

Association Between Tobacco Consumption and Caloric intake Among Adolescents: A Cross-sectional study from urban slums of Jaipur.

Shashank Pathak¹, Dr. J.P. Singh², Dr. V. B. Tripathi³

¹PhD Research Scholar, IIHMR University, 1, Prabhu Dayal Marg, Near Sanganer Airport, Maruti Nagar, Jaipur, Rajasthan 302029.

²Professor, IIHMR University, 1, Prabhu Dayal Marg, Near Sanganer Airport, Maruti Nagar, Jaipur, Rajasthan 302029.

³Assistant Professor, 1, Prabhu Dayal Marg, Near Sanganer Airport, Maruti Nagar, Jaipur, Rajasthan 302029.

Background:

Adolescents in socioeconomically disadvantaged urban settings are at heightened risk of both undernutrition and early initiation of tobacco use. Nicotine's appetite-suppressing effects may adversely influence dietary intake, potentially exacerbating nutritional deficits in resource-constrained environments. However, empirical evidence examining this relationship in urban slum populations remains limited.

Objectives:

To assess the association between tobacco consumption and dietary intake among adolescents, and to identify predictors of caloric intake below the Recommended Dietary Allowance (RDA).

Methods:

A cross-sectional analytical study was conducted among 900 adolescents (10–19 years) residing in selected urban slum clusters of Jaipur, India. Data were collected using a structured questionnaire, anthropometric measurements, and a 7-day dietary logbook. Nutritional status was assessed using Body Mass Index (BMI), and daily caloric intake was compared against ICMR (2010) RDA guidelines. Associations were examined using Chi-square tests and correlation analysis. Multivariate logistic regression was performed to identify independent predictors of caloric intake below RDA.

Results:

Overall, 58.0% of adolescents had caloric intake below RDA. Underweight prevalence was 33.5%, while 60.4% had normal BMI and 6.0% were overweight. Tobacco use was significantly associated with inadequate caloric intake, with 75.6% of users consuming below RDA compared to 40.4% of non-users ($\chi^2 = 113.9$, $p < 0.001$). A significant association was also observed between tobacco use and BMI category ($\chi^2 = 6.13$, $p = 0.047$). Smokeless tobacco, particularly gutkha, was the predominant form, with a mean initiation age of 14.3 years. In multivariate analysis, tobacco consumption emerged as an independent predictor of caloric intake below RDA.

Conclusion:

Tobacco consumption is significantly associated with inadequate caloric intake and increased risk of undernutrition among adolescents in urban slums. Integrated interventions targeting both tobacco use and nutritional improvement are warranted in this vulnerable population.

Keywords: Adolescents, Tobacco use, Caloric intake, Dietary inadequacy, Body Mass Index, Urban slums, Nutrition

1. Introduction

Tobacco use among adolescents remains a major public health concern, particularly in socioeconomically disadvantaged settings. Adolescence is a critical developmental period characterized by rapid growth, increased nutritional requirements, and heightened susceptibility to risk-taking behaviours. Early initiation of tobacco use is associated not only with long-term risks of non-communicable diseases but also with immediate effects on dietary behaviour, nutritional intake, and growth.

Nicotine, the primary psychoactive component of tobacco, influences appetite regulation and energy balance through neurobiological mechanisms, including modulation of hunger- and satiety-related hormones. This may lead to appetite suppression and reduced caloric intake. Such effects are especially concerning in low-income settings, where food insecurity and limited access to balanced diets already compromise nutritional status. Evidence also suggests a bidirectional relationship between tobacco use and food insecurity, wherein tobacco consumption may both result from and contribute to inadequate dietary intake.

Previous studies have independently examined tobacco use, nutrition, and food insecurity; however, limited research has explored their interrelationship among adolescents, particularly in urban slum settings. In India, adolescent tobacco use—especially smokeless forms—remains prevalent among lower socioeconomic groups, where vulnerabilities related to poverty and access to health services are pronounced.

Urban slums in Jaipur provide a relevant context to investigate these overlapping risks, given widespread socioeconomic deprivation and availability of low-cost tobacco products. Understanding the association between tobacco use and dietary intake in this population is essential for informing integrated public health interventions. Therefore, this study aims to examine the association between tobacco consumption and dietary habits, with a specific focus on caloric intake relative to recommended dietary allowances among adolescents residing in urban slums of Jaipur.

2. Methodology

2.1 Study Design and Setting

A cross-sectional analytical study was conducted among adolescents (10–19 years) residing in urban slums of Jaipur, Rajasthan, India, to assess the association between tobacco use and caloric intake. These settings are characterized by socioeconomic deprivation, food insecurity, and easy availability of low-cost tobacco products.

2.2 Sample Size and Sampling

A total of 900 adolescents were included. The sample size was estimated using a prevalence of tobacco use of 30.6%, 95% confidence level, and allowable error, with adjustments for design effect and non-response. A multistage cluster sampling technique was applied. Slums were stratified by administrative zones, and 30 clusters were selected using probability proportional to size. Households were enumerated, and eligible adolescents were selected using systematic random sampling. One participant per household was chosen to minimize clustering.

2.3 Data Collection and Variables

Data were collected through face-to-face interviews using a structured questionnaire and a 7-day dietary logbook. Information on socio-demographic characteristics, tobacco use (type,

frequency, initiation), and dietary practices (meal frequency, meal skipping, appetite changes) was obtained. Daily caloric intake was estimated and compared with age- and sex-specific Recommended Dietary Allowance (RDA) guidelines (ICMR, 2010), and categorized as “meets RDA” or “below RDA.”

2.4 Anthropometry and Data Analysis

Body weight was measured using calibrated digital scales, and Body Mass Index (BMI) was calculated to assess nutritional status using standard age- and sex-specific references.

Descriptive statistics were used to summarize variables. Associations between tobacco use and caloric intake were assessed using Chi-square tests and Cramér’s V. Multivariate logistic regression was performed to identify predictors of caloric intake below RDA. Statistical significance was set at $p < 0.05$.

3. Results:

3.1 Socio-demographic characteristics of the study population

The Age distribution, Marital status, Education level and Occupational level of respondent presented in **Table-3.1**. A total of 900 adolescents aged 10–19 years participated in the study. The mean age of respondents was 15.18 years (SD = 2.66), representing the full span of adolescence. Late adolescents aged 17–19 years constituted the largest proportion of the sample (39.7%), followed by middle adolescents aged 14–16 years (31.4%) and early adolescents aged 10–13 years (28.9%). The gender distribution of the participants was nearly equal, with 50.8% females ($n = 457$) and 49.2% males ($n = 443$), indicating balanced representation across sexes.

Table 3.1: Socio-Demographic and Economic Summary of Respondents (N = 900)

Age Category	Frequency	Percentage
Early adolescence (10-13 years)	260	28.9
Mid adolescence (14-16 Years)	283	31.4
Late adolescence (17-19 Years)	357	39.7
Range (Years)	10-19	
Mean Age (Years)	15.18	
Standard Deviation (SD)	2.66	
Marital status of Adolescent	Frequency	Percentage
Married	32	3.6
Unmarried	868	96.4
Education Level	Frequency	Percentage
Up to 5 th Class	99	11
Up to 8 th Class	352	39.1
Secondary (10 th)	372	41.3
Sr. Secondary (12 th)	77	8.6

Occupation Level	Frequency	Percentage
Family Work	38	4.2
Students	683	75.9
Paid Regular	54	6
Domestic Work /Street Vendors	81	9
Other (Informal Services)	44	4.9

With respect to educational attainment, the majority of adolescents had completed schooling up to the secondary level. Approximately (41.3%) had completed education up to 10th class, while 39.1% had completed up to 8th class. A smaller proportion of respondents reported education only up to the primary level (11.0%) , whereas (8.6%) had progressed to senior secondary education (12th class).

Regarding occupational status, most adolescents were students (75.9%). However, a notable proportion of respondents were engaged in economic activities, including domestic work or street vending (9.0%), paid regular employment (6.0%), family-based work (4.2%), and other informal services (4.9%). Occupational engagement increased with age, with the majority of adolescents engaged in economic activities belonging to the 17–19 year age group. Household characteristics indicated moderate family size and low socioeconomic status presented in Table 3.2 . The majority of adolescents (75.7%) lived in households consisting of 4–6 members, while 18.8% lived in households with 7–9 members. The mean household size was 5.64 members (SD = 1.58). Monthly household income levels reflected economic vulnerability within the study population. Approximately 38.0% of households reported monthly income below ₹10,000, and 39.8% reported income between ₹10,000 and ₹20,000. Only 5.3% of households reported monthly income above ₹30,000.

Table-3.2 Distribution of Households Characteristics of Respondent (N=900)

Household Size (Members)	Frequency	Percentage
1–3 members	26	2.9
4–6 members	681	75.7
7–9 members	169	18.8
10 or more members	24	2.6
Total Mean Household Size	5.64 members	
SD	1.58	
Household Monthly Income in (Rs.)	Frequency n=900	Percentage
Less than 10,000	342	38
10,000 – 20,000	358	39.8
20,000 – 30,000	152	16.9
More than 30,000	48	5.3
Total Mean HH Monthly Income	13956	
Standard deviation (SD)	8,672.65	

3.2 Nutritional status and Caloric intake

Body Mass Index (BMI) was used to assess the nutritional status of adolescents in the study population. Overall, 33.5% of adolescents were classified as underweight, 60.4% had normal BMI, and 6.0% were classified as overweight. Table-3.3 presents the age-specific distribution showed notable variation across BMI categories. Among adolescents aged 10–13 years, the prevalence of underweight was 55.8%, indicating a high burden of undernutrition in early adolescence. In contrast, underweight prevalence declined to 29.0% among adolescents aged 14–16 years and further to 21.0% among adolescents aged 17–19 years.

Table 3.3 – Age wise distribution of BMI Categories (n = 900)

Age Group (years)	Underweight n (%)	Normal n (%)	Overweight n (%)	Total
10–13 (n=260)	145 (55.8%)	114 (43.8%)	1 (0.4%)	260
14–16 (n=283)	82 (29.0%)	192 (67.8%)	9 (3.2%)	283
17–19 (n=357)	75 (21.0%)	238 (66.7%)	44 (12.3%)	357

Conversely, the proportion of adolescents with normal BMI increased with age. Among late adolescents, 66.7% had normal BMI, compared with 43.8% among early adolescents. Overweight prevalence was relatively low overall but increased with age, from 0.4% among early adolescents to 3.2% among middle adolescents and 12.3% among late adolescents (Table 2). These findings suggest a transition from undernutrition in early adolescence toward relatively improved nutritional status with increasing age. Daily caloric intake presented in Table-3.4 was estimated using a seven-day dietary logbook. The estimated energy intake ranged from 1970 kcal/day to 2730 kcal/day, with a mean intake of 2285.87 kcal/day (SD = 264.76). The most frequently reported caloric intake category was 2060 kcal/day, representing 35.3% of respondents, while 2250 kcal/day represented the least frequent intake category (5.3%). The distribution of caloric intake showed slight positive skewness, indicating that a smaller proportion of adolescents reported relatively higher caloric intake levels.

Table-3.4 Distribution of Estimated Energy Intake (kcal/day) Among Adolescents (n = 900)

Estimated Intake (kcal/day)	Frequency	Percentage
1970	91	10.1
2060	318	35.3
2190	75	8.3
2250	48	5.3
2450	140	15.6
2640	164	18.2
2730	64	7.1
Total	900	100
Total Mean	2285.87 kcal/day	
SD	265.47	

When Calorie Intake was evaluated against the Recommended Dietary Allowance (RDA) for adolescents. Participants were classified according to whether their estimated daily caloric intake met or fell below the sex-specific RDA values.

As shown in Table 3.5, 58.0% of participants (n = 522) consumed less than the recommended dietary allowance, whereas 42.0% (n = 378) reported energy intake equal to or greater than the Recommended Dietary Allowance.

Table 3.5 - Distribution of Participants According to Calorie Intake Relative to RDA (n = 900)

Category of Recommended Dietary Allowance (RDA)	Frequency (n)	Percentage
Less than RDA	522	58
Equal or More than RDA	378	42

These findings indicate that more than half of the participants did not meet the recommended daily energy requirement, suggesting a notable prevalence of inadequate energy intake among adolescents in the study population.

3.3 Tobacco Consumption Patterns

The study sample included 450 adolescents who reported tobacco consumption and 450 non-users, as per the sampling design that allowed comparative analysis between the two groups. **Figure 3.1** shows that, Among tobacco users, smokeless tobacco was the predominant method of consumption, accounting for 84.9% of users, whereas 5.3% reported exclusive smoking, 3.8% reported both smoking and smokeless tobacco use, and 6.0% reported other forms of tobacco consumption.

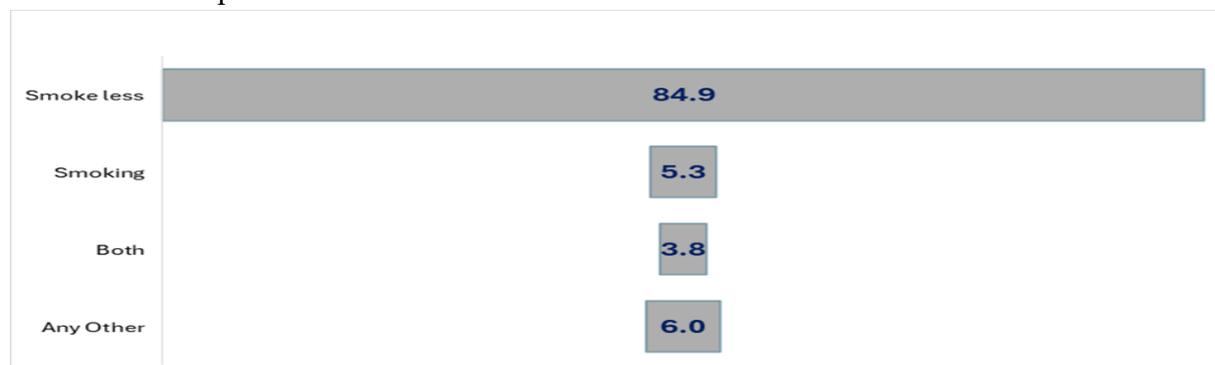


Figure 3.1 – Method of Tobacco Consumption (N=450) (In %)

Analysis of specific tobacco products revealed that gutkha was the most commonly consumed product, reported by 86.9% of tobacco users. Tobacco manjan was used by 6.0%, while 4.4%

reported cigarette use. Very few adolescents reported the use of bidi (0.7%) or zarda (0.4%) as standalone products. A small number of respondents reported multiple product use, including combinations such as cigarette and gutkha.

The mean age of initiation of tobacco use was 14.28 years (SD = 2.12), with initiation occurring as early as 10 years of age. The highest proportion of initiation occurred around 15 years, indicating that early-to-mid adolescence represents a critical period for tobacco initiation.

Table 3.6 presents the distribution of the frequency of tobacco consumption and daily expenditure on tobacco among respondents who reported tobacco use. In terms of consumption patterns, 71.3% of tobacco users reported daily tobacco use, while 21.6% reported occasional use and 7.1% reported less-than-daily use.

Table-3.6 Frequency of Tobacco use and Daily Expenditure on Tobacco (n=450)

Frequency of Tobacco Use	Frequency	Percentage
Daily	321	71.3
Occasionally	97	21.6
Less than daily	32	7.1
Money Spent per Day (INR)		
0–10	64	14.2
11–20	74	16.4
21–30	44	9.8
31–40	18	4.0
41–50	98	21.8
>50	152	33.8

Tobacco expenditure patterns showed that a substantial proportion of adolescents spent significant amounts on tobacco products. Approximately 33.8% reported spending more than ₹50 per day on tobacco, while 21.8% reported daily expenditure between ₹41–50.

Household tobacco exposure was also common. Approximately 78% of adolescents reported two or more family members consuming tobacco, with a mean of 2.32 tobacco-using members per household (SD = 1.14).

3.4 Findings of Bivariate Analysis

3.4.1 Association between tobacco consumption and BMI

The association between tobacco consumption and BMI categories was examined using a Chi-square test of independence. The results indicated a statistically significant association between tobacco use and BMI category ($\chi^2 = 6.13$, $p = 0.047$) presented in **Table-3.5**. However, the magnitude of the association was relatively weak, as indicated by Cramér's $V = 0.083$.

Table 3.5 – Association between BMI and Tobacco Consumption- (n = 900)

Tobacco Consumption	Underweight (%)	Normal (%)	Overweight (%)	χ^2	P value
Yes (n=450)	164(36.4%)	266(59.1%)	20(4.4%)		
No (n=450)	138(30.7%)	278(61.8%)	34(7.6%)		
Total	302 (33.5%)	544 (60.4%)	54 (6%)	6.13	.047

$\chi^2(2, N = 900) = 6.13, p = .047$

Examination of the distribution revealed that a higher proportion of tobacco users were classified as underweight (36.4%) compared with non-users (30.7%). Conversely, the proportion of overweight adolescents was higher among non-users (7.6%) compared with tobacco users (4.4%). The proportion of adolescents with normal BMI was relatively similar between the two groups.

3.4.1 Association between tobacco consumption and Calorie intake

A strong association was observed between tobacco consumption and caloric intake relative to the recommended dietary allowance. Among adolescents who reported tobacco use, 75.6% had caloric intake below the RDA, whereas only 40.4% of non-users had caloric intake below the recommended level presented in Table-3.6

Table-3.6 Association between tobacco consumption and Calorie intake

Variable	Category	Less than RDA n (%)	≥ RDA n (%)	Total	χ^2	p-value	Cramer's V
Ever Consumed Tobacco	Yes	340 (75.6)	110 (24.4)	450			
	No	182 (40.4)	268 (59.6)	450			
	Total	522	378		113.9	<0.001	0.356
						*	
	Category	≤ RDA n (%)	≥RDA n (%)	Total (n=900)	χ^2	p-value	Cramer's V
Method of Tobacco Use	Non-user(n=450)	182 (40.4)	268 (59.6)	450			
	Chewing (n=376)	281 (74.7)	95 (25.3)	376			
	Smoking (n=26)	19 (73.1)	7 (26.9)	26			
	Both (Chew + Smoke) (n=27)	22 (81.5)	5 (18.5)	27			
	Any Other (Manjan, Naswar, Pan) (n=21)	18 (85.7)	3 (14.3)	21			
	Total		522 (58.0)	378 (42.0)	900	187.41	< .001

The Chi-square test indicated a statistically significant association between tobacco consumption and caloric intake adequacy ($\chi^2 = 113.9$, $p < 0.001$), with a moderate strength of association (Cramér's $V = 0.356$). These findings indicate that adolescents who consume tobacco are substantially more likely to experience inadequate dietary intake compared with non-users.

Further analysis examining the Method of tobacco consumption revealed additional variation in dietary adequacy presented in Table-3.6. Adolescents who used both smoked and smokeless tobacco demonstrated the highest prevalence of inadequate caloric intake (81.5% below RDA), followed by those using smokeless tobacco (74.7% below RDA) and smoking tobacco (73.1% below RDA). In contrast, the majority of non-users (59.6%) met or exceeded the recommended dietary allowance. The association between method of tobacco consumption and RDA status was statistically significant ($\chi^2 = 187.41$, $p < 0.001$) with a moderate strength of association (Cramér's $V = 0.36$).

3.5 Multivariate Logistic Regression Analysis

Multivariate logistic regression identified predictors of caloric intake below the Recommended Dietary Allowance (RDA). The model demonstrated good fit (Hosmer–Lemeshow $\chi^2 = 7.42$, $p = 0.48$) and explained 21–29% of the variance (Cox & Snell $R^2 = 0.21$; Nagelkerke $R^2 = 0.29$). Higher secondary education was significantly associated with increased odds of caloric intake below RDA (AOR = 1.40; 95% CI: 1.01–1.95; $p = 0.045$). Other socio-demographic variables were not significant. Tobacco use remained an independent predictor of inadequate caloric intake.

3.6 Key Findings

A high prevalence of inadequate caloric intake (58%) and undernutrition was observed. Tobacco use was strongly associated with caloric deficiency, with users significantly more likely to consume below RDA. Smokeless tobacco, particularly gutkha, was the predominant form, with early initiation during adolescence.

4. Discussion

4.1 Summary of Findings

The study demonstrates a high burden of undernutrition among adolescents in urban slums, with over half reporting caloric intake below RDA and one-third being underweight. Tobacco use was prevalent, initiated early, and strongly associated with inadequate caloric intake and lower BMI. Dual users exhibited the highest nutritional risk.

4.2 Comparison with Existing Evidence

Findings are consistent with global and Indian literature indicating that nicotine influences appetite regulation and is associated with lower caloric intake and BMI. Evidence from low- and middle-income settings suggests that tobacco use and food insecurity are interrelated, particularly in economically disadvantaged populations. The predominance of smokeless tobacco aligns with Indian studies.

4.3 Public Health Implications

The results highlight the need for integrated interventions addressing both tobacco use and adolescent nutrition. Early prevention, school-based education, and strengthened regulation of

smokeless tobacco are critical. Addressing underlying social determinants such as poverty and food insecurity is essential.

4.4 Strengths and Limitations

Strengths include a large sample size, multistage sampling, and combined assessment of behavioural and nutritional factors. Limitations include the cross-sectional design, reliance on self-reported data, and limited generalizability beyond similar urban slum settings.

References:

1. Al'Absi, M., DeAngelis, B., Nakajima, M., Hatsukami, D., & Allen, S. (2021). Early life adversity and appetite hormones: The effects of smoking status, nicotine withdrawal, and relapse on ghrelin and peptide YY during smoking cessation. *Addictive behaviors, 118*, 106866.
2. Bergmans, R. S., Coughlin, L., Wilson, T., & Malecki, K. (2019). Cross-sectional associations of food insecurity with smoking cigarettes and heavy alcohol use in a population-based sample of adults. *Drug and alcohol dependence, 205*, 107646.
3. Berry, K. M., Drew, J. A. R., Brady, P. J., & Widome, R. (2023). Impact of smoking cessation on household food security. *Annals of epidemiology, 79*, 49-55.
4. Cho, B. Y., Seo, D. C., Lin, H. C., Lohrmann, D. K., Chomistek, A. K., Hendricks, P. S., & Timsina, L. (2018). Adolescent weight and electronic vapor product use: Comparing BMI-based with perceived weight status. *American Journal of Preventive Medicine, 55*(4), 541-550.
5. World Health Organization (WHO) & Centers for Disease Control and Prevention (CDC). (2019). Global Youth Tobacco Survey (GYTS): Country report – India 2019. Geneva: World Health Organization.
6. Graff-Iversen, S., Hewitt, S., Forsén, L., Grøtvedt, L., & Ariansen, I. (2019). Associations of tobacco smoking with body mass distribution; a population-based study of 65,875 men and women in midlife. *BMC Public Health, 19*(1), 1439.
7. Grover, S., Anand, T., Kishore, J., Tripathy, J. P., & Sinha, D. N. (2020). Tobacco use among the youth in India: evidence from global adult tobacco survey-2 (2016-2017). *Tobacco Use Insights, 13*, 1179173X20927397.
8. Gu, D., Max, W. B., Yao, T., Wang, Y., Keeler, C., & Sung, H. Y. (2023). Association between e-cigarette use and food insecurity among low-income adults. *Tobacco control, 32*(e2), e212-e219.
9. Gupta, S., Mal, P., Bhadra, D., Rajaa, S., & Goel, S. (2024). Trend and determinants of tobacco use among Indian males over a 22-year period (1998–2021) using nationally representative data. *Plos one, 19*(10), e0308748.
10. Jacob, A. M., Jacob, J., & Shetty, A. K. (2025). Smoked out or chewed up: trends in tobacco consumption in India using National Family Health Survey data from 2015 to 2016 and 2019 to 2021. *BMJ open, 15*(10), e094133.
11. Kim-Mozeleski, J. E., & Pandey, R. (2020). The intersection of food insecurity and tobacco use: a scoping review. *Health promotion practice, 21*(1_suppl), 124S-138S.

12. Lakshmi, R., Romate, J., Rajkumar, E., George, A. J., & Wajid, M. (2023). Factors influencing tobacco use behaviour initiation—From the perspective of the Capability, Opportunity, Motivation-Behaviour (COM-B) Model. *Heliyon*, 9(6).
13. Li, Y., Mao, J., Chai, G., Zheng, R., Liu, X., & Xie, J. (2025). Neurobiological mechanisms of nicotine's effects on feeding and body weight. *Neuroscience & Biobehavioral Reviews*, 106021.
14. Mantey, D. S., Janda-Thomte, K. M., Alexander, A. C., Omega-Njemnobi, O., & Kelder, S. H. (2024). Hunger and housing: Economic disparities in current and daily tobacco use among high school students in the United States in 2021. *Preventive Medicine Reports*, 47, 102901.
15. Mayer, M., Gueorguieva, R., Ma, X., & White, M. A. (2019). Tobacco use increases risk of food insecurity: An analysis of continuous NHANES data from 1999 to 2014. *Preventive Medicine*, 126, 105765.
16. Miller, A. A., Nakajima, M., DeAngelis, B. N., Hatsukami, D. K., & al'Absi, M. (2024). Nicotine addiction and the influence of life adversity and acute stress on PYY: Prediction of early smoking relapse. *Pharmacology Research & Perspectives*, 12(5), e70016.
17. Mistry, R., Kleinsasser, M. J., Puntambekar, N., Gupta, P. C., McCarthy, W. J., Raghunathan, T., ... & Pednekar, M. S. (2022). Neighbourhood tobacco retail access and tobacco use susceptibility in young adolescents in urban India. *Tobacco control*, 31(e2), e162-e168.
18. Moore, S. P., Gunzler, D. D., Spears, C. A., Shaikh, N. I., & Kim-Mozeleski, J. E. (2024). Longitudinal experience of food insecurity & cigarette use in the early COVID-19 pandemic, United States. *Preventive Medicine Reports*, 38, 102624.
19. Pandurangi, R., Mummadi, M. K., Challa, S., Reddy, N. S., Kaliaperumal, V., Khadar Babu, C., ... & Hemalatha, R. (2022). Burden and predictors of malnutrition among Indian adolescents (10–19 years): insights from Comprehensive National Nutrition Survey Data. *Frontiers in Public Health*, 10, 877073.
20. Parida, J., Bagepally, B. S., Patra, P. K., Pati, S., Kaur, H., & Acharya, S. K. (2025). Prevalence and associated factors of undernutrition among adolescents in India: a systematic review. *BMC Public Health*, 25(1), 819.
21. Seman, Z., Singh, J., Sanaudi, R., Abd Rashid, N. H. Y., & Omar, M. A. (2025). Gender-specific Associations between Tobacco Use and Body Mass Index among School-going Adolescents in Malaysia: Results from the National Health Morbidity Survey 2017. *International Journal of Public Health Research*, 15(1), 2157-2166.
22. Seoane-Collazo, P., Diéguez, C., Nogueiras, R., Rahmouni, K., Fernández-Real, J. M., & López, M. (2021). Nicotine's actions on energy balance: Friend or foe?. *Pharmacology & therapeutics*, 219, 107693.
23. Shaheen, N., Shaheen, A., Diab, R. A., Saad, A. M., Abdelwahab, O. A., Soliman, S., ... & Nashwan, A. J. (2023). Association of serum leptin and ghrelin levels with smoking status on body weight: a systematic review and meta-analysis. *Frontiers in Psychiatry*, 14, 1296764.

24. Shevchouk, O. T., Tufvesson-Alm, M., & Jerlhag, E. (2021). An overview of appetite-regulatory peptides in addiction processes; from bench to bed side. *Frontiers in neuroscience*, 15, 774050.
25. Verma, M., Rana, K., Bhatt, G., Sharma, N., & Lal, P. (2023). Trends and determinants of tobacco use initiation in India: analysis of two rounds of the Global Adult Tobacco Survey. *BMJ open*, 13(9), e074389.
26. Wang, Q. (2020). Tobacco use and sleep loss over worry among adolescents aged 12–15 years: A population-based study of 38 countries. *Journal of Global Health*, 10(2), 020427.
27. Wang, Q. (2021). Underweight, overweight, and tobacco use among adolescents aged 12–15 years: Evidence from 23 low-income and middle-income countries. *Tobacco Induced Diseases*, 19, 37.
28. Chiolero, A., Faeh, D., Paccaud, F., & Cornuz, J. (2008). Consequences of smoking for body weight, body fat distribution, and insulin resistance. *The American Journal of Clinical Nutrition*, 87(4), 801–809. <https://doi.org/10.1093/ajcn/87.4.801>.
29. Audrain-McGovern, J., & Benowitz, N. L. (2011). Cigarette smoking, nicotine, and body weight. *Clinical Pharmacology & Therapeutics*, 90(1), 164–168. <https://doi.org/10.1038/clpt.2011.105>.
30. Semba, R. D., Kalm, L. M., de Pee, S., Ricks, M. O., Sari, M., & Bloem, M. W. (2007). Paternal smoking is associated with increased risk of child malnutrition among poor urban families in Indonesia. *Public Health Nutrition*, 10(1), 7–15. <https://doi.org/10.1017/S136898000722292X>
31. Unger, J. B., Johnson, C. A., & Rohrbach, L. A. (2001). Recognition and management of weight concerns in adolescent smoking prevention. *American Journal of Health Behavior*, 25(6), 554–564.
32. Gupta, P. C., & Ray, C. S. (2003). Tobacco and youth in the South East Asian region. *Indian Journal of Cancer*, 40(4), 133–138.
33. Patton, G. C., Sawyer, S. M., Santelli, J. S., Ross, D. A., Afifi, R., Allen, N. B., et al. (2016). Our future: A Lancet commission on adolescent health and wellbeing. *The Lancet*, 387(10036), 2423–2478. [https://doi.org/10.1016/S0140-6736\(16\)00579-1](https://doi.org/10.1016/S0140-6736(16)00579-1).
34. John, R. M. (2008). Crowding-out effect of tobacco expenditure and its implications on household resource allocation in India. *Social Science & Medicine*, 66(6), 1356–1367.