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Electric Vehicle in Kathmandu Valley: Understanding Public Perception and Adoption

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Abstract

Purpose: *This research work aims to explore attitudes and beliefs toward electric vehicle (EV) adoption in Kathmandu Valley; identify the factors influencing these perceptions, and assess how socio-demographic factors and infrastructure availability impact willingness to adopt EVs.*

Methods: *Descriptive and explanatory research design used incorportaing quantitative data. A sample of 500 individuals from Kathmandu Valley participated, during data collection focusing on their travel patterns, attitudes, and reasons for considering EV adoption.*

Results: *Environmental concerns, cost savings, and financial incentives motivate for EV adoption. Most respondents exhibited positive or neutral attitudes, though some remained reluctant or neutral. Socio-demographic factors like gender, income, and education significantly influence pro-environmental behavior and attitudes toward EV adoption. Infrastructure availability is found to be less of a concern for most consumers.*

Conclusion: *There is a need for increased public awareness and targeted education to promote greater EV adoption in Kathmandu Valley especially among people with neutral or negative attitudes. The environmental consciousness and financial incentives are more influential in shaping EV adoption attitudes than infrastructure availability.*

Keywords: Electronic vehicle, environmental concerns, financial incentives, EV adoption behavior

I. Introduction

The world is currently facing an environmental crisis due to pollution and climate change, and efforts are being made globally to reduce carbon emissions (Leiserowitz, 2007). The transportation sector is a major contributor to carbon emissions, leading many countries to promote the adoption of electric vehicles (EVs) as a cleaner alternative (Al-Buenain et

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al., 2021). However, the adoption rate of EVs remains low in many countries, including Nepal. Kathmandu Valley, with a population of over 5 million, suffers from significant air pollution, with vehicles contributing to over 50% of the pollution (Baral et al., 2000). Promoting EV adoption in the valley can significantly reduce air pollution (Filippini et al., 2021). However, the adoption rate of EVs in the area is still low, and there is a lack of research on people's perceptions towards EV adoption (Lohani et al., 2023).

EVs have been around for over a century, but their research and development have gained momentum in the 21st century due to environmental and energy-related concerns (Gielen et al., 2019). Global sales of EVs have been increasing, and major automakers have shown interest in promoting EVs (Barkenbus, 2020). Studies conducted in different countries have found that positive attitudes towards EVs exist, but barriers such as high costs and limited range hinder their adoption (Viola, 2021; İmre et al., 2021). In Nepal, a few studies have explored people's perceptions of EV adoption. These studies have found that people in Nepal generally have a positive attitude towards EVs but face barriers such as the lack of charging infrastructure and high costs (Shandilya & Skotte, 2021).

In Kathmandu Valley, private vehicles account for the majority, with motorcycles being the most common mode of transportation. The number of registered vehicles is increasing annually, and motorcycles consume a significant amount of imported gasoline (Prajapati et al., 2019). The challenging geography and lack of sea access make road transport crucial in Nepal, particularly in the Kathmandu valley region (Bhagat, 2017). The market for traditional gasoline-powered vehicles is thriving in Nepal, and there is a need to understand the factors influencing the adoption of EVs (Maharjan, 2002). There is a significant gap in the literature regarding pro-environmental behavior in developing nations like Nepal, which impedes our understanding of how environmental concerns translate into behavior changes in these contexts (Shandilya & Skotte, 2021).

This is particularly relevant as there is a notable deficiency of information on green consumption behavior in South Asia, including Nepal. Although South Asian consumers exhibit concern for environmental issues, this awareness has not yet resulted in widespread adoption of green technologies. EVs are an illustrative example, despite their clear environmental, economic, and social benefits—such as reduced greenhouse gas emissions and decreased dependence on fossil fuels, they remain underutilized in Nepal. This difference demonstrates the need for research to explore and address the factors influencing public perceptions and adoption of EVs. The objectives of this research include understanding people's attitudes towards EVs in the Kathmandu Valley, identifying the factors that shape these perceptions, examining how demographic variables affect willingness to adopt EVs, and assessing the role of EV infrastructure in influencing adoption intentions.

II. Reviews

The Theory of Planned Behavior (TPB), proposed by Ajzen in 1985, is a widely used framework for predicting behavioral intentions and behavior. It consists of three constructs: Attitude, Subjective norm, and Perceived Behavioral Control (PBC) (Altawallbeh et al., 2015). This theory has been applied in transportation research, including studies on the adoption of Electric Vehicles (EVs) in India (Shalender & Sharma, 2021).

Attitude towards EVs is a key factor influencing adoption intentions (Salari, 2022). Attitude refers to an individual's positive or negative feelings towards a particular object, while attitude towards behavior relates to the evaluation or appraisal of a specific behavior (Afroz et al., 2015). Studies have shown that a positive attitude towards environmentally friendly products, including EVs, increases the likelihood of adoption (Huang, 2023; Dash, 2021). Attitudinal

factors, such as perceptions of cost, convenience, environmental impact, and performance of EVs, as well as beliefs and values regarding sustainability and personal identity, can shape adoption intentions (Dash, 2021).

Pro-environmental behavior encompasses actions that support environmental sustainability, and the adoption of EVs falls under this category (Zamil et al., 2023). EVs reduce greenhouse gas emissions and other pollutants, contributing to climate change mitigation and improved air quality (Sun et al., 2023). They can be powered by renewable energy sources, further reducing their environmental impact (Ercan et al., 2022).

Innovation adoption behavior refers to the process by which individuals or organizations become aware of, evaluate, and decide to adopt or reject a new innovation (Javanmardi et al., 2023). The adoption process typically consists of stages such as knowledge, persuasion, decision, implementation, and confirmation (Rezvani et al., 2015).

Symbolic adoption behavior involves publicly expressing support for a new technology or behavior, without actually engaging in the behavior itself (Foster et al.,1972). In the context of EVs, symbolic adoption can help build awareness and support, signaling demand for the technology (Jain et al., 2022). However, it does not always translate into actual adoption due to factors like cost concerns or lack of charging infrastructure (Ingeborgrud & Ryghaug, 2019).

Emotional behavior in the context of EV adoption relates to the expressions of emotions or feelings individuals exhibit when encountering the topic (Rezvani et al., 2015; Forgas,2002). Positive or negative attitudes towards EVs can lead to emotions such as enthusiasm or anger, respectively. Personal values, social norms, and cultural beliefs also influence emotional responses towards EV adoption (Tchetchik et al., 2020).

Empirical studies have explored the factors influencing EV adoption. These include consumer attitudes, perceived benefits and costs, infrastructure availability, policy incentives, and cultural differences (Viola, 2021; Afroz et al., 2015; Dash, 2021). Positive attitudes have consistently been found to have a significant positive impact on adoption intentions (Huang, 2023; Rezvani et al., 2015).

III. Methodology

Research Design

This study utilized a descriptive and explanatory research design, centered around quantitative data. Surveys were employed as the primary method to gather data from a sample, enabling the measurement of factors influencing adoption intentions and the identification of trends. This approach provided a comprehensive understanding of people's perceptions of EV adoption in the Kathmandu Valley, with the quantitative data supporting generalizations to the broader population.

Study Area and Sample size

This research focuses on the Kathmandu Valley of Nepal. The Kathmandu Valley is chosen because it is the most developed and populated area in Nepal, with the majority of public and private vehicles registered there. The population for this study consists of individuals living in the Kathmandu Valley who either own a vehicle or have the intention to purchase one in the next six months.as per 2021 census the population of the study area is 540000 where age of 18 to 70 is under consideration.

Eight hundred questionnaires were distributed using online and self-administered methods, of which 542 were returned. After reviewing the responses, 500 were considered usable

for the study. The sample was selected using purposive sampling, and data was collected through these questionnaires.

IV. Results and Discussion

Travel Pattern and Mode of Commute

The study analyzed the travel patterns of the respondents which showed that the majority of respondents (54.2%) travel a distance of less than 10 km to their workplace or educational institution. About 25% of respondents travel a distance of 11-20 km, while smaller percentages travel longer distances.

The study indicated that the highest percentage of respondents (37.8%) leave for their daily schedule between 9-10 am, followed by those leaving between 8-9 am (23%). Only a small proportion of respondents (6.6%) leave after 11 am.

Regarding the time of return, it is revealed that the largest group of respondents (37.5%) return home between 5-6 pm, followed by those returning between 6-7 pm (20.4%). Fewer respondents return before 4 pm (10.4%) or after 7 pm (5.5%).

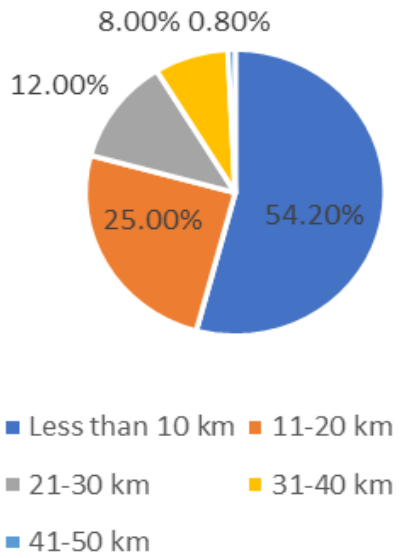
Table 1

Travel Pattern

Mode of Commute	First Choice	Second Choice	Third Choice	Total
Own Vehicle	331	95	74	500
Walking	28	203	269	500
Public Buses	55	179	266	500
Public Transport	21	187	292	500
Total	435.00	664.00	901.00	500

Figure 1

Travel Distance



Likewise, on the preferred modes of commute for the first, second, and third choices. Own Vehicle was the most preferred mode for the first choice (49.8%), followed by Walking (26.3%). For the second choice, Public Transport became the most preferred mode (29.5%), with Walking as the second choice for a similar percentage of respondents (26.7%). For the third choice, Walking remained the most preferred mode (29.5%), followed by Public Transport (33.9%). Overall, a significant majority of respondents chose one of three modes (Own Vehicle, Walking, or Public Transport) for their preferred mode of commute across all three choices.

Reasons for EVs

Table 1 presents insights into the primary reasons why people switch to electric vehicles (EVs). The most frequently chosen reason was environmental concerns, with 55% of respondents indicating it as their primary motivator. Lower operating costs, specifically the price of electricity compared to gasoline, was the second most popular reason, chosen by 30.7% of respondents. Tax breaks and net vehicle price were chosen by 20% of respondents, indicating the importance of financial incentives.

Table 2

Reasons for Switching to EVs

Reason for Buying EV	First (%)	Second (%)	Third (%)
Environmental Concerns	60.0	12.0	18.0
Price of Electricity vs. Gasoline	10.0	25.0	20.0
Reduce Dependence on Petroleum	8.0	10.0	12.0
Advanced Technology	4.0	15.0	8.0
Safety Features of Vehicle	5.0	5.0	4.0
Vehicle Performance	3.0	3.0	8.0
Available Charging Facilities	4.0	8.0	5.0
Tax Breaks	3.0	6.0	10.0
Status of EV Ownership	2.0	1.0	3.0
None	1.0	1.0	2.0

The availability of charging facilities was a minor concern for most consumers, chosen by 5.6% of respondents as their first priority. Reduction of dependence on petroleum was the primary reason for 6.4% of respondents, while advanced technology was chosen by 3.6% of respondents. Vehicle performance, safety features, and the status of EV ownership were primary considerations for a smaller percentage of respondents (ranging from 1.6% to 4%). Some respondents (1.6%) indicated no specific reason for buying an EV.

EV Behavior

The survey results shed light on the attitudes of respondents towards EV adoption behavior across various constructs. In terms of the environment, a majority of respondents (53%) showed a strong inclination towards adopting EVs, considering the environmental impact. This indicates a positive sentiment towards environmentally friendly transportation options. Conversely, a negligible percentage (1%) expressed a strong aversion towards EV adoption, indicating a minor resistance in this aspect. Symbolic behavior also revealed positive attitudes, with 33% of respondents displaying a high likelihood of positive behavior towards EV adoption. Additionally, 22% exhibited positive behavior, further contributing to the overall positive sentiment. A substantial portion (28%) reported a neutral stance, indicating a lack of strong opinion or ambivalence. A smaller percentage demonstrated negative behavior

(7%) or expressed an unlikely attitude towards EV adoption (10%). Overall, a majority of respondents (55%) showcased positive attitudes towards EV adoption.

The behavior of respondents aligned with their attitudes towards EV adoption. Those with a “Most Likely Positive Behavior” attitude demonstrated corresponding behavior, with 47% displaying such behavior. Similarly, for those with a “Positive Behavior” attitude, 29% exhibited corresponding behavior. Among respondents with a “Neutral Behavior” attitude, 16% showcased similar behavior. However, the proportions decreased for negative behavior (6%) and the most unlikely behavior (2%). These findings indicate that a significant majority (76%) of respondents exhibited positive or neutral behaviors towards EV adoption.

Concerning innovative adoption behavior, a substantial 40% of respondents expressed a high likelihood of adopting EVs, while an additional 27% were inclined towards adoption. Although a quarter of the respondents remained neutral (24%), a smaller fraction displayed an unlikely (4%) or most unlikely (5%) attitude. These results highlight a notable positive inclination towards EV adoption, but also indicate the presence of reservations or neutral attitudes.

Similarly, emotional behavior indicated positive attitudes towards EVs, with 24% of respondents exhibiting a high likelihood of positive behavior, and an additional 26% displaying positive behavior. The largest group (32%) reported neutral behavior, signifying a lack of strong emotional association. A smaller proportion showcased negative behavior (6%) or expressed a most unlikely behavior (12%). These findings suggest a significant proportion of respondents with positive attitudes towards EVs, accompanied by neutral and negative attitudes.

The correlation analysis reveals several relationships between variables related to EV adoption behavior. Pro-Environment Behavior (PEB) has a moderate positive correlation with Attitude Towards Adoption of EV (AAEV) and Innovation Adoption Behavior (IAB), indicating that individuals with pro-environment behavior are more likely to have a positive attitude towards EV adoption and adopt innovative behaviors.

PEB also has weak positive correlations with Symbolic Behavior (SB) and Emotional Behavior (EB), suggesting some association between pro-environment behavior and the symbolic and emotional aspects of EV adoption, although the correlations are not as strong as with AAEV.

Table 3

Spearman’s Correlation

Variable	PEB	AAEV	IAB	SB	EB
Pro-Environment Behavior (PEB)	1.00	0.56	0.42	0.31	0.21
Attitude Towards Adoption of EV (AAEV)		1.00	0.37	0.63	0.47
Innovation Adoption Behavior (IAB)			1.00	0.22	0.16
Symbolic Behavior (SB)				1.00	0.33
Emotional Behavior (EB)					1.00

AAEV shows a moderate positive correlation with IAB, indicating that individuals with a positive attitude towards EV adoption are more inclined to adopt innovative behaviors in general. AAEV also has a strong positive correlation with SB and a moderate positive correlation with EB, suggesting that a positive attitude towards EV adoption is associated with higher levels of symbolic and emotional behavior related to EV adoption.

IAB demonstrates weak positive correlations with SB and EB, indicating a slight association

between innovative adoption behavior and the symbolic or emotional aspects of EV adoption, although not as pronounced as with AAEV.

Behavior towards EVs andSocio-demographic profiles

The regression analysis aimed to investigate the associations between the independent variables (Age, Gender, Occupation, Income, and Education) and three different dependent variables: Environment, Attitude, and Emotional.

In the Environment model, the regression coefficients revealed that Age had a negative relationship (-0.478) with the level of environmental concern. On the other hand, Gender, Occupation, Income, and Education showed positive relationships with the environment variable. These findings suggest that as individuals grow older, their environmental concern tends to decrease, while factors such as being female, having higher occupational status, higher income, and higher education level are associated with greater environmental concern. The R^2 value of 0.417 indicated that the independent variables explained approximately 41.7% of the variance in the environment variable. The F-statistic of 56.58 and the p-value of 0.000 indicated that the regression model was statistically significant, indicating that the independent variables collectively had a significant impact on the environment variable.

For the Attitude model, the regression coefficients showed the relationships between the independent variables and the level of attitude towards the subject of interest. Age displayed a positive relationship (0.026), implying that as individuals grow older, their attitude becomes more positive. Similarly, Gender, Occupation, Income, and Education exhibited stronger positive relationships with attitude, indicating that being female, having higher occupational status, higher income, and higher education level were associated with more positive attitudes. The R^2 value of 0.646 indicated that the independent variables accounted for approximately 64.6% of the variance in the attitude variable. The F-statistic of 552.994 and the p-value of 0.000 confirmed the statistical significance of the regression model, indicating that the independent variables collectively had a substantial impact on attitudes.

In the Emotional model, the regression coefficients depicted the relationships between the independent variables and the emotional response variable. Age displayed a negative relationship (-0.126), suggesting that as individuals grow older, their emotional response tends to be less pronounced. Conversely, Gender, Occupation, Income, and Education showed positive relationships with emotional response, indicating that being female, having higher occupational status, higher income, and higher education level were associated with more intense emotional responses. The R^2 value of 0.520 indicated that the independent variables accounted for approximately 52.0% of the variance in the emotional response variable. The F-statistic of 1067.613 and the p-value of 0.000 signified the statistical significance of the regression model, indicating that the independent variables collectively had a significant impact on emotional responses.

V. Conclusion and Implication

The findings of the study highlight that environmental concerns, cost savings, and financial incentives are the key drivers for individuals to transition to electric vehicles in Kathmandu Valley. A majority of the respondents exhibit positive or neutral attitudes towards EV adoption, with a significant portion displaying the most likely positive behavior. However, there is still a notable segment of the population that remains either neutral or unlikely to adopt EVs, suggesting a need for increased awareness and knowledge about electric vehicles among the general public. The availability of charging infrastructure appears to be of less concern to most consumers.

The socio-demographic factors such as gender, income, and education play a significant

role in shaping individuals' pro-environmental behavior, attitude towards EV adoption, and emotional behavior. The survey results indicate that further education and awareness initiatives may be necessary to promote greater EV adoption, particularly among individuals with neutral or negative attitudes towards EVs. Furthermore, the study reveals a positive association between pro-environmental behavior and a favorable attitude towards EV adoption.

The survey findings suggest that the current infrastructure for electric vehicles in Kathmandu Valley may not be a major influencing factor in people's perceptions and willingness to adopt EVs. A majority of the respondents have relatively short commutes, with more than half traveling less than 10 km to their workplace or educational institutions. Private vehicle ownership is the preferred mode of transportation, followed by walking, while public transport is favored as the second choice. The findings suggest the importance of addressing awareness gaps, tailoring strategies to specific socio-demographic groups, and focusing on factors beyond infrastructure, such as environmental consciousness and financial incentives, to encourage widespread adoption of electric vehicles in the region.

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