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Socioeconomic, Lifestyle and Dietary Determinants of Gastroesophageal Reflux Disease among adults in Northern India: A Community based Cross-Sectional Study

Prashant Baraily, Abhishek Sahu, P. K Jain, Supriya, Dhananjay Gautam, Akshay Kumar
Department of Community Medicine, Uttar Pradesh University of Medical Sciences, Saifai

Corresponding author: Dr Prashant Baraily, Department of Community Medicine, Uttar Pradesh University of Medical Sciences, Saifai

Email: prashazz1234@gmail.com

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Abstract

Background: Gastroesophageal reflux disease (GERD) is an increasingly prevalent chronic condition, particularly in developing nations undergoing rapid lifestyle and dietary transitions. Data on GERD determinants from semi-urban and rural communities of northern India remain sparse. **Material & Methods:** A community-based cross-sectional study was conducted from January 2023 to March 2025 in urban and rural areas of district Etawah, Uttar Pradesh, India. A total of 496 adults (18-60 years) were enrolled using multistage sampling (248 urban, 248 rural). GERD was diagnosed using the validated GERD-Q questionnaire (score>8). Sociodemographic, dietary, lifestyle, and anthropometric data were collected via a pre-tested, semi-structured interview schedule. Chi-square test, Fisher's exact test, and multivariable binary logistic regression were applied; $p < 0.05$ was considered statistically significant. **Result:** The overall community prevalence of GERD was 20.2%, with no significant urban-rural variance. Multivariable logistic regression identified several independent determinants of increased GERD risk: age 41-50 years (aOR 5.12), sedentary lifestyle (aOR 4.87), daily spicy food consumption (aOR 4.63), ex-smoking status (aOR 3.89), heavy tea intake >3 cups/day (aOR 3.22), inadequate sleep (aOR 2.43), and psychosocial stress (aOR 2.15). **Conclusion:** GERD affects approximately one-fifth of the adult population in Etawah, with comparable urban-rural burden. Modifiable risk factors like sedentary behaviour, spicy and caffeinated dietary habits, and psychosocial stress constitute the primary drivers. Targeted community-based interventions addressing these determinants are urgently needed.

Keywords: GERD, Cross-sectional study, GERDQ, Obesity, Lifestyle, Diet, India

Introduction

Gastroesophageal reflux disease (GERD) is defined by the Montreal Consensus as "a condition that develops when the reflux of stomach contents causes troublesome symptoms and/or complications".[1] Heartburn and regurgitation are its cardinal manifestations. Long-term acid reflux can induce mucosal alterations in the esophagus, potentially resulting in Barrett's esophagus and subsequent esophageal adenocarcinoma.[2]

Globally, GERD affects an estimated 13-20% of the population, with marked geographic variation: reported prevalence rates range from 18.1% to 27.8% in North America, 8.8% to 25.9% in Europe, and 2.5% to 7.8% in East Asian countries.[3,4] India presents a nuanced epidemiological landscape; a meta-analysis reported a pooled prevalence of 15.6%,[5] whereas regional studies from Kashmir and West Bengal documented rates of 20.3% and 31.3%, respectively.[6,7]

GERD is inherently multifactorial and is rooted in the interplay between anatomical, genetic, and modifiable environmental factors. Abdominal obesity, indicated by an elevated waist-to-hip ratio, is an important factor contributing to increased intra-abdominal pressure, compromised lower esophageal sphincter (LES) function, and significantly amplifies the risk of GERD.[8,9] Dietary triggers, such as spicy foods, caffeine-containing beverages, and high-fat meals, augment acid secretion and reduce LES tone.[10] Sedentary behavior, inadequate sleep, and psychological stress further compound this risk through neurohumoral and motility-related mechanisms.[11,12]

Despite the rising burden, community-level data from semi-urban and rural India, where lifestyle transitions are accelerating, are limited. Published studies predominantly originate from tertiary care settings or specific occupational cohorts, limiting their generalizability. Furthermore, few Indian studies have simultaneously examined socioeconomic, dietary, and anthropometric determinants using multivariate modelling. The present study addressed these gaps by evaluating the prevalence of GERD and its independent determinants among adults in a district of Northern India.

Objectives

1) To estimate the prevalence of Gastroesophageal Reflux Disease among adults in the study.
2) To estimate the association between socioeconomic characteristics and the presence of GERD.
3) To evaluate the influence of lifestyle and dietary factors on the risk of GERD.

Material & Mathods

Study Design and Setting

This community-based cross-sectional study was conducted between January 2024 and January 2025 in the Etawah district of Uttar Pradesh, Northern India. The district comprises 8 community development blocks (rural) and 4 municipal councils (urban).

Study population All population of age group 18 to 60 years of the study area.

Sample Size and Sampling

Using the formula $n = Z^2p\ q/d^2$, with the estimated GERD prevalence in India (p = 15.6%), 5% allowable error (d), and 95% confidence level (Z = 1.96), the minimum required sample per stratum was 201. With a 20% non-response adjustment and design effect, 248 participants per stratum (urban and rural) were recruited, yielding a sample size of 496.

A multistage probability proportionate-to-size sampling strategy was employed. In rural areas, four community development blocks were randomly selected, followed by eight villages, and households were selected using systematic random sampling. In urban areas, eight municipal wards were selected, and households were chosen using systematic sampling. One adult per household (18-60 years) was interviewed using the Kish grid method for random selection.

Inclusion criteria:

1. Individuals aged ≥18 years to 60 years
2. Individuals who gave consent to participate in the study
3. Residents of district Etawah > 6 months

Exclusion criteria:

1. Individuals who were seriously ill
2. Pregnant females
3. Individuals who had history of corrosive ingestion
4. Mentally challenged individuals

Study Instruments

Data were collected using a pre-tested, semi-structured interview schedule comprising four sections: (A) sociodemographic profile; (B) GERD-Q diagnostic questionnaire; (C) dietary habits; and (D) lifestyle parameters. GERD was diagnosed using the validated GERD-Q questionnaire, a six-item validated tool, wherein a score ≥8 indicates a high probability of GERD.[13] The questionnaire inquired about the frequency (0-3 days/week) of heartburn, regurgitation, epigastric pain, nausea, sleep disturbance due to heartburn/regurgitation, and use of over-the-counter antacids. Scores ≥8 were classified as GERD positive, consistent with the validated cutoff.

Operational definitions:

Gastroesophageal Reflux Disease (GERD): According to the Montreal definition, Gastroesophageal Reflux Disease (GERD) is a condition which develops when the reflux of the stomach contents causes troublesome symptoms and / or complications.

Dietary Variables: Daily spicy food was defined as the consumption of meals containing visible chili powders, garam masala, or raw green chilies at least once every day; Occasional spicy food was defined as such intake < 3 days per week. Fatty/Fried foods were defined as items deeply fried in oil or clarified butter (e.g., puris, paranthas, samosas) consumed as part of core daily meals.

Lifestyle Factors: Inadequate sleep was defined as a total duration of <7 hours per night on average over the preceding month. Sound sleep was subjectively defined as uninterrupted, restful sleep where the participant woke up feeling refreshed, free from frequent nocturnal awakenings or tossing and turning.

Statistical Analysis

The dataset was compiled and analyzed using the IBM SPSS Statistics software (Version 24.0; IBM Corp., Armonk, NY, USA).

Results

Table 1 presents the baseline characteristics of the 496 study participants. The mean (±SD) age was 40 ± 11.32 years in urban areas and 38 ± 11.72 years in rural areas. Urban participants had a nearly equal gender distribution (50.4% women vs. 49.6% men), whereas rural areas had more men (56%). The majority identified as Hindu (87.1% urban and 90.7% rural). Most were married (80.6% urban, 77.0% rural), and homemakers constituted the largest occupational group in both settings (38.7% and 37.5%, respectively).

Table 1. Baseline sociodemographic characteristics of study participants (N = 496)

Variable	Category	Urban (n=248) n (%)	Rural (n=248) n (%)
Age(mean ±SD)	Years	40 ±11.32	38 ±11.72
Age group	18-30 years	54 (21.8)	77(31.0)
	31- 40 years	80 (32.3)	74 (29.8)
	41-50 years	56 (22.6)	56 (22.6)
	51-60 years	58 (23.4)	41 (16.5)
Gender	Male	123 (49.6)	139 (56.0)
	Female	125 (50.4)	109 (44.0)

Religion	Hindu	216 (87.1)	225 (90.7)
	Muslim	30 (12.1)	22 (8.9)
Marital status	Married	200 (80.6)	191 (77.0)
	Single/ Unmarried	43 (17.3)	47 (19.0)
Family type	Nuclear	110 (44.4)	131 (52.8)
	Joint	46 (18.5)	63 (25.4)
Occupation	Homemaker	96 (38.7)	93 (37.5)
	Self- employed	85 (34.3)	57 (23.0)
	Student	34 (13.7)	37 (14.9)
Education	Higher Secondary +	133 (53.6)	102 (41.1)
	Secondary or below	115 (46.4)	146 (58.9)
Socioeconomic status	Upper/ Upper middle	99 (39.9)	69(27.8)
	Lower middle	116 (46.8)	99 (39.9)
	Upper lower/Lower	33 (13.3)	80 (32.3)

Most participants were vegetarians (65.7% urban, 61.7% rural). Approximately 92.7% of urban and 80.6% of rural participants had a dinner-to-bedtime interval of <3 hour, a recognized GERD risk factor. Sedentary lifestyle was present in 31.9% (urban) and 31.5% (rural); 8.9% and 6.0%, respectively, reported inadequate sleep. Smokeless tobacco was used occasionally or daily by 29.0% of urban and 28.6% of rural participants (Tables 2 and 3,).

Table 2. Distribution of dietary parameters among study participants

Dietary Variable	Category	Urban n (%)	Rural n (%)
Dietary habit	Vegetarian	163 (65.7)	153 (61.7)
	Eggetarian	52 (21.0)	51 (20.6)
	Non-vegetarian	33 (13.3)	44 (17.7)
Late-night eating	Yes	57 (23.0)	72 (29.0)
Dinner-to-bedtime	<3hours	230 (92.7)	200 (80.6)
Tea intake	>3cups/day	33 (13.3)	38 (15.3)
	≤3cups/day	179 (72.2)	167 (67.3)
Coffee intake	Yes	43 (17.3)	28 (11.3)
Spicy food	Everyday	19 (7.7)	26 (10.5)
	Occasional	221 (89.1)	185 (74.6)
Fried/fatty food	Everyday	1 (0.4)	12 (4.8)
Salad intake	Never	21 (8.5)	25 (10.1)
Fruit intake	Never	9 (3.6)	7 (2.8)

Table 3. Distribution of lifestyle parameters among study participants

LifestyleVariable	Category	Urban n(%)	Rural n(%)
Physical activity	Sedentary	79(31.9)	78(31.5)
Sleep duration	Inadequate(<7h)	22(8.9)	15(6.0)
Self-reported stress	Yes	59(23.8)	71(28.6)
Smoking	Current smoker	10(4.0)	22(8.9)
	Ex-smoker	24(9.7)	22(8.9)
Smokeless tobacco	Occasional/Everyday	72(29.0)	71(28.6)
Alcohol intake	Current user	2(0.8)	5(2.0)
Aerated drinks	Occasional	173(69.8)	185(74.6)
Passive smoking	Yes	49(19.8)	81(32.7)

Table 4 shows the overall prevalence of GERD was 20.2% (100/496). Urban prevalence stands at 21.0% (52/248) and rural at 19.4% (48/248).

Table 4. GERD prevalence across urban and rural study participants

Setting	GERD Present n(%)	GERD Absent n(%)	Total n(%)	χ^2	p-value
Urban	52 (21.0)	196 (79.0)	248 (100)	0.20	0.654
Rural	48 (19.4)	200 (80.6)	248 (100)		
Overall	100 (20.2)	396 (79.8)	496 (100)		

Table 5 shows Sociodemographic Factors: GERD prevalence scaled significantly with age ($p < 0.001$), peaking in the 41-50 age group (37.5%) compared to the 18-30 age group (3.1%). Marital status was significantly associated ($p = 0.025$), with higher prevalence among married individuals (22.8% vs. 12.2%). Gender showed no significant baseline difference ($p = 0.689$).Daily spicy food consumption was strongly associated with GERD, showing a 46.7% prevalence versus 17.3% for occasional intake ($p < 0.001$). Heavy tea intake (>3 cups/day) was also significant ($p = 0.001$). Coffee consumption showed no significant crude association at this unadjusted level ($p = 0.823$). Lifestyle Parameters: Physical inactivity emerged as the strongest behavioral covariate ($p < 0.001$), with a 40.8% prevalence in sedentary individuals compared to 10.6% in non-sedentary individuals. Significant elevations were also tied to tobacco use ($p < 0.001$) highest in ex-smokers at 39.1%), psychosocial stress ($p = 0.002$), and inadequate sleep ($p = 0.016$).

Table 5. Associations of demographic , lifestyle & dietary variables with GERD (N = 496)

Variable	Category	GERD Present n (%)	GERD Absent n (%)	$x2$ / Statistic	p-value
Age group	18-30 years	4 (3.1)	127 (96.9		
	31-40 years	28 (18.2)	126 (81.8)	41.25	<0.001*
	41-50 years	42 (37.5)	70 (62.5)		
	51-60 years	26 (26.3)	73 (73.7)		
Gender	Male	51 (19.5)	211 (80.5)		
	Female	49 (20.9)	185 (79.1)	0.16	0.689
Marital Status	Married	89 (22.8)	302 (77.2)		
	Single/ Unmarried	11 (12.2)	79 (87.8)	5.02	0.025*
Physical activity	Sedentary	64 (40.8)	93 (59.2)		
	Non-sedentary	36 (10.6)	303 (89.4)	56.72	<0.001*
Spicy food	Daily	21 (46.7)	24 (53.3)		
	Occasional	71 (17.3)	335 (82.7)	17.45	<0.001*
Tea intake	> 3 cups/day	20 (28.2)	51 (71.8)		
	< 3cups/day	69 (19.2)	290 (80.8)	10.18	0.001*
Coffee intake	Yes	15 (21.1)	56 (78.9)		
	No	85 (20.0)	340 (80.0)	0.05	0.823
Stress	Yes	38 (29.2)	92 (70.8)		
	No	62 (17.0)	304 (83.0)	9.43	0.002*
Sleep duration (<7h)	Inadequate	11 (29.7)	26 (70.3)		
	Adequate (>7h)	89 (19.4)	370 (80.6)	5.99	0.016*
Smoking status	Current Smoker	10 (31.3)	22 (68.8)		
	Ex-smoker	18 (39.1)	72 (17.4)		
	Non-smoker	28 (60.9)	342 (82.6)	21.14	<0.001*
Smokeless tobacco	User	29 (31.2)	64 (68.8)		
	Never	55 (17.2)	265 (82.8)	14.67	<0.001*

*** p < 0.05 significant.**

Multivariable Logistic Regression Analysis

To isolate the independent determinants of GERD and control for confounding effects, all variables meeting a liberal bivariate entry threshold ($p < 0.25$) alongside clinically plausible covariates were entered into a multivariable binary logistic regression model (Table 6).Advancing age remained a highly significant independent predictor of GERD. Compared to the youngest participants (18-30 years), participants aged 41-50 years exhibited the highest risk, with a five-fold increase in the odds of developing the disease ($p < 0.001$). After adjusting for covariates, gender ($p = 0.785$) and married status ($p = 0.092$) did not retain independent statistical significance. Due to data collection limitations, objective anthropometric indices such as waist-to-hip ratio and central obesity could not be integrated into the final regression architecture.

Dietary triggers strongly influenced GERD status after multivariable adjustment. Daily spicy food consumption conferred a substantial four-fold risk increase relative to occasional or non-consumers ($p < 0.001$). Heavy tea consumption (>3cups/day) also remained an independent driver, more than tripling the odds of symptomatic disease ($p = 0.004$). Notably, heavy coffee consumption (>3 cups/day) demonstrated the largest effect size in the model (aOR 8.47; 95% CI 1.21-59.20; $p = 0.031$); however, the extremely wide 95% confidence interval reflects a statistical limitation due to the small sample size of heavy coffee drinkers within the study population.

Physical inactivity proved to be the strongest behavioral determinant, with a sedentary lifestyle increasing the odds of GERD nearly five-fold ($p < 0.001$). Among tobacco variables, ex-smoking status retained a sharp and significant association, yielding an almost four-fold risk elevation compared to non-smokers ($p = 0.002$). Finally, adverse lifestyle parameters including inadequate sleep duration ($p = 0.032$) and self-reported psychosocial stress ($p = 0.018$) were confirmed as significant independent correlates.

Table 6. Multivariable binary logistic regression: independent determinants of GERD (N = 496)

Variable	Category	Adjusted Odds Ratio (aOR)	95% Confidence Interval (CI)	p-value
Age group	31-40 years	2.14	0.87-5.27	0.097
(Ref: 18-30	41-50 years	5.12	2.14-12.26	<0.001*
years)	51-60 years	3.64	1.49-8.90	0.004*
Gender (Ref: Male)	Female	1.08	0.62-1.88	0.785
Marital status (Ref: Single)	Married	2.04	0.89-4.66	0.092
Physical activity (Ref: Non-sedentary)	Sedentary	4.87	2.56-9.27	<0.001*
Dietary habits (Ref: Occasional/ Never)	Daily spicy food	4.63	2.01-10.67	<0.001*
Tea intake (Ref: ≤ 3 cups/day)	> 3 cups/day	3.22	1.44-7.19	0.004*
Coffee intake (Ref: No coffee)	Heavy coffee intake	8.47	1.21-59.20	0.031*
Lifestyle parameters (Ref: No)	Psychosocial stress	2.15	1.14-4.06	0.018*
Sleep duration (Ref: Adequate ≥ 7h)	Inadequate sleep (<7h)	2.43	1.08-5.47	0.032*
Smoking status	Current smoker	1.82	0.74-4.48	0.191
(Ref: Non-smoker)	Ex-smoker	3.89	1.65-9.17	0.002*
Smokeless tobacco (Ref: Never)	Occasional/ Daily user	1.87	0.98-3.57	

aOR = adjusted odds ratio; CI = confidence interval; * $p < 0.05$ significant.

Discussion

The present community-based cross-sectional study offers a robust epidemiological assessment of Gastroesophageal Reflux Disease (GERD) and its multi-dimensional determinants among adults in Northern India. The observed overall GERD prevalence of 20.2% aligns closely with the regional burdens documented in North Bihar (23.6%) by Shivalli et al.[18] and remains consistent with the upper limits of the national pooled prevalence (15.6%) reported in the landmark Indian meta-analysis by Rai et al.[5] Crucially, the lack of a statistically significant urban-rural gradient (21.0% vs. 19.4%, p = 0.654)

indicates a notable epidemiological shift. Traditional Indian cohorts, such as the one evaluated by Chowdhury et al.[16] in southern India, demonstrated a stark urban-to-rural prevalence divide (11.1% vs. 5.1%). The narrowing disparity captured in our study suggests that the conventional protection afforded by rural lifestyles is rapidly eroding, driven by the uniform penetration of dietary and behavioral transitions into semi-urban and rural landscapes, a trend supported by recent work from Parasher et al.[7]

Advancing age emerged as a highly significant independent predictor of GERD in the multivariable model, with the odds peaking substantially in the 41-50 age cohort (aOR 5.12). This finding corroborates global evidence from Eusebi et al.[3] and regional Indian data from Rai et al.,[5] which consistently highlight increased symptomatic risk in middle-aged and older populations. The physiological mechanism underlying this association is well-established, rooted in the progressive age-related decline in lower esophageal sphincter (LES) basal pressure, reduced salivary bicarbonate secretion, and an increased frequency of transient LES relaxations (TLESRs), as outlined by Vakil down through Bhatia et al.[1, 10] Notably, after robust multivariable adjustment, gender did not retain an independent association with GERD (p = 0.785$), reinforcing the premise that modifiable behavioral risks supersede unmodifiable biological factors in this cohort.

Among the lifestyle determinants evaluated, physical inactivity demonstrated a striking independent relationship, with a sedentary lifestyle increasing the odds of GERD nearly five-fold (aOR 4.87). This finding is heavily supported by the prospective HUNT study by Hallan et al.[19] and comparative cross-sectional work by Eslami et al. [11], which confirm that physical inactivity serves as a primary driver of new-onset reflux symptoms. Mechanistically, prolonged physical inactivity promotes visceral adiposity and diminishes gastric motility, which collectively delay acid clearance and elevate intra-abdominal pressure. [8,9,21]

Dietary triggers also occupied a prominent role in the final model. Daily spicy food consumption conferred a substantial four-fold risk increase (aOR 4.63), matching outcomes reported by Rasool et al.[22] and Parasher et al.[7] Capsaicin, an active component in spicy dishes, stimulates transient receptor potential vanilloid-1 (TRPV1) receptors in the esophageal mucosa, inducing visceral hypersensitivity and microvascular inflammation.[23] Furthermore, heavy tea consumption (>3 cups/day) more than tripled the odds of GERD (aOR 3.22), a relationship similarly highlighted by Ghoshal et al.[24] Both tea and coffee contain methylxanthines, which directly compromise the smooth muscle tone of the LES and stimulate gastric acid hypersecretion. [10]

A key statistical finding requiring careful interpretation is the exceptionally large effect size observed for heavy coffee consumption (aOR 8.47), which presented an extremely wide 95% confidence interval (1.21-59.20). While the biological plausibility of caffeine-induced LES relaxation is clear,[10] the wide interval reveals a distinct statistical limitation: the subpopulation of heavy coffee drinkers within this specific northern Indian cohort was highly constrained, resulting in low statistical precision. This instability necessitates caution when generalizing the absolute magnitude of the coffee-associated risk from this sample.

Finally, our findings confirm the independent role of neuropsychological and sleep parameters, where self-reported stress (aOR 2.15) and inadequate sleep (aOR 2.43) significantly amplified the odds of symptomatic GERD. Psychosocial stress triggers cortisol-mediated delays in gastric emptying and heightens pain perception via the brain-gut axis, aligning with the findings of Alsaleem et al.[25] Concurrently, sleep deprivation disrupts the esophago-upper esophageal sphincter contractile reflex, leaving the mucosa vulnerable to nocturnal reflux events as observed by Yamamichi et al

Conclusions

GERD affects approximately one-fifth of the adult population in Etawah, with no statistically significant urban-rural gradient, suggesting a convergence of risk exposure driven by dietary and lifestyle transitions. Independent determinants were identified via multivariable regression: advancing age (41-60 years), sedentary lifestyle, daily spicy food consumption, heavy tea and coffee intake, psychosocial stress, and inadequate sleep. These findings underscore the primacy of modifiable behavioural and metabolic factors in GERD etiopathogenesis.

The use of the validated GERD-Q questionnaire enables symptom-based community diagnosis is a cost-effective, non-invasive strategy for early case detection and referral in resource-limited settings. Targeted public health interventions must integrate weight management, physical activity promotion, dietary counselling on spicy food and caffeine reduction, stress management, and optimal chronic disease control to reduce GERD burden in both urban and rural communities.

Strengths And Limitations

The principal strengths of this study include its community-based design with house-to-house surveys minimising selection bias, simultaneous evaluation of socioeconomic, dietary, lifestyle, anthropometric and comorbidity determinants, use of the validated GERD-Q tool, and statistical control for confounders through multivariable logistic regression.

Limitations

Due to the cross-sectional design of this study, temporal sequencing cannot be verified. It remains unproven whether lifestyle choices, such as high tea and daily spicy food intake,

initiated the pathophysiology of GERD. Clinical case identification relied entirely on subjective responses to the 6-item GERD-Q symptom schedule. The lack of objective diagnostic confirmations, such as upper gastrointestinal endoscopy or 24-hour ambulatory pH monitoring, prevents the definitive exclusion of structural alternatives like Barrett's esophagus or non-erosive reflux disease variants and non-inclusion of psychometric instruments for depression and anxiety assessment.

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