

ASSOCIATION OF SOCIO-DEMOGRAPHIC FACTORS WITH BODY MASS INDEX AMONG ADOLESCENT GIRLS: A CROSS-SECTIONAL STUDY

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Abstract

Adolescence is a formative period of life marked by rapid biological, emotional, and social changes that shape long-term health. While factors such as age, parental education, family income, and body mass index (BMI) are recognized as key influences, evidence from low- and middle-income contexts remains limited and sometimes inconsistent. In India, where urbanization and lifestyle shifts have created a dual burden of malnutrition, understanding the determinants of adolescent health is especially critical.

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Objective: This study examined the relationship between sociodemographic characteristics, BMI, and adolescent health outcomes, with the aim of informing more targeted interventions.

Methods: A school-based cross-sectional survey was conducted among 326 adolescents aged 13–17 years in Raibareli district, Uttar Pradesh. Sociodemographic data were gathered using structured questionnaires, and anthropometric measurements were obtained using standardized procedures. BMI was calculated and classified according to the WHO growth references. Chi-square tests were used to examine associations between variables, with statistical significance defined as $p < 0.05$.

Results: Of the participants, 244 (74.8%) were categorized as ‘Yes’ and 82 (25.2%) as ‘No’. Age ($p = 0.047$) and BMI ($p = 0.047$) showed significant associations with health outcomes. Adolescents aged 13–15 years were more likely to fall into the ‘Yes’ category than those aged 16–17. Overweight and obese adolescents had the highest prevalence (90.0%), followed by normal weight (75.6%) and underweight (67.5%). No significant associations were observed for grade level, parental education, income, or residence.

Conclusion: Younger adolescents and those with higher BMI appear more vulnerable, underscoring the need for interventions that combine nutritional awareness with age-sensitive support programs. School-based initiatives and policy-level strategies are essential to address these risks in India’s adolescent population.

Introduction

Adolescence, defined by the World Health Organization as the stage between 10 and 19 years, is a pivotal developmental phase characterized by significant physical, psychological, and social transformations. During these years, young people establish health behaviors and coping strategies that often persist into adulthood and influence lifelong well-being¹The importance of this period has been increasingly recognized in global health agendas, with adolescence framed as a window of opportunity for interventions that can yield lifelong benefits.

Globally, adolescents constitute nearly 1.2 billion individuals, accounting for one-sixth of the world’s population². The vast majority live in low- and middle-income countries, where rapid demographic and social changes present unique challenges for adolescent health. India, with its 250 million adolescents, represents one of the largest adolescent populations worldwide. The health and well-being of this group will shape the country’s demographic dividend, making it a critical focus for policymakers³.

Indian adolescents face a dual burden of malnutrition. Undernutrition continues to be prevalent, particularly among disadvantaged populations, manifesting

in stunting, anemia, and deficiencies in micronutrients such as iron and vitamin A. At the same time, urbanization and lifestyle changes have contributed to rising rates of overweight and obesity, especially in cities and semi-urban areas⁴. This ‘nutrition transition,’ characterized by greater consumption of processed foods and declining physical activity, has placed adolescents at risk for both communicable and non-communicable diseases.

In addition to nutritional concerns, adolescents in India face a range of psychosocial challenges. Academic pressures, peer influences, exposure to social media, and limited access to youth-friendly health services all play significant roles in shaping adolescent health. These intersecting challenges underscore the need for a more holistic

Understanding of the determinants of adolescent health, particularly within the Indian context.

Previous research in high-income countries has established strong links between parental education, family income, and adolescent health outcomes, with socioeconomic status often serving as a key predictor of well-being^{6,7}. However, findings from middle-income countries like India are less consistent, suggesting that school environments, peer relationships, and cultural factors may dilute or mediate the influence of socioeconomic status⁸. Body mass index (BMI), meanwhile, remains a universally relevant indicator of adolescent health, given its association with both undernutrition and overweight-related risks⁹.

Despite a growing body of literature, research in India remains limited, particularly in terms of examining the combined role of sociodemographic characteristics and nutritional status in shaping adolescent health. This study therefore investigates the associations between age, grade level, residence, parental education, family income, and BMI with adolescent health outcomes in a school-based population. By doing so, it contributes to evidence-based approaches for interventions that target adolescents’ unique needs within the Indian context.

Methods

Study Design and Participants

This study utilized a cross-sectional design, chosen for its ability to provide a snapshot of associations between sociodemographic factors and health outcomes within a defined population of the Raibareli district. A total of 326 adolescents aged 13–17 years, drawn from grades 8 to 12, were recruited from schools representing a range of socioeconomic and residential contexts.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee prior

to data collection. Written informed consent was obtained from parents, while adolescents provided assent. Confidentiality was preserved through anonymized data collection, and anthropometric assessments were carried out privately to maintain participants' comfort.

Data Collection

Data was collected in two stages. First, a structured questionnaire captured sociodemographic details, including age, grade, parental education, family income, and residence. Second, anthropometric measurements were taken. Height was measured using a stadiometer, and weight was recorded using a calibrated digital scale. BMI was calculated as weight in kilograms divided by the square of height in meters (kg/m^2). The World Health Organization's growth reference standards for individuals aged 5–19 years were used to classify BMI ⁹

Statistical Analysis

Data were entered and analyzed using statistical software. Descriptive statistics were used to summarize participant characteristics. Chi-square tests were employed to examine associations between independent variables and the binary outcome variable. A significance level of $p < 0.05$ was applied. Due to the cross-sectional nature of the study, results are interpreted as associations rather than causal effects.

Results

A total of 326 adolescents participated in the study. Of these, 244 (74.8%) were categorized in the 'Yes' group, while 82 (25.2%) were categorized in the 'No' group. This indicates that nearly three out of every four adolescents demonstrated the outcome of interest.

Age and Grade

Age was significantly associated with outcomes ($p = 0.047$). Adolescents aged 13–15 years showed a higher prevalence (85.5%) compared to those aged 16–17 years (72.7%).

This suggests that younger adolescents were more vulnerable within the studied outcomes. Grade level, however, did not reveal a significant association ($p = 0.268$). Nonetheless, lower grade students (grades 8–10) demonstrated a slightly higher prevalence (81.3%) compared with students in higher grades (grades 11–12: 73.7%).

Body Mass Index

BMI displayed a significant relationship with outcomes ($p = 0.047$). Overweight and obese adolescents exhibited the highest prevalence (90.0%), followed by those of normal weight (75.6%) and underweight peers (67.5%). The 22.5% gap between underweight and overweight/obese groups underscores the critical role of nutrition in shaping adolescent health.

Residence

Residence did not demonstrate a significant association ($p = 0.765$). Adolescents from rural or semi-urban areas showed a prevalence of 73.3%, nearly identical to the 75.2% observed among urban adolescents. This suggests that differences in lifestyle between rural and urban adolescents may be diminishing due to increasing globalization and shared exposures.

Parental Education and Family Income

Neither parental education nor family income showed significant associations with outcomes. For fathers, prevalence ranged from 64.3% among those with no formal education to 80.0% among those with primary education. Among mothers, prevalence varied between 66.7% and 85.7%, without a clear pattern. Similarly, prevalence across income categories ranged from 70% to 78% ($p = 0.639$). These results suggest that socioeconomic factors, while important in other contexts, may play a smaller role in shaping adolescent health outcomes in this sample.

	Category	No (n, %)	Yes (n,%)	Total (n)	P Value
Age (in years)	13-15	8 (14.5%)	47 (85.5%)	55	0.047
	16-17	74 (27.3%)	197 (72.7%)	271	
Class	8-10	9 (18.8%)	39 (81.3%)	48	0.268
	11-12	73 (26.3%)	205 (73.7%)	278	
Body Mass Index	Underweight	27 (32.5%)	56 (67.5%)	83	0.047
	Healthy weight	52 (24.4%)	161 (75.6%)	213	
	Overweight/Obese	3 (10.0%)	27 (90.0%)	30	
Residence	Rural/Semi-Urban	16 (26.7%)	44 (73.3%)	60	0.765
	Urban	66 (24.8%)	200 (75.2%)	266	
Father's Education	Illiterate	5 (35.7%)	9 (64.3%)	14	0.757
	Primary	5 (20.0%)	20 (80.0%)	25	
	Secondary	23 (25.0%)	69 (75.0%)	92	
Mother's Education	Graduate/Above	49 (25.1%)	146 (74.9%)	195	0.323
	Illiterate	3 (14.3%)	18 (85.7%)	21	
	Primary	13 (33.3%)	26 (66.7%)	39	
Family Income	Secondary	27 (28.1%)	69 (71.9%)	96	0.639
	Graduate/Above	39 (22.9%)	131 (77.1%)	170	
	< ₹10,000	3 (23.1%)	10 (76.9%)	13	
	₹10,000-20,000	15 (30.0%)	35 (70.0%)	50	
	₹20,000-50,000	29 (21.8%)	104 (78.2%)	133	
	> ₹50,000	35 (26.9%)	95 (73.1%)	130	
Total		82 (25.2%)	244 (74.8%)	326	

Table 1: Socio-demographic factors of Adolescent Girls

Discussion

The findings of this study highlight age and BMI as significant determinants of adolescent health, while grade level, parental education, family income, and residence did not show meaningful associations. These outcomes provide valuable insights into the complexity of adolescent health in India and the shifting influence of traditional versus emerging determinants. The observation that younger adolescents (13–15 years) were more vulnerable resonates with developmental theories identifying early adolescence as a sensitive period. During this phase, rapid biological changes, identity formation, and peer influences converge, making adolescents more **susceptible to health risks**¹⁰. International research presents mixed findings, with some studies suggesting greater vulnerability in late adolescence, particularly **for mental health outcomes**¹¹. In India, however, early adolescence often coincides with increased academic expectations and restricted autonomy, intensifying **stress and vulnerability**¹².

BMI emerged as another key determinant, consistent with global evidence linking overweight and obesity to adverse health outcomes, including psychosocial distress and long-term metabolic risks^{13,14}. Overweight adolescents in India frequently face body image concerns and social stigma, in addition to the physical risks of excess weight. The relatively lower prevalence among underweight adolescents in this study differs from findings in severely resource-constrained settings, where undernutrition carries greater morbidity and mortality risks⁽¹⁵⁾. This may reflect contextual differences where undernutrition is still normalized in parts of India.

The lack of significant associations with parental education and family income contrasts with evidence from high-income countries, where socioeconomic gradients remain strong **predictors of adolescent health**. In the Indian context, increasing exposure to digital platforms and shared cultural influences may reduce the impact of **socioeconomic disparities**. Gupta et al. (2012) similarly observed that peer influence and media exposure outweighed household background in **shaping adolescent behaviors**. This suggests that interventions should not be restricted to specific income groups but should adopt a universal approach.

Equally significant is the finding that residence did not differentiate adolescent health outcomes. The convergence of rural and urban lifestyles in India, driven by globalization, internet access, and similar cultural exposures, likely explains this outcome. This points to the importance of developing interventions that are broad-based rather than narrowly focused on rural or urban populations.

Policy implications are clear. Schools should serve as central venues for interventions, combining nutrition education, opportunities for physical activity,

and access to counseling. Families must play a supportive role in reinforcing healthy habits, while policymakers should ensure adolescent-friendly services and safe public spaces. The integration of adolescent health priorities into broader national health strategies will be critical to addressing the dual challenges of undernutrition and obesity.

Limitations and Future Research

This study is not without limitations. Its cross-sectional design restricts causal interpretation, meaning that while associations were identified, the directionality of relationships cannot be established. The reliance on self-reported sociodemographic data may also introduce recall or reporting biases. Additionally, the binary classification of outcomes into “Yes/No” categories may oversimplify the complexity of adolescent health behaviors.

Despite these limitations, the study adds to a growing body of literature emphasizing the importance of localized evidence in shaping adolescent health strategies. Future research should adopt longitudinal designs to track changes across adolescence and capture how risk and protective factors evolve over time. Moreover, mixed-method approaches that include qualitative insights could enrich understanding of how adolescents perceive their own health challenges and the social contexts influencing them.

Conclusion

This study examined the associations between sociodemographic variables, nutritional status as measured by BMI, and adolescent health outcomes in a school-based sample of Indian adolescents. The results highlight two main determinants—age and BMI—as significant predictors, while grade level, parental education, family income, and place of residence did not show strong associations.

The vulnerability of younger adolescents (13–15 years) emphasizes the need for age-specific interventions that focus on building resilience, coping strategies, and awareness of healthy behaviors during this formative stage. Similarly, the association of higher BMI with poorer outcomes underscores the urgency of addressing overweight and obesity alongside persistent undernutrition. India’s adolescents face a dual nutritional challenge, and public health programs must adopt a balanced approach that neither overlooks the risks of undernutrition nor underestimates the growing burden of overweight and obesity.

The absence of significant effects for socioeconomic and residential variables reflects a broader social transition in India. Increasing globalization, peer influence, and digital connectivity appear to be shaping adolescent lifestyles in ways that

diminish the predictive power of parental education and income. This convergence signals that adolescent health strategies should move beyond traditional demographic divides and address adolescents more holistically across the spectrum of society.

Implications for Policy and Practice

Schools remain the most strategic setting for intervention, given their ability to reach large adolescent populations in structured environments. Integrating nutrition education, physical activity programs, and psychosocial support into curricula can create comprehensive frameworks for promoting health. Families should be actively engaged through parent workshops and communication strategies that extend healthy behaviors into the home. At the policy level, adolescent health must be elevated within the national agenda, ensuring adequate funding for youth-friendly services, safe recreational infrastructure, and awareness campaigns.

Recommendations for Future Research

Future studies should adopt longitudinal designs to better understand how health trajectories evolve through adolescence into adulthood. Mixed-method research, combining quantitative surveys with qualitative insights, would provide a deeper understanding of the lived experiences of adolescents, including their perceptions of body image, peer influence, and digital media exposure. Such evidence would enable the design of culturally sensitive and sustainable interventions tailored to the Indian context.

Final Reflection

Adolescence represents a period of both vulnerability and opportunity. The findings of this study reaffirm that interventions targeted at this age group are not simply a matter of immediate well-being but an investment in the future health, productivity, and resilience of the nation. By addressing nutritional and psychosocial challenges in a timely and inclusive manner, India can empower its adolescents to transition into healthy, capable, and socially responsible adults.

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