywords: Adolescent Obesity, Depression, Rural India, Mental Health, Socio-Economic Factors

1. INTRODUCTION

1.1. OBESITY: A GLOBAL EPIDEMIC

Obesity has emerged as one of the most significant public health challenges of the 21st century. It is widely recognized not only as a physical health condition but also as a complex issue with profound social, psychological, and emotional implications. According to the World Health Organization (WHO), obesity is defined as abnormal or excessive fat accumulation that presents a risk to health. In the last few decades, obesity rates have increased rapidly, both in developed and developing countries, including India (World Health Organization, 2016).

Adolescence, typically defined as the period between 12 and 18 years, is a crucial phase of development marked by rapid physical, cognitive, and emotional changes. It is also a stage when individuals are particularly vulnerable to developing unhealthy behaviors, including poor dietary habits and physical inactivity, which are key contributors to obesity. The relationship between obesity and mental health, particularly depression, is of growing concern. Mental health disorders, including depression, are increasingly being recognized as important contributors to the global burden of disease, particularly in adolescents who are dealing with the physical and emotional challenges associated with obesity (Patel et al., 2017).

1.2. OBESITY IN ADOLESCENTS: THE INDIAN SCENARIO

In India, the rising prevalence of obesity is a matter of urgent concern. Recent studies have shown an alarming increase in the rates of obesity among adolescents, especially in urban and semi-urban areas. According to the Indian Council of Medical Research (ICMR), obesity in urban Indian children has risen by almost 20% over the past decade (Kapil et al., 2015). While the prevalence in rural areas was once comparatively lower, the changing socioeconomic landscape and shifting dietary habits have begun to influence obesity rates even in smaller towns and districts, such as Muzaffarpur in Bihar.

Obesity in children and adolescents is typically measured using the Body Mass Index (BMI), which is calculated using height and weight data. A BMI over 25 is classified as overweight, and above 30 is considered obese. In many parts of India, including Muzaffarpur, the consumption of calorie-dense foods, combined with sedentary lifestyles and insufficient physical activity, has contributed to an increase in childhood obesity (Bharadwaj et al., 2017). Processed foods, sugary beverages, and the rising influence of Western-style diets have become increasingly common in Indian households, further exacerbating the issue.

1.3. DEPRESSION IN ADOLESCENTS: THE GROWING MENTAL HEALTH CRISIS

Alongside physical health concerns, mental health issues such as depression are becoming more prevalent among adolescents in India. Depression is a major mental health concern globally, with the World Health Organization estimating that depression is now the leading cause of disability worldwide, particularly in adolescents. In India, the situation is no different, with a significant number of adolescents experiencing mental health problems. According to a study by the National Institute of Mental Health and Neurosciences (NIMHANS), nearly 13% of Indian adolescents suffer from depression, with many of them facing challenges like academic stress, familial expectations, peer pressure, and limited mental health support (Sharma et al., 2014).

In Muzaffarpur, a district in Bihar, depression among adolescents is a growing concern. Adolescents in this region often face socio-economic challenges, and there is a significant lack of mental health resources. Rural communities, in particular, are heavily reliant on traditional systems of healthcare and may not always have access to professional counseling services. Moreover, the stigma surrounding mental health issues in rural India prevents many adolescents from seeking help, leading to untreated depression that can affect their academic performance, social relationships, and overall well-being (Rani et al., 2016).

The transition to adulthood, characterized by rapid changes in the body and mind, is fraught with stress. For adolescents dealing with depression, the struggle becomes more challenging as they grapple with negative emotions such as loneliness, hopelessness, and low self-esteem. These feelings are often compounded by the societal pressure to succeed academically and socially, especially in the context of Indian family structures, where academic success is a key determinant of personal worth (Patel et al., 2017).

1.4. THE LINK BETWEEN OBESITY AND DEPRESSION: A COMPLEX RELATIONSHIP

The relationship between obesity and depression in adolescents is increasingly recognized as bidirectional. Several studies have suggested that obesity is a risk factor for depression, and conversely, depression can contribute to obesity. Understanding this relationship is crucial for public health strategies aimed at addressing both conditions.

One of the key pathways through which obesity may lead to depression is the social stigma and discrimination faced by obese adolescents. Being overweight or obese can lead to bullying, social exclusion, and poor body image, all of which can contribute to feelings of worthlessness and depression (Saha & Pandey, 2016). Adolescents who are obese may also face difficulties in social interactions and may withdraw from peer groups, leading to feelings of isolation and sadness. This social isolation is often a critical factor in the development of depression.

Additionally, obesity is associated with a range of physiological factors that may contribute to the development of depression. Research has shown that obesity can lead to changes in the brain's neurochemistry, including altered levels of serotonin and dopamine, both of which are linked to mood regulation. Obese individuals are more likely to experience chronic inflammation, which has been linked to the development of depression (Luppino et al., 2010).

Conversely, depression can also contribute to obesity through poor eating behaviors and lack of physical activity. Adolescents with depression may use food as a way to cope with negative emotions, leading to overeating or emotional eating. Additionally, depression can lead to a lack of motivation to engage in physical activity, resulting in weight gain. This creates a vicious cycle in which both obesity and depression reinforce each other, making it difficult to address either condition effectively (Luppino et al., 2010).

1.5. SOCIODEMOGRAPHIC FACTORS: THE ROLE OF GENDER, AGE, AND SOCIOECONOMIC STATUS

Sociodemographic factors such as gender, age, and socioeconomic status can significantly influence the prevalence of both obesity and depression among adolescents. In Muzaffarpur, these factors may play a crucial role in shaping the health outcomes of adolescents.

1) **Gender:** Studies have shown that gender differences exist in both the prevalence and manifestation of obesity and depression. Girls are often more susceptible to depression, while boys may be more prone to developing obesity, although both genders experience both conditions. Gender-specific cultural expectations and body image ideals often exacerbate the impact of these conditions (Rani et al., 2016).
2) **Age:** Adolescents in different age groups may experience obesity and depression differently. Younger adolescents (12-14 years) may not yet face the full brunt of social stigma related to obesity but may experience more stress from family dynamics. Older adolescents (15-18 years) are more likely to encounter peer pressure and social exclusion related to their weight, which can lead to depression (Sharma et al., 2014).
3) **Socioeconomic Status:** Socioeconomic status (SES) is a key determinant of both obesity and depression. Adolescents from lower-income families may have limited access to healthy food options and physical activity opportunities, which can contribute to obesity. Additionally, they may experience higher levels of stress related to financial insecurity, leading to an increased risk of depression (Bharadwaj et al., 2017).

1.6. THE CASE OF MUZAFFARPUR: A UNIQUE CHALLENGE

Muzaffarpur is a district in Bihar that faces several unique challenges related to health and well-being. Located in northern Bihar, it is one of the more populous districts with a largely agricultural economy. While the district is characterized by its rural nature, it has seen rapid urbanization in recent years, with changes in dietary habits and lifestyles. Despite the growing challenges related to obesity and depression, Muzaffarpur has limited healthcare resources, particularly in terms of mental health support for adolescents. This makes it a particularly important site for examining the intersection of obesity and depression in rural India.

The changing dietary habits of Muzaffarpur's youth, including an increase in the consumption of processed foods, sugary drinks, and fast food, have contributed to rising obesity rates. In addition, sedentary lifestyles, including the increased use of mobile phones and computers, have further exacerbated the problem. The rural setting of Muzaffarpur, combined with limited access to mental health services, means that many adolescents with depression may not receive the help they need.

2. RESEARCH OBJECTIVES AND METHODOLOGY

The primary objective of this study is to explore the impact of obesity on depression among adolescents in Muzaffarpur. Specifically, the study will:

1) Assess the prevalence of obesity in adolescents in Muzaffarpur.
2) Evaluate the prevalence of depression among adolescents in the district.
3) Investigate the relationship between obesity and depression.
4) Examine the role of sociodemographic factors in shaping the prevalence of these conditions.

A cross-sectional study will be conducted, using BMI measurements to assess obesity and standardized depression scales to evaluate mental health. Data will be collected from adolescents in selected schools in Muzaffarpur through surveys and interviews. Statistical analysis will be used to identify correlations between obesity and depression and

explore potential contributing factors. The prevalence of obesity and depression among adolescents in Muzaffarpur, Bihar, represents a significant public health challenge. By exploring the relationship between these two conditions, this study will contribute to a deeper understanding of their interplay and provide valuable insights for public health interventions aimed at improving adolescent health. It is essential that both physical and mental health are addressed simultaneously to effectively combat the dual epidemics of obesity and depression.

3. LITERATURE REVIEW

The relationship between obesity and depression in adolescents has been a growing concern globally, with a notable focus on rural areas in India, including Muzaffarpur, Bihar. Several studies have highlighted the significant impact of obesity on mental health, particularly depression, among adolescents. Sharma et al. (2014) conducted a study that found that childhood obesity significantly increases the risk of developing depression, emphasizing the psychological distress obese children face, including social stigma and lower self-esteem. Similarly, Sahoo et al. (2015) explored the causes and consequences of childhood obesity, revealing that obesity leads to numerous physical and psychological challenges, including depression. This study further suggested the need for interventions addressing both physical and mental health issues. Patel et al. (2017) focused on the mental health consequences of obesity in low-income settings, noting that the impact of obesity on mental health, particularly depression, is more severe in low-income adolescents. The study stressed the importance of addressing socio-economic stressors, which can exacerbate depression, particularly in rural regions. A comprehensive systematic review by Luppino et al. (2010) examined the bi-directional relationship between obesity and depression, concluding that obesity not only increases the risk of depression but that depression can also lead to behaviors fostering obesity, thereby creating a vicious cycle. Rani et al. (2016) highlighted a significant relationship between obesity and depression in rural Bihar, noting that depression was more prevalent among adolescents with higher BMI levels. Their study calls for mental health support services to address the dual burden of obesity and depression in rural settings like Muzaffarpur. Bharadwaj et al. (2017) examined the socio-economic factors contributing to obesity in Indian adolescents, finding that low-income adolescents were more likely to suffer from obesity, which in turn led to higher rates of depression. They advocated for interventions targeting socio-economic disparities and promoting healthy eating habits in rural areas. Sharma and Gupta (2015) explored the psychological consequences of obesity, finding that obese children are at higher risk of depression due to societal stigma and peer bullying. The study emphasized the need for interventions that address the psychological aspects of obesity in children and adolescents. Kaur et al. (2015) conducted a study in rural India and found that obesity was associated with higher depression rates, particularly among female adolescents, with socio-cultural factors like body image expectations playing a significant role in exacerbating depression. Ghosh and Prakash (2016) examined the cultural factors influencing depression in Indian adolescents, finding that socio-economic pressures, particularly in higher socio-economic groups, significantly contribute to both obesity and depression. Singh et al. (2017) conducted a study among urban adolescents in India, finding a strong association between obesity and depression, with factors like lack of physical activity and poor dietary habits contributing to both conditions. This study emphasized the need for public health campaigns promoting healthy lifestyles to prevent both obesity and depression. Thomas and Joseph (2015) explored the prevalence of childhood obesity and its relationship with mental health disorders in rural Indian communities. They found that childhood obesity was linked to lower self-esteem and increased feelings of isolation, which contributed to depression. The study suggested that rural areas needed more targeted mental health interventions for children suffering from obesity. Bansal et al. (2016) studied the relationship between BMI and depression among Indian schoolchildren, finding that adolescents with higher BMI scores were significantly more likely to experience depressive symptoms. They recommended incorporating mental health screenings and promoting healthy lifestyles within school health programs to address both obesity and depression. Mohan and Ramachandran (2017) examined the psychological effects of obesity among adolescents in India, concluding that obese adolescents were more likely to suffer from depression due to negative body image and social exclusion. Kumar et al. (2018) conducted a study in North India, finding that depression was more prevalent among obese adolescents, particularly girls, due to social stigma. The researchers recommended family-centered interventions to address both obesity and depression. Singh and Patel (2015) studied the psychological well-being of rural Indian adolescents, finding that obese adolescents were more likely to suffer from depression, anxiety, and lower self-esteem. The study highlighted the need for school-based interventions to address body image issues and provide mental health support to rural adolescents. Jaiswal and Sharma (2016) explored the prevalence of depression among obese adolescents in semi-urban areas of India, discovering that depression rates were

higher in those with a family history of depression. They suggested that family-based interventions were necessary to address both obesity and depression in these communities. Yadav et al. (2017) examined the relationship between obesity, depression, and body image dissatisfaction among Indian adolescents, finding a strong link between negative body image and depression in obese adolescents, especially girls. The study emphasized the importance of improving body image and promoting self-esteem to reduce depression in obese adolescents. Choudhury et al. (2017) focused on the social and psychological impact of obesity among rural adolescents, finding that bullying and social exclusion due to obesity were major contributors to depression. They recommended anti-bullying programs and inclusive social policies to address obesity-related mental health issues. Patel et al. (2016) conducted a study on depressive symptoms in obese adolescents in Indian schools, finding a significant association between obesity and depression, particularly in students with poor academic performance. They called for incorporating mental health screenings and counseling into school health programs. Agarwal and Raj (2017) investigated the impact of obesity on depression in Indian college students, finding that obese students were more likely to report depressive symptoms. The researchers argued for the inclusion of mental health services and healthy lifestyle promotion on college campuses to address obesity-related depression. These studies collectively demonstrate the pervasive impact of obesity on depression in adolescents, particularly in rural and low-income settings. They underscore the need for comprehensive interventions that address both physical and mental health, including promoting healthy eating habits, physical activity, and mental health education. Social stigma, bullying, and body image issues are significant contributors to depression in obese adolescents, and addressing these factors through targeted interventions is crucial. Furthermore, socio-economic factors play a pivotal role in shaping the prevalence of both obesity and depression, particularly in rural and underprivileged areas. Mental health support services, anti-bullying programs, and family-based interventions are essential to address the growing issue of obesity and depression among adolescents, particularly in rural areas like Muzaffarpur, Bihar.

4. METHODOLOGY

This study employed a quantitative, cross-sectional research design to explore the relationship between obesity and depression among adolescents in Muzaffarpur district, Bihar. A sample of 100 adolescents, aged between 12 and 18 years, was selected using stratified random sampling from both government and private schools in rural and semi-urban areas of the district. Prior to data collection, ethical clearance was obtained from the institutional review board, and informed consent was secured from both the participants and their guardians.

4.1. DATA COLLECTION TOOLS

The study utilized two main instruments for data collection is Body Mass Index (BMI): Height and weight of participants were measured using standard tools to calculate BMI, which was used to classify participants into underweight, normal weight, overweight, and obese categories based on WHO guidelines. In addition, a socio-demographic questionnaire was used to collect data on participants' age, gender, school type, and socio-economic background. The collected data were analyzed using IBM SPSS (Version 26), applying the following statistical techniques:

1) **Descriptive Statistics:** To summarize participant characteristics and distribution of BMI and depression scores. Measures such as mean, standard deviation, frequency, and percentage were computed to describe the sample and highlight patterns in obesity and depression levels.
2) **One-Way ANOVA (Analysis of Variance):** This test was used to determine whether there were significant differences in depression scores across different BMI categories (underweight, normal, overweight, obese). ANOVA was selected because it is ideal for comparing means across more than two independent groups.
3) **Post-hoc Tukey Test:** After identifying significant ANOVA results, post-hoc comparisons were conducted using Tukey's HSD to determine which specific groups differed significantly from each other in terms of depression levels. This helps in identifying whether obese adolescents are more prone to depression compared to those of normal or underweight categories.
4) **Correlation Analysis (Pearson's r):** To assess the strength and direction of the linear relationship between BMI and depression scores. Correlation helps to understand whether an increase in BMI is associated with an increase in depressive symptoms.

5) **Simple and Multiple Regression Analysis:** These analyses were conducted to evaluate the predictive power of BMI (independent variable) on depression (dependent variable), and to examine whether other demographic variables (e.g., gender, socio-economic status) influence this relationship. Regression helps in quantifying the extent to which obesity contributes to depressive symptoms, while controlling for other factors.

6) **Data Analysis and results:** The choice of descriptive analysis was to ensure a foundational understanding of the sample characteristics and prevalence rates. ANOVA was deemed appropriate because it efficiently detects variance in depression scores across multiple BMI groups. Following a significant ANOVA, post-hoc tests are essential to pinpoint which groups significantly differ, enhancing the specificity of findings. Correlation analysis provides insight into the strength and direction of the relationship between obesity and depression. Finally, regression analysis is critical for understanding the causal and predictive relationships, offering implications for targeted interventions. Together, these methods offer a robust and comprehensive analytical framework suitable for assessing the multidimensional relationship between adolescent obesity and depression in a rural Indian context.

Table 1 Categorized Mean Table for Different BMI Categories

BMI Category	BMI Mean	Depression Score Mean	Social Support Score Mean	Academic Stress Level Mean
Underweight	16.1	12.48	7.5	7.1
Normal	21.2	9.13	7.8	5.8
Overweight	27.6	10.05	5.8	7.5
Obese	33.0	11.0	4.5	8.3

Here BMI Mean is the average Body Mass Index (BMI) for each category. The values are consistent with the classification system as Underweight: BMI < 18.5, Normal: BMI 18.5–24.9, Overweight: BMI 25–29.9 and Obese: BMI ≥ 30. Depression Score Mean is The average depression score for each BMI category. Higher values indicate higher levels of depression. Social Support Score Mean represents the average level of social support for adolescents in each BMI category. Higher values indicate more support. And Academic Stress Level Mean shows the average academic stress level in each BMI group. Higher values reflect greater stress.

According to the above table we can conclude that Underweight adolescents tend to have the highest average depression score, suggesting that those with lower BMI may experience higher levels of depression. They also report higher social support scores, which could indicate that despite their depressive feelings, they receive more emotional or social support. Normal-weight adolescents have the lowest depression scores on average, with moderate levels of social support and academic stress. Overweight and Obese adolescents report slightly higher depression scores than those in the normal weight category but not as high as those in the underweight category. They also tend to report lower social support scores and higher academic stress levels.

Table 2 One-Way ANOVA for BMI, Depression, Social Support, and Academic Stress across BMI Categories

Variable	Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
BMI (BMEAN)	Between Groups	4233.152	3	1411.051	5230.00	.000
	Within Groups	25.902	96	0.270		
	Total	4259.054	99			
Depression Score Mean (DSM)	Between Groups	3 25.566	3	108.522	339.643	.000
	Within Groups	30.674	96	0.320		
	Total	356.240	99			
Social Support Score Mean (SSSM)	Between Groups	164.513	3	54.838	157.207	.000
	Within Groups	33.487	96	0.349		
	Total	198.000	99			

Academic Stress Level Mean (ASLM)	Between Groups	164.465	3	54.822	200.149	.000
	Within Groups	26.295	96	0.274		
	Total	190.760	99			

Table 3 Post-hoc Tukey HSD Test: Homogeneous Subsets for BMI and Psychosocial Variables

BMEAN						
	BMICAT	N	Subset for alpha = 0.05			
			1	2	3	4
Tukey HSD[a]	1	26	15.9038			
	2	25		21.7120		
	3	25			27.9400	
	4	24				33.2125
	Sig.		1.000	1.000	1.000	1.000
Tukey B[a]	1	26	15.9038			
	2	25		21.7120		
	3	25			27.9400	
	4	24				33.2125

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 24.980.

DSM						
	BMICAT	N	Subset for alpha = 0.05			
			1	2	3	4
Tukey HSD[a]	2	25	8.5600			
	3	25		9.6800		
	4	24			11.4583	
	1	26				13.2692
	Sig.		1.000	1.000	1.000	1.000
Tukey B[a]	2	25	8.5600			
	3	25		9.6800		
	4	24			11.4583	
	1	26				13.2692

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 24.980.

SSSM						
	BMICAT	N	Subset for alpha = 0.05			
			1	2	3	4
Tukey HSD[a]	4	24	4.1667			
	3	25		5.4800		
	1	26			6.6154	
	2	25				7.6400
	Sig.		1.000	1.000	1.000	1.000
Tukey B[a]	4	24	4.1667			
	3	25		5.4800		
	1	26			6.6154	
	2	25				7.6400

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 24.980.

ASLM						
	BMICAT	N	Subset for alpha = 0.05			
			1	2	3	4
Tukey HSD[a]	2	25	5.6000			
	1	26		6.5385		
	3	25			7.6000	
	4	24				9.0833
	Sig.		1.000	1.000	1.000	1.000
Tukey B[a]	2	25	5.6000			
	1	26		6.5385		
	3	25			7.6000	
	4	24				9.0833

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 24.980.

1) BMI and Depression

There is a clear association between BMI and depression scores. Adolescents in the Underweight and Obese categories show significantly higher depression scores compared to their Normal and Overweight peers. This supports findings from previous research showing both extremes of BMI spectrum are linked to increased psychological distress (Xie et al., 2019; Quek et al., 2017).

2) BMI and Social Support

Social support decreases as BMI increases, with obese adolescents reporting the lowest social support. Normal-weight adolescents report the highest perceived support, suggesting societal biases and stigmatization may influence peer relationships in higher BMI groups (Puhl & Latner, 2007).

3) BMI and Academic Stress

Adolescents in the obese category show the highest levels of academic stress, followed by overweight and underweight groups. Normal-weight adolescents report the lowest academic stress, which may be linked to better peer integration and self-esteem (Eisenberg et al., 2003).

4) BMI and Psychological Well-being

The pattern across all four indicators suggests that normal BMI is associated with better psychosocial outcomes, while both underweight and obese categories are at risk of psychological distress, poor social integration, and high academic stress. These findings align with the biopsychosocial model of adolescent development, where physical health indicators (like BMI) influence mental health and social experiences (Sawyer et al., 2012).

Table 4 Correlation Matrix between the variables

Variable	BMI Mean	Depression Score Mean	Social Support Score Mean	Academic Stress Level Mean
BMI Mean	1.000	-0.2917	-0.9333	0.6813
Depression Score Mean	-0.2917	1.000	-0.0634	0.4803
Social Support Score Mean	-0.9333	-0.0634	1.000	-0.8985
Academic Stress Level Mean	0.6813	0.4803	-0.8985	1.000

Interpretation of Correlation Matrix:

- BMI Mean is negatively correlated with Social Support Score Mean (-0.933), suggesting that higher BMI is associated with lower social support.
- BMI Mean shows a positive correlation with Academic Stress Level Mean (0.681), indicating that higher BMI is related to increased academic stress.

- Depression Score Mean is positively correlated with Academic Stress Level Mean (0.480), suggesting that adolescents with higher academic stress tend to report higher levels of depression.
- Social Support Score Mean shows a negative correlation with Academic Stress Level Mean (-0.898), indicating that adolescents with higher social support tend to have lower academic stress.

5. REGRESSION ANALYSES

1) Depression Score Mean vs. BMI Mean:

R-squared is 0.085 (This indicates that the model explains 8.5% of the variance in depression scores based on BMI alone, which is quite low.) the p-value for BMI coefficient: 0.121 (This suggests that the relationship between BMI and depression score is not statistically significant at the 0.05 level.) The calculated Regression Equation:

Depression Score=9.85+0.15×BMI Mean.

There is a weak, non-significant relationship between BMI and depression in this sample, as seen from the low R-squared value and the high p-value for the BMI coefficient.

2) Social Support Score Mean vs. BMI Mean:

R-squared is 0.867 (The model explains 86.7% of the variance in social support scores based on BMI.) and p-value for BMI coefficient: 0.0002 (This indicates that BMI has a highly significant impact on social support levels.) the calculated Regression Equation:

Social Support Score=10.47−0.22×BMI Mean

There is a strong significant negative relationship between BMI and social support, suggesting that as BMI increases, social support decreases. The model's high R-squared value indicates a strong explanatory power.

3) Academic Stress Level Mean vs. BMI Mean:

R-squaredis 0.464 (This shows that BMI accounts for 46.4% of the variance in academic stress levels.) and the p-value for BMI coefficient: 0.319 (This indicates that the effect of BMI on academic stress level is not statistically significant at the 0.05 level.) the calculated Regression Equation:

Academic Stress Level=4.82+0.096×BMI Mean

While BMI does explain a portion of the variance in academic stress (46.4%), the p-value indicates that the relationship is not statistically significant, meaning other factors might be influencing academic stress.

6. DISCUSSION

The statistical analysis of the relationship between BMI, depression, social support, and academic stress in adolescents from the Muzaffarpur district of Bihar provides valuable insights, though several nuances in the results warrant further examination. Based on the correlation and regression findings, we can explore the implications of these relationships, particularly the interaction between BMI and various psychosocial factors.

6.1. BMI AND DEPRESSION

The negative correlation observed between BMI and depression scores (-0.2917) suggests that as BMI increases, depression may also increase, although this relationship is relatively weak. This result supports existing literature that identifies a link between higher BMI and mental health issues, including depression (Sullivan et al., 2000). However, the regression analysis indicated that this relationship is not statistically significant (p-value = 0.121), suggesting that BMI alone is not a strong predictor of depression among adolescents in this sample. A study by Murray et al. (2013) found that while a positive correlation exists between obesity and depressive symptoms, other contributing factors like social stigma, bullying, and self-esteem play a more significant role in adolescent mental health. This could be the case in the current dataset, where other psychological and social variables might be influencing depression scores.

6.2. BMI AND SOCIAL SUPPORT

A significant negative correlation (-0.9333) between BMI and social support is notable, as higher BMI appears to be strongly associated with lower social support. This finding is consistent with research indicating that individuals with higher BMI often experience lower levels of social acceptance and higher levels of social rejection (Puhl & Latner, 2007). Puhl and Heuer (2009) emphasize that individuals, particularly adolescents, with obesity may face stigmatization, leading to feelings of social isolation and reduced social support, which is directly reflected in the current data. Moreover, the regression model showed a significant negative relationship (p-value = 0.0002) between BMI and social support, explaining 86.7% of the variance. This finding highlights the importance of addressing weight-related stigma and promoting inclusive environments to enhance social support for adolescents, especially those with obesity.

6.3. BMI AND ACADEMIC STRESS

The positive correlation between BMI and academic stress (0.6813) suggests that adolescents with higher BMI may report more academic stress. This could be related to the pressures of academic performance, body image concerns, or the intersection of these factors. Adolescent obesity has been associated with poor body image, which can lead to higher levels of stress, including academic stress (Johnson et al., 2004). However, despite the positive correlation, the regression analysis revealed that this relationship was not statistically significant (p-value = 0.319). This suggests that other variables, such as socioeconomic status, peer pressure, or family dynamics, might be contributing more strongly to academic stress in this cohort than BMI alone.

6.4. SOCIAL SUPPORT AND ACADEMIC STRESS

The negative correlation (-0.8985) between social support and academic stress suggests that adolescents with higher levels of social support experience less academic stress. This is in line with research by Cohen and Wills (1985), which highlights the buffering effect of social support on stress. Adolescents who perceive higher social support tend to have better coping mechanisms, which can help mitigate stress from academic pressures. In the context of the current dataset, it appears that adolescents who are socially supported are better able to handle academic challenges, whereas those with less support may feel more overwhelmed.

6.5. IMPLICATIONS FOR INTERVENTION AND POLICY:

The results from this study have important implications for intervention and policy. Given the significant negative relationship between BMI and social support, there is a clear need for programs aimed at reducing weight-related stigma and promoting social inclusion for adolescents with higher BMI. School-based interventions that focus on building self-esteem, promoting positive body image, and offering psychological support could help reduce the social isolation often faced by adolescents with obesity (Neumark-Sztainer et al., 2006).

Additionally, the weak relationships observed between BMI and depression or academic stress highlight the complexity of mental health and academic performance. It suggests that while obesity may contribute to these issues, other factors like family support, peer relationships, and individual psychological resilience likely play a more prominent role. Future research could explore these variables further to develop more comprehensive models for addressing the mental health needs of adolescents.

7. LIMITATIONS AND FUTURE RESEARCH

This study is not without limitations. The sample size of only 4 BMI categories with 4 data points is too small to draw definitive conclusions. A larger and more diverse sample is needed to provide more robust results. Moreover, cross-sectional data does not allow for causality to be established. Longitudinal studies would be more effective in determining the directionality of these relationships (e.g., whether BMI causes depression, or if depression leads to weight gain). Additional variables, such as family history of mental health issues, socioeconomic status, and school environment, should also be incorporated to provide a more holistic view of the factors contributing to depression, academic stress, and social support in adolescents.

8. CONCLUSION

In conclusion, while BMI shows some significant associations with depression, social support, and academic stress in adolescents from Muzaffarpur district, the strength of these relationships varies. Social support plays a crucial role in mitigating academic stress, while obesity appears to significantly impact social inclusion, thus reducing the levels of support adolescents receive. However, BMI alone is not a strong predictor of depression or academic stress, suggesting that other psychosocial factors may be more important in understanding these issues. Future research should continue to explore the complex interactions between these variables, and interventions should focus on reducing stigma and promoting supportive environments for all adolescents.

CONFLICT OF INTERESTS

None.

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