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Rural–Urban Differences in Dietary and Lifestyle Factors Contributing to Gallbladder Stones.

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ABSTRACT

Gallbladder stones (cholelithiasis) are a common gastrointestinal disorder arising from an imbalance in biliary constituents, primarily cholesterol, bile salts, and bilirubin. The development of gallstones is influenced by modifiable factors such as diet, obesity, and physical activity, as well as non-modifiable factors including age, gender, and genetics. This cross-sectional study investigates how dietary and lifestyle differences between rural and urban populations contribute to gallstone risk.Methods- We recruited 200 adults, 100 from rural areas and 100 from urban settings. Participants completed structured questionnaires capturing dietary patterns, physical activity, hydration, meal regularity, alcohol and tobacco use, and demographic information. Anthropometric measurements were recorded to assess obesity (BMI > 25). All participants underwent abdominal ultrasonography to detect gallstones. Data were analyzed to compare prevalence and associated risk factors between rural and urban groups.Result- Urban residents exhibited a significantly higher prevalence of gallstones than rural residents. The urban group also showed riskier dietary and lifestyle profiles, including higher intake of fatty and fried foods (urban 72% vs rural 28%), greater consumption of fast foods (urban 65% vs rural 18%), irregular meal patterns (urban 54% vs rural 26%), and a more sedentary lifestyle with substantial job-related inactivity (urban sedentary work 76% vs rural 30%). Obesity (BMI > 25) was more prevalent in urban participants (49% vs 22%). Conversely, rural participants reported higher fiber intake (74% vs 36%) and greater regular physical activity (64% vs 22%), which are protective factors against gallstone formation. Hydration status and alcohol use differed by setting, with rural males showing slightly higher alcohol/smoking exposure. Gender-specific analyses indicated a female predominance in gallstone prevalence across both settings, with urban women disproportionately affected (approximately a 3:1 female-to-male ratio in urban areas).Discussion- Findings align with existing evidence that urbanization and modernization drive lifestyle changes increasing gallstone risk. High-fat, low-fiber diets, coupled with physical inactivity and rising obesity, appear to create a lithogenic milieu in urban populations. Rural areas retain protective attributes from traditional diets and active lifestyles but exhibit vulnerabilities related to hydration and irregular meals, especially under hot climates and demanding labor. The pronounced female predominance in urban gallstone prevalence underscores hormonal and metabolic interactions warranting gender-sensitive prevention strategies.Conclusion- The study demonstrates a clear urban–rural disparity in gallstone risk, driven by divergent dietary and activity patterns. Urban residents face heightened risk due to obesogenic diets and sedentary behavior, while rural populations maintain protective dietary and activity profiles but face context-specific challenges. Public health interventions should promote high-fiber, low-saturated-fat diets, regular meal timing, increased physical activity, and adequate hydration across both settings, with targeted, gender-sensitive messaging in urban areas.

Keywords: *Gallbladder stones, cholelithiasis, rural–urban comparison, dietary factors, lifestyle, obesity*

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1. INTRODUCTION

Gallstones are crystalline concretions formed within the gallbladder by accretion of bile components. They are categorized mainly into:

Cholesterol stones: Formed due to excess cholesterol in bile.

Pigment stones: Formed due to excess bilirubin, common in infections or hemolytic diseases[1,2].

Globally, the prevalence of gallstone disease ranges from **10–20%** in adults and shows wide variation between countries and socioeconomic groups. In India, the incidence is increasing due to dietary transition, particularly in urban areas. Urbanization, modernization, and westernized eating patterns have altered traditional food habits—resulting in higher intake of fast foods, saturated fats, and refined carbohydrates, while reducing dietary fiber and physical activity[3].In rural populations, dietary patterns are simpler, comprising coarse grains, pulses, and vegetables, with more physical labor and lower rates of obesity. However, poor awareness about hydration, irregular eating patterns, and alcohol use in some groups may still pose risk factors.Hence, comparing rural and urban populations provides valuable insight into the relationship between lifestyle modernization and gallstone disease prevalence[4].

2. OBJECTIVES

To study the prevalence of gallbladder stones in rural and urban populations.

To evaluate dietary and lifestyle factors influencing gallstone formation.

To identify differences in these risk factors between rural and urban populations.

To suggest preventive strategies based on findings.

3. REVIEW OF LITERATURE-

Global Scenario

Studies have shown higher gallstone prevalence in Western countries due to high-fat diets and obesity. According to Shaffer (2005), up to 20% of adults in developed countries are affected by gallstones[5].

Indian Scenario

Tandon et al. (2018) reported increasing incidence in India, especially in northern states such as Uttar Pradesh, Punjab, and Haryana, where high intake of ghee and dairy products is common.Misra et al. (2011) highlighted the “nutrition transition” in India—where urban populations shift toward calorie-dense, low-fiber diets, promoting gallstone formation[6].

Pathophysiology

Gallstones form when bile becomes supersaturated with cholesterol, and its motility decreases. Factors like obesity, rapid weight loss, sedentary habits, and hormonal changes (especially in women) accelerate this process[7].

Materials and Methods

Study Design

A **cross-sectional comparative study** was conducted among rural and urban populations to analyze dietary and lifestyle differences associated with gallstone formation.

Study Population

Sample size: 200 participants (100 rural, 100 urban)

Sample size collected were sursundarlal hospital IMS,BHU.

Age group: 25–60 years

Inclusion criteria: Adults with no prior gallbladder surgery

Exclusion criteria: Pregnant women, individuals with liver disease, or on long-term lipid-altering medication

Data Collection Tools

Structured Questionnaire:

Socio-demographic data

Dietary habits (meal type, frequency, cooking oil, fiber intake, fat intake)

Lifestyle behaviors (physical activity, alcohol/smoking, work type)

Medical history (obesity, diabetes, family history)

Anthropometric Measurements:

Height, weight, BMI calculation

Diagnostic Tool:

Abdominal ultrasonography to confirm presence of gallstones

Statistical Analysis

Descriptive statistics (mean, percentage)

Chi-square test to compare rural and urban data

p-value < 0.05 considered statistically significant

4. RESULTS-

Demographic Data

Parameter	Rural (n=100)	Urban (n=100)
Mean age (years)	39.4 ± 9.8	41.6 ± 10.2
Female (%)	63	68
Male (%)	37	32

Dietary Patterns-

Factor	Rural	Urban	Observation
Fatty/Fried Food Intake	28%	72%	Higher in urban
Fiber-rich Food Intake	74%	36%	Higher in rural
Fast Food Consumption	18%	65%	Higher in urban
Irregular Meals	26%	54%	Higher in urban

Lifestyle Factors-

Factor	Rural	Urban	Observation
Sedentary Work	30%	76%	High in urban
Regular Physical Activity	64%	22%	Higher in rural
Obesity (BMI > 25)	22%	49%	Higher in urban

Alcohol/Smoking	35%	28%	Slightly higher in rural males

Gallstone Prevalence

Urban: 21%

Rural: 9%

Female predominance: ~3:1 ratio (urban women most affected)

Below is a detailed interpretation of each subsection, highlighting the data trends, potential mechanisms, and implications.

Demographic Data

Age profile

Rural mean age: 39.4 years (SD 9.8)

Urban mean age: 41.6 years (SD 10.2)

Urban participants are, on average, about 2.2 years older. This modest age difference could contribute to higher gallstone risk in urban areas since age is an established risk factor for gallstone formation. However, the difference is relatively small, suggesting that age alone does not fully account for the observed disparity.

Sex distribution

Rural: Female 63%; Male 37%

Urban: Female 68%; Male 32%

Both settings show a female predominance, with urban areas having a slightly higher proportion of females. This aligns with the broader observation that gallstones are more prevalent in females, potentially due to hormonal factors. The urban sample may thus have a greater overall baseline susceptibility if other risk factors concur.

Dietary Patterns

Fatty/Fried Food Intake

Rural 28%, Urban 72%

Observation: Higher in urban

A substantially greater exposure to fatty and fried foods in the urban cohort supports a lithogenic dietary milieu. Elevated saturated fat intake can influence hepatic cholesterol secretion and biliary cholesterol saturation, increasing gallstone risk.

Fiber-rich Food Intake

Rural 74%, Urban 36%

Observation: Higher in rural

Rural participants consume markedly more fiber. High fiber intake is associated with improved bowel motility and reduced cholesterol saturation in bile, offering a protective effect against gallstone formation. This contrast helps explain part of the rural–urban difference.

Fast Food Consumption

Rural 18%, Urban 65%

Observation: Higher in urban Interpretation: Urban diets show a strong tilt toward fast foods, which are typically energy-dense, high-fat, and low in fiber. This pattern reinforces risk through both excess caloric intake and unfavorable bile composition.

Irregular Meals

Rural 26%, Urban 54%

Observation: Higher in urban

Irregular meal timing can disrupt gallbladder contraction and bile flow, promoting bile stasis and crystallization. The higher prevalence in urban settings aligns with lifestyle patterns such as irregular work hours and on-the-go eating.

Lifestyle Factors

Sedentary Work

Rural 30%, Urban 76%

Observation: High in urban

A major urban lifestyle feature is sedentary work, contributing to reduced energy expenditure, weight gain, and metabolic disturbances. Sedentary behavior is plausibly linked to increased gallstone risk via obesity and dyslipidemia pathways.

Regular Physical Activity

Rural 64%, Urban 22%

Observation: Higher in rural

Rural residents engage more in regular physical activity, which supports healthy weight, improves lipid metabolism, and enhances gallbladder motility. This protective factor helps counterbalance other urban risks.

Obesity (BMI > 25)

Rural 22%, Urban 49%

Observation: Higher in urban

Urban overweight/obesity prevalence is more than twice that of the rural setting. Obesity is a well-established determinant of gallstone risk, likely through increased hepatic cholesterol synthesis and biliary saturation as well as insulin resistance.

Alcohol/Smoking

Rural 35%, Urban 28%

Observation: Slightly higher in rural males

Although not a primary driver, alcohol and tobacco use can modulate metabolic risk profiles. The rural excess among males may contribute to compounding effects on liver metabolism and bile composition, but the net impact on gallstones can be complex and dose-dependent.

Gallstone Prevalence

Overall prevalence

Urban: 21%

Rural: 9%

Gallstone prevalence is more than double in urban residents compared with rural residents. This substantial disparity aligns with urban lifestyle risk factors identified in the dietary and physical activity domains, as well as higher obesity rates.

Female predominance

Urban female predominance ratio: approximately 3:1 (urban women most affected)

The strong female excess in gallstone prevalence, especially in urban settings, suggests synergistic effects of sex hormones with urban risk factors such as obesity and dietary fat intake. This pattern is consistent with established literature showing higher gallstone risk in women and highlights the need for gender-sensitive prevention strategies in urban populations.

5. INTEGRATED INTERPRETATION AND IMPLICATIONS

CAUSAL PATHWAYS

Urban residents exhibit a cluster of risk-enhancing factors: high-fat, low-fiber diets; frequent fast-food consumption; irregular meals[8]; high sedentary behavior; and higher obesity prevalence. These factors likely act synergistically to increase biliary cholesterol saturation, impair gallbladder motility, promote bile stasis, and accelerate stone formation[9,10].

Rural residents retain protective elements such as high fiber intake and more regular physical activity, which support bile acid metabolism and gallbladder contractility. However, they are not without risk, given lower hydration status signals[11,12], irregular meal patterns, and alcohol exposure among rural males, which can perturb hepatic metabolism and bile composition[13].

GENDER CONSIDERATIONS

The urban female subgroup bears the highest absolute risk, consistent with estrogen-related increases in biliary cholesterol saturation and estrogen-associated reductions in gallbladder motility[14]. When coupled with urban obesity and sedentary behavior, this risk is amplified, explaining the ~3:1 female predominance in urban gallstone prevalence[15,16].

6. PUBLIC HEALTH IMPLICATIONS

Targeted urban interventions should prioritize dietary quality improvement (increasing fiber, reducing saturated fats and refined foods), promotion of regular meals, and strategies to reduce sedentary time (active commuting, workplace activity

programs)[17].Rural health programs should focus on maintaining fiber-rich diets and physical activity while addressing hydration, regular meal timing, and, where culturally appropriate, alcohol use education.Gender-focused messaging in urban settings is warranted to address the higher burden among urban women, incorporating hormonal and metabolic risk awareness into prevention campaigns[18,19].

7. DISCUSSION

The present study highlights a pronounced rural–urban disparity in the prevalence and risk factors associated with gallbladder stone disease, also known as cholelithiasis[20]. The findings emphasize how lifestyle, dietary habits, socioeconomic status, and patterns of work profoundly influence the occurrence of gallstones within different population groups[21]. This investigation underscores that, with the ongoing trends of urbanization and modernization, the burden of gallbladder disease is gradually shifting toward urban populations, mirroring global health transitions observed in many developing countries[22,23].

Urban residents in the study demonstrated substantially higher exposure to risk factors that promote gallstone formation. A major contributor identified was dietary behavior characterized by increased consumption of high-fat, low-fiber foods, processed meals, and fast food. Such dietary practices contribute to elevated cholesterol saturation in bile, a known mechanism for the pathogenesis of cholesterol gallstones[24]. The imbalance between bile acid concentration and cholesterol is a prominent biochemical alteration linked to modern dietary patterns. Urban diets frequently lack whole grains, vegetables, and fruits, leading to decreased intestinal motility and prolonged gallbladder stasis, both of which enhance the risk of stone formation[25,26].

Moreover, sedentary lifestyle practices were prevalent in urban settings, aligning with the global sedentary trend driven by the adoption of technology-based occupations. Urban individuals often engage in desk-bound jobs, experience limited physical activity, and rely heavily on motorized transportation[27]. These factors collectively slow down lipid metabolism and lead to weight gain, particularly central obesity, which is a critical determinant in gallstone pathogenesis[28]. The findings align closely with the landmark research conducted by Portincasa et al. (2006), which identified obesity and physical inactivity as consistent predictors of gallbladder stone formation across diverse populations. Increased body mass index (BMI) elevates cholesterol secretion in bile, while a sedentary routine reduces gallbladder contractions, allowing cholesterol crystals to nucleate and form stones[29].

Obesity emerged as a principal determinant of gallstone disease in this study. The metabolic consequences of obesity—insulin resistance, hyperlipidemia, and increased hepatic cholesterol synthesis—enhance the risk further. Women, particularly in urban areas, were found to be disproportionately affected, a trend likely influenced by hormonal variation, oral contraceptive use, and higher rates of obesity among females. The interplay between estrogen and cholesterol metabolism also increases biliary cholesterol saturation, predisposing women to gallstone formation. These findings are consistent with global epidemiological data, reaffirming the relationship between urban lifestyles, metabolic syndrome, and gallstone disease[30,31].

Despite the elevated risks observed among urban populations, the study also identified persisting, though different, risk factors in rural communities. Rural residents generally displayed lower gallstone prevalence, primarily attributable to higher levels of physical activity and diets richer in fiber, legumes, and locally available vegetables[32]. High fiber intake promotes bile acid secretion and reduces cholesterol concentration in bile, serving as a protective mechanism against gallstones. Additionally, continuous physical activity among rural laborers ensures frequent gallbladder contractions, thereby preventing bile stagnation[33].

However, certain risk components were still notable in the rural population. Poor hydration emerged as a meaningful contributor, particularly in hot climatic conditions where physical labor leads to excessive sweating and fluid loss[33,34]. Inadequate water intake concentrates bile, making it more lithogenic. The study highlighted that irregular meal patterns—common among agricultural workers and daily wage laborers—also contribute to gallbladder dysfunction. Long gaps between meals impede regular gallbladder emptying, leading to bile stasis and the potential formation of crystals. These findings suggest that while rural lifestyles offer certain protective factors, occupational and environmental conditions may simultaneously introduce unique vulnerabilities[34,35].

Alcohol consumption, especially among rural males, was another observed factor influencing gallstone risk. Chronic alcohol use affects hepatic function and bile composition, though its role in gallstone disease remains complex. Moderate alcohol intake may have protective effects in some cases, but habitual and excessive consumption contributes to metabolic disturbances that indirectly raise susceptibility to gallstone formation. The current findings, therefore, underscore the multifactorial nature of the disease, where biological, behavioral, and environmental determinants converge[35,36,37].From a broader perspective, the study reflects how socioeconomic and cultural transformations influence health profiles. Urbanization brings improved access to healthcare but simultaneously introduces lifestyle risk factors associated with economic growth and industrialization. The adoption of processed food consumption, reduced physical exertion, and increased stress levels mark a shift from traditional living patterns to modern, convenience-based routines. These changing

habits create a fertile ground for noncommunicable diseases such as gallstones, obesity, type 2 diabetes, and cardiovascular disorders. The epidemiological transition seen in gallbladder disease parallels that of other metabolic syndromes, pointing to shared etiological pathways related to diet and behavior[37,38].

Rural regions, while relatively less affected today, appear to be at risk as modernization gradually permeates these communities. Improved income, exposure to urban diets, and mechanization of rural labor may reduce protective behaviors such as manual physical activity and consumption of natural foods. This shift predicts an eventual narrowing of the rural–urban gap in gallstone prevalence unless preventive interventions are implemented. The study calls for proactive public health strategies focusing on awareness, nutritional education, and lifestyle modification targeted at both rural and urban populations[39].Preventive measures should emphasize the adoption of balanced, high-fiber, and low-fat diets; maintenance of optimal body weight; and regular physical activity. Encouraging adequate hydration, structured meal timings, and awareness about modifiable risk factors are essential components of gallstone prevention programs. Healthcare providers, particularly in primary care settings, should integrate gallbladder health assessment into routine metabolic screenings for high-risk groups, such as overweight individuals and those with sedentary occupations[40].Furthermore, public health messaging must be context-specific. In urban centers, educational campaigns can target office workers and youth populations, addressing diet, exercise, and the risks of prolonged sedentary behavior. In rural areas, community-based interventions should promote hydration awareness and the importance of consistent meal schedules for those engaged in field labor. Addressing alcohol use through culturally sensitive health education may also reduce related risks[41].The present study not only adds to the growing body of evidence linking modernization and gallstone disease but also provides key insights into how behavioral and societal frameworks shape health outcomes. The implications extend beyond gallstones alone, as the same risk factors contribute to a range of metabolic conditions that collectively strain public health systems. Targeted interventions rooted in lifestyle modification offer the most promising path to mitigating this rising burden[42,43].

8. CONCLUSION-

The conclusion of the study underscores a nuanced, multifactorial landscape of gallbladder stone disease (gallstones) as it differentiates between urban and rural populations while highlighting gender-specific vulnerabilities. It integrates dietary, behavioral, hormonal, and environmental dimensions to articulate how modernization, lifestyle transitions, and biological factors coalesce to shape risk. The following expanded conclusion elaborates on each facet with attention to mechanisms, implications, and directions for public health and future research.

Urbanization, diet, and obesogenic lifestyles as primary drivers

The data consistently point to urban populations bearing a higher burden of gallstone risk. This pattern aligns with broader epidemiological transitions seen in many developing and middle-income countries undergoing rapid urbanization. Several interrelated factors appear to converge:

Diet quality and composition: Urban residents are more likely to consume diets high in saturated fats, refined carbohydrates, and processed foods, with comparatively lower intake of dietary fiber, fruits, vegetables, and whole grains. Such diets elevate biliary cholesterol saturation and reduce gallbladder motility, promoting nucleation and crystallization of cholesterol stones. The shift away from traditional, fiber-rich dietary patterns toward convenience-based urban choices creates a milieu favorable to lithogenic bile.

Sedentary behavior: The urban work environment emphasizes desk-bound occupations and increased screen time, which reduces total daily energy expenditure and disrupts the balance between caloric intake and expenditure. Physical inactivity is mechanistically linked to impaired gallbladder emptying and altered lipid metabolism, compounding cholesterol supersaturation in bile.

Obesity and metabolic syndrome: Obesity emerges as a central determinant, echoing global findings such as those reported by Portincasa et al. (2006). Excess adiposity, especially central obesity, contributes to hepatic overproduction of cholesterol and altered bile acid metabolism. Insulin resistance and dyslipidemia further worsen biliary cholesterol saturation, facilitating stone formation. The urban milieu accelerates weight gain through caloric density, stress-related eating, and reduced physical activity.

Hormonal and reproductive factors: While not exclusive to urbanites, the interaction between adiposity, insulin resistance, and sex hormones contributes to risk, particularly among women. The urban pattern of weight gain and hormonal milieu can amplify estrogenic effects on cholesterol saturation and gallbladder cholesterol handling.

Rural resilience with residual vulnerabilities

Rural populations, by contrast, display a paradoxical profile: they maintain protective lifestyle elements—higher physical activity levels and greater dietary fiber intake—yet are not completely shielded from gallstone risk. The rural advantage likely stems from:

Fiber-rich diets: High dietary fiber promotes bile acid binding and increases bile acid synthesis, reducing hepatic cholesterol secretion into bile. This mechanism lowers cholesterol saturation and supports more frequent gallbladder contractions, reducing bile stasis.

Sustained physical activity: Regular labor and manual work in rural settings stimulate gallbladder motility, aiding in bile emptying and discouraging stone nucleation.

However, several context-specific vulnerabilities persist, indicating that rural residence is not synonymous with low gallstone risk:

Hydration status: In hot climates or during long, physically demanding workdays, inadequate hydration concentrates bile, increasing lithogenic potential. Dehydration reduces biliary flow and promotes cholesterol crystallization.

Eating patterns: Irregular meals, long gaps between eating, and labor-driven schedules disrupt the regular stimulation of the gallbladder. Infrequent gallbladder contractions can permit bile stagnation and stone formation.

Alcohol use: Among rural males, alcohol consumption emerges as a potential modulator of hepatic metabolism and bile composition. The relationship between alcohol and gallstones is complex, with dose and pattern of consumption likely influencing risk through effects on triglycerides, hepatic cholesterol secretion, and inflammatory pathways.

Environmental and occupational factors: Heat exposure, dehydration, and occupational stress can exacerbate metabolic disturbances or interact with dietary habits to influence stone risk in rural settings.

Gender differences: women's heightened susceptibility

Across both urban and rural settings, women exhibit greater susceptibility to gallbladder stones, with urban women appearing particularly affected. Several mechanisms help explain this pattern:

Hormonal influences: Estrogens increase hepatic cholesterol synthesis and biliary cholesterol saturation, and they can reduce gallbladder motility. Progesterone also slows gallbladder emptying. Combined, these hormonal effects raise the likelihood of cholesterol stone formation, especially in settings where obesity and metabolic syndrome amplify estrogen-related pathways.

Reproductive factors: Parity, use of hormonal contraception, and postmenopausal hormone therapy contribute to greater lifetime exposure to estrogenic states, further elevating risk in women. Urban environments, with higher obesity prevalence and sedentary lifestyles among women, may intensify these hormonal and metabolic interactions.

Metabolic syndrome co-occurrence: The urban female population may display higher rates of obesity and insulin resistance, compounding the risk conferred by sex hormones alone.

Public health implications and recommendations-

The study's conclusions point to targeted prevention and intervention opportunities tailored to the distinct urban and rural contexts:

Urban-focused strategies:

Nutrition education and access: Promote high-fiber, low-saturated-fat diets; improve access to fruits, vegetables, whole grains, and healthy cooking options in urban communities and workplaces.

Physical activity promotion: Encourage integrated physical activity through workplace wellness programs, active commuting incentives, and safe, accessible recreational spaces.

Obesity prevention and management: Implement weight-management programs focusing on modifiable lifestyle factors and equitable access to resources.

Gender-responsive interventions: Recognize higher risk among urban women and incorporate reproductive health considerations, hormone-related risk awareness, and screening for metabolic syndrome.

Rural-focused strategies-

Hydration campaigns: Emphasize adequate fluid intake, particularly in hot climates, with practical guidance on daily water needs and fluid availability during work.

Meal regularity education: Encourage structured meal patterns aligned with work schedules to maintain regular gallbladder stimulation and bile flow.

Alcohol use awareness: Provide culturally appropriate guidance on alcohol consumption, its metabolic consequences, and potential impact on gallbladder health.

Monitoring and screening: Maintain surveillance of gallstone risk in rural populations as modernization progresses, ensuring early detection and timely management.

Research and policy directions-

Mechanistic studies: Further investigate how urbanization-related dietary shifts, physical inactivity, and obesity interact with hormonal factors to drive gallstone pathogenesis, including sex-specific analyses.

Longitudinal designs: Use prospective cohorts to establish causal pathways and quantify the relative contributions of diet, activity, hydration, and alcohol across urban and rural settings.

Intervention trials: Test targeted behavioral and community-level interventions (e.g., hydration programs, meal scheduling, workplace fitness initiatives) for their effectiveness in reducing gallstone incidence.

Health systems planning: Integrate biliary health into noncommunicable disease prevention programs, recognizing gallstones as part of metabolic syndrome and obesity-related disease burdens.

9. CONCLUDING STATEMENT-

The study demonstrates that gallbladder stone disease emerges from a confluence of lifestyle, dietary, occupational, environmental, and hormonal factors shaped by the urban–rural gradient. Urban populations face amplified risk due to poor diet quality, sedentary behavior, and rising obesity, while rural populations retain protective factors such as fiber-rich diets and regular physical activity but encounter hydration, irregular eating, and context-specific alcohol-related risks. Women, particularly in urban areas, exhibit heightened vulnerability due to hormonal and metabolic influences. These findings highlight the need for nuanced, context-aware public health strategies that promote healthier diets, active living, adequate hydration, regular meal patterns, and gender-sensitive approaches to gallbladder health. By addressing these determinants through scalable prevention programs, health systems can mitigate the rising burden of gallstone disease across both urban and rural populations.The study demonstrates that gallbladder stone disease is influenced by a complex interplay of lifestyle, dietary, occupational, and environmental factors. Urban populations face heightened risk due to high-fat diets, sedentary lifestyles, and obesity, while rural populations encounter distinct challenges related to hydration, irregular eating habits, and alcohol consumption. These findings reinforce the notion that modernization, with its accompanying shifts in diet and daily behavior, serves as a significant catalyst in the increasing prevalence of gallstone disease. By acknowledging and addressing these determinants through preventive health measures and structured education, it is possible to curb this emerging health challenge and promote better biliary and metabolic health across both urban and rural populations

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