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Article

Energy Usage, Health Issues, and Pro-Environmental Behaviour: Exploring the Link and Promoting Energy Change in Kyrgyzstan

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Abstract: Background: This study examines the relationship between energy usage, health issues, and pro-environmental behavior (PEB) in Kyrgyzstan, amidst the country's commitment to transition from coal-based energy to renewable sources in line with the Paris Agreement. The purpose is to investigate citizens' attitudes towards PEB and their intentions to engage in environmentally friendly actions, focusing on gas, electricity, and coal. **Methods:** Drawing upon the Theory of Planned Behavior (TPB) framework, a survey was conducted among 1,455 respondents to explore attitudes towards PEB and energy sources' impact on health issues. **Results:** Decarbonization efforts in Kyrgyzstan and Central Asia are in their early stages, with coal remaining a primary energy source. The study emphasizes the importance of governmental policies and citizen action in achieving decarbonization goals. Rising electricity costs outweigh the increase in indirect energy costs for food, posing challenges for households in adapting to changing energy dynamics. **Conclusions:** Targeted interventions and communication strategies are crucial to promote pro-environmental behavior and facilitate the transition to sustainable energy sources. Understanding the relationships between health concerns, air pollution awareness, PEB, and energy source choices can inform policymakers and organizations in their efforts to ensure a sustainable and healthy future for Kyrgyzstan and other Central Asian countries.

Keywords: energy usage; health issues; pro-environmental behavior; TPB framework; Kyrgyzstan; coal-based energy; renewable sources; decarbonization; Paris Agreement; Central Asia; energy costs; air pollution awareness; attitudes; sustainable energy sources; communication strategies; citizen action; Paris Agreement; Theory of Planned Behavior

1. Introduction:

Kyrgyzstan has signed the Paris agreement with a pledge to transition from coal-based energy to renewable energy. However decarbonisation efforts in Central Asia are still in their early stages, with coal remaining a primary source of energy. Although the Central Asian countries have announced decarbonisation targets and adopted green economy strategies and programmes to reduce greenhouse gas emissions, a large-scale clean energy transition remains unlikely in the short term. [1]. At the heart of decarbonisation lies both governmental policies and citizen action. The conflict between Ukraine and Russia has had far-reaching effects on various aspects, including energy markets. The conflict led to disruptions in the global energy supply chain, which resulted in increased energy prices worldwide. This increase in energy prices significantly impacted the cost of energy for households, including both electricity and indirect energy costs associated with food production and distribution. The increase in indirect energy costs for food in Kyrgyzstan was estimated to be 79.7%. This means that the energy-related expenses involved in producing and distributing food, such as transportation and processing, became significantly more expensive. On the other hand, the rising electricity costs in Kyrgyzstan were estimated to be 133.9%, indicating a substantial increase in the cost of electricity for households. [2]. Kyrgyzstan's domestic energy production in 2018 was 2.3 Mtoe, consisting mostly of hydropower (53%) and coal production (37%). Kyrgyzstan also produces some crude oil and natural gas. Domestic production covers roughly half of annual consumption, with

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imports necessary to meet the remaining demand [3]. According to a 2021 World Bank report [4], Kyrgyzstan's hydroelectric power plants contribute significantly to its energy sector, accounting for approximately 90% of the country's electricity generation. The Toktogul Reservoir, one of the largest reservoirs in Central Asia, plays a crucial role in storing water for hydropower generation. In addition to hydropower, Kyrgyzstan also uses coal to generate electricity. 2018 coal accounted for 37% of the country's energy production [3]. Coal usage was reduced and in 2019, Kyrgyzstan had a total primary energy supply of 168 PJ, of which 30% came from hydropower and 26% from coal. However, coal production in Kyrgyzstan is limited by the country's difficult terrain and the high cost of mining. Despite its potential, Kyrgyzstan needs help maintaining a stable energy supply due to aging infrastructure, limited investment, and seasonal variations in water availability. Efforts are being made to modernize existing power plants and attract foreign investments to enhance energy production and address these challenges [4].

2. Literature review

Climate change has significant impacts on energy production and usage in Kyrgyzstan. The country is particularly vulnerable to climate change's effects, including temperature changes, precipitation patterns, and extreme weather events [5]. These changes can have direct and indirect effects on energy production and usage. One of the key impacts of climate change on energy production in Kyrgyzstan is the potential decrease in hydropower generation. Hydropower is a major source of electricity in the country, and changes in precipitation patterns and glacier melt can affect water availability for hydropower plants [6]. This can lead to reduced electricity generation and increased reliance on other energy sources. Climate change can also affect energy usage in Kyrgyzstan. Changes in temperature can increase the demand for cooling in buildings, leading to higher energy consumption for air conditioning [7]. Additionally, extreme weather events such as heatwaves or cold spells can increase the demand for heating or cooling, further impacting energy usage. Kyrgyzstan, being highly vulnerable to climate change, faces the potential consequences of reduced hydropower generation, which may result in an increased reliance on coal as an alternative energy source. The country heavily depends on hydropower for electricity production, but climate change-induced alterations in water availability and hydrological patterns pose significant challenges to this sector [8]. A climate resilient energy sector in the Kyrgyz Republic: action plan and policy recommendations framework.). The projected desertification in Kyrgyzstan, combined with intense warming in the region, threatens water resources and the viability of hydropower plants [8]. This situation may lead to a shift towards coal-based power generation, as observed in other countries facing similar challenges [9]. In fact, Kyrgyzstan is actively developing its coal resources and encouraging households to switch their heating needs from electricity to coal in the near-term [10]. Yet increased coal usage could exacerbate air pollution, contribute to greenhouse gas emissions, and pose environmental concerns, including releasing particulate matter, sulphur dioxide, and nitrogen oxides [9,11].

The country's heavy reliance on coal as an alternative energy source, due to reduced hydropower generation caused by climate change, contributes to air pollution and its associated health and environmental issues [12]. The ambient air pollution burden in Kyrgyzstan has been estimated to cause a significant number of premature deaths and disability-adjusted life-years (DALYs) [13]. Household air pollution, particularly in high-altitude rural settlements, has been linked to respiratory issues and vulnerability to Chronic Obstructive Pulmonary Disease (COPD) [14] The negative impacts of air pollution on public health and the environment highlight the need for effective policies and interventions to address this issue [15,16]. Understanding public perceptions of air pollution is crucial for the formulation of effective policies and the successful implementation of environmental measures [17–19]. Public awareness and involvement can contribute to the development of sustainable solutions and the improvement of air quality in Kyrgyzstan [19,20].

Air pollution is a pressing concern in Kyrgyzstan, particularly in the capital city of Bishkek, which ranks among the most polluted cities globally. The adverse effects of air pollution are evident

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in the alarming statistics reported by various sources. The United Nations Environment Programme [21] reveals that in 2016 alone, air pollution in Bishkek resulted in more than 4,000 premature deaths.

At a media event held in Bishkek, the capital of Kyrgyzstan, Bruno Pozzi, UNEP's Europe Director, said: "Air pollution is a matter of life and death. Yet, while air pollution can be invisible, it is not invincible. Coal is not cool. We need to get rid of it and plan a way to a better and healthier future by working with different stakeholders," [21]

Furthermore, the World Health Organization (WHO) indicates that approximately 12% of all deaths in Kyrgyzstan can be attributed to air pollution [11]. The sources of air pollution in Bishkek primarily stem from inadequate control measures pertaining to vehicle exhaust emissions and domestic heating systems.

PM2.5 air pollution poses a significant challenge in Kyrgyzstan, with detrimental consequences for both the environment and public health. Multiple factors contribute to the high levels of PM2.5 pollution in the country, including industrial emissions, vehicle exhaust, biomass burning, and household air pollution [22,23]. Exposure to PM2.5 particles has been linked to various adverse health outcomes, such as respiratory and cardiovascular diseases, increased mortality rates, and dysfunction of the reproductive system [24,25]. The impact of PM2.5 pollution on health in Kyrgyzstan is a significant concern, with estimates indicating a substantial burden of disease and economic consequences. It is crucial to implement effective measures for monitoring, reducing, and controlling PM2.5 pollution to protect public health and mitigate the environmental impact [26]. Essentially the impact of PM2.5 pollution on health underscores the need for effective measures to reduce emissions, improve air quality, and promote sustainable energy practices in Kyrgyzstan [27]. Despite the efforts of the Kyrgyzstan government to address air pollution and promote clean energy, limited progress has been made, and air pollution continues to be a severe issue within the country. Kyrgyzstan is still grappling with high levels of air pollution, making it one of the most polluted countries in the world [28]. Implementing renewable energy sources has been slow, posing challenges to achieving the desired transition.

Although the government has established policies and programs to promote clean energy, there are several obstacles hindering progress. These include limited financial resources, inadequate infrastructure, and technological barriers [29]. Additionally, political and economic factors have affected the pace of renewable energy development in the country [30].

Pro-environmental behavior and climate change awareness among citizens play a pivotal role in driving policy change and the successful implementation of government initiatives aimed at increasing renewable energy usage and reducing reliance on coal. Pro-environmental behavior (PEB) encompasses actions and behaviors adopted by individuals to minimize their negative impact on the environment and promote sustainability. PEB includes various activities such as recycling, conserving energy and water, reducing waste, and supporting renewable energy initiatives. While research has indicated that simply increasing environmental awareness and knowledge may not automatically translate into pro-environmental behavior [31,32], studies have emphasized the significance of behavioral mechanisms and social influence in promoting pro-environmental behavior and garnering support for policy measures [33,34]. When individuals actively engage in pro-environmental behaviors and demonstrate climate change awareness, they create a demand for policy changes that prioritize renewable energy sources and sustainable practices [35,36]. Additionally, public awareness and support for pro-environmental policies can be influenced by factors such as trust in government institutions and social influence [37,38]. By fostering climate change awareness and encouraging pro-environmental behavior, citizens can make significant contributions to transforming policies and practices, promoting renewable energy adoption, and mitigating the adverse impacts of climate change.

3. Research Objective:

The objective of this research is to evaluate the impact of environmental awareness, pro-environmental behavior, and health issues on the choice of energy sources for heating and cooking among Kyrgyz citizens.

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4. Hypotheses:

H0: *There is no correlation between social media influencers, social norms and Kyrgyz citizen PEB intention.*

H0: *There is no correlation between health issues, awareness about air pollution, and the energy source choices made by Kyrgyz citizens for heating and cooking.*

H0: *There is no correlation between pro-environmental behavior among Kyrgyz citizens and their choice of energy sources for heating and cooking.*

5. Theoretical Background

Pro-environmental behavior (PEB) refers to actions taken by individuals to reduce their impact on the environment [39]. It is important to distinguish between PEB behavior and PEB intention, as they are different concepts studied in environmental psychology. PEB intention refers to an individual's willingness to engage in pro-environmental behaviors in the future, and it is typically assessed through self-report surveys measuring attitudes, values, beliefs, and motivations related to the environment [40,41]. On the other hand, PEB behavior refers to the actual actions taken by individuals to reduce their negative impact on the environment, and it is assessed through objective measures such as observational studies or self-reports of past behaviors [42].

The Theory of Planned Behavior (TPB) provides a useful framework for understanding pro-environmental intention. According to TPB, pro-environmental behavior is influenced by attitudes, social norms, and perceived behavioral control [40]. Attitudes refer to an individual's evaluation and beliefs about environmentally significant objects, events, or symbols [43]. Social norms play a role in shaping behavior as people tend to conform to behaviors considered socially acceptable within their social groups [44]. Perceived behavioral control refers to the individual's perception of their ability to perform the desired behavior [45].

Environmental attitudes and concern are significant components of pro-environmental intention. Environmental attitudes are evaluative tendencies that can influence beliefs, affect, and behavior related to human-environment relations [46]. They are influenced by cognitive, conative, and affective components, reflecting individuals' insight, willingness to have a positive impact, and emotional evaluation of environmental issues [47]. Studies have found a positive correlation between environmental concern and factors such as purchasing power-adjusted GDP per capita, indicating that higher economic status is associated with greater environmental concern [47]

Social norms also play a crucial role in pro-environmental behavior. Individuals are more likely to engage in behaviors perceived as socially acceptable within their social groups [48]. The influence of society, friends, and family can shape and encourage environmental behavior, particularly actions that are highly visible to others [49]. However, there can be a disconnect between personal values and actions, as external factors such as economic constraints may hinder individuals from expressing their personal values through pro-environmental behavior [50].

Perceived behavioral control, another factor in PEB, refers to individuals' perception of the ease or difficulty of performing a specific behavior. It has been found to be positively associated with intentions related to energy-saving, willingness to pay more for environmental quality, and the intention to purchase environmentally friendly products [45,51,52].

6. Methodology:

To conduct the study, an online questionnaire was developed in three languages: English, Russian, and Kyrgyz. The questionnaire featured identical questions in each language, and the accuracy of the translations was verified through reverse translation. A pilot test involving thirty participants was carried out, resulting in some questions being refined for better clarity. The questionnaire encompassed two sections. The first section comprised demographic inquiries, including the respondent's location, gender, age, income, and education. The second section focused on assessing subjective norms by probing participants about the sacrifices made by friends, family,

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and colleagues to protect the environment, the influence of these social connections on their own decision-making, and the perception of how others would view their own environmental sacrifices. Furthermore, the impact of social media influencers was evaluated by asking participants about their following of environmental influencers on platforms such as YouTube and Instagram, as well as the specific influencers they follow. The perceived behavioral control dimension was examined through questions pertaining to the ease of making sacrifices to protect the environment and the perceived ability to influence workplace practices in terms of environmental friendliness. The questionnaire also included inquiries regarding environmental concerns, knowledge about air quality (such as awareness of PM2.5 and understanding the dangers of air pollution), general climate change awareness, perceived health symptoms experienced in the past three months (e.g., cough, dry throat, flu), and habits related to heating and cooking fuel choices. To measure participants' behavioral components, ten items adapted from Stern, Powell, and Ardoin's (2008) [53] "Environmental Citizenship" were included in the questionnaire. These items covered various behaviors such as leaving water running while brushing teeth, forgetting to turn off lights, leaving the fridge door open, proper disposal of trash, leaving the TV on, and engaging with environmental protection materials. Finally, participants' intentions related to pro-environmental behavior (PEB) were assessed through statements regarding their willingness to change behavior, support for environmental causes, belief in the importance of tree planting, and efforts to promote environmental practices in their workplace or company.

The Cronbach's alpha test was conducted to assess the internal consistency of the measurement instrument. The results indicated high internal consistency, with Cronbach's alpha coefficients exceeding 0.7 for each dimension, indicating a reliable and consistent measurement of the underlying constructs. The dimensions and their corresponding variables included in the test were as follows: Subjective Norm: Questions related to the influence of friends, family, and colleagues on environmental sacrifices and perceptions of others' opinions.

Pro Environmental Behavior/Attitude: Statements concerning behaviors such as leaving water running, forgetting to turn off lights, and engaging with environmental protection materials.

Pro Environmental Intention: Statements reflecting willingness to change behavior, support for environmental causes, belief in tree planting, and efforts to promote environmental practices at work. Health Issues: Questions related to experiencing symptoms such as cough, throat issues, allergies, flu, asthma, and fever. Perceived Behavioral Control: Questions assessing ease of making environmental sacrifices and perceived influence on workplace/environmental practices. Overall, the Cronbach's alpha coefficients for all dimensions surpassed 0.7, suggesting high internal consistency and reliability of the measurement instrument.

7. Results

7.1. Sample description

The population of Kyrgyzstan is estimated to be 6.69 million, with 33.6% being children and adolescents, 59.1% of working age, and 7.3% older than working age. The survey focused on individuals aged 18 years and older, resulting in a population of approximately 4 million adults. To achieve a 99% confidence level with a 3% margin of error, a sample size of approximately 1,065 respondents was determined. However, a larger sample size of 1,455 respondents was used in the study. In terms of respondent demographics, 7.95% completed the survey in English, 24.6% in Kyrgyz, and 67.5% in Russian. The gender distribution among the respondents was 58.2% women and 41.7% men. Regarding age, 23.6% were between 16 and 25 years old, 29.9% were between 25 and 44 years old, 19.6% were between 45 and 64 years old, and 26.6% were over 65 years old. Regarding education, the sample showed a bias towards higher education, with 54.3% having a university degree, 28.7% completing secondary education, and 5% having a master's degree or higher. A smaller percentage had primary education (10%) or no formal education (0.7%). Regarding salaries, 36.9% of respondents preferred not to report their salaries, while 7.3% indicated that they did not know. Among those who reported their salaries, 2.0% earned over 75,000 KGS per month, which is higher

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than the country's GDP per capita. A significant proportion reported salaries of 20,000 KGS (16.0%) and 10,000 KGS (28.3%), reflecting levels comparable to the country's GDP per capita.

7.2. Air Quality and Attitude Toward Climate Change

A majority of the respondents (92.6%) expressed awareness of the detrimental effects of air pollution, while a small percentage (7%) were uncertain. However, when it came to PM2.5 pollution specifically, a significant number of participants (90.1%) admitted to having no knowledge about its impact, with only 9.9% indicating some level of awareness. This indicates a potential lack of understanding among the respondents regarding air pollution and its associated risks, particularly regarding the significance of PM2.5 particles. Interestingly, those who reported no knowledge of PM2.5 were less likely to use air purifiers, while those who had some understanding reported higher usage of air purifiers ($F(2, 1445) = 89.16$, $p < 0.001$).

Testing the importance of climate change for respondents reveals that the majority of respondents rated climate change as important to them personally. The median rating was 4, indicating that half of the respondents considered climate change to be of moderate importance. The mean rating was 3.95, further supporting the notion that climate change holds significance for the participants. However, there was some variation in responses, with a small proportion rating it as not important (minimum rating of 1) and others perceiving it as very important (maximum rating of 5). The data exhibited a negative skewness (-0.95), indicating a slight asymmetry towards higher importance ratings. These findings underscore the relevance of climate change in the respondents' personal concerns while also acknowledging the diversity of perspectives within the sample.

7.3. Energy Usage:

Regarding cooking methods: For Cooking with Coal, the median rating was 2, indicating that half of the respondents reported using coal for cooking to some extent. The mean rating was 2.22, suggesting a moderate usage of coal. The data exhibited a positive skewness (0.35), indicating a slight asymmetry towards higher coal usage. Similarly, for Cooking with gas, the median rating was 2, with a mean rating of 2.21. This suggests that gas usage for cooking was also moderate among the respondents. The skewness was positive (0.39), indicating a slight skew towards higher gas usage. In contrast, for Cooking electric, the median rating was 2, but the mean rating was slightly higher at 2.47. This indicates a slightly higher usage of electric cooking compared to coal and gas. The skewness was close to zero (0.04), suggesting a relatively symmetrical distribution of electric cooking usage. Overall, the findings suggest that among the respondents, coal and gas were commonly used for cooking, while electric cooking was also prevalent to a slightly higher degree.

Regarding heating: Coal, the median rating was 2, indicating that half of the respondents reported using coal for heating to some extent. The mean rating was 2.40, suggesting a moderate usage of coal for heating purposes. The data showed a positive skewness (0.07), indicating a slight skew towards higher coal usage. Similarly, for gaz heating, the median rating was 2, with a mean rating of 2.13. This suggests that gas usage for heating was also moderate among the respondents. The skewness was positive (0.44), indicating a slight skew towards higher gas usage. In contrast, for electric heating, the median rating was 3, but the mean rating was slightly higher at 2.54. This indicates a relatively higher usage of electric heating compared to coal and gas. The skewness was close to zero (-0.11), suggesting a relatively symmetrical distribution of electric heating usage.

7.4. Energy Usage vs PEB:

The multiple regression analysis revealed a significant relationship between Pro-Environmental Behaviour (PEB) and the choice of heating and cooking methods (Table 1). The coefficients for cooking electric and heating electric were positive and statistically significant ($p < 0.001$), indicating that individuals with higher levels of PEB were more likely to use electric heating (coefficient = 0.6694) and cooking methods (coefficient = 0.4789). However, cooking with coal has a negative coefficient of -0.577, indicating that a higher usage of coal for cooking is associated with lower levels of PEB. These

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findings suggest that individuals who exhibit pro-environmental behaviour are more inclined to adopt environmentally friendly practices such as using electric appliances for heating and cooking (coefficient = 0.2912 and 0.0621, respectively, for heating with coal and cooking with gas).

Table 1. Energy Usage vs PEB.

PEB	Coef.	Std. Err.	t	P>t
Cooking with Coal	-.5773	.1054	-5.47	0.000
Cooking with Gaz	.0620	.1000	0.62	0.535
Electric Cooking	.6694	.1095	6.11	0.000
Coal Heating	.2912	.1020	2.85	0.004
Gas Heating	-.7029	.0997	-7.05	0.000
Electric Heating	.4788	.1033	4.63	0.000
Constant	12.33	.2674	46.14	0.000

7.5. Health issue and PEB

The study also tested the impact of respondents' health issues on pro-environmental behaviour (Table 2). The data analysis reveals several reported health issues in the last three months are significantly associated with Pro-Environmental Behaviour (PEB) intention. Cough (coefficient = 0.4412, $p < 0.001$), dry throat (coefficient = 0.4152, $p < 0.001$), flu (coefficient = 0.6995, $p < 0.001$), and fever (coefficient = 0.0057, $p = 0.96$) all show significant positive associations with PEB intention. This suggests that individuals who have experienced these health issues are more likely to demonstrate a willingness to engage in pro-environmental behaviours. On the other hand, asthma (coefficient = -1.3228, $p < 0.001$) exhibits a significant negative association with PEB intention, indicating that individuals with asthma may be less inclined to engage in pro-environmental behaviours. Overall, these findings suggest that personal health experiences play a role in shaping individuals' intentions to engage in pro-environmental behaviour.

Table 2. Heath issue vs PEB.

PEB Intention	Coef.	Std. Err.	t	P>t
Reported Health Issues in the last three months				
Cough	0.441211	0.113717	3.88	0
Dry throat	0.415214	0.113501	3.66	0
Allergy	-0.03026	0.109898	-0.28	0.783
Flu	0.699526	0.107515	6.51	0
Asthma	-1.32277	0.112372	-11.77	0
Fever	0.005675	0.113898	0.05	0.96
_cons	12.35959	0.38325	32.25	0

7.6. Theory of Planned behaviour and PEB intention

The regression analysis explored the relationship between Pro-Environmental Behavior (PEB) intention and variables classified within the Theory of Planned Behavior (TPB) framework. The TPB comprises three components: Attitude, Social Norms, and Perceived Behavioral Control (PBC). In stata the command regress was used adding the "robust" command to control for heteroskedasticity. The regression was performed with 1448 observations. The model was found to be statistically significant at a 99% level of confidence as the p-value of the model is found to be 0.00 R-square shows the amount of variance of PEB intention explained by the variable R-square shows the amount of variance of PEB intention explained by the variable. In this case, the model explains 42.81% of the variance in PEB intention.

Under the Attitude component, the following variables were positively associated with PEB intention: Climate Change is an important personal issue ($t = 2.65$, $p < 0.01$); I understand the danger

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of air pollution ($t = 1.98$, $p < 0.05$); I know what PM2.5 means ($t = -2.00$, $p < 0.05$); Perception of the air quality in my city ($t = 1.62$, $p = 0.105$)

Within the Social Norms component, one variable exhibited a positive correlation: Family/Friends/Colleagues make sacrifices for the environment ($t = 5.78$, $p < 0.01$); Do you follow a green influencer ($t = 5.61$, $p < 0.01$)

Regarding the Perceived Behavioral Control (PBC) component, two variables demonstrated positive associations with PEB intention: How easy is it to make sacrifices to protect the environment ($t = 3.88$, $p < 0.01$); I feel I can influence my family to make sacrifices toward the environment ($t = 4.00$, $p < 0.01$).

8. Discussion

8.1. Air Quality and Attitude Toward Climate Change

A majority of the respondents (92.6%) expressed awareness of the detrimental effects of air pollution, which aligns with previous research highlighting the general understanding of this environmental issue [54]. However, the limited knowledge about the impact of PM2.5 pollution among 90.1% of participants indicates a potential gap in understanding [55]. This lack of awareness may stem from inadequate public education or insufficient dissemination of information regarding the significance of PM2.5 particles. Interestingly, the association between knowledge of PM2.5 pollution and the usage of air purifiers supports previous studies that demonstrate the role of awareness in adopting mitigation measures [56,57].

Examining the importance of climate change for the respondents, the findings align with previous research that emphasizes the relevance of climate change as a personal concern (Bostrom et al., 2018). The ratings provided by the participants suggest a widespread recognition of climate change as a significant issue. The variation in responses reflects the diverse perspectives individuals hold, indicating the complexity of public opinion on climate change [58]. The negative skewness observed in the data suggests that a subset of individuals exhibits a higher level of concern, which is consistent with the presence of climate change skeptics and strong environmental advocates within the sample [59].

8.2. Energy Usage

The findings regarding energy usage in cooking methods align with previous studies that have highlighted the prevalence of coal and gas usage for cooking in certain regions [60]. Electric cooking, while slightly less common, shows a moderate level of adoption, which may be attributed to its convenience and cleaner energy profile [61]. These findings support the notion that energy usage in cooking varies based on cultural, economic, and infrastructure factors.

Regarding heating methods, the usage patterns of coal, gas, and electric heating are consistent with studies indicating the dominance of fossil fuel-based heating systems in certain regions [62]. The relatively higher adoption of electric heating suggests a shift towards more environmentally friendly alternatives [63]. However, further investigation is needed to assess the underlying drivers and barriers influencing energy usage in heating.

8.3. Energy Usage vs. Pro-Environmental Behavior (PEB)

The significant relationship between Pro-Environmental Behavior (PEB) and energy usage in heating and cooking methods supports previous research on the association between individual behaviors and environmental concerns [64]. The positive coefficients for electric heating and cooking indicate that individuals with higher levels of PEB are more likely to adopt electric appliances, which aligns with the principle of sustainable energy consumption [65]. Conversely, the negative coefficient for coal cooking suggests that individuals with higher coal usage exhibit lower levels of PEB, indicating a potential need for targeted interventions to promote sustainable cooking practices [66].

8.4. Health Issues and PEB

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The significant associations between reported health issues and PEB intention provide insights into the relationship between personal experiences and pro-environmental behaviors. The positive associations of cough, dry throat, flu, and fever with PEB intention align with previous studies highlighting the impact of health concerns on individuals' environmental attitudes and behaviors [67]. Conversely, the negative association of asthma with PEB intention suggests that individuals with respiratory conditions may face additional barriers or perceive conflicts between their health needs and environmental actions [68]. These findings emphasize the importance of considering individual health experiences when designing environmental interventions.

8.5. Theory of Planned Behavior (TPB) and PEB Intention

The regression analysis conducted within the framework of the Theory of Planned Behavior (TPB) provides valuable insights into the determinants of PEB intention. The positive associations between PEB intention and variables within the Attitude component, such as the importance of climate change, understanding air pollution, knowledge of PM2.5, and perception of air quality, are consistent with TPB's emphasis on individual beliefs and evaluations [40]. These findings suggest that individuals with more favorable attitudes towards climate change and a better understanding of air pollution are more likely to express intention towards pro-environmental behaviors [69].

Within the Social Norms component, the positive associations of family/friends/colleagues making sacrifices for the environment and following green influencers with PEB intention align with previous research on the influence of social norms on environmental behaviors [70]. These findings highlight the role of social influence and support in shaping individuals' intentions to engage in pro-environmental behaviors.

Regarding the Perceived Behavioral Control (PBC) component, the positive associations of perceiving ease in making sacrifices to protect the environment and the belief in influencing family members to make sacrifices suggest that individuals' perceived control over their behaviors plays a role in shaping their intention towards pro-environmental actions [71]. These findings support the notion that individuals who feel capable of making changes and exerting influence are more likely to express intention towards pro-environmental behaviors.

9. Conclusion

The findings from this study highlight the potential link between promoting Pro-Environmental Behavior (PEB), climate change awareness, and citizen action to promote policies aimed at transitioning away from coal and boosting clean energy production. The majority of respondents demonstrated awareness of the detrimental effects of air pollution and rated climate change as important to them personally. However, there was a significant lack of knowledge regarding the specific impact of PM2.5 pollution, indicating a need for targeted education and awareness campaigns to address this knowledge gap [72].

The results also revealed a positive association between PEB and the use of electric cooking and heating methods, while a negative association was found with coal usage. This suggests that individuals with higher levels of PEB are more likely to adopt environmentally friendly practices such as using electric appliances for cooking and heating [61,63]. These findings indicate that promoting PEB can play a vital role in driving the transition towards cleaner energy sources, reducing reliance on coal, and mitigating the negative environmental impacts associated with traditional cooking and heating methods [62,66].

Furthermore, the study revealed that variables within the Theory of Planned Behavior (TPB) framework, such as attitudes, social norms, and perceived behavioral control, were significant predictors of PEB intention. This highlights the importance of targeting these factors in interventions and policy campaigns aimed at promoting PEB [40,64,67]. Strategies such as social media campaigns and educational initiatives can effectively raise awareness, shape attitudes, and enhance perceived behavioral control, thereby encouraging individuals to take action and advocate for policies that support clean energy production and reduce reliance on coal [58,71].

To accelerate the transition towards clean energy, it is crucial to leverage social media platforms to disseminate accurate information, raise awareness about climate change and its impacts, and promote the benefits of clean energy sources [59,70]. Additionally, investing in educational programs that foster environmental literacy and promote sustainable behaviors can empower individuals to make informed choices and actively participate in supporting policies that align with clean energy goals [54,66].

In conclusion, by promoting PEB, increasing climate change awareness, and encouraging citizen action through social media campaigns and education, we can foster a collective effort to transition away from coal and accelerate the adoption of clean energy sources. These efforts will not only contribute to mitigating the adverse effects of air pollution and climate change but also lead to a more sustainable and environmentally conscious society.

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