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Energy Justice and Women's Health in Delhi: Gendered Impacts of Urban Energy Inequality

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Abstract

The lack of energy access is perceived as a leading factor in creating a barrier to achieve an equitable society; thus, the significance of energy access, as well as energy- related injustices experienced by women in urban centres is widely studied within a variety of disciplines (for example, energy justice and health). The primary aim of this research is to explore how energy access contributes to health equity and women's well-being in the city of Delhi, India... To facilitate this aim, we conducted: (1) a literature review; (2) an examination of existing debates on energy poverty, the gendered experiences surrounding energy access, and health outcomes; and, finally (3) an examination of the existing data on women's gendered experiences of energy access, their perceptions of injustice due to energy-related issues and the impact on their health. The ultimate goal is to explore household energy access patterns for women living in diverse social and economic conditions throughout Delhi, and the individually perceived or experienced injustices of energy-related injustice (and how they are relative to their socioeconomic status), as well as the health-related implications of inadequate or unequal access to energy. The study will be conducted through a structured survey instrument implemented on women from multiple socioeconomic backgrounds in multiple types of housing in Delhi to obtain data on energy use and perception of injustices within the context of their residences. It was through the use of both qualitative and quantitative data that the 'Questionnaire' gathered information about energy sources/costs/reliability of energy services; health issues related to energy and energy use; women's involvement in making household/community decisions related to energy. Both the literature and responses collected through the 'Questionnaire' indicate that women, particularly in low-income communities, are heavily impacted by energy insecurity and experience negative psychosocial and physical health outcomes as a result. Furthermore, both qualitative findings from the literature review and responses from the 'Questionnaire' demonstrate gaps in gender-sensitive energy policy and limited assistance to women in energy decision-making processes (i.e., energy governance). These findings from this study support the incorporation of energy justice within urban energy planning, which will shape improvements to women's health/residential urban development throughout Delhi.

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Keywords
Energy justice, energy inequality, energy access, energy poverty, women's health, indoor PM 2.5 levels.

1. Introduction

My topic is based on something that impacts everyone on a daily basis: energy. While everyone in our society needs energy, not everyone has equal access to energy. Currently, energy access is considered to be important in relation to global issues of health, environment, and social justice. Several countries are working diligently toward transitioning to clean energy, yet there are significant numbers of individuals, specifically women, who still face issues associated with unsafe cooking fuels, indoor air pollution from these fuels, or unreliable access to energy. Each of these challenges impacts women's ability to participate in daily work and adversely affects their physical and mental well-being. In India, there are national programs, such as LPG connections and electrification, that are increasing access to clean energy for many individuals; however, there are still many inequalities that affect individuals' access to clean energy. For example, many low-income individuals living in urban areas do not have access to clean energy due to the high cost of clean energy sources or the unreliable supply of accessible clean energy. Because women are primarily responsible for cooking and managing household energy, they are disproportionately impacted by the use of unsafe cooking fuels, stress, and health risks associated with accessing energy.

Numerous studies have examined energy access and women's health separately but only a handful have examined how both issues relate to each other using energy justice in terms of energy equality, particularly within the context of Delhi. Most studies have either focused their attention on rural areas or simply looked at numerical energy access data without providing any details regarding women's firsthand experiences with such access, existing health conditions therefrom, and their influence over the decision-making process involved in gaining access to energy resources. Thus, it remains unclear as to how urban energy deprivation (i.e., energy injustice) affects the health of women living in urban areas like Delhi. While Delhi is an urban center with well-developed urban infrastructure, significant variations exist in terms of wealth between affluent and impoverished neighbourhoods. For example, members of informal residents frequently experience the impacts of excessive power outages, use of mixed fuels for cooking, and deteriorating physical living conditions (e.g., inadequate sanitation services) that negatively affect their health and quality of life. Studying energy access and women's health at the level of urban areas will allow for a more thorough understanding of both issues. This research will be useful locally as it can inform the development of more effective governmental policies focused on improving women's access to energy and healthcare, especially with regard to women in low-income urban communities; globally, this research will further help in building a broader understanding of the relationship that exists between energy justice and women's health.

2. Literature Review

Several scholars have examined how energy, gender and health are related to one another. All of these studies indicate that energy access is not distributed evenly around the globe. The United Nations Women's Organisation Report (UN Women) and the United Nations Industrial Development Organisation Report (UNIDO) (2023) demonstrate that women in many of the world's nations struggle to obtain access to clean and safe forms of energy - which has a direct impact on their health, opportunities, and way of

life. McKernan, Lozano, and Bagshaw (2020) support this conclusion when highlighting that social justice issues are connected to and influenced by energy systems. They also assert that women bear a disproportionate burden when it comes to managing household energy resources. Similarly, Paul (2024) and Posy (2024) highlight the strong link between energy, gender, and health in terms of how a lack of clean energy increases the health risks faced by women, particularly in developing nations.

A number of researchers have been more focused on the concept of energy justice. For instance, Götzmann and Dicalou (2025) characterize energy justice as representing equity in energy access, equity in energy related decision making, and equity in recognizing the individual needs of all people relative to their energy needs. Cellini and his co-authors (2025) also contend that gender-based discrimination is closely tied to energy systems and assert that women are, therefore, frequently omitted from energy policy development.

According to Singh and Victor (2023) and Zhang et al. (2022), women still encounter many challenges with energy access in India even if there are improvements. This is due to affordability and unequal decision-making power regarding energy use. Yadav and Bharati (2025) and Raman (2021) make the connection between the way women assume a household role and experience of energy poverty. Jain et al. (2018) and NITI Aayog (2020) focus on clean cooking energy and electricity access while highlighting the experience of data, schemes, and the experiences of women.

Smith et al. (2013) and World Health Organisation (2014) both identify that indoor air pollution from cooking fuels contributes to serious diseases such as respiratory illnesses, particularly for women. Khandelwal et al. (2017) and Malakar et al. (2018) explain that people will often use traditional fuels, even if clean energy is available, because of habit or cost or accessibility — this practice is referred to as fuel stacking. Cheng and Urpelainen (2014) confirmed that the experience of multiple fuel use is indeed widespread within India.

3. AIMS/Objectives and Hypotheses:

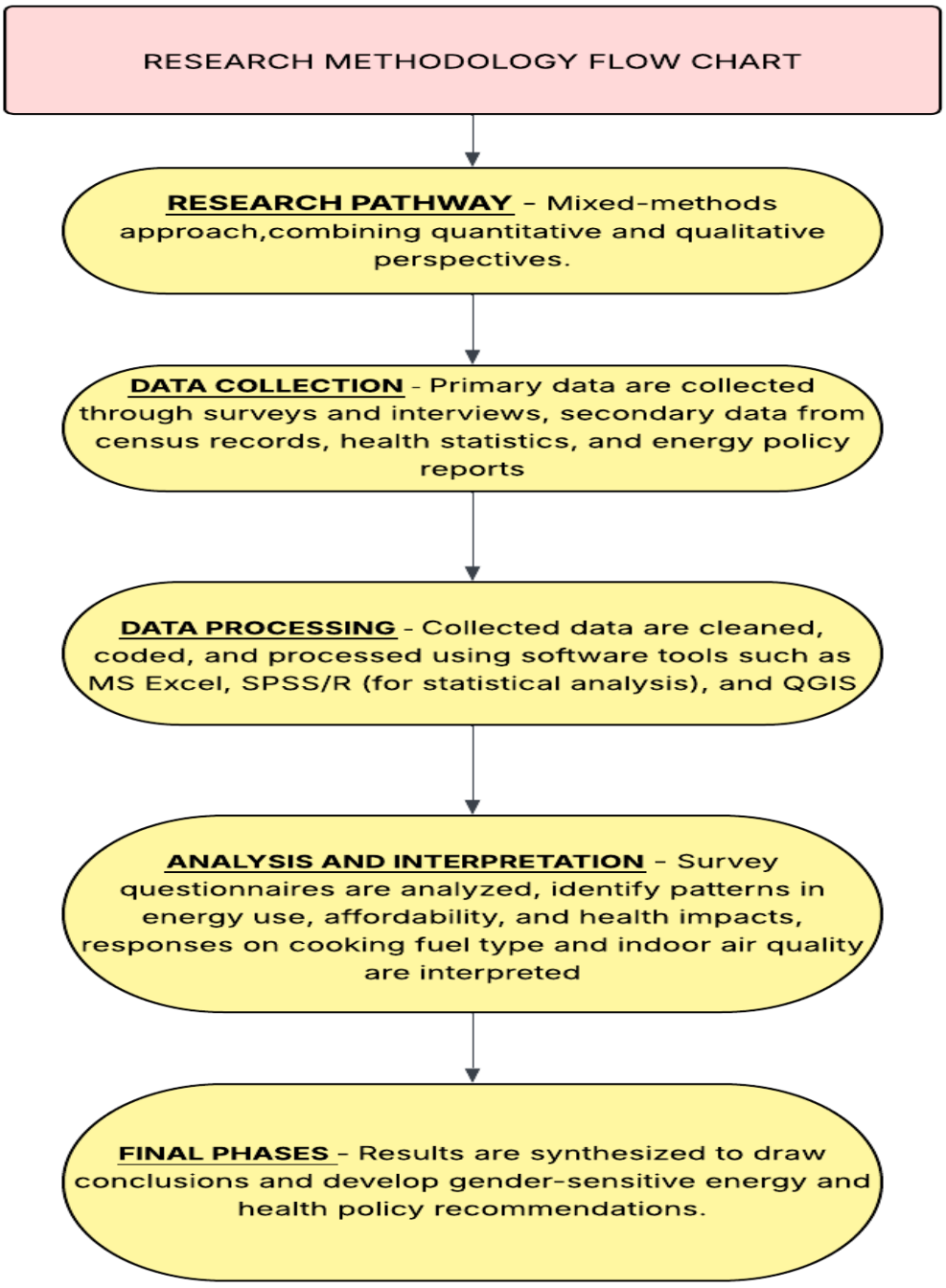
1. What impact does energy access (or lack of) have on women's health across Delhi's settlements?
2. What forms of justice issues are present related to the distribution and governance of energy resources within these communities?
3. How do women perceive and manage their daily lives regarding the lack of access to available energy forms.
4. How adequately does the inclusion of gender perspectives in the formulation of energy policies in Delhi contribute toward improving women's health and wellness?
5. How can an energy justice perspective aid in the understanding and addressing gendered health disparities in urban energy systems?

Hypothesis:

1. Women who lack access to clean and reliable energy are more likely than those with greater access to experience negative health implications.

2. Energy injustice in Delhi results in greater negative implications for the health of women in comparison to men.

4. Research Methodology



5. Primary Data

To collect the first set of data, the districts of Delhi that I chose to include for the analysis are North Delhi, South Delhi, East Delhi, West Delhi and Central Delhi. It was necessary to obtain a wide range of coverage for the overall characteristics of living conditions and access to energy throughout the city by selecting these locations. The first part of the research involved gathering data through surveying these areas about how energy is consumed by the households within these areas and how this impacts women's health and their daily lives.A questionnaire was created to measure demographic data for respondents, such as age, gender, and residence information. After the demographic section of the questionnaire was completed, the questionnaire asked questions about the main issues being studied, i.e., type of cooking fuel used; availability and reliability of electricity; challenges faced while using energy; and the impact of these challenges on health and everyday life.

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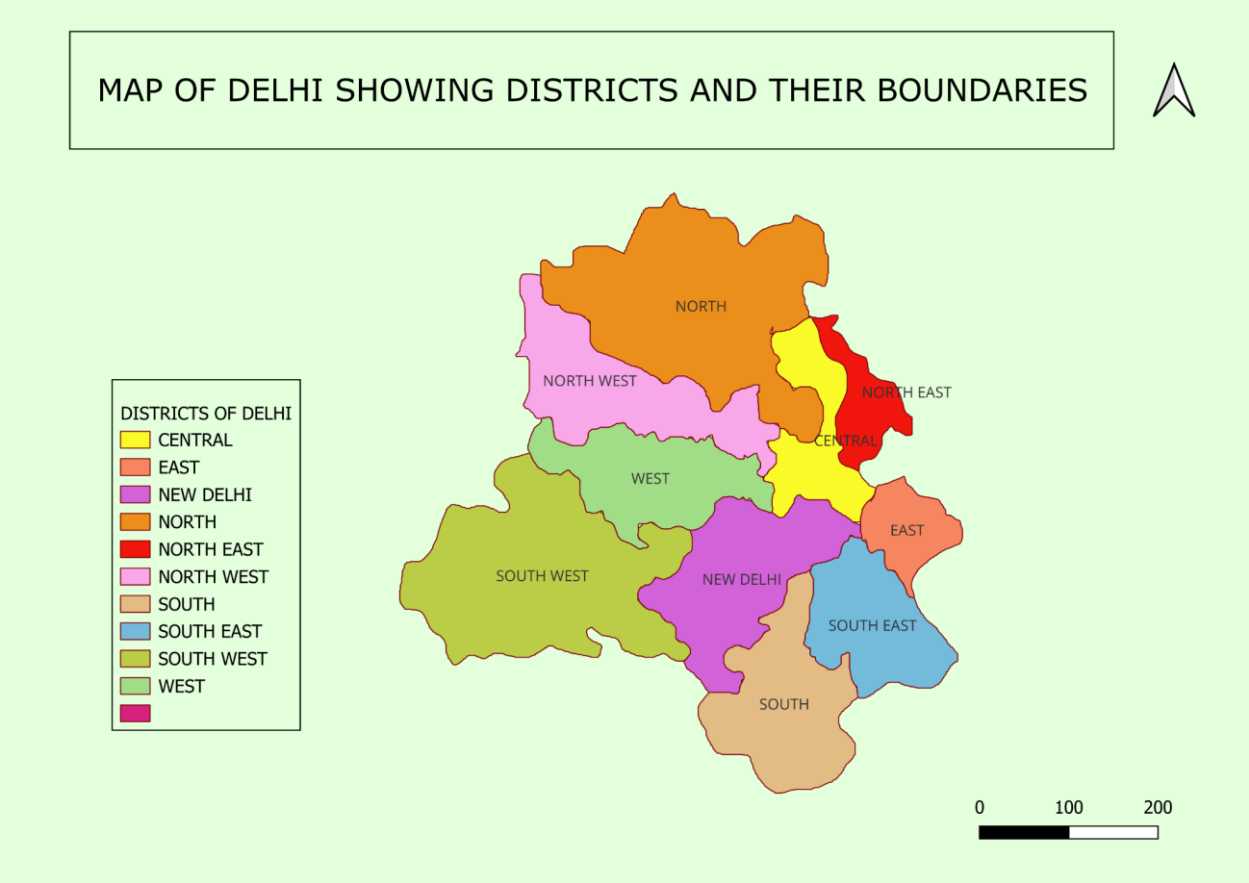
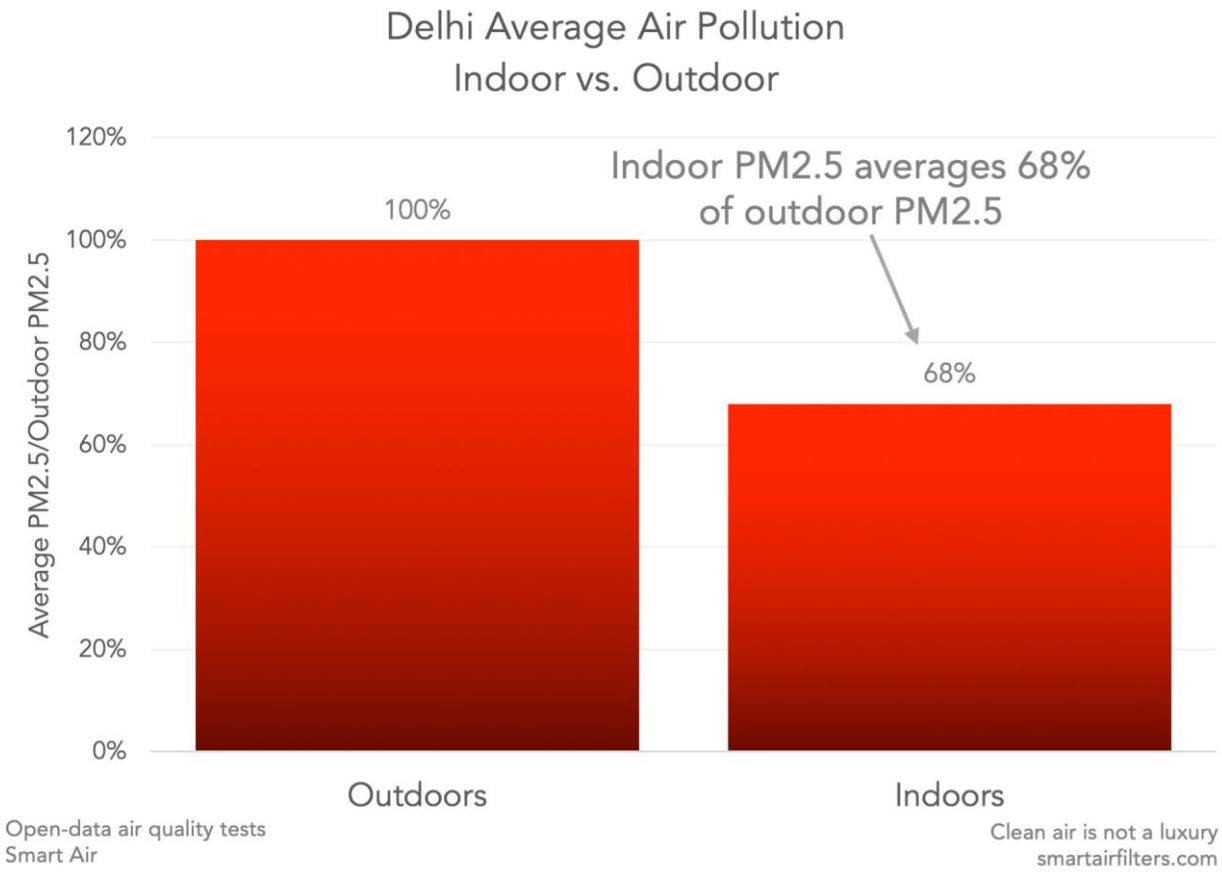


When creating the survey, I made a concerted effort to get a mixed sample of people so that the data would not be skewed toward any one type of household. Therefore, I sampled from individuals in low-income households, middle-income households, and high-income residential areas. Additionally, I also sampled individuals living in informal settlements and slum areas because they tend to experience more difficulties with accessing energy. Thereby providing a better overall understanding of the situation. The survey also contained some opinion-based questions to allow the participant to share their experience and opinion regarding energy use and health.

6. Secondary Data

Indoor Air Pollution & Air-Inequality Data (Delhi)



Data Interpretation

Indoor PM2.5 levels are approximately seven times greater than the safe level, indicating that even indoor air is not safe for breathing over long periods of time. This illustrates that the issue of pollution in Delhi is a problem both outdoors and indoors.

There are only 259 hours of clean comfortable air available per year, indicating that the access to safe air for residents of Delhi is extremely limited. Most residents are exposed to unhealthy indoor air for the majority of the year, which leads to long-term health impacts.

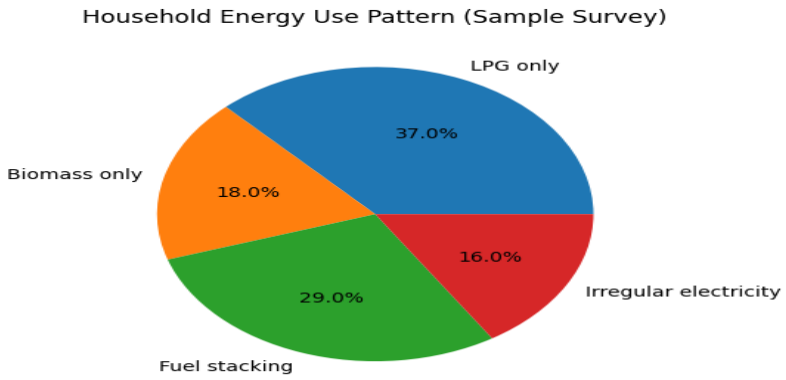
Long-term exposure to high levels of PM2.5 has been directly connected to various forms of illness. Long-term exposure to high levels of PM2.5 is a contributor to respiratory diseases, cardiovascular illnesses, and other health issues related to pollution. The information presented illustrates how air pollution creates a significant public health burden on urban populations.

Indoor air pollution affects all groups in the urban population; however, access to mitigation strategies (e.g., air purifiers, improved ventilation systems, safer fuel) varies significantly from one household to another. This results in a disparity of air quality or "air inequality" in which wealthier households may have access to slightly better air quality than lower-income households. Yet, both groups are breathing air quality above acceptable levels.

The data reviewed collectively illustrates that indoor air pollution is an ongoing challenge in Delhi due to the quality of outdoor air, the behaviour of households, and their socio-economic position.

7. Results

I conducted interviews with 100 people from five different locations throughout Delhi, including North, South, East, West, and Central areas. To help me gain a complete view of energy use by women, I chose participants from all types of households, including low-income housing, slums, and high-income residential areas. The selection of people from each of those areas helped me compare energy access between the different parts of the city. In general, the results of the interviews confirmed that people in areas with lower incomes and people living in informal settlements experienced more challenges accessing traditional fuel sources and electricity, had higher health-related issues than women who lived in relatively higher-income areas, and had less access to clean and reliable energy than women in higher-income areas.



The pie chart illustrates the different sources of energy used by different households. As the pie chart indicates, many people in Delhi continue to use LPG, a clean-burning fuel; therefore, the results of my

survey indicate that clean fuels are available in many homes in Delhi. However, there are still a significant number of households that use more than one type of fuel for cooking, which is referred to as "fuel stacking"; for example, some households use both LPG and biomass. Additionally, there are still some households in Delhi that rely entirely on biomass for cooking, which is detrimental to health and socioeconomically. The pie chart indicates that a majority.

Another phenomenon elicited from the current study, due to the latest war between Iran and Israel, was that the rise in world prices has severely influenced the price and availability of LPG (Liquefied Petroleum Gas). So, many low-income households no longer have access to LPG on a regular basis. As a result, they are reverting to other less expensive sources of cooking fuel or energy for their daily activities.

In addition, women in low-income and/or informal settlements must also deal with additional barriers such as high costs of LPG refills, use of dirty fuels, ongoing power outages, and health concerns (e.g., coughing, eye irritation, headache, and stress). There seems to be a slight advantage for women living in middle- or high-income areas with regard to access to fuels or other sources of energy as their opportunities to find nutritional sources or cook with cleaner energy sources are somewhat greater. However, the management of energy use remains primarily the responsibility of women in both middle- and high-income households.

The study also indicated that women often have little or no influence in the decision-making processes affecting their energy use within their home or community. Most of those who expressed concern for this situation stated they were not included in any local decisions on these issues.

The findings of this study reveal how the characteristics of energy affect the quality of life for women in terms of their health, comfort levels and activities from day to day.
Energy policies should be further focused upon making energy more cost-effective, increasing available power so that women have access to sufficient amounts of energy, and increasing women’s participation in making decisions regarding energy services.
The findings of the study link directly back to the research questions that were established during the planning process. The evidence from this research has shown that access to energy means that women experience fewer health-related problems in Delhi urban housing (settlements). Increased availability of clean and regular energy eliminates respiratory illnesses, eye irritation or inflammation and headaches, as well as reducing emotional and psychological stress associated with smoke and poor environmental conditions.
Furthermore, the evidence in the study shows that there exist inequities in how energy resources are managed and distributed in both low-income and informal economies, where people who have low or no access to energy produced by renewable resources have the most difficulty.

Policy Framework (from Findings of Study)

- Making Clean Energy, Such as LPGs and Electricity, More Available for Low Income Households, So That They Do Not Return To Using Harmful Fuels.
- Providing Electricity To All Areas, Including Slums and Informal Settlements, To Reduce Daily Burdens Placed on Women.

- Increasing Awareness About Energy Programs, Subsidies, and Safe Energy Use, As Many Individuals Are Not Fully Aware.
- Involving Women in Decision-Making at Household and Community Level, So That They Are Considered When Determining What Is Needed.
- Creating Local Community or Women's Groups to Discuss Issues Related to Energy and Finding Solutions At a Local Level.
- Providing Support for Using Clean, Safe Technologies, Such as Improved Cook Stoves or Other Affordable Alternatives.
- Enhancing Safety Measures Associated With Wiring, LPG Use, and Periodic Inspection to Minimize Risk and Reduce Stress for Women.
- Policies Need to Be Developed Not Only To Increase Access To Energy, But Also To Ensure Equitable Distribution of Energy Services, So That All Women, Including Marginalized Women, Return Appropriate Services.

8. Conclusion

The research supports that women's energy consumption is linked to the impact of energy access on their health and their everyday lives in the city of Delhi. Women are disproportionately affected by energy-related issues, particularly those with lower income or without formal income situated in informal settlements and urban slums, such as: high cost of household fuels, irregularity of electricity supply, and use of unsafe household fuels are much more prevalent in these areas. Although there are some improvements in the accessibility of clean fuels for cooking, many women still do not have access to them frequently; therefore, it is still necessary to develop other effective means of providing an adequate household fuel supply for women who need them. The report demonstrates that the number of women involved in making energy supply-related decisions is very limited thereby placing additional burdens on these women and limiting the ability of women to pursue entrepreneurial endeavours where energy utilization can provide the motivation for women to empower themselves, become self-sufficient, and provide for their families.

The information presented for the above paragraphs correspond ruptively with the presumptions that were originally placed upon them. The assumptions that were found in this study were supported by the findings and a conclusion concerning the study's objectives has been made. The connection between energy access, energy inequality, and women's health has been outlined in the report and the author has illustrated that there is an increased need for improving policy-making around both energy supply and utilization by all individuals equally.

Definitions

1. Energy Justice - Fair distribution of energy access, benefits and decision-making throughout society.
2. Women's Health - Women’s physical and mental health and wellbeing affected by social and environmental aspects of their lives.
3. Energy Inequality - Different groups of people do not have access to similar energy services.

4. Urban Energy Systems - The infrastructure and systems that provide energy to cities.
5. Gender Inequality - The difference between men and women in terms of roles, opportunities and rights.
6. Energy Access - The availability of affordable, reliable and clean forms of energy to households.
7. Energy Poverty - No access to the required basic modern energy services necessary for daily living.
8. Energy Insecurity - Unstable or unreliable access to energy is having an impact on quality of life.
9. Clean Energy Access - Access to clean/non-polluting forms of energy like: liquefied petroleum gas and electricity.
10. Household Energy Use - The ways (patterns) in which homes consume energy for their daily activities.
11. Fuel Stacking - Using multiple fuels (both clean and traditional) at the same time for producing heat or cooking food.
12. Cooking Fuels (LPG, biomass, kerosene) - Different sources of energy used to prepare food for consumption.
13. Electricity Reliability - Reliability/consistency of delivery (power going out) of electricity consistently without electricity going off frequently.
14. Energy Affordability - The extent to which households are able to pay for energy services without significant financial hardship.
15. Indoor Air Pollution - The existence of hazardous, or noxious pollutants produced from fuels and daily activities inside homes.
16. Indoor PM2.5 Levels - The level of fine particulate matter (PM2.5) found in the air we breathe which affects our respiratory health.

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