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# Housing Characteristics, Household Environmental Exposures, and Respiratory Morbidity Among Adults in Ibadan, Southwest Nigeria

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**Abstract**

**Background:** Housing conditions and household activities can influence respiratory health through ventilation, moisture, smoke, crowding, and other residential exposures. This study examined housing characteristics and occupant activities associated with respiratory morbidity among adults in Ibadan, Nigeria.

**Methods:** A cross-sectional study included 215 adults in Ibadan South-West Local Government Area. An interviewer-administered questionnaire adapted from the European Community Respiratory Health Survey and a housing walkthrough checklist were used to assess housing conditions, household exposures, occupant activities, and self-reported respiratory morbidity. Associations were examined using chi-square tests and logistic regression.

**Results:** Overall, 134 participants (62.3%) had respiratory morbidity. Eighteen percent of households lacked proper ventilation, 17.2% reported outdoor smoke, 23.3% reported dampness, 74.9% reported dust, and 17.7% were overcrowded. Respiratory morbidity was more frequent among urban than rural residents (70.4% vs. 54.2%, $p = .014$), among those reporting outdoor smoke (78.4% vs. 59.0%, $p = .027$), and varied by indoor clothes-drying frequency ($p = .001$). Wall, roof, and floor materials, cooking fuel, overcrowding, and cooking location were not significantly associated with respiratory morbidity. Multivariable estimates were imprecise and their confidence intervals included the null.

**Conclusion:** Selected residential exposures and household practices were associated with respiratory morbidity in bivariate analyses, but independent associations were not clearly demonstrated. Improving ventilation, moisture control, and smoke exposure prevention remains relevant to healthy housing.

**Keywords:** Housing Conditions, Respiratory Morbidity, Dampness, Ventilation, Household Exposures, Indoor Clothes Drying, Nigeria

## 1. Introduction

Housing is a major social and environmental determinant of health because the dwelling influences exposure to physical, chemical, biological, and behavioural hazards. The World Health Organization (WHO, 2018) [7] identifies healthy housing as housing that protects occupants from crowding, unsafe temperatures, poor indoor air quality, dampness, mould, injury hazards, and other conditions that can impair health. Respiratory health is particularly sensitive to the residential environment because people spend substantial time indoors and may be repeatedly exposed to pollutants and moisture generated within the home or entering from outside. Poor housing can therefore contribute to both infectious and non-communicable respiratory conditions through multiple, interacting pathways rather than a single exposure.

Several housing characteristics are relevant to respiratory morbidity. Inadequate ventilation can allow smoke, particles, moisture, and other contaminants to accumulate indoors, while dampness and water intrusion can promote mould and microbial growth. Crowding may increase opportunities for transmission of respiratory infections and can also increase indoor moisture and pollutant generation. Housing materials, condition of repair, number and placement of windows, cooking location, and proximity to outdoor pollution sources may further influence exposure. A systematic review of 360 studies identified poor indoor air quality, particularly in relation to inadequate ventilation, as a major housing-related respiratory risk and highlighted structural, non-structural, indoor-pollution, and outdoor-environment pathways (Wimalasena *et al*., 2021) [6]. A subsequent scoping review of housing typologies and asthma similarly identified ventilation, building materials, housing age and condition, crowding, appliances, urban density, and environmental pollutants as relevant housing characteristics (Howard *et al*., 2023) [3].

Moisture-related housing conditions are of particular concern. Dampness can arise from structural defects, leaks, inadequate ventilation, or moisture-generating activities within the home. Persistent dampness may support mould, microbial growth, and dust mites, all of which can contribute to respiratory symptoms. Recent evidence continues to support the respiratory relevance of damp and mould. Clark *et al*. (2023) [1] described a measurable burden of asthma and lower respiratory infection associated with residential dampness and mould, while WHO guidance emphasizes prevention and remediation of persistent dampness and microbial growth (WHO, 2018) [7]. Occupant activities may interact with these structural conditions. Cooking, washing, bathing, and drying clothes indoors generate moisture; when ventilation is limited, these activities can contribute to condensation and dampness. Thus, respiratory risk may reflect the combined effects of the building and the way occupants use the dwelling.

Household combustion and smoke exposures provide another important pathway. Polluting fuels and inefficient combustion can generate particulate matter, carbon monoxide, and other respiratory irritants, while tobacco smoke and infiltration of outdoor smoke can add to the indoor pollutant burden. Although the transition to cleaner cooking fuels is increasing in many settings, household air pollution remains an important respiratory-health problem across Africa. Jafta *et al*. (2025) [4] noted that African evidence remains comparatively limited despite persistent household exposure and a substantial burden of acute and chronic respiratory disease. Importantly, exposure within a household is not determined by fuel type alone: cooking location, ventilation, time spent near the cooking area, smoking, and neighbourhood pollution can alter the intensity and duration of exposure.

The relationship between housing and respiratory health is also shaped by rapid urbanisation. Urban growth can increase demand for affordable housing and contribute to overcrowded or poorly serviced residential environments. At the same time, urban residents may experience greater exposure to road traffic, commercial activity, waste burning, and other outdoor sources that penetrate homes. In Nigeria, these issues occur within a housing system marked by wide variation in dwelling quality, infrastructure, sanitation, ventilation, and access to clean household energy. A recent study of urban slum residents in Enugu documented persistent substandard housing conditions despite awareness of their health implications (Ogbonna *et al*., 2024) [5]. Such findings underscore the need for locally generated evidence that considers both structural housing characteristics and everyday household practices.

Nigerian evidence also supports concern about dampness and respiratory health. In Ibadan, Fakunle *et al*. (2023) [2] found that objectively assessed residential dampness and mould damage were associated with increased odds of severe lower respiratory tract infection among children younger than five years. Although that study focused on children, it demonstrates the relevance of moisture-related housing exposures in the same urban context. Adult residents may have different patterns of exposure because of occupation, smoking, domestic activities, and time spent in different parts of the home. Evidence focusing specifically on adults and examining multiple housing characteristics and occupant behaviours together remains limited.

Housing-related respiratory risk is also shaped by how occupants use available space. Overcrowding can increase person-to-person exposure to respiratory infections and may intensify indoor moisture generation, while cooking in enclosed spaces and smoking can add combustion products to the indoor environment. Moisture-producing activities such as indoor clothes drying may become more important where natural ventilation is limited or outdoor drying is impractical. These interactions mean that a dwelling with apparently acceptable construction materials may still provide an unhealthy indoor environment if airflow, moisture control, or household practices are suboptimal. Conversely, structural deficiencies may magnify otherwise routine household activities. Recent housing research therefore increasingly treats respiratory risk as the product of dwelling features, occupancy patterns, and neighbourhood exposures rather than a single housing attribute (Howard *et al*., 2023; Wimalasena *et al*., 2021) [3, 6].

Understanding these relationships is important for environmental health practice because many housing-related exposures are potentially modifiable. Improved ventilation, control of water intrusion and indoor moisture, reduced exposure to indoor and outdoor smoke, safer cooking arrangements, and healthier household practices are practical targets for prevention. However, interventions should be guided by evidence from the local setting rather than assuming that associations observed elsewhere operate identically in Nigerian communities. Cross-sectional household studies cannot establish causality, but they can identify prevalent housing conditions, describe behavioural exposures, and highlight factors that merit closer investigation.

This study therefore assessed housing characteristics, household environmental exposures, and occupant activities among adult residents of Ibadan South-West Local Government Area, Nigeria, and examined their associations with self-reported respiratory morbidity. The analysis focused on the housing and behavioural components of the broader study, distinct from the objective indoor air-quality monitoring reported separately.

## 2. Materials and Methods

### Study Area and Design

A descriptive cross-sectional study was conducted in Ibadan South-West Local Government Area (LGA), Oyo State, Nigeria. The LGA is part of the Ibadan metropolis and comprises 12 wards. The study covered residential locations including Oluyole Estate, Odo-Ona, Oke-Bola, Oke-Ado, Iyagankun GRA, Ring Road, Gege, Foko, Born Photo, Joyce B, Agbokojo, and Imalefalafia.

### Study Population and Sampling

The study population comprised adult residents aged 18 years and older living in residential buildings within the study area. Adults residing outside the study area, persons living in buildings not primarily used for residential purposes, and those unable to provide informed consent were excluded. Residential buildings were selected by simple random sampling using a ballot procedure. The head of household was approached for participation; where the head was unavailable, an eligible adult resident was selected. The analytical dataset contained 215 participants.

**Data Collection**

Data were collected using a semi-structured interviewer-administered questionnaire and a walkthrough housing checklist. The questionnaire was adapted from the European Community Respiratory Health Survey and covered sociodemographic characteristics, housing characteristics, occupant activities, and respiratory health. The walkthrough checklist documented housing structure, energy sources and uses, and environmental conditions.

**Housing and Household Exposures**

Housing variables included dwelling type, wall, roof and floor materials, ventilation, number of rooms and bedroom windows, presence of an indoor kitchen, dampness, sanitation and water characteristics, cooking fuel, and cooking location. Household environmental experiences included stale air, odour, indoor and outdoor smoke, dampness, dust particles, and pests. Occupant activities included time spent in the cooking area, current smoking, presence of another smoker in the home, dusting practices, dusty or smoky work, indoor clothes drying, and overcrowding. Overcrowding was defined in the thesis as three or more people per room. For regression analyses, the study grouped selected housing characteristics into improved and unimproved categories.

**Respiratory Morbidity**

The health section of the questionnaire asked about respiratory illness and symptoms during the previous 30 days, including coughing, wheezing, and difficulty breathing. The thesis classified participants into a binary outcome of having or not having respiratory issues. This classification is referred to as respiratory morbidity in this study.

**Statistical Analysis**

Data were analysed using STATA MP version 17. Frequencies and percentages were used to summarise categorical variables, and means with standard deviations were used for continuous variables. Pearson chi-square tests assessed associations between sociodemographic, housing, environmental, and behavioural factors and respiratory morbidity. Logistic regression was used to estimate odds ratios (ORs) and 95% confidence intervals (CIs). Model 1 included housing-related variables, while Model 2 additionally included employment status, place of residence, outdoor smoke exposure, current smoking, and indoor clothes-drying frequency. Statistical significance was set at $p < .05$.

**Ethical Considerations**

Ethical approval was obtained from the University of Ibadan/University College Hospital Research Ethics Committee. Participation was voluntary, informed consent was obtained before data collection, and confidentiality and privacy were maintained.

**3. Results**

**Participant and Housing Characteristics**

The analysis included 215 adults with a mean age of 34.9 ± 12.4 years; 134 (62.3%) were female. Urban and rural residents accounted for 50.2% and 49.8% of the sample, respectively. Overall, 134 participants (62.3%) were classified as having respiratory morbidity.

The mean household size was 3.8 ± 2.1 persons. Face-to-face houses were the most common dwelling type (38.6%), followed by compound houses (27.9%). Most dwellings had cement-block walls (87.9%), while 18.1% lacked proper ventilation and 72.1% had an indoor kitchen. Outdoor smoke was reported by 17.2% of respondents, dampness by 23.3%, and indoor dust by 74.9%. Overcrowding was reported by 17.7%. Gas was the main cooking fuel in 80.0% of households, while 11.2% used electricity, 5.6% charcoal, and 2.8% firewood. Indoor clothes drying occurred all the time in 3.7% of households, during the rainy season in 14.9%, and sometimes in 12.6%.

**Table 1:** Selected Housing, Environmental, and Occupant Characteristics

| Characteristic | n | % |
|---|---|---|
| Proper ventilation: No | 39 | 18.1 |
| Indoor kitchen: Yes | 155 | 72.1 |
| Bedroom windows: <2 | 73 | 34.0 |
| Outdoor smoke: Yes | 37 | 17.2 |
| Dampness: Yes | 50 | 23.3 |
| Indoor dust particles: Yes | 161 | 74.9 |
| Pests: Yes | 186 | 86.5 |
| Current smoker: Yes | 10 | 4.7 |
| Smoker in household: Yes | 30 | 14.0 |
| Dusty/smoky occupation: Yes | 22 | 10.2 |
| Indoor clothes drying: All the time | 8 | 3.7 |
| Indoor clothes drying: Rainy season | 32 | 14.9 |
| Indoor clothes drying: Sometimes | 27 | 12.6 |
| Indoor clothes drying: Never | 148 | 68.8 |
| Overcrowding (≥3 persons/room): Yes | 38 | 17.7 |
| Cooking fuel: Gas | 172 | 80.0 |
| Cooking fuel: Electricity | 24 | 11.2 |
| Cooking fuel: Charcoal | 12 | 5.6 |
| Cooking fuel: Firewood | 6 | 2.8 |

**Bivariate Associations with Respiratory Morbidity**

Place of residence was associated with respiratory morbidity ($\chi^2 = 5.98$, $p = .014$): 70.4% of urban residents had respiratory morbidity compared with 54.2% of rural residents. Outdoor smoke was also associated with respiratory morbidity ($\chi^2 = 4.91$, $p = .027$); 78.4% of exposed participants had respiratory morbidity compared with 59.0% of those who did not report outdoor smoke.

Indoor clothes-drying frequency was associated with respiratory morbidity ($\chi^2 = 16.98$, $p = .001$). Respiratory morbidity was reported by 75.0% of participants who always dried clothes indoors, 87.5% of those who did so during the rainy season, 77.8% of those who sometimes did so, and 53.4% of those who never dried clothes indoors. Current smoking was associated with respiratory morbidity in the bivariate analysis ($p = .031$), but the direction was unexpected: 30.0% of current smokers and 63.9% of nonsmokers reported respiratory morbidity. Only 10 participants were current smokers.

Dampness, overcrowding, cooking location, cooking fuel, time spent in the cooking area, household smoking exposure, dusty or smoky occupation, and wall, roof, and floor materials were not significantly associated with respiratory morbidity in bivariate analyses.

**Table 2:** Selected Bivariate Associations With Respiratory Morbidity

| Exposure | Category | Respiratory morbidity, % | p |
|---|---|---|---|
| Place of residence | Urban | 70.4 | .014 |
| | Rural | 54.2 | |
| Outdoor smoke | Yes | 78.4 | .027 |
| | No | 59.0 | |
| Dampness | Yes | 72.0 | .107 |
| | No | 59.4 | |
| Current smoking | Yes | 30.0 | .031 |
| | No | 63.9 | |
| Indoor clothes drying | All the time | 75.0 | .001 |
| | Rainy season | 87.5 | |
| | Sometimes | 77.8 | |
| | Never | 53.4 | |
| Overcrowding | Yes | 65.8 | .627 |
| | No | 61.6 | |
| Cooking area | Outdoors | 63.6 | .410 |
| | Living/sleeping room | 76.9 | |
| | Separate room | 60.3 | |
| | Separate building | 85.7 | |
| | Passage | 50.0 | |

### Logistic Regression

In Model 2, the estimated odds of respiratory morbidity were higher for unimproved wall, roof, and floor materials than for improved materials, but confidence intervals were wide and included 1. Rural residence had lower estimated odds than urban residence (OR = 0.68, 95% CI [0.35, 1.35]), and absence of outdoor smoke had lower estimated odds than reported exposure (OR = 0.41, 95% CI [0.16, 1.07]). Neither estimate was statistically conclusive. Nonsmokers had higher estimated odds than current smokers (OR = 5.04, 95% CI [0.97, 26.17]), but the estimate was imprecise. Indoor clothes-drying categories also had wide confidence intervals. No principal housing or lifestyle estimate in Model 2 had a 95% confidence interval that excluded 1 (Table 3).

**Table 3:** Model 2 Logistic Regression Estimates for Housing and Lifestyle Factors

| Variable | Comparison | OR | 95% CI |
|---|---|---|---|
| Wall material | Unimproved vs. improved | 2.91 | 0.39–21.68 |
| Roof material | Unimproved vs. improved | 2.55 | 0.35–18.63 |
| Floor material | Unimproved vs. improved | 5.17 | 0.82–32.63 |
| House status | Unimproved vs. improved | 0.25 | 0.03–1.87 |
| Drinking water source | Unimproved vs. improved | 1.12 | 0.56–2.25 |
| Water treatment | Unimproved vs. improved | 1.38 | 0.38–4.95 |
| Water treatment | None vs. improved | 0.54 | 0.27–1.09 |
| Cooking fuel | Unimproved vs. improved | 0.79 | 0.23–2.72 |
| Employment | Student vs. unemployed | 2.35 | 0.45–12.14 |
| Employment | Self-employed vs. unemployed | 0.88 | 0.25–3.10 |
| Employment | Salaried vs. unemployed | 1.76 | 0.40–7.68 |
| Residence | Rural vs. urban | 0.68 | 0.35–1.35 |
| Outdoor smoke | No vs. yes | 0.41 | 0.16–1.07 |
| Current smoking | No vs. yes | 5.04 | 0.97–26.17 |
| Indoor clothes drying | Rainy season vs. all the time | 1.63 | 0.20–13.32 |
| Indoor clothes drying | Sometimes vs. all the time | 0.75 | 0.10–5.73 |
| Indoor clothes drying | Never vs. all the time | 0.39 | 0.07–2.35 |

*Note.* OR = odds ratio; CI = confidence interval. Reference categories are shown in the comparison column.

## 4. Discussion

This study examined housing characteristics, household environmental exposures, and occupant activities in relation to respiratory morbidity among adults in Ibadan South-West LGA. Respiratory morbidity was common, affecting 62.3% of participants. Urban residence, outdoor smoke exposure, and indoor clothes-drying frequency were associated with respiratory morbidity in bivariate analyses. However, structural housing characteristics, cooking fuel, overcrowding, and cooking location were not statistically significant, and the multivariable estimates were imprecise. These findings support a cautious interpretation: selected residential exposures were related to respiratory morbidity at the descriptive and bivariate levels, but the study did not establish clear independent effects for most housing variables.

The higher prevalence of respiratory morbidity among urban residents is consistent with the broader recognition that residential respiratory risk reflects both the dwelling and its surrounding environment. WHO guidance identifies outdoor air pollution, crowding, ventilation, and household energy among housing-related pathways that influence health (WHO, 2018) [7]. Recent reviews similarly describe urban density and environmental pollution as components of the housing–respiratory relationship (Howard *et al.*, 2023; Wimalasena *et al.*, 2021) [3, 6]. In the present study, the urban–rural difference weakened in Model 2, indicating that residence alone should not be interpreted as an independent cause of respiratory morbidity.

Outdoor smoke exposure was associated with a higher prevalence of respiratory morbidity. This direction is biologically and environmentally plausible because smoke entering a dwelling can add to indoor pollutant exposure, particularly where ventilation does not effectively remove contaminants. The adjusted estimate for participants without outdoor-smoke exposure remained below 1 but was not statistically conclusive. The result therefore supports attention to neighbourhood and household smoke sources without permitting a causal claim.

Indoor clothes drying showed one of the clearest bivariate patterns. Participants who dried clothes indoors, particularly during the rainy season, reported more respiratory morbidity than those who never did so. Indoor drying adds moisture to the residential environment and, where ventilation is inadequate, can contribute to condensation, dampness, and conditions favourable to mould growth (Clark *et al.*, 2023) [1]. This mechanism is relevant to the present setting because dampness was reported in a substantial minority of homes. Nigerian evidence from Ibadan has also linked objectively assessed residential dampness and mould damage with respiratory infection in children (Fakunle *et al.*, 2023) [2]. Nevertheless, the regression estimates for clothes-drying frequency were very imprecise, partly because the reference group who dried clothes indoors all the time was small. The observed association should therefore be viewed as hypothesis-generating rather than evidence of an independent effect.

Most structural housing indicators were not significantly associated with respiratory morbidity. Although unimproved wall, roof, and floor materials had elevated odds ratios in Model 2, their confidence intervals were wide. This imprecision may reflect small numbers within unimproved-material categories and the modest sample size. The finding does not negate the established importance of housing quality; rather, it indicates that this study could not estimate those effects precisely. Systematic reviews show that respiratory risk commonly arises from combinations of ventilation, dampness, indoor pollution, building condition, and occupancy characteristics rather than from a single construction material (Howard *et al*., 2023; Wimalasena *et al*., 2021) [3, 6].

Cooking fuel was not significantly associated with respiratory morbidity. Most participants used gas or electricity, leaving relatively few households using charcoal or firewood. This limited contrast may have reduced the ability to detect differences by fuel category. Household air pollution remains an important respiratory risk in Africa, but recent reviews also note that African exposure–outcome studies are often limited by modest sample sizes and proxy measures of household exposure (Jafta *et al*., 2025) [4]. In this study, cooking location and time spent in the cooking area were also not significantly associated with respiratory morbidity.

The smoking result warrants particular caution. Only 10 participants reported current smoking, and respiratory morbidity was less frequent among smokers than nonsmokers in the bivariate analysis. In Model 2, the estimate for nonsmokers was large but had a very wide confidence interval that included 1. Given the small number of smokers and the cross-sectional design, this result should not be interpreted as evidence that smoking is protective or that nonsmoking increases respiratory risk.

A strength of the study was its combined assessment of housing structure, household environmental experiences, occupant activities, and respiratory health using both questionnaire data and a housing walkthrough. The study also included adults from multiple residential locations across Ibadan South-West LGA. Important limitations include the cross-sectional design, which prevents determination of temporal or causal relationships; reliance on self-reported respiratory symptoms and some household exposures; small numbers in several exposure categories; and wide confidence intervals in the regression models. Residual confounding is also possible. These limitations are particularly important when interpreting unexpected findings such as the smoking pattern.

Future studies should use larger samples, prospective designs, and more detailed assessment of ventilation, dampness, mould, household smoke, and activity patterns. Combining these measures with objective respiratory assessments would help clarify which modifiable housing conditions are most important for adult respiratory health in Nigerian cities.

## 5. Conclusion

Respiratory morbidity was common among adults in Ibadan South-West LGA. Urban residence, outdoor smoke exposure, and indoor clothes-drying frequency were associated with respiratory morbidity in bivariate analyses, while structural housing materials, cooking fuel, overcrowding, and cooking location were not. Multivariable estimates were generally imprecise and did not demonstrate clear independent associations. The findings nevertheless highlight the relevance of smoke exposure, moisture-generating household practices, ventilation, and broader housing conditions to environmental health and support further investigation using stronger longitudinal and exposure-assessment designs.

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