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Identifying key barriers to electric vehicle adoption in Bangladesh: Insights from a survey

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Abstract

Electric vehicles (EVs) are emerging as a promising solution for reducing greenhouse gas emissions and mitigating environmental damage caused by traditional automobiles. This study examines the barriers to EV adoption in Bangladesh by focusing on various impediments, including technological, infrastructural, financial, behavioral, and external factors. Based on a survey of 111 individuals with substantial knowledge of EVs, this study explores the challenges impeding EV deployment, providing a deeper understanding of the factors that limit their widespread adoption. This research highlights that key obstacles include battery life limitations, inadequate infrastructure, high costs, and long charging durations. By assessing and prioritizing these barriers, the study offers valuable insights for administrators and policymakers to allocate resources effectively and address the most critical issues. The findings underscore the complex, multidimensional nature of EV adoption challenges in Bangladesh and provide actionable recommendations for enhancing decision-making and developing targeted policies to promote the adoption of EVs.

Keywords: electric vehicles; EV barrier in Bangladesh; EV adoption; decision-making framework.

I. Introduction

The automobile industry significantly contributes to emissions and air pollution in large urban areas. Roughly 25 % of the world's fossil fuel supply is used for transport, with a significant amount of this being utilized by transportation on roads. Transportation emits almost 14 % of global GHGs, making it a major contributor [1]. Transportation accounts for 24 % of fuel combustion-related CO_2 emissions, according to the 2020 IEA study [2]. The primary issue involves the fact that emissions originating from this sector are anticipated to increase gradually, reaching up to 70 % by the year 2050, if no changes are made to current practices [1]. EVs have gained significant traction in the worldwide automotive market in the twenty-first century.

The latest analysis indicates that the USA, Europe, and China achieved a remarkable sales record of 90 % in 2019, with approximately 0.326, 0.56, and 1.06 million EVs sold in each respective region [2]. The global electric vehicle fleet surpassed a value of USD 10 million in 2020. However, Figure 1 illustrates the total number of EVs sold in 2023. China stands out as the leading country in EV usage, followed by the United

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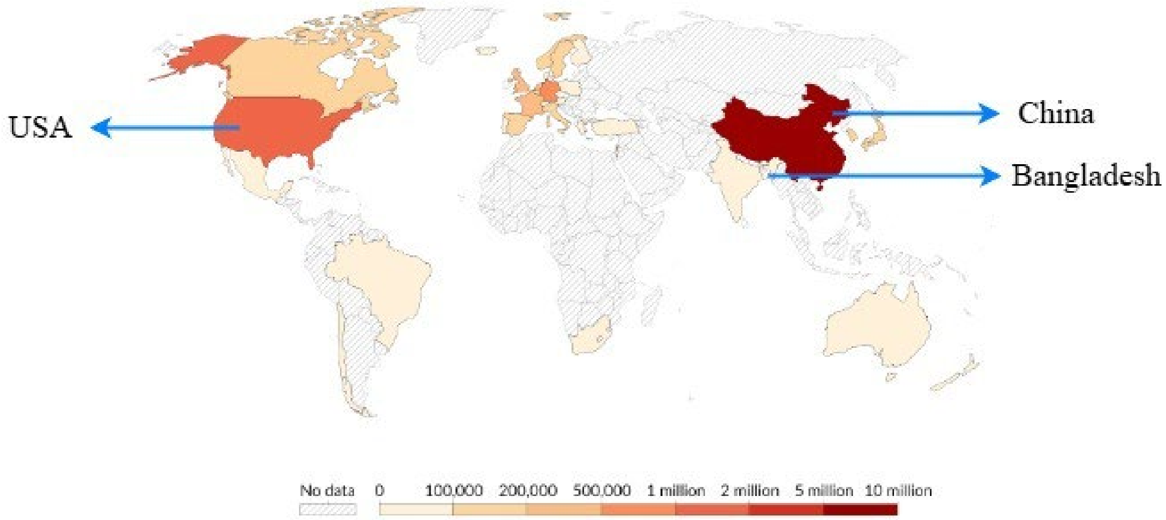

Figure 1. Number of new EVs sold in 2023 [9].

States, which ranks second. In contrast, Bangladesh remains in the early stages of EV adoption.

In 2019, global sales of EVs rose to 14 %, with Europe representing 80 % and Canada at 43 %, while China and the United States had steady sales. Electric car usage has also increased in other nations throughout the world, including 39.6 % in Norway, 10.61 % in Hong Kong, 3.32 % in the USA, 1.94 % in the UK, and 2.41 % in China [3][4]. EVs offer numerous benefits, such as reduced greenhouse gas emissions, enhanced safety, cost-effectiveness, and little maintenance requirements. They provide a sustainable solution to environmental issues, as seen by their increasing use and projected advancements. EVs provide a sustainable transportation choice as a substitute for internal combustion engine vehicles [5]. EVs have the capacity to diminish dependence on energy from fossil sources.

EVs, while eco-friendly, present challenges to the distribution system, such as higher system load from plug-in hybrid electric vehicle charging; this results in decreased substation capability for reserves and feeders' transmission of load capacities, along with charging for EVs peaks clashing with conventional distributing demands. Moreover, inconstancy in electric vehicle operating patterns causes consumer preferences to change [6]. Integrating the EV industry into utilities distributing load patterns has attracted considerable attention. An electric vehicle battery may consume up to double the amount of energy compared to a standard home. Managing the electricity system will become challenging as electric vehicle adoption increases [7]. Denmark embarked on a project to develop electric car battery storage to support the integration of large-scale wind generation [8]. Car-to-grid technology allows individuals who own EVs to provide electricity from their batteries to the system when energy demand is high. This strategy could guarantee the dependability and adaptability of the grid.

Three primary types of EVs exist worldwide: Hybrid electric vehicle, plug-in hybrid electric vehicle, and battery electric vehicle. In Bangladesh, battery electric vehicle is the most commonly used type of electric vehicle. Battery electric vehicles are driven by an electrical motor powered by a battery. Battery electric vehicles do not use energy from fossil fuels and produce lower emissions compared to hybrid electric vehicles and plug-in hybrid electric vehicles [10].

EVs are becoming more popular in developing and underdeveloped countries as well as wealthy countries. The adoption of EVs requires a large amount of power, which puts a substantial burden on the electrical grids and distributing systems. Most EVs in Bangladesh, such as easy-bikes, auto-rickshaws, and electric-bikes, are powered by batteries. Research revealed that over 0.5 million EVs are operational in Bangladesh, consuming 450 MW of electricity from the national grid every day [11]. Batteries get recharged with the help of a charger connected to an AC power source. The charging system is a non-linear equipment that reduces the quality of power through the production of harmonic and fluctuations in voltage. Connecting several chargers to distribution networks might lead to power quality issues [12].

Based on the 2021 IQAir study, Bangladesh was ranked first for having the highest annual average PM2.5 concentrations adjusted for population at 76.9 μg/m^3 [13]. Analyzing the pollution data collected in recent years shows, it is evident that Bangladesh is facing significant challenges with its pollution levels. In the current scenario, EVs can be a significant way to reduce the toxicity of air. Bangladesh has initiated a plan to ensure that 50 % of the population has access to EVs by 2050 [14].

The information on particular barriers and influences affects the uptake of EVs in countries such as Thailand [15], India [16] and Norway [17]. While accurate, a recent assessment curated a compilation of nationwide scientific literature relevant to EVs [18]. To gain a deeper understanding of the factors influencing EV purchases in Bangladesh, this study utilized a web-based questionnaire.

Many works have investigated the advantages of EVs as eco-friendly transport system. Several investigations have examined the market penetration through the analysis of government organizations, shareholders, and industries. This work centers on consumers pinpointing potential barriers to EV adoption.

A. Worldwide EV barriers

Specialists worldwide have examined EV market conditions in different regions, highlighted possible barriers to implementation [19][20], and provided research potential to improve laws and regulations. A study conducted [21] on the adoption of EVs in Europe has barriers such as insufficient electrical infrastructure for charging, excessive EV prices, lengthy charging times, increasing electricity demand for EVs, and a scarcity of battery raw materials. The study identified the high purchase price of EVs and the restricted availability of charging stations as significant obstacles to widespread EV adoption in the United Kingdom [22]. A survey in China found that safety, trustworthiness, and capacity are the main obstacles to EVs in terms of the perception of the public [23]. A study on hurdles to EV adoption in the market in Ireland found that a lack of promotions and understanding about EVs, with the lack of incentives, are significant obstacles [19]. An investigation conducted on an EV organization in [24] highlighted that consumer opposition to changing usage habits, high capital costs of EVs, and a lack of electrical infrastructure for charging were identified as the key factors leading to the failure of the studied organization. The study in [25] analyzes the progress of EVs in the US, highlighting the uncertainty surrounding EV technology and the minimal influence of public policies as hindering factors. The study also underscores the necessity for further research on EV obstacles to diminish uncertainty and establish a structure for making decisions for the development of policies. Customer habits, cognition, and perceptions significantly influence purchasing decisions, making it a crucial field for future research [26]. Collaboration among various electric vehicle stakeholders speeds up electric vehicle adoption, as shown in [27]. Another study on electric vehicle barriers in Sweden identified the absence of a robust incentives system as a major barrier to adoption [28].

B. EV categorization barriers

An analysis of an EV company emphasized the interconnected obstacles of social, technical, political, and environmental factors that led to its downfall [24]. A comprehensive review of e-mobility in Europe discovered barriers to EVs and categorized them into four main groups: infrastructural, economic, technical, and environmental [21]. A study investigated the obstacles hindering the widespread use of EVs in the Chinese market using a public assessment [23]. The barriers were classified as financial, infrastructural, and vehicle performance. EV adoption in thirty different nations was examined in [29], identifying barriers categorized into two categories: general and innovation. EV barriers were categorized into three distinct clusters: technological, financial/ economic, and attitudinal [30]. Scholars have used terminology like attitudinal, psychological, and behavioral interchangeably to refer to barriers associated with customer opinion, skepticism, and consciousness.

This study has refined earlier studies and categorized the barriers into five main groups: Financial, Infrastructural, Performance, Behavioral, and External depending on their origin, supported by scientific evidence. The EV barriers have been separated into twenty sub-barriers according to their features. Table 1 demonstrates a comprehensive literature overview categorizing EV barriers and sub-barriers.

C. Critique of reviewed literature with gaps

An investigative study in Section I (A) indicates the presence of multiple impediments to electric vehicle adoption, differing by location and circumstances due to a mix of distinct contextual elements [18]. The impact of regulations and incentives on eliminating obstacles varies significantly based on factors such as local and regional technology maturity, infrastructure development, consumer knowledge, and acceptance of EVs. In [21], the lack of current studies on examining barriers to electric vehicle adoption on a collective scale is emphasized. An integrated ecosystems strategy is necessary to address barriers effectively, as they appear to be interrelated, instead of addressing EV barriers on an individual basis [22]. Thus, creating policy suggestions tailored to a particular country necessitates thorough contextual analysis that emphasizes the interplay of barriers in addressing EV challenges effectively.

Table 1.
EV barriers and sub-barriers are considered from existing literature for evaluation [15].

Barrier Category	Sub-barrier	Explaination	References
Financial barrier	Cost of EV	Non-subsidized EV price	[31]
	Price of battery	Battery substitute expenses at the end of life	[32]
	Maintenance expenses of EV	EV maintenance expenses, excluding accident repairs	[33]
	The resale price of an EV	EV used-car price when resold	[34]
	EV fuel expenses	Costs of electricity for EVs	[33]
Performance barrier	Charging capacity	A fully charged range for driving is the maximum	[34]
	Strength of engine	Highest EV speed and acceleration	[35]
	Lifespan of battery	Degradation-induced battery longevity	[15]
	Time required for charging	Duration to completely energize EVs	[36]
	Safety	EV driving safety	[34]
	Size and styles	Market EV sizes and styles	[31][37]
	Reliability	EV reliability and dependability	[15]
Infrastructure barrier	Infrastructure availability at houses	Community charging constraint	[38] [39]
	Infrastructure availability at workplaces	Charging conditions at workplaces	[35]
	Infrastructure availability in public places	Publicly available charging counters	[40]
	Infrastructure availability on highways	Highway terminal for charging	[35]
Behavioral barrier	Awareness lacking	The electric vehicle sector is new	[15]
	Perception of consumers	Trust among consumers in EVs as a viable choice is minimal	[15]
External barrier	Battery wastage and recycling	Repurposing battery cells for alternative power preservation is ecologically worrisome and remains a barrier to sale.	[20][41]
	EVs advertisement	EV advantages and awareness are neglected	[20][27]

Various research studies have investigated diverse obstacles to worldwide EV adoption. Nevertheless, the impact of these impediments on EV adoption in Bangladesh has not been explored properly. This study examines the barriers in Bangladesh to address this research gap.

The research focused on identifying the key barriers to widespread EV adoption and examining how these obstacles impact societal acceptance and integration of EV technology in Bangladesh.

II. Materials and Methods

To achieve the research goals, a comprehensive methodology is used. This method is significant for comprehending views on the barriers to EV adoption in Bangladesh and the solutions to address these barriers. Figure 2 shows a graphical representation of the methodology used in this study.

A. Questionnaire design and survey

This study created the survey to uncover the obstacles to EV adoption in Bangladesh. These themes also include the present scenarios and future scopes of EVs in Bangladesh. This would allow stakeholders to prioritize the impediments that need to be addressed as a top priority.

Before widely distributing and finalizing the questionnaire, this study conducted a pilot phase with five experts who possess significant knowledge of EVs and the broader context of Bangladesh. These experts helped us trial the tool, ensuring that the questions were clear and relevant and effectively captured the key barriers to EV adoption in the country. The feedback from this pilot phase allowed us to refine the questionnaire and ensure its validity before launching the full survey. The complete questionnaire validation process is illustrated in Figure 3.

A survey was carried out online in Bangladesh, and questionnaires were utilized to find barriers to EV adoption. The survey questionnaire first targeted fundamental data such as gender, financial status of the household, number of family members, vehicle ownership, experience with driving, familiarity with EV varieties, and anticipated EV prices. Additionally, barriers to EV adoption were rated using a five-point Likert-type scale [42]. Based on the literature study, five primary barriers with a focus on 20 sub-barriers were selected for the EV adopting assessment (Table 1). Participants were requested to evaluate the significance of the barriers to electric vehicle adoption using the scale of 1-severely disagree; 2-disagree; 3-neutral; 4-agree; 5-highly agree. Lastly, this study examined public attitudes towards EVs by inquiring about respondents'

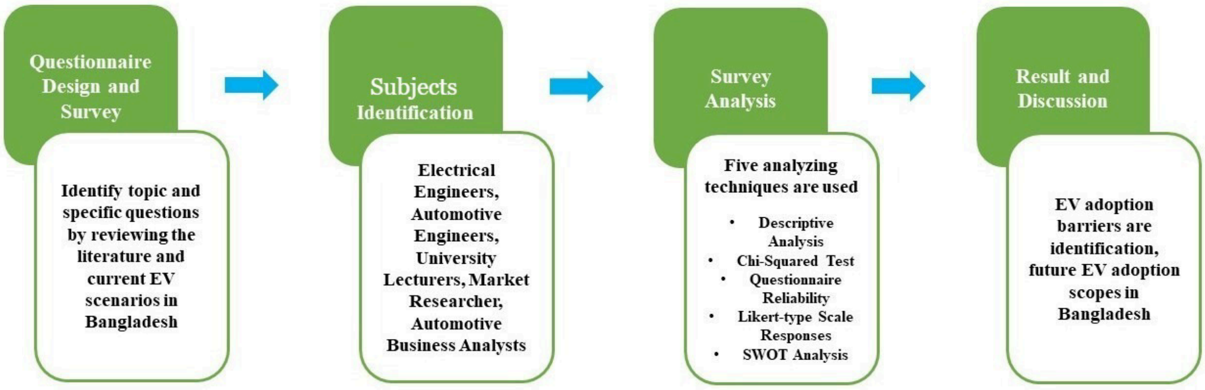

Figure 2. Illustration of the methodology used in this study.

inclination to purchase an EV, suggest an EV to others, and own another EV. The questionnaire was available online for 15 days in January 2024. Excluded questionnaires were removed prior to analysis.

B. Subjects identification

The study selected a research group comprising a total of 111 individuals. Although the sample size is limited to 111 individuals, this selection ensures high-quality, expert-driven insights that are crucial for understanding the barriers to EV adoption. The participants were strategically chosen from various sectors to ensure a diverse range of perspectives with adequate knowledge. Furthermore, the reliability of the responses has been validated using Cronbach's alpha, ensuring that the insights are both credible and meaningful. The main objective was to guarantee a diverse spectrum of knowledge and experience. The population consists of approximately the same quantity of members from the governmental and non-governmental sectors, including professionals from manufacturing businesses and electricity utility companies. Almost all the respondents were electrical engineers, automotive engineers, university lecturers, market researchers, and business analysts.

C. Chi-squared test

The Chi-squared test is a statistical analysis that evaluates the statistical relationships among parameters by examining the null hypotheses of no link between categories and response outputs, which can be calculated using equations (1) and equation (2) [15].

$$x^2 = \sum_{i=1}^{c} \sum_{j=1}^{r} \frac{(O_{i,j}-E_{i,j})^2}{E_{i,j}} \tag{1}$$

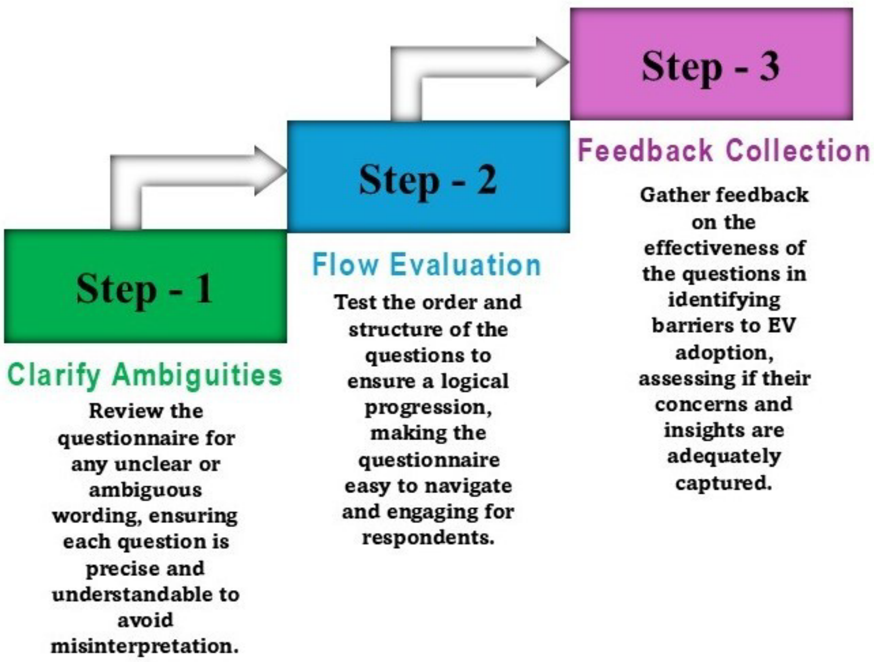

Figure 3. Questionnaire validation process in this study.

Table 2.
Reliability level for Cronbach's alpha.

Score of Cronbach's alpha	Reliability level
0.0 – 0.20	Less reliable
>0.20 – 0.40	Rather reliable
>0.40 – 0.60	Quite reliable
>0.60 – 0.80	Reliable
>0.80 – 1.00	Very reliable

$$E_{i,j} = \frac{n_i n_j}{N} \quad (2)$$

Pearson's Chi-squared statistic, denoted as x^2, converges to an unusual distribution with degrees of freedom equal to $(r-1)(c-1)$. Where r is rows, and c is columns. The degrees of freedom were associated with the rows, whereas the column parameters were considered independently. $O_{i,j}$ represents the number of entries in row i as well as column j. $E_{i,j}$ represents the anticipated frequency values in the i row and j column. N represents the entire quantity of assessments, while n signifies the quantity of cells in the chart. The study utilized the Chi-squared test to investigate the connection between barriers and individual attributes in conjunction with the adoption of EVs.

D. Reliability of questionnaire

Cronbach's alpha [9], a measurement of reliability determined using equation (3), was utilized to assess the dependability.

$$\alpha = \frac{k * \bar{c}}{\bar{v} + (k-1)\bar{c}} \quad (3)$$

here, α represents Cronbach's alpha; k represents the number of items, while c denotes the average of all covariances among the items, and v represents the average variance of every single item. The reliability level for Cronbach's alpha is represented in Table 2.

E. SWOT analysis

A strengths, weaknesses, opportunities, and threats (SWOT) study is now an important part of figuring out where a business stands in the market. It is also commonly used to look at the internal and external environments when people aren't sure what to do [43]. The four elements distinguish between internal and external factors. Strengths are internal factors that help an organization achieve its objectives, while weaknesses are internal factors that hinder the organization's achievement. Opportunities are external factors that aid a business in achieving its objectives. They encompass good environmental features and provide chances to fill gaps and start new initiatives. Threats are outside factors that act as obstacles or potential obstacles to the aims of business [44]. SWOT is an indispensable technique for identifying the obstacles that hinder the growth of electric vehicle usage in Bangladesh.

III. Results and Discussions

A. Descriptive analysis

Table 3 presents a summary of the results obtained from the descriptive analysis. The primary obstacle here is battery life. This indicates that most responders are worried about battery life. Enterprises must prioritize extending the battery life when incorporating EVs. Highway infrastructure, charging time, and EV price are ranked as the second, third, and fourth most effective barriers. Most respondents are concerned about public infrastructure and the quality of EVs. The EV range does not meet the standards for current battery life, safety concerns, and charging time, which could hinder EV adoption for most users. The primary concern of the respondents regarding the introduction of EVs was performance barriers. This indicates that respondents have limited confidence in the performance of EVs. Respondents were worried about public infrastructure and the expenses related to EV maintenance, in addition to battery cost and reliability. Respondents prioritize factors other than battery size and style, battery recycling and waste, gasoline expenses, and battery promotion. Aside from technical specifics, respondents prioritize performance. The absence of easily accessible public infrastructure, specifically on roads and in residential areas, was the greatest obstacle to EV charging. The main challenge in establishing dedicated charging stations is the distance between urban areas, exacerbated by the high real estate prices in large cities and metropolitan regions. Consequently, a greater number of participants chose public charging infrastructure over residential and highway infrastructure. Battery advertising was seen as the least important obstacle. People may be knowledgeable about both conventional vehicles and battery technology. Regular autos also utilize batteries. The respondents were not concerned about the resale value. This could be due to the fact that EVs are a recent innovation, and there is a lack of demand for pre-owned EVs.

B. Chi-squared test

The Chi-squared test is straightforward in terms of computation. This study utilized the chi-squared test to investigate the correlation between barriers and personal traits in connection to the adoption of EVs. The statistically significant level was established at 0.05. If the p-value was below 0.05, then the null hypothesis

Table 3.
Descriptive analysis of barriers to EV adoption in Bangladesh.

Barriers	Minimum	Maximum	Mean ± SD	Rank
Lifespan of battery	1	5	3.36 ± 1.040	1
Infrastructure availability on highways	1	5	3.234 ± 1.190	2
Time required for charging	1	5	3.195 ± 1.128	3
Cost of EV	1	5	3.13 ± 1.117	4
Maintenance expenses of EV	1	5	3.105 ± 1.087	5
Infrastructure availability in public places	1	5	3.063 ± 1.112	6
Reliability	1	5	3.035 ± 1.117	7
Price of battery	1	5	3.015 ± 1.125	8
Infrastructure availability at workplaces	1	5	2.986 ± 0.971	9
Charging capacity	1	5	2.985 ± 1.075	10
Infrastructure availability at houses	1	5	2.932 ± 1.071	11
Safety	1	5	2.915 ± 1.264	12
The resale price of EV	1	5	2.9 ± 1.095	13
Awareness lacking	1	5	2.87 ± 1.103	14
Strength of engine	1	5	2.825 ± 1.149	15
Perception of consumers	1	5	2.80 ± 1.113	16
Size and styles	1	5	2.773 ± 1.238	17
Battery wastage and recycling	1	5	2.631 ± 1.261	18
EV fuel expenses	1	5	2.53 ± 1.208	19
EVs advertisement	1	5	2.50 ± 1.119	20

Table 4.
Pearson chi-squared test of respondents.

Barrier category	Gender			Monthly income			Family size			Driving experience		
	Chi-squared	p-value	df	Chi-squared	p-value	df	Chi-squared	p-value	df	Chi-squared	p-value	df
Financial barrier	5.683	0.224	4	7.534	0.480	8	9.336	0.050	4	7.722	0.461	8
Performance barrier	5.910	0.433	6	6.370	0.722	12	11.082	0.051	6	5.578	0.901	12
Infrastructure barrier	7.833	0.050	3	8.382	0.135	6	6.780	0.072	3	9.322	0.361	6
Behavioral barrier	9.650	0.046	1	7.857	0.059	2	6.983	0.052	1	4.163	0.241	2
External barrier	12.360	0.014	1	5.850	0.061	2	3.398	0.190	1	3.841	0.211	2

**df = Degree of freedom*

was ignored. Table 4 illustrates the respondents' Chi-squared test.

From Table 4, it is clear that all the p-value surpass the significance level, which indicates the robustness of the Chi-squared test with respect to the data distribution. The resultant value of the chi-squared test revealed significant findings, providing valuable insights into the relationship between EV adoption barriers and personal characteristics. This statistical analysis enhances the understanding of EV adoption barriers in Bangladesh depending on the current scenario of EVs.

C. Questionnaire reliability using Cronbach's alpha

Cronbach's alpha assesses trustworthiness by measuring the proportion of shared variance between the item of a measure in relation to the overall variance. It is typically used to assess the validity and dependability of questionnaires that evaluate hidden variables. Table 5 illustrates Cronbach's alpha value above 0.70 for financial, performance, infrastructure, behavioral, and external barriers is suggested for strong reliability [45]. The calculated Cronbach's alpha coefficient for all the barriers surpasses established

Table 5.
Reliability of questionnaires among barriers.

Barrier category	Cronbach's alpha
Financial barrier	0.781
Performance barrier	0.873
Infrastructure barrier	0.835
Behavioral barrier	0.762
External barrier	0.729

benchmarks for internal consistency (> 0.7), affirming the reliability in capturing the intended construct.

D. Likert-type scale response

A Likert-type scale is a technique for measuring utilized throughout studies to assess attitudes, views, and perceptions. This psychometric scale is commonly employed to comprehend the attitudes and opinions regarding a specific market segment. A Likert-type scale was carefully used to understand the detailed viewpoints of respondents, allowing for a systematic way to gather a range of replies and identify slight differences in attitudes. The Likert-type scale underwent rigorous validation procedures to ensure its psychometric integrity, culminating in a robust instrument capable of effectively measuring the complex dimensions under investigation. Analysis of Likert-scale responses yielded valuable insights into the nuanced nuances of participants' opinions, shedding light on the intricate interplay of factors that shape their perceptions. Figure 4 depicts the respondents' view of EV adoption barriers.

E. SWOT analysis

SWOT analysis is a method of strategic planning used to categorize strengths, weaknesses, opportunities, and threats. The SWOT analysis for EV adoption is presented in Figure 5, which also identifies the obstacles to EV acceptance in Bangladesh.

While the global momentum towards EVs is undeniable, Bangladesh, with its burgeoning urban centers, is witnessing a gradual shift in consumer preferences, reflecting an emerging interest in sustainable and electric mobility options. Depending on factors such as features, brands, models, engine capacity, performance, build quality materials, battery capacity, and technology used, participants' pricing estimations range from 4200$ to 12600$. However, the majority of respondents believe that the tariff paid on imported cars is a burden. The additional tax on

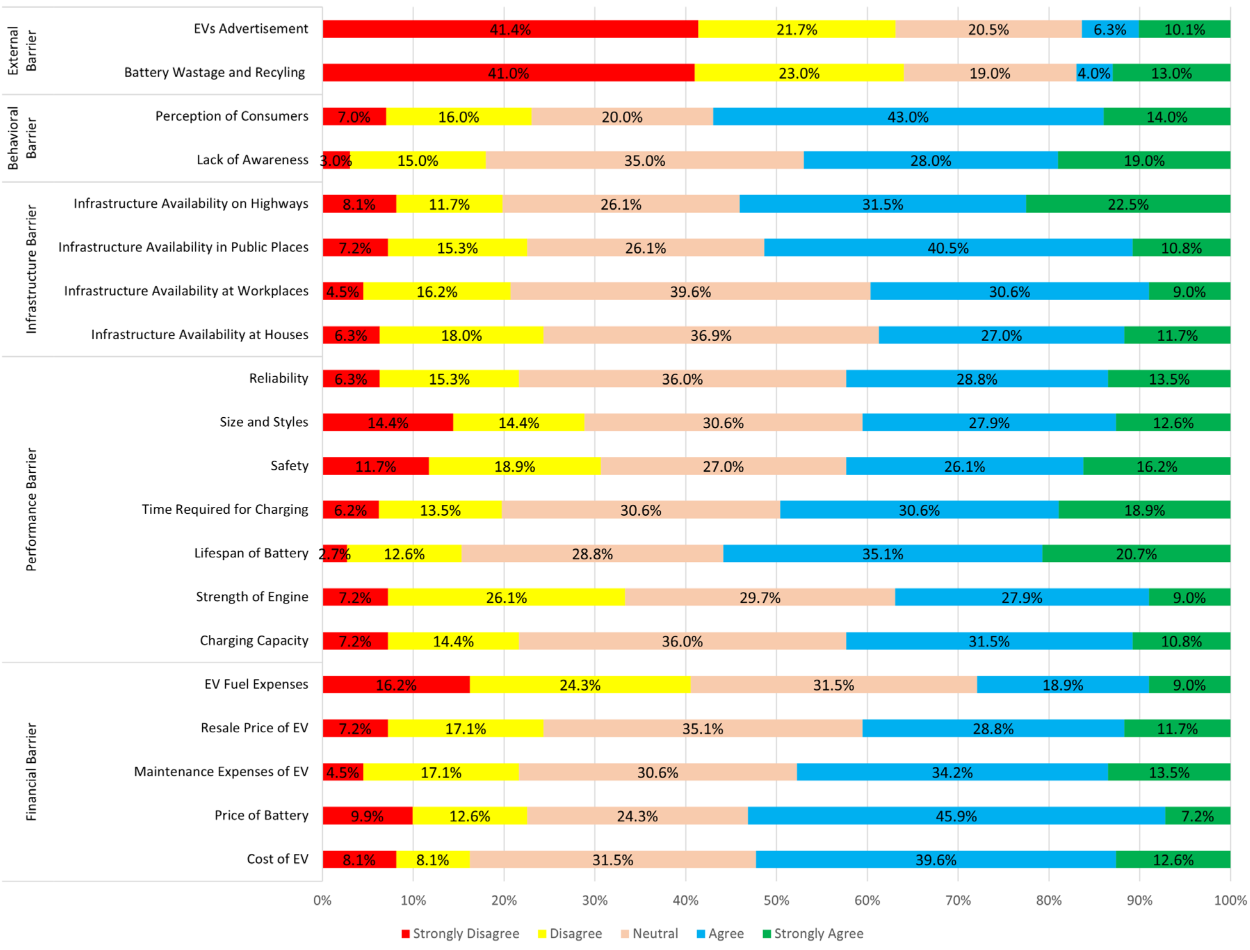

Figure 4. Respondents' levels of agreement or disagreement with statements of EV adoption barriers in Bangladesh.

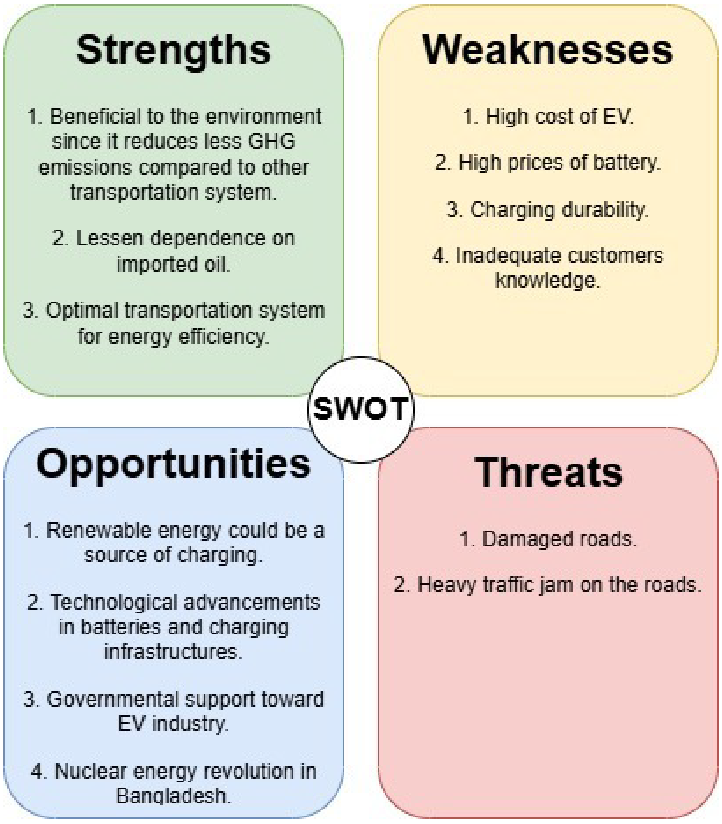

Figure 5. SWOT analysis for EV adoption in Bangladesh.

imported cars with engine sizes between 2001 cc and 3000 cc has been raised to 250 % from 200 %, while for cars with engine sizes between 3001 cc and 4000 cc, the tariff has been raised to 500 % from 350 % [46]. The lack of information in the general population and comprehension of EVs poses a challenge. Thorough educational efforts and community outreach programs are crucial to debunk misconceptions, instill trust, and cultivate a favorable view of electric transportation. Emphasizing the environmental advantages of EVs and their role in decreasing air pollution and greenhouse gas emissions is crucial. The dedication of Bangladesh to environmental sustainability is in line with highlighting the beneficial effects of electric mobility.

Currently, Bangladesh is experiencing tremendous prospects in the field of EV. As Bangladesh has already completed the construction of its inaugural nuclear power plant [47], people's reliance on EVs could reduce the government's dependence on imported oil. Solar and green energy are two of the most ambitious energy aspirations in Bangladesh. By the year 2030, the nation intends to generate 4,100 megawatts (MW) of renewable energy, with solar power accounting for 2,277 MW, hydropower accounting for 1,000 MW, and wind power accounting for 597 MW [48]. At the same time, solar energy systems are proven technologies that provide the required electricity [49]. In recent times, the Bangladesh rural electrification board (BREB) has established a solar charging station in Keranigonj that is capable of producing 21 kW of power. Two substation control systems (SCS) have been installed in Chittagong by the Bangladesh Power Development Board (BPDB), and one SCS has been installed in Sylhet. Together, these three SCSs have a combined power generation capacity of twenty kilowatts [50]. Based on these reports and the perspectives of the respondents, it could be confidently inferred that the future of EVs in Bangladesh is promising.

IV. Conclusion

This study identifies key barriers to EV adoption in Bangladesh, focusing on critical factors such as infrastructure limitations, financial constraints, performance issues, and behavioral challenges. While EVs present a promising solution to reduce pollution and improve energy sustainability, the transition remains hindered by challenges, particularly the lack of public charging infrastructure, high initial costs, and battery-related performance concerns. Addressing these barriers will require a multifaceted approach involving policy reforms, private sector participation, and public awareness efforts. However, participants in this study were knowledgeable about EVs, and their lack of practical experience with the technology may influence their perceptions and adoption rates after firsthand experience. The findings are relevant for analyzing EV adoption barriers in regions with similar economic conditions, purchasing behaviors, and transportation characteristics. Future research should explore potential risks associated with EV usage, examine alternative methodologies to validate the results and assess how varying financial and economic policies might impact EV adoption. The effectiveness of these policies in overcoming identified barriers warrants further investigation.

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Declarations

Author contribution

M.M. Hasan: Writing - Original Draft, Writing - Review & Editing, Conceptualization, Formal analysis, Investigation, Visualization, Supervision. **A. Islam**: Writing - Original Draft, Writing - Review & Editing, Conceptualization, Investigation, Validation, Data Curation. **M.N. Islam**: Writing - Review & Editing, Conceptualization. **M. Ashikujjaman**: Formal analysis, Investigation. **M.A. Hossain**: Writing - Review & Editing, Conceptualization.

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Competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Additional information

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