Understanding Adoption Barriers and Consumer Readiness for Electric Vehicles in Tier-2 India: A Comprehensive Study in Jalandhar City

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Abstract

Electric vehicles (EVs) have become the focus of the whole world in the transition to sustainable transportation as a substitute to conventional vehicles with fuel. Electric mobility is being encouraged by the governments and automotive companies to minimize carbon emission, enhance air quality, and curb reliance on fossilized fuels. Nevertheless, introduction of electric vehicles in most of the developing nations especially in Tier-2 cities in India is still comparatively low owing to various economical, technological and infrastructural hurdles. The paper will review obstacles and consumer willingness to the EV adoption in the city of Jalandhar through psychological, financial, infrastructural, and social factors that predispose consumer attitudes and buying intentions. A structured questionnaire survey was conducted using the primary data collected on 158 respondents who lived in Jalandhar. Statistical analysis was applied to the data collected by using the statistical methods such as descriptive analysis, percentage analysis, chi-square tests, correlation analysis, and regression analysis. Those findings show that despite all the environmental and economic advantages of electric vehicles, the issues of short driving range, battery life, cost of initial purchase and the availability of chargers still influence the choice of adopting an electric vehicle. The results indicate that the development of charging infrastructure and financial incentives are significant factors to enhance consumer preparedness. The paper can offer useful lessons to policymakers, urban planners, and EV manufacturers to develop policies that expedite the adoption of electric vehicles in Tier-2 cities and enable them to switch to sustainable transportation systems.

Keywords: Electric vehicles, EV adoption, consumer readiness, charging infrastructure, range anxiety, financial barriers, Tier-2 cities.

I. INTRODUCTION

i.Background and Overview of the Study

The transportation industry forms an important part of all global carbon emissions, which has developed a high necessity in finding the way to sustainable mobility. Electric vehicles (EV) are now an emerging substitute to traditional fuels-powered vehicles in that they will minimize greenhouse gas emissions, enhance energy efficiency, and enable the presence of environmentally sustainable transport systems (Li et al., 2017; Rezvani et al., 2015). Policies in governments are encouraging the use of EVs by providing policy incentives, technological advancement, and expanding infrastructure. In India, the shift to electric mobility is becoming a priority, yet it is at a comparatively low adoption rate because of a number of impediments, i.e., high cost of purchasing the vehicle, lack of sufficient charging stations, and apprehension of the population about the performance of the battery and its driving range (Tarei et al., 2021; Patel et al., 2024). These barriers should be comprehended to enhance EV uptake in the new urban centers like Tier-2 cities.

ii.*Problem statement*

Although the global interest towards sustainable transportation is increasing and the use of electric vehicles (EVs) is becoming more common, the pace of

their introduction in developing countries is quite low, especially in Tier-2 cities where infrastructure and awareness among consumers are still immature. Various programs have been launched in India to promote the adoption of EVs, yet many people are still reluctant to do so because of the expensive prices of the vehicles, low power range, battery life, and the presence of charging stations (Tarei et al., 2021; Jain et al., 2022). Also, a financial incentive, familiarity with technology, and the perceived risks of EV performance are among the factors that have a substantial impact on consumer purchasing intentions (Bansal et al., 2021; Joshi et al., 2022). These impediments make a difference between policy goals and real consumer adoption, which makes it important to look into the factors that impact the EV adoption preparedness in such cities as Jalandhar.

iii. *Importance of Electric Vehicle Adoption in Urban Transportation*

The use of electric vehicles (EVs) is significant in ensuring the sustainability of the transportation system in cities. The high rate of urbanization and the growth of the number of vehicles have been a major cause of air pollution, emission of greenhouse gases, and reliance on fossil fuels in the majority of cities. Electric vehicles are a cleaner option since they generate less emissions and have better energy efficiency than traditional vehicles powered by internal combustion engine (Li et al., 2017). Besides environmental advantages, EVs have the capacity to lower operating and maintenance expenses in the long run by the consumers as well as help to transition to the integration of renewable energy (Hardman et al., 2017). It is thus necessary to encourage the use of EVs in urban centers to ensure cleaner transportation, less negative effects on the environment, and sustainable urban development.

iv. *Electric Mobility Ecosystem and Consumer Adoption Dynamics*

The electric vehicle adoption requires the building and establishment of an electric mobility ecosystem that involves vehicle manufacturers, charging infrastructure providers, policymakers, energy suppliers, and consumers. An enabling ecosystem will make EV technology viable, convenient, and usable in the daily transportation requirements. Technological reliability, availability of charging infrastructure, financial recommendations, and environmental sensitivity are some of the factors that have a relationship with consumer adoption (Rezvani et al., 2015). Moreover, the perception of the driving range, battery performance, and purchasing cost also have a substantial impact on the readiness of consumers to use EVs (Degirmenci & Breitner, 2017). The aspects of social influence, governmental policies, and market awareness are also significant factors that influenced consumer attitudes and contributed to the process of the switching to electric mobility (Jaiswal et al., 2021).

v. *Significance of the study*

This study is significant for policymakers, automobile manufacturers, and urban planners who aim to accelerate the adoption of electric vehicles in emerging urban markets. By examining the barriers and consumer readiness in Jalandhar, a Tier-2 Indian city, the research provides insights into the psychological, financial, infrastructural, and social factors influencing EV adoption. The findings can help policymakers design effective policies and incentives to promote electric mobility. Additionally, EV manufacturers and infrastructure providers can use the results to improve charging networks, pricing strategies, and consumer awareness programs. Overall, the study contributes to understanding EV adoption challenges in Tier-2 cities and supports the transition toward sustainable urban transportation systems.

vi. *Scope of the study*

This paper is aimed at investigating the barriers and consumer willingness to adopt electric vehicles (EV) in Jalandhar, which is a Tier-2 city in India. The study mostly explores the psychological, financial, infrastructural, and social determinants affecting the intentions of the consumer to buy electric cars. The paper is based on primary data obtained in the form of a questionnaire survey of the population of Jalandhar and evaluates the perception of the participants on the reliability of EVs, their range, charging systems, the cost of its purchase, and social pressure. It is hoped that the results of the findings will bring light into the way policy makers, car manufacturers, and people planning infrastructures can strategy their operations to enhance the uptake of EVs in the new urban markets. Despite being restricted to the city of Jalandhar, the findings can have some helpful implications to the other Tier-2 cities in India due to their similar socio-economic and infrastructural factors (Jain et al., 2022; Dua et al., 2021).

vii. *Research gaps*

Even though a number of studies have been conducted to determine the factors affecting the adoption of

electric vehicles, a lot of the available literature dwells on developed nations or large urban centres. Scarcity of literature has explicitly dealt with the barriers to adoption and the consumer readiness to EVs specifically to Tier-2 cities in India, where the infrastructure development, consumer knowledge, and purchasing power might vary highly as compared to the mega cities. Other past research has pointed out financial incentives, perceptions of technology, and environmental impact to be the major determinants of EV adoption (Li et al., 2017; Hardman et al., 2018). Nevertheless, the issue of the interaction of these factors in smaller urban markets like Jalandhar has to be investigated. Consequently, the proposed research will address this gap by offering a data-driven perception of the consumer and the obstacles affecting EV adoption in a Tier-2 Indian city.

viii. *Research questions*

- What are the major barriers affecting electric vehicle adoption among consumers in Jalandhar city?
- How do psychological, financial, infrastructural, and social factors influence consumer readiness for EV adoption?
- What strategies can policymakers and EV companies adopt to accelerate electric vehicle adoption in Tier-2 Indian cities?

ix. *Research objectives*

- The study will deliver a data-driven understanding of the psychological, infrastructural, financial, and social barriers limiting EV adoption in Jalandhar, and provide an actionable framework for policymakers and EV companies to accelerate readiness, improve infrastructure planning, and design targeted adoption strategies for Tier-2 Indian cities.

x. *Literature review*

Patel et al. (2024) explore the policy context and institutional hindrances in the adoption of battery electric vehicles in India. Their research emphasizes that lack of charging infrastructure, high initial prices of the vehicles, and policy execution loopholes have remained the primary obstacle to EVs despite a growing governmental support and consumer consciousness.

Joshi et al. (2022) examine the purchasing intentions of the Indian consumer to purchase an electric vehicle and discover that the importance of the environmental concern, the perceived usefulness, and social influence are crucial in the decision to purchase the product. Another aspect that is highlighted in their comparative analysis is that financial affordability and readiness of the infrastructure have a strong impact on whether consumers will buy EVs.

Tarei et al. (2021), state that there are a number of obstacles to the adoption of electric vehicles in India, such as range anxiety, insufficient electric charging infrastructure, and battery life and maintenance issues. Their results imply that by means of policy incentives and technological progress, the conversion of EV can be boosted to a considerable degree.

Bansal et al. (2021) investigate the readiness of consumers to pay an electric vehicle in India and finding that the environmental awareness and the perception of the long-term cost-saving contribute positively to the purchase of an EV. Nonetheless, the expensive cost of purchase at the outset and doubt over the possibility of changing the battery is also a significant challenge that impacts consumer acceptance.

Jain et al. (2022) use a combined UTAUT model to study the intentions to adopt EV in India. They demonstrate in their study that performance expectancy, facilitating conditions, and social influence play an important role in consumer adoption decisions, and the issues of infrastructure availability and cost still dictate consumer attitudes towards EVs.

Sharma et al. (2022) explore the drivers of EV adoption in the emerging economies and come to a conclusion that technological awareness, environmental concern, and financial incentives have a substantial impact on consumer readiness. Their results highlight that government actions and infrastructure advancement are critical towards speeding up the adoption of EV in the developing markets.

Egbue and Long (2012) examine the attitudes of consumers towards electric cars and present the key obstacles such as the short driving range, high costs of purchase, and lack of charging stations. Their study emphasizes that consumer attitudes and technological issues are significant in determining the adoption of EV.

Sierzchula et al. (2014) discuss how financial incentives and socio-economic determinants affect the adoption of the electric vehicles in various nations. According to their research, government subsidies, incomes, and availability of charging infrastructure has a substantial impact on the adoption rates of EVs in different areas.

Li et al. (2017) conduct a literature review of studies on consumer intentions to purchase battery electric vehicles and find that environmental concern, financial

incentives, technological awareness, and access to infrastructure are the most powerful factors that can affect the EV adoption behavior.

Rezvani et al. (2015) present a review of the studies on the adoption of electric vehicles in detail and conclude that the use of the psychological, environmental awareness, and perceived risks as the driving forces significantly affect consumer behavior. Policy support and the development of infrastructure is also important in their study.

Degirmenci and Breitner (2017) discuss the question of whether environmental concern is more important than economics in the EV adoptions. According to their results, there is a positive effect of environmental awareness on adoption but consumers consider other factors like vehicle price, driving distance and technological reliability.

Hidrue and his team (2011) research on consumer willingness towards electric cars and discover that some features of the vehicle like driving range, charging time, and savings of fuel are key factor in affecting consumer purchases. Their study has indicated the significance of advances in technology in promoting the uptake of EV.

Liano et al. (2017) review preferences to electric vehicles of consumers and in the end conclude that financial incentives, the level of technological familiarity, and the availability of infrastructure represent the critical factors determining the adoption of EVs. The paper also includes the importance of government policies in favor of electric mobility.

Hardman et al. (2017) assess the efficacy of such incentives as the electric vehicles and find that the EV adoption is highly stimulated by the subsidies and tax incentives. According to their study, government policies are significant in lessening the financial constraints to consumers.

Hardman (2019) continues to discuss the effect of recurrent and non-financial incentives on the adoption of plug-in electric vehicles. The researchers conclude that the consumer acceptance may be greatly enhanced with the help of incentives, including charging infrastructure and parking privileges, as well as a lower operating cost.

Hardman et al. (2018) focus on the interaction of consumers with the electric vehicle charging infrastructure, noting that the accessibility and presence of the charging stations play an important role in the adoption of EVs. According to their findings, the infrastructure expansion is necessary to boost the consumer confidence in EV technology.

Jaiswal et al. (2021) explore the intentions of Indian customers to buy EV and underline that the level of environmental concern, the level of technological awareness, and social influence have a significant implication to consumer attitudes. According to their investigation, the adoption of EVs in India can be expedited with the support of the better level of awareness and infrastructures.

Dua et al. (2021) examine the opinion of experts regarding the facilitators and obstacles to the adoption of plug-in electric vehicles in India. Their study has cited policy support, availability of infrastructure and advancement in technology as some of the enablers with cost and infrastructural constraint being major barriers.

Kumar et al. (2025) examine the role of the environmental awareness, technological anxiety, and range anxiety as contributing factors to EV adoption intentions. Their results indicate that consumer acceptance of electric vehicles can be substantially increased with the help of technological confidence and higher battery performance.

Wang et al. (2020) discuss sustainable purchasing behavior on the topic of electric vehicles, and it is found that environmental awareness, government incentives, and the perceived technological advantage have a remarkable impact on the willingness of consumers to use EV technology.

II. MATERIALS AND METHOD

i. Research design

The current research design is quantitative descriptive research design because it will investigate consumer perceptions and barriers that influence the adoption of electric vehicles (EV) in the city of Jalandhar. The descriptive design fits the purpose since it aids in determining patterns, trends and relationship between various factors that affect consumer adoption behavior. The study is aimed at studying psychological, financial, infrastructural, and social factors which influence the readiness of consumers to buy EVs. The survey was done using a structured questionnaire, which collected primary data based on the questionnaire survey on respondents who live in Jalandhar. The responses obtained were statistically interpreted to see the consumer attitudes, preferences, and willingness to electric mobility in the context of a Tier-2 Indian city.

ii. Sampling method and sample size

The research employs the non-probability convenience sampling method to receive feedbacks of respondents living in Jalandhar and who have knowledge or interest in electric vehicles. This sampling method will be easy to access respondents with various demographics. The study collected 158 valid responses that were used in the statistical analysis.

iii. Data sources

Primary and secondary sources of data are used in the study. The primary data was gathered by the use of a questionnaire survey, which was structured and carried out among the residents of the city of Jalandhar. Secondary data were gathered through academic journals, research papers, government reports and publications regarding the adoption of electric vehicles, green transportation and consumer behavior studies.

iv. Questionnaire design

The questionnaire was structured such that it gathers both demographic and those based on perceptions as far as adoption of electric vehicles is concerned. The demographic section consisted of the first part which consisted of age, gender, income level, occupation and current vehicle ownership. The second part was comprised of the statements, which were connected with the EV reliability, driving range, financial issues, charging infrastructure, and social influence. A five-point Likert scale, which consisted of strong disagree, strongly agree, was used to measure these statements.

v. Data collection procedure

The data used in this study were obtained through the online survey mode in order to provide the study with efficient and convenient respondents to the survey. The questionnaire was administered online via the online platforms and social networks to the residents of Jalandhar. The participants were notified of the objective of the research and were asked to volunteer in taking part in the survey. The answers to the online form were automatically captured and then imported to a spreadsheet where further analysis was to be performed. This approach facilitated the gathering of data within a short time and reduced paper work besides making data recording accurate. One hundred and eighty-eight valid responses were received and were sent to the final analysis.

vi. Data analysis plan

- Descriptive Analysis: It is applied to present demographic data about the respondents and determine the means and standard deviation of the variables in the survey.
- Percentage Analysis: It is employed to analyse the distribution of responses and comprehend the proportion of the respondents who conceived, dissented, or were noncommittal on EV adoption statements.
- Chi-Square Test: The chi-square test was used to test the existence of significant relationships among demographic variables (age, income, occupation, and vehicle ownership) and EV purchase intention.
- Regression Analysis: It was done to determine the most significant factors that influence the intention of consumers to buy electric vehicles.

vii. Ethical considerations

During the research, ethical standards were observed in order to protect the privacy and safety of the study participants. The entire survey participation was voluntary, and the respondents were informed of the study before filling the survey. Participants were not asked to provide any personal information that identifies them like their names or contacts. All the answers were considered confidential and were utilized only as an academic research. The data obtained had to be properly stored and analyzed in aggregate to maintain the anonymity and avoid abuse of the respondent data..

III. EXPERIMENTAL

i. Study procedure

Online questionnaire survey to the residents of Jalandhar city was used to conduct the research. The study was conducted with the participants who were made aware of the purpose of the research and filled in the questionnaire at their own will. The responses were recorded automatically and they were collected and compiled and then analyzed through statistical tools to further interpret them.

ii. Measures and variables

Measures of the survey items were on 5-point Likert scale (5 = Strongly Agree to 1 = Strongly Disagree). The analyzed constructs were psychological factors (range and battery concerns), financial factors (purchase price and battery cost), infrastructural factors (charging availability), social influence, and EV purchase intention.

IV. RESULTS AND DISCUSSIONS

i. Descriptive analysis

A total of **158 respondents** participated in the survey. The descriptive statistics show moderate responses across most variables, with mean values around the mid-scale (e.g., EV reliability mean ≈ 3.65; driving range concern mean ≈ 3.67; EV cost effectiveness mean ≈ 3.68), indicating balanced perceptions toward EV adoption.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age_Group	158	1	6	4.01	1.326
Gender_category	158	1	3	2.45	.524
MonthlyHousehold_Income	158	1	6	3.46	1.353
Occupation_Data	158	1	7	4.22	1.676
CurrentVehicle_Ownership	158	1	6	3.84	1.461
IBelieveElectricalEVsare Reliablefordaily_use	158	1	6	3.65	1.340
Iamconcernedabouttheli miteddriving_range	158	1	6	3.67	1.347
Idoubtthelongtermbattery lifeanddurabilityof_EVs	158	1	6	3.59	1.297
Ifeelconfidentaboutswitc hingfrompetrolto_EVs	158	1	6	3.39	1.348
Ibelieve_EVsaremorecos teffective	158	1	6	3.68	1.346
Thehighinitialpurchasepr iceof_EVsdiscourageme	158	1	6	3.63	1.371
Batteryreplacementcost_ aremajorfinantialconcern	158	1	6	3.49	1.315
Publicchargingstation_ea silyavailableinJalandher	158	1	6	3.63	1.403
IintendtobuyanEV_withi nthisyear	158	1	6	3.54	1.240
Myfamilyandpeersinflue ncemyvehicle_purchased ecision	158	1	6	3.59	1.415
Availabilityoffast_chargi ngstationswouldincrease mywilling	158	1	6	3.53	1.324
Iwouldconciderpurchasin gan_EVifmorepeopleinJa landheradoptthem	158	1	6	3.51	1.305
Ihaveaccestoprivateparki ngspaceforEV_chargings tation	158	1	6	3.65	1.363
Valid N (listwise)	158				

ii. Percentage analysis

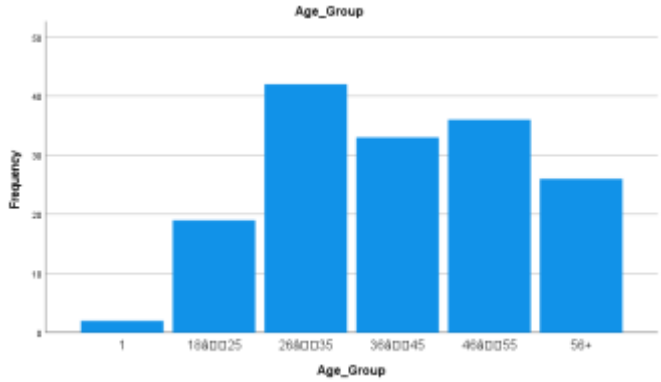
Most respondents fall in the **26–35 age group (26.6%)**, followed by **46–55 (22.8%) and 36–45 (20.9%)**, indicating strong participation from middle-aged consumers. Regarding EV purchase intention, responses are mixed, with **29.1% disagreeing**, **27.2% neutral**, and **21.5% agreeing**, showing moderate adoption interest.

Age_Group

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	2	1.3	1.3	1.3
	18â□□25	19	12.0	12.0	13.3
	26â□□35	42	26.6	26.6	39.9
	36â□□45	33	20.9	20.9	60.8
	46â□□55	36	22.8	22.8	83.5
	56+	26	16.5	16.5	100.0
	Total	158	100.0	100.0	

Iintendtobuyan EV_withinthisyear

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	2	1.3	1.3	1.3
	Agree	34	21.5	21.5	22.8
	Disagree	46	29.1	29.1	51.9
	Neutral	43	27.2	27.2	79.1
	Strongly Agree	19	12.0	12.0	91.1
	Strongly Disagree	14	8.9	8.9	100.0
	Total	158	100.0	100.0	



iii. Chi-square test

The relationship between **age group and intention to buy an electric vehicle within this year** was examined using a chi-square test. The results show that the relationship is **statistically significant (Pearson p < .001)**, indicating that age group significantly influences respondents' intention to purchase an electric vehicle.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	174.875[a]	25	<.001
Likelihood Ratio	39.627	25	.032
Linear-by-Linear Association	.232	1	.630
N of Valid Cases	158		

a. 21 cells (58.3%) have expected count less than 5. The minimum expected count is .03.

iv. Regression analysis

The regression analysis examined factors influencing the intention to buy an electric vehicle. The model shows limited overall significance (F = 2.118, p = .066). However, the availability of public charging stations significantly influences purchase intention (p = .004), while other variables such as range concern, battery durability, and price show no significant effect.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.715	5	3.143	2.118	.066[b]
	Residual	225.557	152	1.484		
	Total	241.272	157			

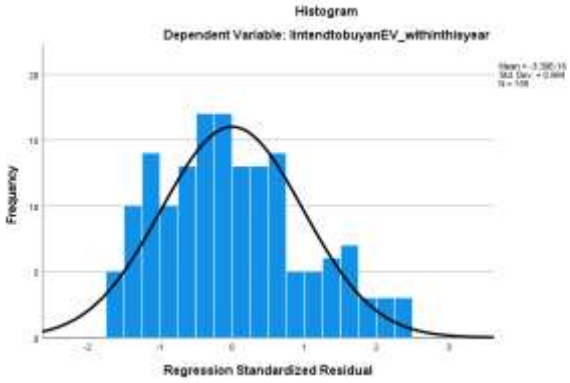
a. Dependent Variable: Iintendtobuyan EV_withinthisyear

b. Predictors: (Constant), Ifeelconfidentaboutswitchingfrompetrolto_EVs, Iamconcernedaboutthelimiteddriving_range, Thehighinitialpurchasepriceof_EVsdiscourageme, Publiccharingstation_easilyavailableinJalandher, Idoubtthelongtermbatterylifeanddurabilityof_EVs

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	2.588	.536		4.843	<.001		
	Iamconcernedaboutthelimiteddriving_range	.029	.074	.030	.372	.710	.952	1.051
	Idoubtthelongtermbatterylifeanddurabilityof_EVs	.071	.077	.074	.925	.356	.949	1.054
	Thehighinitialpurchasepriceof_EVsdiscourageme	-.037	.072	-.041	-.516	.606	.981	1.019
	Publiccharingstation_easilyavailableinJalandher	.207	.070	.234	2.960	.004	.981	1.020
	Ifeelconfidentaboutswitchingfrompetrolto_EVs	-.010	.073	-.011	-.135	.892	.962	1.039

a. Dependent Variable: Iintendtobuyan EV_withinthisyear



v. Thematic Analysis

Open-ended responses were analyzed using thematic analysis by grouping similar responses into common themes such as charging infrastructure concerns, financial barriers, and technological perceptions. The frequency of each theme was calculated to understand key consumer concerns regarding EV adoption.

Question	**Identified Theme**	**Frequency**	**Percentage**
Biggest challenge preventing EV adoption	Lack of charging infrastructure	3	42.9%
	High purchase cost of EVs	3	42.9%

	Battery life concerns	1	14.2%
Charging improvements needed	More public charging stations	7	100%
Financial concerns	High vehicle purchase cost	4	57.1%
	Maintenance cost uncertainty	1	14.3%
	Resale value concerns	1	14.3%
	Insurance cost concerns	1	14.3%
Factors increasing confidence in EVs	More charging stations	2	28.6%
	Social influence (friends/family using EVs)	2	28.6%
	Better battery range	1	14.3%
	Affordable EV price	1	14.3%
	Better after-sales service	1	14.3%
Actions government/companies should take	Expand charging infrastructure	2	40%
	Awareness programs	1	20%
	Affordable EV models	1	20%
	Financial incentives	1	20%

vi. Discussion

The results show that infrastructural availability, financial issues, and technological perceptions are the factors that affect consumer preparedness to buy electric vehicles in Jalandhar. The problem of range anxiety and battery reliability is still one of the major obstacles, whereas a better battery charges infrastructure can have a positive impact on the readiness of consumers to purchase EVs. Open-ended responses further highlight that consumers frequently mention charging infrastructure availability and vehicle affordability as major barriers to EV adoption.

vii. Recommendations

The creation of more charging infrastructure, offering monetary incentives, and raising public awareness campaigns can contribute to the minimization of obstacles during adoption and promote the shift of consumers in Tier-2 cities to electric vehicles.

V. CONCLUSION

This paper has discussed barriers and consumer willingness to adopt electric vehicles (EV) in Jalandhar, a Tier-2 city in India. The results reveal that despite the growing awareness of the consumers on the environmental and economic advantages of EVs, a number of difficulties remain to influence the adoption choices of the consumers. Issues regarding driving range, battery life, excessive price of purchasing and poor availability of charging stations are major setbacks. Infrastructure availability and demographic factors are also brought out as the crucial variables in the evolution of EV purchase intention in the statistical analysis. On the whole, enhancing the charging infrastructure, reinforcing financial incentives, and dividing the consumer awareness can be very instrumental in driving the EV adoption in the newly urbanized markets.

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