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Impact of indoor air pollution from cooking fuel usage and practices on self-reported health among older adults in India: Evidence from LASI

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ABSTRACT

This research aims to explore the impact of various components of Indoor air pollution (IAP) on the Self-Reported Health (SRH) of older adults in India. Using a sample of 27,090 from the Longitudinal Aging Study in India (LASI) Wave-1, a multiple binary logistic regression model was employed to identify specific risk factors associated with poor SRH among older adults. Adjusting for demographic, socioeconomic, and IAP-related components, it was revealed that IAP significantly contributes to poor SRH. The adjusted model indicated that individuals using solid cooking fuels face a higher risk of poor SRH compared to those using liquid fuels. Additionally, individuals not using electric chimneys and cooking near windows are associated with an elevated risk of poor SRH, highlighting the importance of adequate ventilation. Health risk factors, including lung disease, diabetes, cough, and depression, further contribute to poor SRH among older adults exposed to IAP. Overall, the study offers crucial insights for policymakers, healthcare professionals, and environmentalists to improve the well-being of the vulnerable older population in India.

1. Introduction

Air pollution within homes, known as indoor air pollution (IAP), poses an increasing health risk to older adults in India, primarily due to traditional cooking practices and the widespread use of solid biomass fuels (Shakya et al., 2021). The widespread use of conventional biomass fuels like wood, shrubs, animal dung, crop residue, and coal combustion is a major contributor to this problem, particularly in developing nations where these solid biomass fuels are prevalent for domestic cooking (Meyers & Leach, 1989). This concern highlights the need to address the health implications of IAP in the context of older adults, emphasizing the reliance on solid biomass fuels and traditional cooking practices in households across India (Agarwal et al., 2020).

The extensive use of unclean solid biomass fuels in household cooking releases harmful substances, leading to various health problems, including lung diseases, respiratory issues, diabetes, and more (Ali et al., 2021; Balmes, 2019; Mortimer et al., 2012). Sustainable Development Goal (SDG)-7 aims to ensure universal access to clean fuels and technologies, highlighting the imperative to reduce dependence on harmful energy sources for cooking, heating, and lighting (Jayachandran et al., 2022; Čukić et al., 2021).

IAP constitutes four percent of the total global disease burden, with its major source being solid biomass cooking fuels (Mocumbi et al., 2019). This issue disproportionately affects the health of women and older adults, who spend significant time in cooking areas. The World Health Organization (WHO) estimates that 40% of premature deaths due to air pollution are attributable to IAP, resulting in 3.8 million premature deaths annually globally (WHO, 2012).

In India, the older adult population constitutes 8.6% and is projected to reach 19.1% by 2050 (Census of India, 2011). Consequently, Indian policymakers express concerns about the rapid growth of the older population and the increased use of traditional biomass burning, adversely affecting the health of older adults (Sigsgaard et al., 2015). Health, as per the WHO definition, is holistic, encompassing physical, mental, and social well-being. This study builds on prior research about the impact of IAP on health, including components like fuel sources and methods of cooking practices (Ezzati & Kammen, 2002b; Mocumbi et al., 2019; Sinha & Ray, 2015). This study also examines various socioeconomic, health, and, IAP-related components to comprehensively assess their collective influence on the health of older adults (Agrawal & Yamamoto, 2015; Ashwani & Kalosona, 2016; Belkin, 2018; Dakua et al., 2022; Fatmi et al., 2014; Pan et al., 2015).

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Despite the growing health risks posed by IAP in developing nations like India, most studies have focused on specific regions and other demographic groups, neglecting the health concerns of older adults (Chen et al., 2018; Eccleston et al., 2021; Franklin et al., 2019, p. 1364; Htay et al., 2023; James et al., 2020; Jana et al., 2022; Krishnamoorthy et al., 2022; Qiu et al., 2020; Yaya et al., 2018; Yeatts et al., 2012b). To our knowledge, no research has specifically examined the impact of IAP on the Self-Reported Health (SRH) of older adults in India. This study aims to fill this gap and provide insights for environmentalists, healthcare professionals, and policymakers to improve household environmental conditions and shape health policies, particularly for this vulnerable demographic.

2. Materials and methods

2.1. Data source

We gathered data during the initial phase of the Longitudinal Aging Study in India (LASI), which took place between 2017 and 2018. This research specifically concentrates on individuals aged 45 and older, examining their health, socioeconomic status, and overall well-being. LASI, a collaborative effort involving the International Institute for Population Sciences (IIPS) compiled extensive information on the social, physical, psychological, and cognitive aspects of the aging population in India. The survey encompassed 73,396 individual adults and 74,496 households, employing a multistage stratified cluster sampling design to ensure representation from all states and union territories in India.

2.2. Study sample

From the initial 74,496 participants, we excluded 42,594 individuals below 60 years and 4,812 cases with missing values. The ultimate sample size utilized in our study consisted of 27,090 individuals categorized as older adults. The procedure of sample selection has been presented in Fig. 1.

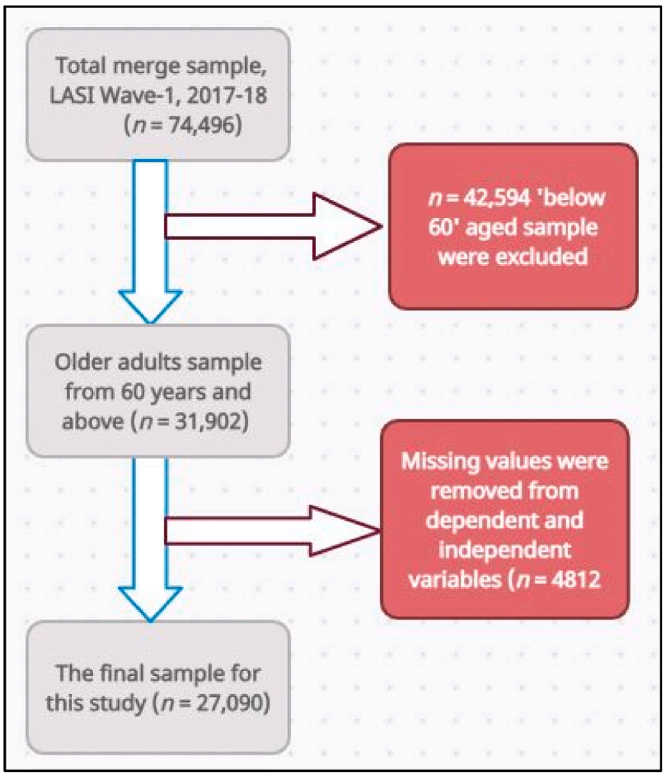

Fig. 1. Flow diagram showing older adults aged 60 years and above included in the study for analyses from the LASI Wave −1, 2017–18, India.

2.3. Dependent variable

In our study, the dependent variable is SRH, which serves as a binary measure reflecting participants' subjective evaluation of their current well-being. SRH is influenced by a multitude of factors encompassing socioeconomic, biological, and psychological dimensions. Within the framework of the LASI survey, participants were asked with the question: "Now I want to ask you about your general health. Overall, how is your health in general? Would you say it is very good, good, fair, poor, or very poor?". In alignment with earlier studies, we dichotomized SRH into two distinct categories: "good," encompassing ratings of fair, good, and very good, and "poor," encompassing ratings of poor or very poor (Arokiasamy et al., 2015; Blazer & Houpt, 1979; Rani et al., 2021; Wångdahl et al., 2018).

2.4. Independent variables

We studied IAP by analyzing the type of fuel used and the methods of cooking practices (Chafe et al., 2015; Dakua et al., 2022; Fatmi et al., 2014). The cooking fuels were stratified into two distinct categories: solid fuels and liquid/clean fuels. Solid fuels comprised a range of materials including wood, shrub, animal dung, crop residue, and coal, while liquid/clean fuels encompassed modern alternatives such as Liquefied Petroleum Gas (LPG), Biogas, Kerosene, and electricity.

Concurrently, we delved into a detailed exploration of the various cooking practices prevalent among households. These practices were systematically categorized into several modalities, each representing a unique approach to cooking. Specifically, we examined traditional chimney usage, electric chimney utilization, deployment of exhaust fans, cooking conducted in proximity to windows or doors, and miscellaneous or alternative approaches categorized under none/other. Additionally, we took into account various demographic and socioeconomic factors (age, gender, social group, religion, living situation, education, and Monthly Per Capita Expenditure quintile) along with health-related factors (such as lung disease, cough, diabetes, and depression) (Gu et al., 2019; Halder et al., 2023; Hamplova et al., 2022; Liu et al., 2020; Mannucci & Franchini, 2017; Ortiz et al., 2020; Singh & Chattopadhyay, 2023). A detailed description about all variables is presented in Table 1.

2.5. Statistical analyses

Statistical analyses were performed to investigate the factors associated with poor SRH among older adults in India. Initially, descriptive statistics were computed to ascertain the prevalence of poor SRH. The multiple logistic regression model, which adjusts for confounding variables, enhances the Chi-Square test, providing a more comprehensive understanding of the relationships under investigation. Before fitting the adjusted model, we computed unadjusted odds for each predictor variable. To ensure national representativeness, individual weights are applied to the estimates. All analyses were conducted using STATA software (Mehmetoglu & Jakobsen, 2022).

The final multiple logistic regression model included only those independent variables that were statistically significant (p-value <0.05) in the unadjusted model. Additionally, a variance inflation factor (VIF) analysis was conducted to assess multicollinearity among predictor variables. Following the criteria established by Alkan et al., a VIF of 5 or higher indicates a moderate degree of multicollinearity, while a VIF of 10 or higher indicates a high level of multicollinearity (Alkan et al., 2023). However, in our investigation, no variables exhibited multicollinearity issues, with the mean VIF value for our study determined to be 1.48.

Table 1
Description of independent variables included in the study, LASI Wave - 1, 2017-18.

Variables	Operational definition and codes
Type of fuel	Liquefied Petroleum Gas (LPG), Biogas, Kerosene, and electricity are classified as liquid/clean fuels, coded as 1, and wood, shrub, animal dung, crop residue, and coal, which are categorized as solid fuels, coded as 2.
Cooking practices	Cooking mainly done under- traditional chimney coded as 1, electric chimney and exhaust fan = 2, near window/door = 3, None/other = 4
Age in years	The age distribution of the study participants has been segmented into three specific cohorts in alignment with the age categorization delineated by The World Health Organization (WHO) for older adults. These categories are coded as follows: 1 corresponds to individuals aged 60–69 years, 2 represents those aged 70–79 years, and 3 denotes respondents aged 80 years and above.
Sex	Coded as 1 = Male, 2 = Female
Social group	Social group is classified into 4 classes and coded as 1 = Scheduled Caste, 2 = Scheduled Tribe, 3 = Other Backward Class, and 4 = Other
Religion	Hindu = 1, Muslim = 2, Christian = 3, Other = 4
MPCE quintile	In the Longitudinal Aging Study in India, the Monthly Per Capita Consumption Expenditure (MPCE) quintile serves as a metric for stratifying individuals or households according to their economic status. The MPCE quintile divides the population into five equal groups, ranging from the lowest expenditure level (poorest) to the highest expenditure level (richest). Such stratification aids in examining socioeconomic variances and their implications on diverse health and social outcomes within the older adult demographic in India. In our study, respondents' economic circumstances are segmented into three distinct categories and encoded as follows: 1 = Poor (encompassing the Poorest and Poorer groups), 2 = Middle, and 3 = Rich (comprising the Richer and Richest groups).
Living arrangements	The living arrangement is categorized and coded as 1 = Living alone, 2 = Living with a spouse or children or others
Schooling	It means whether the respondent ever attends school or not. Coded as 0 = No, 1 = Yes
Lung disease	Lung disease is coded as 0 = No, 1 = Yes
Cough	Cough is coded as 0 = No, 1 = Yes
Diabetes	It is coded as 0 = No, 1 = Yes
Depression	It means the respondents felt sad, blue, or depressed. Coded as 0 = No, 1 = Yes

3. Results

3.1. Indoor air pollution indicators and socioeconomic characteristics of the respondent

Table 2 outlines the indicators of IAP and the socioeconomic features of 27,090 older adults aged 60 years and above. The study included a diverse population, with 47.7% males and 52.3% females. The majority fell within the 60–69 years age group (59.4%), followed by the 70–79 years group (29.9%) and the 80+ years group (10.6%). Hindus comprised the largest religious group (83%), with Muslims (10.2%), Christians (2.8%), and others (26.4%) making up the rest. Different social group were represented, including Scheduled Tribe (ST) respondents (8.3%), Scheduled Caste (SC) respondents (18.8%), Other Backward Class (OBC) respondents (46.4%), and others (26.4%). Health conditions were prevalent, with 8.2% having lung disease, 14.5% diabetes, 9.6% coughs, and 20.5% experiencing depression. A significant portion (55.2%) of respondents never attended school.

Fig. 2 provides an overview of the percentage of Indian households using various daily products, offering insights into their indoor habits. From traditional practices like incense sticks to modern solutions such as liquid vaporizers, these products reveal prevalent behaviors shaping the indoor environment. Incense sticks play a significant role, being used in around 57.3% of homes, emphasizing their cultural and religious significance. Mosquito coil usage is observed in 7.3% of households, indicating concerns about mosquito-borne diseases and aligning with public health efforts. Approximately 10.9% of households utilize liquid vaporizers or mosquito repellents, reflecting a moderate reliance on these methods for pest control. A smaller percentage, about 1.6%, uses fast cards, sticks, or cakes, possibly associated with religious practices, cultural rituals, or personal preferences. Significantly, 23.1% of households report indoor smoking, highlighting a potential source of IAP and emphasizing the need to address associated health risks. Fig. 2 illustrates the coexistence of traditional practices and modern solutions in Indian

Table 2
Characteristics of respondents and prevalence of poor SRH among older adults in India, 2017-18.

Variables	Frequency (*n*)	Percentage (%)	Poor SRH		
			Frequency (*n*)	Prevalence (%)	*p*-value
Type of fuel					
Liquid	14,749	54.4	3247	22	0.02
Solid	12,341	45.6	3095	25.1	
Cooking practices					
Traditional chimney	1,979	7.3	420	21.2	<0.001
Electric chimney and exhaust fan	1,791	6.6	290	16.2	
Near window/ door	17,081	63.1	4014	23.5	
None/other	6,239	23	1617	25.9	
Age in years					
60–69	16,102	59.4	3162	19.6	<0.001
70–79	8,109	29.9	2132	26.3	
80+	2,879	10.6	1048	36.4	
Sex					
Male	12,930	47.7	2768	21.4	<0.001
Female	14,160	52.3	3574	25.2	
Social group					
SC	5,090	18.8	1342	26.4	<0.001
ST	2,258	8.3	405	18	
OBC	12,578	46.4	3147	25	
Others	7,163	26.4	1448	20.2	
Religion					
Hindu	22,484	83	5199	23.1	<0.001
Muslim	2,753	10.2	644	23.4	
Christian	748	2.8	262	35	
Other	1,105	4.1	236	21.4	
MPCE quintile					
Poor	11,617	42.9	2820	24.3	0.001
Middle	5,684	21	1208	21.2	
Rich	9,789	36.1	2315	23.6	
Living arrangement					
Alone	1,407	5.2	433	30.8	<0.001
Living with spouse/ children/ others	25,683	94.8	5909	23	
Schooling					
Yes	12,126	44.8	2518	20.8	<0.001
No	14,964	55.2	3824	25.6	
Lung disease					
No	24,870	91.8	5432	21.8	<0.001
Yes	2,220	8.2	910	41	
Cough					
No	24,496	90.4	5385	22	<0.001
Yes	2,594	9.6	957	36.9	
Diabetes					
No	23,162	85.5	5037	21.7	<0.001
Yes	3,928	14.5	1305	33.2	
Depression					
No	21,537	79.5	4306	20	<0.001
Yes	5,553	20.5	2036	36.7	

Note: Data from LASI Wave - 1, India, 2017–2018. Percentages were computed by applying sample weights. SC, Scheduled Caste; ST, Scheduled Tribe, OBC, Other Backward Classes.

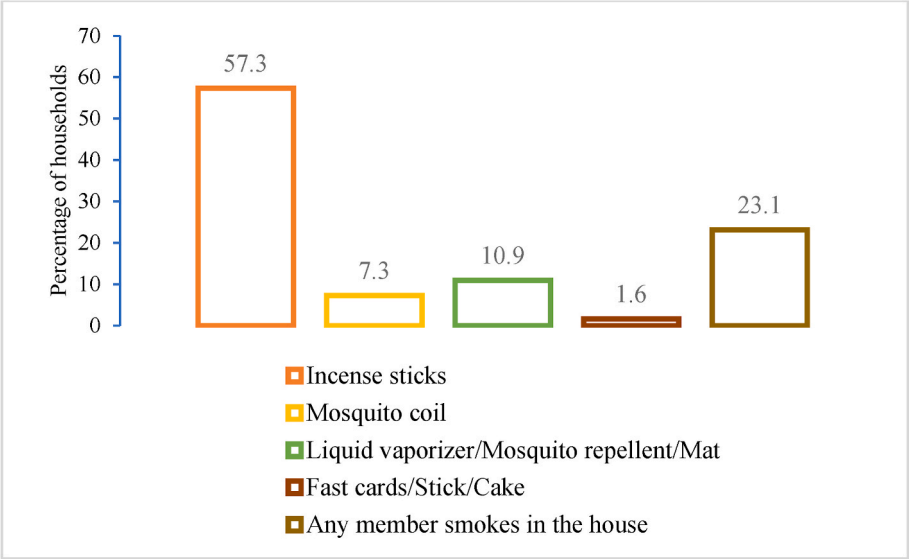

Fig. 2. Percentage of households using various products inside the house daily, in India.

households. While incense sticks and mosquito coils persist due to cultural and health concerns, the presence of liquid vaporizers indicates an adaptation to contemporary pest control methods. The relatively low use of fast cards/sticks/cakes suggests a niche cultural or personal preference. Importantly, the prevalence of indoor smoking in 23.1% of households raises concerns about indoor air quality and associated health impacts.

3.2. Prevalence of poor SRH among older adults

The prevalence of poor SRH was slightly higher among those using solid fuels for cooking (25.1%) compared to those using clean/liquid fuels (22%). Older adults using specific cooking methods, such as cooking near the door/window (23.5%), using traditional chimneys (21.2%), or employing other cooking methods (25.9%), showed higher rates of poor SRH than those using electric chimneys/extraction fans (16.2%) (Table 2). Table 2 further details the prevalence of poor SRH across various demographic and socioeconomic factors. The prevalence increased with age, with the 80+ years group exhibiting the highest rates (36.4%). Female respondents (25.2%) had slightly higher rates than male respondents (21.4%). Different social groups, religions, MPCE quintile, living arrangements, schooling, and regional variations in poor SRH were observed.

Fig. 3 illustrates the distribution of poor SRH among older adults in India, categorizing regions based on the prevalence levels. In areas classified as having low prevalence, including the Western, Southern, and Northeastern regions, as well as other states, the prevalence of poor SRH is below 20%, indicating relatively lower rates of SRH issues among older adults. Moderate prevalence regions, such as Punjab, Haryana, Delhi, Bihar, West Bengal, Assam, Meghalaya, Telangana, Orissa, and Madhya Pradesh, exhibit prevalence rates ranging from 20 to 25%, suggesting a moderate level of SRH concerns among older adults. Conversely, regions with high prevalence, including Uttar Pradesh, Kashmir, Bihar, Himachal Pradesh, Ladakh, Goa, Kerala, Tamil Nadu, and Tripura, report a prevalence exceeding 25%, signifying a notably higher prevalence of poor SRH among the older adult population in these areas.

3.3. Factors influencing poor SRH among older adults

The multivariable logistic regression model highlighted significant associations between poor SRH and IAP variables, considering fuel

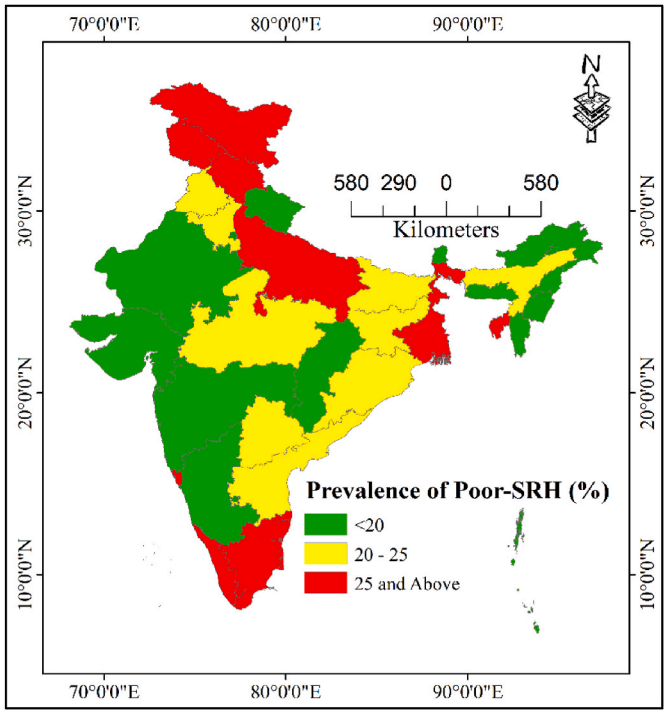

Fig. 3. State and union territory-wise prevalence of poor SRH among older adults in India.

sources, methods of cooking practices, and health risk factors adversely affected by IAP. After adjusting for various variables (age, sex, social group, religion, MPCE quintile, living arrangement, and schooling), the study found that respondents using solid cooking fuels faced a higher risk of poor SRH compared to those using liquid fuels (AOR = 1.191, 95%CI = 1.062–1.335). Additionally, respondents not using electric chimneys and cooking near the window/door were more prone to poor SRH (AOR = 1.675, 95% CI = 1.111–2.526; AOR = 1.819, 95% CI = 1.196–2.769). Health risk factors, including lung disease, cough, diabetes, and depression, were associated with an increased likelihood of poor SRH. Age group, gender, social group, religion, schooling, and other factors also exhibited associations with poor SRH in the adjusted model, indicating their influence on SRH among older adults in India

Table 3
Factors affecting poor SRH by IAP and other characteristics among older adults in India, 2017-18.

Variables	UOR	95% CI	AOR	95% CI
Type of fuel				
Liquid®	1		1	
Solid	1.186***	(1.075–1.307)	1.191***	(1.062–1.335)
Cooking practices				
Traditional chimney	1.393*	(1.000–1.939)	1.351	(0.829–2.203)
Electric chimney and exhaust fan®	1		1	
Near window/door	1.588***	(1.218–2.071)	1.675**	(1.111–2.526)
None/other	1.809***	(1.379–2.373)	1.819***	(1.196–2.769)
Age in years				
60-69®	1		1	
70–79	1.459***	(1.299–1.640)	1.445***	(1.275–1.638)
80+	2.343***	(2.008–2.733)	2.398***	(2.052–2.801)
Sex				
Male®	1		1	
Female	1.240***	(1.124–1.368)	1.191***	(1.058–1.342)
Social group				
SC	1.413***	(1.234–1.619)	1.278***	(1.087–1.503)
ST	0.864*	(0.730–1.023)	0.755***	(0.614–0.929)
OBC	1.318***	(1.175–1.478)	1.244***	(1.088–1.424)
Other®	1		1	
Religion				
Hindu	1.107	(0.881–1.389)	1.081	(0.858–1.361)
Muslim	1.123	(0.848–1.488)	1.038	(0.745–1.447)
Christian	1.982***	(1.461–2.691)	2.381***	(1.719–3.299)
Other®	1		1	
MPCE quintile				
Poor	1.188**	(1.041–1.356)	1.036	(0.921–1.165)
Middle	1.148*	(0.998–1.322)	0.869*	(0.752–1.005)
Rich®	1		1	
Living arrangement				
Alone	1.486***	(1.231–1.795)	1.200*	(0.969–1.484)
Living with spouse/ children/others®	1		1	
Schooling				
Yes®	1		1.157**	(1.025–1.306)
No	1.311***	(1.187–1.447)	1	
Lung disease				
No®	1		1	
Yes	2.487***	(1.961–3.154)	2.042***	(1.646–2.533)
Cough				
No®	1		1	
Yes	2.073***	(1.832–2.346)	1.742***	(1.520–1.995)
Diabetes				
No®	1		1	
Yes	1.790***	(1.527–2.099)	2.151***	(1.850–2.500)
Depression				
No®	1		1	
Yes	2.317***	(2.072–2.590)	2.217***	(1.978–2.485)

*** if $p < 0.01$, ** if $p < 0.05$, * if $p < 0.1$. UOR = unadjusted odds ratio, AOR = adjusted odds ratio, CI = confidence interval, ® = reference category.

(Table 3).

4. Discussion

This study undertakes an exploration of the relationship between IAP stemming from household cooking fuels and its implications on the SRH status of older adults in India. Leveraging nationally representative cross-sectional data from the LASI, our findings highlight a substantial association between exposure to IAP and an increased risk of poor SRH among the older adult demographic.

4.1. Role of solid fuel use and health consequences

The widespread dependence on solid fuels, encompassing wood, shrubs, animal dung, crop residue, and coal, poses a significant global challenge, affecting approximately three billion people worldwide. This reliance is particularly pronounced in India, where a substantial portion of the population continues to utilize these environmentally detrimental energy sources for cooking. Notably, the prevalent use of solid cooking fuels in India, encompassing animal dung, wood, shrubs, crop residue, and coal, is linked with a heightened prevalence of poor SRH among older adults, delineating a concerning nexus between fuel utilization and health outcomes. This scenario underscores persistent economic challenges, compelling individuals, especially during periods of financial constrain, to resort to traditional non-renewable energy sources. A relevant study by Oluwatosin et al. delves into the intricate patterns of household biomass fuel utilization in a periurban population in Sub-Saharan Africa, shedding light on potential health implications arising from such practices (Oluwatosin et al., 2022). This study aligns with Sustainable Development Goal 7, emphasizing the critical need to advocate for universal access to renewable energy sources and eco-friendly technologies. Numerous scholars have echoed the urgency of this advocacy by providing valuable insights into the positive impacts of transitioning to cleaner energy sources. Their research emphasizes the importance of addressing the environmental and health challenges associated with solid fuel use, aligning with global sustainability goals (Carlsen & Bruggemann, 2022; Parra et al., 2020; Čukić et al., 2021).

4.2. The role of cooking practices and health consequences

The role of cooking practices in influencing health outcomes is significant, as evidenced by our findings which indicate an 83% higher risk of poor SRH among older adults who do not utilize electric chimneys or exhaust fans during cooking. This emphasizes the pivotal role that methods of cooking practices play in the health outcomes of the elderly. Beyond the absence of such ventilation mechanisms, several contributing components intensify the health risks faced by older adults. The use of kerosene in households, as well as exposure to neighborhood and secondhand smoke, are identified as significant contributors to health issues in this demographic. Moreover, inadequate ventilation within living spaces, often exacerbated by low-income circumstances, exacerbates the challenges posed by IAP. These findings align with research conducted in Mexico and China, demonstrating a consistent association between IAP components, such as cooking practices and solid fuel use, and declining SRH among older adults (Du et al., 2022; Hou et al., 2018; Saenz et al., 2018). This international evidence underscores the global nature of the issue and emphasizes the necessity for targeted interventions. The implications are significant, highlighting the urgent need to reinforce initiatives like the Ujjwala Yojana scheme, which aims to mitigate solid fuel exposure by facilitating access to clean fuels at affordable prices.

4.3. Associations with specific health conditions

The study unveils an increased risk of poor SRH among older adults with pre-existing health conditions, including diabetes, lung disease, cough, and depression. The risk is particularly pronounced for those with lung diseases, who are 2.5 times more likely to experience poor SRH. These findings resonate with global studies underlining the impact of IAP on respiratory health, diabetes, and mental health conditions among older adults. The broader context of this research aligns with studies conducted in Canada, China, and the United States, emphasizing the correlation between depression and exposure to indoor air (Chafe et al., 2015; Eze et al., 2015; Ghorani-Azam et al., 2016; Jeuland et al., 2015; Kioumourtzoglou et al., 2017; Mu et al., 2013; Szyszkowicz et al., 2016; Wang & Yang, 2018).

4.4. Policy implications and public health interventions

The urgency for public health interventions is underscored by the study, emphasizing the need for an expanded and more affordable Pradhan Mantri Ujjwala Yojana to promote clean cooking practices in rural households (Jagadale & Kemper, 2022). Policymakers and

stakeholders are urged to enhance rural health programs with a specific focus on the older adult population. Comprehensive public health initiatives should include health education, promotion of clean cooking stoves, and measures to alter fuel sources and living environments at local and national levels (Rehfuess, 2006). Furthermore, raising awareness about the dangers of solid cooking fuel use emerges as a pivotal components of government initiatives to improve public health in the context of IAP (Ezzati & Kammen, 2002a).

4.5. Building on global insights

Aligning with a wealth of global insights, the study positions itself within the broader discourse on IAP and its repercussions on the health of older adults. Insights from studies in Mexico, China, and various developed countries enrich the understanding of the multifaceted impact of IAP, providing a comprehensive foundation for the present study's implications (Dida et al., 2022; Faisal et al., 2021; Saenz et al., 2018; Yeatts et al., 2012a).

In summary, this study contributes significantly to the discourse on the health implications of IAP for older adults in India. The findings not only underscore the urgent need for tailored public health interventions but also reinforce the importance of aligning with global initiatives for sustainable and healthier living environments for older populations (Grazuleviciute-Vileniske et al., 2020).

4.6. Strengths and limitations of the study

The study benefits from recently released 2021 data, providing an updated view of older adults' health with a well-selected sample representing each state. However, the study has several limitations: Firstly, the subjective nature of SRH assessments introduces potential bias, as individual perceptions may vary. Secondly, the cross-sectional design precludes establishing causal relationships between variables, warranting cautious interpretation. Thirdly, the absence of ventilation data restricts a thorough analysis of indoor air pollution (IAP) impacts on health outcomes. Lastly, this study used only those variables available in the datasets so that analysis can be affected by omitted variable bias.

5. Conclusion

The study's findings underscore a significant association between IAP and poor SRH among older adults in India. The risk of poor SRH is notably elevated due to the persistent use of solid fuels and, the use of traditional cooking practices. This highlights the urgent need for targeted interventions to mitigate the adverse effects of IAP on older adults' health. Specifically, policies should prioritize the adoption of clean cooking practices and the promotion of advanced technologies, such as electric chimneys and exhaust fans, to reduce IAP levels. Moreover, expanding initiatives like the Ujjwala Yojana can facilitate broader access to clean cooking fuels, thereby improving overall air quality within households. Furthermore, the study emphasizes the importance of tailored interventions for older adults with specific health conditions exacerbated by IAP, such as lung diseases, diabetes, and depression. Comprehensive public health initiatives are essential to address these challenges and ensure healthier aging among older adults in India. In summary, the study highlights the critical role of dynamic policy frameworks in creating cleaner cooking environments and enhancing the overall well-being of older adults. By addressing the root causes of IAP and its impact on health, policymakers can significantly improve the quality of life for older adults in India.

Ethics approval and consent to participate

The present study used secondary data. Therefore, no ethical approval is required for conducting this study.

Consent for publication

Not applicable.

Availability of data and material

The LASI Wave-1 data was utilized for this research. This data is publicly available. Anyone can utilized this data without any restrictions.

The link is bellow:
https://www.iipsindia.ac.in/content/lasi-wave-i.

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CRediT authorship contribution statement

Manik Halder: Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization, Formal analysis, Visualization. **Nuruzzaman Kasemi:** Conceptualization, Formal analysis, Supervision, Validation, Visualization, Writing – review & editing. **Doli Roy:** Writing – review & editing, Visualization, Methodology, Formal analysis. **Malasree Majumder:** Formal analysis, Supervision, Validation, Visualization, Writing – review & editing.

Declaration of competing interest

The authors declare no conflict of interest.

Data availability

Data will be made available on request.

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