

Proceeding Paper

# Housing Conditions and Their Impact on Health of Residents <sup>†</sup>

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**Abstract:** Housing amounts to the physical structures that provide shelter, social services with a hygienic neighborhood, to fulfill the essential needs of the people. Housing factors have been shown to have an effect on an individual's state of physical, mental, social and economic well-being. Indoor environmental factors such as crowding, environmental tobacco smoke, biofuels, dampness, house dust mites, temperature, age of building, pets, and indoor plants affect the wellbeing and productivity of the occupants. A literature review was performed on studies of housing conditions and health outcomes conducted in India and abroad from 1999 to 2020. The studies assessed housing quality by self-reported questionnaires administered through the postal system, face-to-face or via the internet. Visual signs and non-volumetric methods were used to assess indoor air quality and housing conditions, while the health of residents was assessed by self-reported questionnaire, or SF-36 questionnaire. Studies conducted in the United States of America, Europe, the United Kingdom, Middle East, Africa and Australasia have revealed that factors affecting health conditions were ventilation, dampness, presence of molds, overcrowding, house dust mite allergens, age and renovation of buildings and these factors showed an association with respiratory illnesses, colds, coughs, asthma, conjunctivitis, atopic dermatitis and ear infections. However, studies in India revealed that lack of proper ventilation, use of traditional fuels, crowding and poor hygienic conditions are the main factors associated with acute respiratory infections, asthma, tuberculosis, cardiovascular diseases and lung cancer. Thus, the review highlights that there is a need to improve housing conditions in India to enable the people to lead a healthy and productive life.



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## 1. Introduction

Housing amounts to the physical structures that provide shelter, social services with a hygienic neighborhood, to fulfill the essential needs of the people [1]. The World Health Organization (WHO) states that “housing should provide protection against communicable diseases, protection against injury, poisoning and chronic diseases and reduce psychological and social stress to a minimum” [2].

Housing factors have been shown to have an effect on an individual's state of physical, mental, social and economic well-being [3]. Housing is a place in which a group of individuals spend more than 80% (3/5) of their time for daily activities, which can be somewhere between 15.5 and 15.7 h per day [4,5]. Housing is seen as a “key determinant of health” as it is stated, “good housing and good health go together” [6]. Breysse et al. (2004) reported housing as a neglected site for public health action [7].

The indoor environment comprises the fundamental environmental factors that affect the health, wellbeing and productivity of the occupants [8]. The consequence on health

progresses with an increase in the exposure time and level of air pollution [9,10]. Indoor air is composed of a heterogeneous combination of bio-aerosols (fungi, bacteria, and irritants) and non-biological particles such as dust, smoke and particle emissions produced during cooking activities along with organic and inorganic gases [11]. A high concentration of airborne microorganisms when present in indoor environments result in the development of various health problems [12]. Indoor air pollution is being linked in the ongoing research literature to a greater probability of upper and lower respiratory tract infections, aggravation of the underlying inflammatory lung diseases, leading to chronic obstructive pulmonary disease (COPD), cardiac events, stroke, eye disorders, tuberculosis, cancer, and hospital admissions that are particularly common in females and children, those who are most prone to developing such infections because of their longer stays indoors [13–18]. In developing countries, around one-third of hospital inpatients and 20–30% of fatalities among children below the age of five years occur due to acute respiratory infections (ARIs) [19,20].

As limited studies have been conducted in India in respect of housing conditions and health of the people, this review was completed to discover the housing conditions of residents and their health status, that will help us to identify risk factors that are associated with health conditions. This study will provide evidence so that policy makers can take it into consideration regarding the development of common housing standards for the population.

## 2. Methods

The literature on the topic was searched on the websites, base-search.net, academic.microsoft.com, dimensions.ai, PubMed, and Google scholar using the keywords “housing quality” “indoor air quality” “ventilation” “dampness” “health outcomes” “health status” “ill health”, “India” and the Boolean operator “AND” was used to make the search more precise. The literature review was classified based on research papers of studies conducted in India and other countries.

## 3. Results and Discussion

### 3.1. Studies Conducted in India

- Pokhrel et al. [14] aimed to associate indoor cooking with cataracts. This was an institutional case-control study that was designed to include women with cataracts as cases and women attending refractive error clinics as controls. The study utilized a standardized questionnaire to collect the data. The lack of proper ventilation in the kitchen was identified as an independent risk factor for developing cataracts.
- Firdaus G and Ahmad A [21] aimed to analyze the indoor air quality (IAQ) and its determinants with its contribution to possible health outcomes at the household level. A questionnaire was used for data collection across homes from 35 wards in Delhi. The highest risk to the health of individuals was posed by the utilization of traditional fuels, the absence of a proper separate cooking space, vulnerability to ETS, and insufficient ventilation. The residents' most common medical problem was found to be acute respiratory infections, which were closely linked to the usage of traditional fuels. Asthma was strongly associated with the use of conventional energy sources, exposure to ETS and poor ventilation. Exposure to ETS was found to have a strong correlation with lung cancer and cardiovascular diseases.
- In another study, Firdaus G and Ahmad A [22] aimed to assess accommodation standards with possible health outcomes across three selected districts of the National Capital Territory (NCT) of Delhi, India. A door-to-door survey was conducted to collect the data. In the analysis, household level data were controlled for individual socio-economic and demographic covariates. Overcrowded housing conditions were observed in the selected districts. Respiratory infections were the main health outcomes attached to overcrowding that included ARI, tuberculosis and asthma.
- Vaid U and Evans GW [23] conducted a study to assess whether improved housing standards improve occupants' health and well-being. Trained raters assessed the

housing quality at a walk-through amidst females residing in public dwellings and those currently living in slums on waiting lists to relocate to the public housing. This is the only study from India that has assessed the slum rehabilitation program. A limitation of the study was that all the health outcomes reported in this study were self-reported through a standard questionnaire, which may result in over- or under-reporting of health conditions. Better physical and mental health was described by those females who moved from slum locality to public housing but they had fewer social connections compared to those females who were staying in slum dwellings.

### 3.2. Studies Conducted in Other Countries

- Koskinen O et al. [24] aimed to assess the health of adults based on the presence of moisture or mold in their houses. This study was conducted in Finland. The strengths were the survey used a random sampling for studying the outcomes. The researcher collected data about the presence of moisture and mold by visualizing it at the identification reported by the occupant. Secondly, health data were collected by sending out postal questionnaires which helped in controlling the interviewer bias. A limitation of the study was that it had not adjusted the findings for other confounding factors which can be associated with the outcomes observed. In this study, it was concluded that the exposure of occupants to moisture was related to the developing of sinusitis, acute bronchitis, nocturnal cough and dyspnea, and sore throat. Meanwhile, mold exposure of the occupants was associated with the development of the common cold, coughs without phlegm, nocturnal coughs, sore throats, rhinitis, tiredness, and attention problems.
- Oie L et al. [25] conducted a study to assess the effect of ventilation rates in the development of bronchial obstruction during the first two years of life. The study was conducted in Oslo, Norway. The strength of the study was the selection of cases and controls which were matched for date of birth and the ventilation rate was measured so the results are reliable. In the households included in this study, the ventilation rate was not directly linked with the risk of developing bronchial obstruction.
- Evans J et al. [26] conducted a study with the aim of examining the association between damp housing and adult health, including other factors that may influence health and can be a confounder. The study was conducted on adults, aged between 18 and 64 years, from Oxfordshire, Buckinghamshire, Berkshire and Northamptonshire, in the United Kingdom. The strength of the study was that the confounders which may influence health were acknowledged and the use of the SF-36 questionnaire, a standardized health questionnaire. However, it has limitations such as it being a secondary analysis and housing dampness was assessed by self-reporting which may have led to over- or under-reporting of dampness. Those occupants who were unable to keep their homes warm “very frequently” and “most of the time” had a worse health status than those who were unable to keep their homes warm “just sometimes”.
- Baker M et al. [27] conducted a case-control study to assess the risk factors related to meningococcal disease in Auckland children. The inclusion criterion was children less than 8 years of age with or without meningococcal disease as case and control, respectively. The strength of the study was that the confounders were adjusted and overcrowding was measured by the number of adolescent and adult (10 years or older) household members residing in a room. In this study, a multivariate model was used to control the age, ethnicity, season and socioeconomic factors. There was a strong association between the possibility of developing meningococcal disease and overcrowding. Measurement was performed by the number of adolescents and adults (10 years or older) residing in one room of a household. When two more adolescents or adults were added to a six-room residence, the risk was doubled.
- Kilpelainen M et al. [28] conducted a study to assess the relationship between housing dampness and respiratory symptoms in adults. The study was carried out on university students in Finland. The strength of this study was a large sample size, and

analysis was performed controlling for confounders. A limitation of the study was the dampness assessment and health condition assessment were based on self-report survey questionnaires, so may result in over- or under-reporting of dampness and health conditions. A positive association was observed with home dampness and conditions like recent asthma, allergic rhinitis, atopic dermatitis and the common cold occurring more than or equal to four times a year along with other respiratory illnesses. There was a strong association between exposure to visible mold, asthma and the common cold.

- Zock JP et al. [29] in his study aimed to assess the distribution and determinants of house dust allergens in 10 European countries. The strength of the study was the large sample size, multi-centric assessment of allergens conducted on mattress dust sample, the details of housing features were obtained by observation and interview as well as the geographical distribution and determinants being assessed using a common protocol. There was a large difference in allergen levels between the study centers that were located at different geographic locations. The Der p 1 allergens were reduced by low winter temperatures in comparison to Der f 1 allergens.
- Al-Khatib IA and Tabakhna H [30] in their study aimed to assess the impact of housing conditions in camp with refugees' health, especially respiratory symptoms and disease. The strength of the study was randomized sampling from the housing units covering one-fifth of the camp's population. A limitation of the analysis was that it did not control for the confounders. Respiratory illnesses such as the common cold, coughs, tonsillitis, and ear infections were significantly linked to overcrowding and large population density, as well as poor living conditions such as dampness and mold.
- Habib R et al. [31] in his study aimed to examine the association between housing quality and chronic illness among the household members. This was a population-based cross-sectional study conducted in Lebanon. The strength of the study was that the researcher conducted face-to-face interviews to obtain the details of health and for assessing housing conditions. Moreover, a multivariate regression model was applied to examine the alliance of poor health and housing quality alongside controlling for other covariates. Housing conditions were found to have a substantial positive link with chronic illness.
- Turunen M et al. [3] in their study aimed to create a data collection and response system to help in the assessment of the Finnish housing stock in relation to quality, health and safety. The strength of the study was its large sample size and random selection of the sample population. A limitation of this study was that all the health outcomes were self-reported through a questionnaire by the respondents, which may have resulted in over- or under-reporting of health conditions. Most respondents had mechanical ventilation or mechanical exhaust in their homes. The primary heating system used in the households was direct heating. Among the other heating systems used were electric heating and oil heating. The most common symptoms reported by the respondents were upper respiratory tract infections and/or arthralgia followed by general symptoms including eye and skin symptoms and muscular pain. Few respondents reported of regularly having sleeping problems, daily lower respiratory tract symptoms and doctor-diagnosed asthma. The common allergies reported by the respondents were hay fever and pet allergies.
- Pudpong N et al. [32] conducted a study with the aim of finding out the indoor concentrations of particulate matter of less than  $10\mu\text{m}$  in diameter (PM10). The strength of the study lies in the quantification of the PM10 as it provides a result which will be reliable. An important finding was reported in the study. In a non-smoking setting, the most significant source of indoor PM10 concentrations was cooking. A positive correlation was observed between the PM10 concentrations and number of children who complained of cough in the highly polluted areas of Bangkok city.
- Ana GR et al. [33] in their study aimed to determine the amount of airborne microorganisms in the interior dwelling environment that predispose children under the age

of five years to acute respiratory illnesses. In this study, a prospective case-control methodology was used. The study's strength was that it used a non-volumetric method to determine the load of indoor airborne microorganisms. The total counts per cubic meter were compared using the parameters provided by the American Industrial Hygiene Association. In comparison to controls, for cases, the mean indoor total bacterial count was markedly elevated compared to the acceptable limit of ( $\leq 500 \text{ cfu/m}^3$ ) recommended by the American Industrial Hygiene Association. It was advocated to educate the mothers of children aged below five years regarding the importance of improved ventilation and the following of proper sanitary practices so as to reduce the indoor microbial load.

- Heijnen M et al. [34] conducted a systematic review and meta-analysis to compare the effects of shared sanitation with individual household latrines (IHLs) on health outcomes. Only 22 titles and abstracts out of 25,477 were found to meet the inclusion requirements. The majority of studies established a correlation between shared sanitation and poor health outcomes. However, the quality of these studies varied, and the data were insufficient, so they should be treated with caution.
- Tusting S L et al. [35] conducted a study with the aim of characterizing all published and unpublished data, as well as assessing the strength and quality of these data, in order to conduct a systematic evaluation of the evidence regarding the influence of housing renovations on malaria. African, Asian, and South American studies were included. Despite a scarcity of high-quality evidence, the direction and consistency of effects suggest that housing is a substantial malaria risk factor. Future research should look into the protective effects of certain dwelling features as well as incremental housing improvements linked to socioeconomic advancement.
- Palacios J et al. [36] in their study examined the association between housing conditions and health outcomes. A good sample size of 25,000 German families was used in the study, which spanned 25 years. Individual, housing, and temporally fixed factors were adjusted for, and the study was resilient to changes in socioeconomic position, lifestyle choices, and neighborhood conditions. Individuals exposed to poor housing conditions were reported as having the worst mental and physical health. A significant reduction in doctor visits was observed that was related to home renovations. This corroborated the findings on home conditions and health outcomes.

The information obtained from this review provides evidence that changes in housing conditions are triggered by a number of factors including environment and climate. Though the prevalence of respiratory symptoms and diseases are common in developing countries, there are a scarcity of data on housing condition and its association with health from developing countries, including India.

#### 4. Conclusions

Most of the research work focusing on the impact of housing conditions on occupants' health have been carried out in developed countries and have reported the indoor environment of the house as detrimental to the occupants' health, especially respiratory-related symptoms and diseases. The studies which have been conducted in India have used self-reported methods to assess the house quality or trained raters have assessed it and indoor air quality was addressed. Therefore, there is a need to address housing quality using quantitative measures to correctly recognize the indoor environmental factors that are detrimental to the health of the occupants. Further, based on the results of the study, awareness should be enhanced amongst the residents, government officials and construction agencies in the country regarding housing conditions, maintenance of the buildings and the health of individuals.

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