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Indoor Air Pollution and Its Household Determinants in a Rural Community of Cooch Behar District, West Bengal:

A Community-Based Cross-Sectional Study

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Abstract

Background: Indoor (household) air pollution is a leading global environmental health risk and remains highly prevalent in rural India, where reliance on solid biomass fuels, suboptimal ventilation and indoor tobacco smoke coexist. Community-level data from northern West Bengal are scarce, and we found no published study on the subject from Cooch Behar district.

Objectives: To assess the status of indoor air pollution and to describe the household and behavioural determinants associated with it in a rural community of Cooch Behar district.

Methods: A community-based, descriptive cross-sectional study was conducted among 117 households (484 residents) in the rural area of Guriahati, Cooch Behar, over April 2026, using a pre-designed, pre-tested, interviewer-administered schedule covering socio-demographic, housing, fuel use-and-exposure and health domains. Households resident for more than six months that provided consent were included; locked houses and refusals were excluded. Socio-economic status was graded by the updated B.G. Prasad scale (January 2025). Data were summarised as frequencies, percentages, mean, median and range; reporting follows the STROBE statement.

Results: Most respondents had primary-level education (63.2%) and belonged to the lower-middle (41.9%) or middle (29.9%) socio-economic class. Liquefied petroleum gas (LPG) was the main cooking fuel in 71.8% of households, yet 27.0% still used biomass exclusively or in combination; visible cracks/slits in the kitchen (67.5%), absent chimney/exhaust (63.2%), absent cross-ventilation (72.6%), overcrowding (61.5%) and wall dampness/mould (48.7%) were common. Indoor smoking occurred in 31.6% of households. Respiratory symptoms were reported by 29.9% and eye/skin/headache irritation by 45.3%; 13.7% reported a gritty ocular sensation while cooking, and 26.5% reported illness in the preceding two weeks.

Conclusion: Despite predominant LPG adoption, fuel stacking, poor kitchen ventilation, structural deficiencies and indoor smoking sustain a substantial indoor air pollution burden, mirrored by a high prevalence of respiratory and irritative symptoms. Programmes promoting exclusive clean-fuel use, improved kitchen design and ventilation, and reduction of indoor smoking are warranted.

INTRODUCTION

Indoor air pollution (IAP), also termed household air pollution, refers to the contamination of air within enclosed living spaces by physical, chemical and biological pollutants — smoke from solid-

Keywords: Biomass, cooking, household air pollution, respiratory symptom, ventilation



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-fuel combustion, environmental tobacco smoke, household chemicals, and biological agents such as moulds and dust mites. Worldwide, around 2.1 billion people still cook using open fires or inefficient stoves fuelled by biomass (wood, animal dung and crop waste), coal or kerosene, generating health-damaging fine particulate matter; household air pollution was responsible for an estimated 2.9 million deaths and about 95 million disability-adjusted life-years in 2021, including over 309 000 deaths among children younger than five years.¹ The exposure is causally linked to ischaemic heart disease, stroke, chronic obstructive pulmonary disease (COPD), lower respiratory infection and lung cancer,^{1,2} and more than a quarter of lower-respiratory-infection deaths among children aged 5–14 years are attributable to it;³ women and young children, who spend the most time near the domestic hearth, bear the greatest burden.^{1,4}

In India, the determinants of IAP — widespread biomass use, poorly ventilated dwellings, traditional cooking practices and low socio-economic position — remain entrenched in rural and peri-urban settings. According to the National Family Health Survey (NFHS-5, 2019–21), only 58.6% of Indian households use a clean cooking fuel, and this falls to approximately 43% in rural areas, where the majority of households continue to rely on solid biomass.⁵ Despite the Pradhan Mantri Ujjwala Yojana (PMUY), launched in 2016 to extend subsidised LPG connections to economically disadvantaged households,⁶ ground-level transition is incomplete: “fuel stacking” (concurrent use of LPG and biomass) is common, and even among LPG-owning households a large proportion continue to burn firewood.⁷ The net effect is sustained exposure to indoor combustion products in precisely those communities least able to mitigate it.

At the regional level, studies from West Bengal have documented high indoor particulate concentrations and a heavy symptom burden among women cooking with biomass — for example, micro-environmental monitoring in rural Medinipur–Jhargram kitchens recorded PM_{2.5} levels reaching 565 µg/m³, with eye irritation, breathlessness and cough widely reported,⁸ while biomass-using tribal women in western West Bengal showed significantly elevated odds of runny nose, wheezing, breathlessness and lung-function abnormality.⁹ Comparable community studies elsewhere in India reported biomass use in 72.5% of rural households in coastal Karnataka¹⁰ and solid-fuel use in 51% of never-smoking women in Odisha.¹¹ However, the northern districts of West Bengal remain under-studied, and we did not find any published research describing the status and determinants of indoor air pollution at the household level in Cooch Behar district. Locally grounded data are needed to inform district health planning and clean-fuel promotion.

MATERIALS AND METHODS

Study design, place and duration: A community-based, descriptive cross-sectional study was carried out at the household level in the rural area of Guriahati (PIN 736101), Cooch Behar district, West Bengal, India, over a four-week period during April 2026 (9–30 April). Cooch Behar is a predominantly rural district in northern West Bengal; the selected area is served by the field-practice area of the Department of Community Medicine, Maharaja Jitendra Narayan (MJN) Medical College and Hospital, Cooch Behar.

Study population, sample size and sampling technique:

The study population comprised all households resident in the selected area, with the head of the family and the primary cook serving as respondents. Respondents residing in the area for more than six months and providing informed consent were included; locked houses encountered during the visit and households declining consent were excluded. A total of 117 households, comprising 484 residents, were studied. As the survey was undertaken as a time-bound community posting, a convenience (non-probability) sampling technique was used: each trained investigator enrolled at least ten contiguous, eligible and consenting households until the target was reached.

A formal a-priori sample-size calculation was not performed for this descriptive exercise. For transparency, a post-hoc precision estimate indicates that, for the observed respiratory-symptom prevalence of 29.9%, a sample of 117 households yields an absolute precision (half-width of the 95% confidence interval) of approximately ±8.3%, which is adequate for describing the principal indicators reported here. The non-probability design is acknowledged as a limitation (*see Limitations*).

Tools and techniques – Data collection: Data were collected by trained medical students through face-to-face interviews using a pre-designed, pre-tested, structured schedule. The schedule captured four domains:

- (A) background and socio-demographic features (type of family, religion, education and occupation of the head of family, family income and family size);
- (B) housing and environmental characteristics (type of house, number of rooms, separate kitchen, overcrowding, ventilation, visible cracks/slits in the kitchen, cross-ventilation and chimney/exhaust);
- (C) indoor-air-pollution-related chemical and biological triggers (cooking-stove and main fuel type, duration of cooking, source of light while cooking, use of incense/mosquito repellents, indoor smoking and its duration and quantity, presence and type of pets, wall dampness/mould, window practice during cooking, and the window-to-stove gap); and
- (D) medical history and additional clinical aspects (chronic disease, respiratory symptoms, eye/skin/headache irritation, daily cough/wheeze, condition of nose and throat, illness in the preceding two weeks, nausea/vomiting and gritty ocular sensation while cooking). Per-capita monthly income was used to assign socio-economic status using the updated B.G. Prasad scale (January 2025; CPI-IW = 143.2).¹²

Data management and analysis: Responses were entered and compiled in Microsoft Excel and analysed using standard statistical software. Categorical variables were summarised as frequencies and percentages (reported to one decimal place); the continuous variable (family size) was summarised as mean, median and range. Relationships between exposures and the self-reported health profile are therefore described narratively rather than inferentially, and association testing is identified as a priority for future work.



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Ethical Consideration

Written informed consent was obtained from each participating respondent. Confidentiality and anonymity of the participants were maintained throughout, and the data were used solely for the stated research purpose.

RESULTS

Background characteristics

The 117 study households comprised 484 residents. The mean family size was 4.14 members (median 4; range 2–12), consistent with national household-size estimates. The majority of respondents were engaged in moderate occupational activity (84.6%), with heavy and sedentary work each accounting for 7.7%. Primary-level education predominated (63.2%), while illiteracy and secondary education were equally represented (12.0% each); only 7.7% and 5.1% had attained higher-secondary and graduate levels, respectively. Hindus constituted 59.0% and Muslims 41.0% of the sample, and nuclear families predominated (72.6%). On the updated B.G. Prasad scale, most households belonged to the lower-middle (Class IV, 41.9%) and middle (Class III, 29.9%) classes, followed by upper-middle (Class II, 23.9%); the upper class (Class I) accounted for 0.9% and the residual lower class (Class V) for 3.4% (Table 1).

Housing and environmental conditions

Nearly half of the population lived in pucca houses (48.7%), while katcha-pucca (41.9%) and katcha (9.4%) dwellings made up the remainder. A separate kitchen was present in 53.0% of households, but 47.0% lacked this facility. Overcrowding was highly prevalent, affecting 61.5% of households. Ventilation was suboptimal: 46.2% relied on natural ventilation alone, 37.6% on artificial/mechanical means and 16.2% on both; cross-ventilation was absent in 72.6%, and 63.2% had no chimney or exhaust system (Table 2).

Fuel use and indoor-air-pollution exposure

Liquefied petroleum gas (LPG) was the principal cooking fuel in 71.8% of households; firewood was the main fuel in 17.9%, with smaller proportions reporting LPG-and-biomass (6.0%), LPG-and-firewood (3.4%) and electricity (0.9%). When the cooking arrangement was examined, 65.0% used an LPG stove only, while 23.1% combined LPG with biomass and 11.1% used biomass alone, indicating that 27.0% of households still relied on biomass exclusively or in combination. Cooking lasted 2–3 hours daily in 61.5% of households and exceeded three hours in 38.4%. Visible cracks or slits in the kitchen were present in 67.5% of households, wall dampness or mould in 48.7%, and an adequate (≥ 2 ft) window-to-stove gap was absent in 51.3%. Although 82.9% kept a window open while cooking, indoor smoking was reported in 31.6% of households (Table 3).

Respiratory and general health profile

Respiratory symptoms were reported in 29.9% of households and eye/skin/headache irritation in 45.3%. Daily cough and/or wheezing affected 16.2%, with an additional 2.6% reporting cough alone. A runny nose was noted in 17.9% and a dry/irritated throat in 6.8%, while most respondents had a normal nose (82.1%) and throat (88.9%). A

chronic disease in the family was reported by 26.5%, and illness in the preceding two weeks by 26.5% — most commonly fever/cough/cold (17.1%), followed by loose motion (6.0%) and skin problems (2.6%). Nausea/vomiting was uncommon (6.0%), whereas a gritty ocular sensation while cooking was reported by 13.7% (Table 4).

DISCUSSION

This community-based cross-sectional study describes the status and household determinants of indoor air pollution, and the accompanying self-reported health profile, in a rural community of Cooch Behar district — a setting for which we found no previously published data. The principal observations were a high but incomplete transition to LPG with persistent biomass “fuel stacking”, widespread structural and ventilation deficiencies, frequent wall dampness and indoor smoking, and a substantial burden of respiratory and irritative symptoms.

Fuel use and fuel stacking: LPG was the main fuel in 71.8% of households, yet 27.0% continued to use biomass exclusively or in combination. Clean-fuel uptake here is considerably higher than the ~43% reported for rural India in NFHS-5,⁵ and biomass reliance (27.0%) is lower than that reported among rural women in Udupi, Karnataka (72.5%, mostly combined with LPG)¹⁰ and never-smoking women in Odisha (51% exclusive solid fuel).¹¹ The persistence of biomass even where LPG is available echoes the analysis of forest-fringe households in central India by Khanwilkar et al, in which roughly 90% of LPG-owning households continued to use firewood,⁷ and the West Bengal micro-environmental work of Bisui et al., which linked traditional fuels to markedly higher PM_{2.5} and carbon-monoxide levels.⁸

Respiratory symptom burden. Respiratory symptoms were reported by 29.9% of households, with daily cough/wheeze in 16.2%. Direct comparison is constrained because denominators and case definitions differ across studies (household-level self-report here versus individual women or spirometry-based diagnoses elsewhere). Nonetheless, the burden is in line with the higher symptom prevalence reported in rural relative to urban communities by Hossain and Niloy,¹³ and lower than the symptom and lung-function abnormality rates seen specifically among biomass-exposed women: James et al. reported a respiratory odds ratio of about 5.0 for biomass exposure in southern India,¹⁰ and Mitra et al. found significantly elevated odds of wheezing, breathlessness and lung abnormality among biomass-using tribal women in West Bengal.⁹ At the level of pooled evidence, systematic reviews and meta-analyses confirm a consistent association of solid-fuel smoke with COPD and chronic bronchitis (Kurmi et al.: COPD odds ratio 2.80, chronic bronchitis 2.32)¹⁴ and with COPD in women specifically;¹⁵ even partial reduction of biomass use has been associated with better respiratory health in central India,¹⁶ and biomass exposure adversely affects respiratory indices in pregnancy.¹⁷ That our community-wide estimate is lower than these biomass-specific figures is expected given predominant LPG use, and reinforces clean-fuel transition as the central preventive lever.^{4,14}



Irritative and ocular symptoms: Irritation of the eye, skin or head was reported by 45.3% of households, and 13.7% described a gritty ocular sensation while cooking. These findings align closely with the West Bengal monitoring study of Bisui et al., in which eye irritation was the most prevalent symptom across all fuel types,⁸ and with James et al., who reported a significant association between biomass exposure and self-reported ophthalmic symptoms (adjusted odds ratio 3.85).¹⁰ The pattern suggests that even households that have largely transitioned to LPG experience acute mucosal irritation attributable to residual combustion, incense/repellent use and indoor smoking, and that ocular symptoms are a sensitive, easily elicited marker of indoor exposure in community surveys.

Kitchen structure and ventilation: Absent cross-ventilation (72.6%), absent chimney/exhaust (63.2%), absence of a separate kitchen (47.0%), overcrowding (61.5%) and an inadequate window-to-stove gap (51.3%) were common. These structural determinants are precisely those shown to govern indoor-pollutant concentrations: in rural Delhi-NCR, households cooking without a separate, well-ventilated kitchen had significantly higher particulate matter and a higher proportion of women with chronic respiratory symptoms (13.0% versus 3.1%),¹⁸ and in Telangana, indoor kitchens without partition produced respiratory-tract pollutant dosages up to 10.6 times those of outdoor kitchens using the same fuel.¹⁹ Our findings therefore indicate that, independent of fuel type, kitchen design and ventilation are modifiable determinants of exposure in this community, and that improved stove placement, chimneys/exhausts and cross-ventilation could yield measurable benefit.⁴

Dampness, mould and biological triggers: Wall dampness or mould was present in 48.7% of households. Although distinct from combustion-related pollution, indoor dampness and mould are independently associated with respiratory morbidity: meta-analyses report increased risks of developing asthma (summary effect estimates of roughly 1.3–1.7 for dampness, visible mould and mould odour),²⁰ heightened asthma exacerbation with higher indoor fungal concentrations,²¹ and a weak-to-moderate increase in respiratory-tract infections in children (odds ratios 1.28–1.76).²² The high prevalence of dampness alongside structural cracks/slits (67.5%) suggests that biological triggers compound combustion-related exposure in nearly half of the households studied and should be addressed jointly in any housing-improvement effort.

Indoor tobacco smoke: An indoor smoker was present in 31.6% of households. Environmental tobacco smoke is itself a major source of indoor fine particulate matter, and its co-occurrence with biomass smoke is of particular concern because the two exposures may act together on the respiratory tract; biomass smoke has additionally been associated with an elevated risk of pulmonary tuberculosis in northern India (adjusted odds ratio 3.14)²³ and impaired lung function among exposed women.²⁴ The coexistence of indoor smoking with residual biomass use in this community identifies a combined, potentially synergistic exposure that behavioural interventions — promoting smoke-free homes — could mitigate at low cost.

Socio-economic and educational gradient: The community was predominantly lower-middle class (Class IV, 41.9%) with low educa-

tional attainment (the majority having primary-level schooling or less). Socio-economic and educational position are recognised upstream determinants of clean-fuel adoption and exposure: James et al. found that biomass exposure was significantly associated with lower literacy, occupation and socio-economic status ($p < 0.001$),¹⁰ and the national LPG-adoption analysis showed the lowest clean-fuel use among the poorest and least-educated groups.⁷ These gradients indicate that fuel and ventilation interventions in this setting must be coupled with financial support and targeted health education to be equitable and effective.

STRENGTHS

The study addresses a genuine geographical evidence gap by providing the first household-level description of indoor air pollution and its determinants from rural Cooch Behar. Its community-based design, direct interviewer-administered data collection by trained personnel using a pre-tested schedule, and comprehensive coverage of socio-demographic, structural, fuel-related, behavioural and health domains allow a holistic characterisation of exposure in a real-world setting. Reporting follows the STROBE guideline,²⁵ and all tabulated frequencies have been internally reconciled against the total sample.

LIMITATIONS

First, the convenience (non-probability) sampling and single-area design limit generalisability beyond the study community. Second, the cross-sectional design precludes causal inference between exposures and symptoms. Third, exposure and outcome data were self-reported and based on a single household respondent, introducing potential recall and information bias and possible misclassification; no objective measurements of indoor particulate matter, carbon monoxide or spirometry were undertaken, which would have strengthened exposure-response assessment. Fourth, the study was descriptive: formal tests of association and multivariable adjustment were not performed, so the determinants are described rather than statistically confirmed.

CONCLUSION

Indoor air pollution remains a relevant public-health concern in this rural lower-middle-socio-economic community of Cooch Behar district. Although LPG is now the predominant cooking fuel, persistent biomass fuel stacking, poor kitchen ventilation and structural design, frequent wall dampness and indoor tobacco smoking together sustain appreciable exposure, mirrored by a high prevalence of respiratory and irritative symptoms. Promotion of exclusive use of clean fuels (reinforcing PMUY uptake and refills), support low-cost improvements in kitchen ventilation and stove placement, address housing dampness, and encourage smoke-free homes are needed.

CONFLICT OF INTEREST

None Declared

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This study received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.



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Table 1. Socio-demographic characteristics of the study households (N = 117)

Variable	Category	Frequency (%)
Occupation (head of family)	Moderate	99 (84.6)
	Heavy	9 (7.7)
	Sedentary	9 (7.7)
Education	Illiterate	14 (12.0)
	Primary	74 (63.2)
	Secondary	14 (12.0)
	Higher secondary	9 (7.7)
	Graduate	6 (5.1)
Religion	Hindu	69 (59.0)
	Muslim	48 (41.0)
Type of family	Nuclear	85 (72.6)
	Joint	32 (27.4)
Socio-economic class*	I – Upper (≥ 9414)	1 (0.9)
(B.G. Prasad, Jan 2025)	II – Upper middle (4707–9413)	28 (23.9)
	III – Middle (2824–4706)	35 (29.9)
	IV – Lower middle (1412–2823)	49 (41.9)
	V – Lower (< 1412)†	4 (3.4)

*Note: Percentages are of N = 117 and may not total 100.0 owing to rounding. *Socio-economic class graded by the updated B.G. Prasad scale (January 2025; CPI-IW = 143.2; correction factor = 94.14); income limits are per-capita monthly income in Indian Rupees (₹).¹² †The original tabulation classified 113 households into Classes I–IV; the remaining 4 households (3.4%) are shown here as the residual Class V (Lower) so that the column totals 117 — this row should be verified against the raw income data. CPI –IW, Consumer Price Index for Industrial Workers.*

Inference: The community is predominantly lower-middle socio-economic in status with low educational attainment and a nuclear -family structure — a profile associated with limited capacity to adopt and sustain clean-fuel and ventilation improvements.

Table 2. Housing and environmental characteristics (N = 117)

Variable	Category	Frequency (%)
Type of house	Katcha	11 (9.4)
	Pucca	57 (48.7)
	Katcha-pucca	49 (41.9)
Separate kitchen	Yes	62 (53.0)
	No	55 (47.0)
Overcrowding	Yes	72 (61.5)
	No	45 (38.5)
Ventilation	Natural	54 (46.2)
	Artificial/mechanical	44 (37.6)
	Both	19 (16.2)
Cross-ventilation	Absent	85 (72.6)
	Present	32 (27.4)
Chimney/exhaust	Absent	74 (63.2)
	Present	43 (36.8)

Note: Percentages are of N = 117. Overcrowding defined per standard norms of persons per room.

Inference: Structural and ventilation deficiencies — absent cross-ventilation in nearly three-quarters of homes, no chimney/exhaust in nearly two-thirds, and overcrowding in over three-fifths — favour the accumulation and retention of indoor combustion products.

Table 3. Cooking fuel, kitchen environment and indoor-pollution exposure (N = 117)

Variable	Category	Frequency (%)
Main cooking fuel	LPG	84 (71.8)
	Firewood	21 (17.9)
	LPG + biomass	7 (6.0)
	LPG + firewood	4 (3.4)
	Electricity	1 (0.9)
Cooking arrangement	LPG stove only	76 (65.0)
	LPG + biomass	27 (23.1)
	Biomass only	13 (11.1)
	Induction	1 (0.9)
Duration of cooking	2–3 h	72 (61.5)
	3–4 h	35 (29.9)
	> 4 h	10 (8.5)
Light source while cooking	Artificial	52 (44.4)
	Natural	46 (39.3)
	Both	19 (16.2)
Indoor smoker present	No	80 (68.4)
	Yes	37 (31.6)
Amount smoked indoors/day	None	80 (68.4)
	< 1 packet	8 (6.8)
	1–2 packets	23 (19.7)
	> 2 packets	6 (5.1)
Duration of indoor smoking‡	None	88 (75.2)
	0.5 h	22 (18.8)
	1 h	7 (6.0)
Visible cracks/slits in kitchen	Yes	79 (67.5)
	No	38 (32.5)
Wall dampness/mould	Present	57 (48.7)
	Absent	60 (51.3)
Window open while cooking	Open	97 (82.9)
	Closed	12 (10.3)
	Not applicable	8 (6.8)
Window-to-stove gap ≥ 2 ft	Present	49 (41.9)
	Absent	60 (51.3)
	Not applicable	8 (6.8)
Pets present	No	98 (83.8)
	Yes	19 (16.2)
Pet species (among 19)§	Cat	6 (5.1)
	Hen	3 (2.6)
	Pigeon	2 (1.7)
	Not specified	8 (6.8)

Note: Percentages are of N = 117. LPG, liquefied petroleum gas. ‡Duration was recorded for 29 of the 37 households reporting an indoor smoker; the remaining 8 are included under “None”, and this discrepancy with the smoker count (37) should be reconciled against the raw data. §Species was specified for 11 of the 19 pet-owning households; the schedule listed cat/dog, and the 8 “not specified” entries require verification.

Inference: LPG predominates, yet biomass persists in about one-quarter of kitchens (fuel stacking), and this is compounded by structural defects, inadequate stove–window spacing, wall dampness and indoor smoking — a constellation that maintains appreciable indoor-pollutant exposure despite high reported window-opening.

Table 4. Self-reported respiratory and general health profile (N = 117)

Variable	Category	Frequency (%)
Chronic disease in family	No	86 (73.5)
	Yes	31 (26.5)
Respiratory symptom	No	82 (70.1)
	Yes	35 (29.9)
Irritation (eye/skin/headache)	Yes	53 (45.3)
	No	64 (54.7)
Daily cough/wheeze	No	95 (81.2)
	Cough and/or wheeze	19 (16.2)
	Cough only	3 (2.6)
Condition of nose	Normal	96 (82.1)
	Runny	21 (17.9)
Condition of throat	Normal	104 (88.9)
	Dry/irritation	8 (6.8)
	Seasonal	5 (4.3)
Illness in past 2 weeks	No	86 (73.5)
	Yes	31 (26.5)
Type of recent illness	Fever/cough/cold	20 (17.1)
	Loose motion	7 (6.0)
	Skin problem	3 (2.6)
	Loose motion + skin	1 (0.9)
Nausea/vomiting	No	110 (94.0)
	Yes	7 (6.0)
Gritty sensation in eyes while cooking	Yes	16 (13.7)
	No	101 (86.3)

Note: Percentages are of N = 117. ¶“Type of recent illness” is a breakdown of the 31 households (26.5%) reporting illness in the preceding two weeks; the four sub-categories therefore sum to 31, and percentages are expressed of the total 117.

Inference: Nearly one-third of households reported respiratory symptoms and almost half reported irritative symptoms, with ocular grittiness during cooking in one in seven — a symptom pattern consistent with ongoing exposure to indoor combustion products and irritant gases.



REFERENCES

- World Health Organization. Household air pollution. Fact sheet. Geneva: WHO; 16 December 2025. Available from: <https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health> (accessed 24 June 2026).
- GBD 2021 Diseases and Injuries Collaborators. Global incidence, prevalence, years lived with disability (YLDs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990-2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet*. 2024;403(10440):2133-61. doi:10.1016/S0140-6736(24)00757-8.
- GBD 2019 Lower Respiratory Infections Collaborators. Age-sex differences in the global burden of lower respiratory infections and risk factors, 1990-2019: results from the Global Burden of Disease Study 2019. *Lancet Infect Dis*. 2022;22(11):1626-47. doi:10.1016/S1473-3099(22)00510-2.
- Bruce N, Perez-Padilla R, Albalak R. Indoor air pollution in developing countries: a major environmental and public health challenge. *Bull World Health Organ*. 2000;78(9):1078-92.
- International Institute for Population Sciences (IIPS) and ICF. National Family Health Survey (NFHS-5), 2019-21: India. Mumbai: IIPS; 2021.
- Ministry of Petroleum and Natural Gas, Government of India. Pradhan Mantri Ujjwala Yojana (PMUY). New Delhi: MoPNG; 2016. Available from: <https://www.pmuy.gov.in> (accessed 24 June 2026).
- Khanwilkar S, Gould CF, DeFries R, Habib B, Urpelainen J. Firewood, forests, and fringe populations: exploring the inequitable socioeconomic dimensions of Liquefied Petroleum Gas (LPG) adoption in India. *Energy Res Soc Sci*. 2021;75:102012. doi:10.1016/j.erss.2021.102012.
- Bisui S, Hasanuzzaman M, Sing J, Midya S, Shit PK. Exploring the cooking energy biomass and its impact on women's health and quality of life in rural households: a micro-environmental study from West Bengal in India. *Environ Monit Assess*. 2024;196(12):1184. doi:10.1007/s10661-024-13335-1.
- Mitra P, Chakraborty D, Nayek S, Kundu S, Mishra D, Dan U, et al. Biomass using tribal women exhibited respiratory symptoms, hypertensive risks and abnormal pulmonary function. *Chemosphere*. 2023;311(Pt 1):136995. doi:10.1016/j.chemosphere.2022.136995.
- James BS, Shetty RS, Kamath A, Shetty A. Household cooking fuel use and its health effects among rural women in southern India - a cross-sectional study. *PLoS One*. 2020;15(4):e0231757. doi:10.1371/journal.pone.0231757.
- Panigrahi A, Padhi BK. Chronic bronchitis and airflow obstruction is associated with household cooking fuel use among never-smoking women: a community-based cross-sectional study in Odisha, India. *BMC Public Health*. 2018;18(1):924. doi:10.1186/s12889-018-5846-2.
- Anand A, Mandal I, Hossain S. B.G. Prasad scale 2025: an updated framework for socioeconomic assessment in India. *Natl J Community Med*. 2025;16(5):555-8.
- Hossain I, Niloy LT. Indoor air pollution and respiratory symptoms among residents in urban and rural community. *Med Res Arch*. 2025;13(5). doi:10.18103/mra.v13i5.6305.
- Kurmi OP, Semple S, Simkhada P, Smith WCS, Ayres JG. COPD and chronic bronchitis risk of indoor air pollution from solid fuel: a systematic review and meta-analysis. *Thorax*. 2010;65(3):221-8. doi:10.1136/thx.2009.124644.
- Kamal R, Srivastava AK, Kesavachandran CN, Bihari V, Singh A. Chronic obstructive pulmonary disease (COPD) in women due to indoor biomass burning: a meta analysis. *Int J Environ Health Res*. 2022;32(6):1403-17. doi:10.1080/09603123.2021.1887460.
- Sukhsahle ND, Narlawar UW, Ughade SN, Kulkarni H. Even partial reduction of biomass fuel use may improve the respiratory health of rural women in Central India. *Int J Tuberc Lung Dis*. 2012;16(3):423-5. doi:10.5588/ijtld.11.0621.
- Parikh R, Rao SR, Kukde R, O'Connor GT, Patel A, Hibberd PL. Assessing the respiratory effects of air pollution from biomass cookstoves on pregnant women in rural India. *Int J Environ Res Public Health*. 2021;18(1):183. doi:10.3390/ijerph18010183.
- Kumar R, Singh K, Nagar S, Kumar M, Mehto UK, Rai G, et al. Pollutant levels at cooking place and their association with respiratory symptoms in women in a rural area of Delhi-NCR. *Indian J Chest Dis Allied Sci*. 2015;57(4):225-31.
- Deepthi Y, Shiva Nagendra SM, Gummadi SN. Characteristics of indoor air pollution and estimation of respiratory dosage under varied fuel-type and kitchen-type in the rural areas of Telangana state in India. *Sci Total Environ*. 2019;650(Pt 1):616-25. doi:10.1016/j.scitotenv.2018.08.381.
- Quansah R, Jaakkola MS, Hugg TT, Heikkinen SAM, Jaakkola JJK. Residential dampness and molds and the risk of developing asthma: a systematic review and meta-analysis. *PLoS One*. 2012;7(11):e47526. doi:10.1371/journal.pone.0047526.
- Sharpe RA, Bearman N, Thornton CR, Husk K, Osborne NJ. Indoor fungal diversity and asthma: a meta-analysis and systematic review of risk factors. *J Allergy Clin Immunol*. 2015;135(1):110-22. doi:10.1016/j.jaci.2014.07.002.
- Groot J, Nielsen ET, Nielsen TF, Andersen PK, Pedersen M, Sigsgaard T, et al. Exposure to residential mold and dampness and the associations with respiratory tract infections and symptoms thereof in children in high income countries: a systematic review and meta-analyses of epidemiological studies. *Paediatr Respir Rev*. 2023;48:47-64. doi:10.1016/j.prrv.2023.06.003.





23. Lakshmi PVM, Viridi NK, Thakur JS, Smith KR, Bates MN, Kumar R. Biomass fuel and risk of tuberculosis: a case-control study from Northern India. *J Epidemiol Community Health*. 2012;66(5):457-61. doi:10.1136/jech.2010.115840.
24. Bihari V, Iqbal SM, Srivastava LP, Kesavachandran C, Siddique MJA. Lung function impairment in women exposed to biomass fuels during cooking compared to cleaner fuels in Uttar Pradesh, India. *J Environ Biol*. 2013;34(6):971-4.
25. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet*. 2007;370(9596):1453-7. doi:10.1016/S0140-6736(07)61602-X.



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