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DYNAMICS OF ELECTRIC VEHICLE ADOPTION: A COMPREHENSIVE ANALYSIS OF CONSUMER PREFERENCES

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A B S T R A C T

This study investigates the factors influencing electric vehicle (EV) adoption among a diverse sample of 303 respondents, primarily focusing on demographic characteristics, price sensitivity, performance expectations, and sustainability concerns. Data were collected using structured questionnaires, which were validated through Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). The demographic analysis revealed a predominantly young and well-educated sample, with 64.7% male respondents and 95.7% holding at least a Bachelor's degree. EFA identified three significant components affecting EV adoption: Price, Performance, and Sustainability, accounting for a cumulative variance of 67.624%. CFA confirmed the model's fit with a CMIN/DF ratio of 2.508 and an RMSEA of 0.071, indicating an acceptable model fit. Results highlight the importance of price considerations, particularly government incentives and long-term savings, as well as performance attributes such as driving experience and reliability. The factor of sustainability emerged as a critical driver, reflecting growing environmental awareness among consumers. The findings suggest that strategies promoting the financial and environmental benefits of EVs could resonate with potential buyers, particularly within younger, educated demographics. This research contributes to the understanding of consumer attitudes toward EVs and provides valuable insights for manufacturers and policymakers aiming to enhance EV adoption. Future research is recommended to explore diverse consumer perspectives and motivations for adopting electric vehicles across various demographics.

1. INTRODUCTION

The automotive industry is currently experiencing a significant transformation as it transitions from traditional gasoline-powered vehicles to electric vehicles (EVs). This shift is fueled by a confluence of environmental concerns, technological advancements, and evolving regulatory frameworks aimed at curbing greenhouse gas emissions (International Energy Agency [IEA], 2023). With governments worldwide tightening emission standards and offering incentives for cleaner technologies, understanding consumer preferences is becoming essential for both policymakers and automotive manufacturers (Deloitte, 2023).
For many years, gasoline vehicles have served as the backbone of personal and commercial transportation, recognized for their established infrastructure, long driving ranges, and relatively lower initial costs (U.S. Department of Energy, 2023). However, these conventional vehicles contribute significantly to

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greenhouse gas emissions and are subject to fluctuating fuel prices, which can affect their overall cost-effectiveness and environmental impact (Environmental Protection Agency [EPA], 2023).

In contrast, electric vehicles present a promising alternative that can alleviate many of the environmental issues associated with fossil fuels. Improvements in battery technology have enhanced the range and performance of EVs while driving down their overall costs (Bloomberg New Energy Finance, 2023). Additionally, the expanding charging infrastructure and government incentives are making EVs increasingly accessible to a broader audience (McKinsey & Company, 2023). Despite these advantages, challenges such as higher upfront costs, range anxiety, and limited charging options continue to influence consumer choices (Pew Research Center, 2023).

Gasoline vehicles are major contributors to air pollution and greenhouse gas emissions, primarily due to carbon dioxide (CO_2) released from fossil fuel combustion, a key factor in climate change (National Oceanic and Atmospheric Administration [NOAA], 2023). In contrast, EVs produce zero tailpipe emissions, and as the electricity grid incorporates more renewable energy sources, the environmental benefits of EVs are expected to grow (International Renewable Energy Agency [IRENA], 2023).

While advancements in fuel efficiency and engine technology have improved the performance of gasoline vehicles over time, their reliance on fossil fuels remains a significant drawback (World Resources Institute, 2023). In comparison, ongoing developments in battery technology are addressing issues related to range, performance, and affordability of EVs, with research focused on reducing charging times and extending battery life (U.S. Department of Energy, 2023).

When comparing costs, gasoline vehicles incur ongoing expenses for fuel, maintenance, and repairs. Fuel prices can fluctuate, impacting overall cost-effectiveness (Energy Information Administration [EIA], 2023). Although EVs often have higher initial purchase prices, they can result in lower operating costs due to reduced fuel and maintenance expenses. Government incentives and tax breaks can further offset these initial costs (Deloitte, 2023).

Consumers are accustomed to gasoline vehicles and their existing infrastructure; however, growing concerns about long-term sustainability and rising fuel costs are shifting preferences. There is increasing consumer interest in EVs driven by heightened awareness of environmental issues and technological advancements (McKinsey & Company, 2023). Nevertheless, factors such as range anxiety and charging infrastructure still play a role in consumer acceptance (Pew Research Center, 2023).

Regulatory pressures are mounting, with stricter emission regulations and potential bans on new gasoline vehicle sales emerging in various regions (IEA, 2023). States are promoting EV adoption through incentives, grants, and supportive infrastructure development, shaping market dynamics and influencing consumer choices (EPA, 2023).

The automotive industry is undergoing a significant transformation as it shifts from internal combustion engine vehicles (ICEVs) to electric vehicles (EVs). Historically, gasoline-powered vehicles have dominated the market, benefiting from extensive infrastructure and ongoing improvements in fuel efficiency and hybrid technologies. However, the rise of EVs, driven by technological advancements in battery capacity and energy management, is reshaping the industry landscape (International Energy Agency [IEA], 2023).

Governments worldwide are implementing stringent emissions regulations and offering incentives to promote the adoption of EVs, including tax rebates and investments in charging infrastructure (Deloitte, 2023). Consumers are increasingly prioritizing sustainability and cost-effectiveness, further boosting demand for electric vehicles (McKinsey & Company, 2023).

Despite challenges such as the need for expanded charging networks and supply chain limitations for critical battery materials, the industry is poised for growth. Traditional automakers are making substantial investments in EV technology, while new entrants like Tesla and Rivian are disrupting the market with innovative approaches (Bloomberg New Energy Finance, 2023).

This dynamic interplay of regulatory, technological, and consumer-driven factors is creating a rapidly evolving market, positioning EVs as a central element of the automotive industry's future.

The automotive industry is experiencing a major transformation as it transitions from traditional gasoline-powered vehicles (ICEVs) to electric vehicles (EVs). This shift is primarily driven by growing environmental concerns, technological advancements, and evolving regulatory frameworks aimed at reducing greenhouse gas emissions (International Energy Agency [IEA], 2023). Governments globally are implementing stricter emission standards and providing incentives, such as tax rebates and investments in charging infrastructure, to promote the adoption of EVs (Deloitte, 2023).

While gasoline vehicles have long dominated the transportation sector due to their established infrastructure and lower initial costs, they contribute significantly to greenhouse gas emissions and are affected by fluctuating fuel prices, which undermine their overall cost-effectiveness and environmental impact (Environmental Protection Agency [EPA], 2023; U.S. Department of Energy, 2023). Conversely, advancements in battery technology have improved the performance and affordability of EVs, making them a promising alternative to fossil fuel-powered vehicles (Bloomberg New Energy Finance, 2023).

Despite the advantages of EVs, challenges such as higher upfront costs, range anxiety, and limited charging options continue to affect consumer decisions (Pew Research Center, 2023). Regulatory pressures are increasing, with some regions considering bans on new gasoline vehicle sales, while traditional automakers and new entrants like

Tesla are heavily investing in EV technologies (IEA, 2023; Bloomberg New Energy Finance, 2023). This interplay of regulatory, technological, and consumer factors is creating a dynamic market environment that positions EVs as a central component of the automotive industry's future.

Understanding the ongoing transition from ICEVs to EVs is crucial for multiple stakeholders, including policymakers, automotive manufacturers, and consumers. As governments enforce stricter emissions regulations and incentivize cleaner technologies, research on consumer preferences and market dynamics becomes vital to inform effective policy and business strategies (Deloitte, 2023). Additionally, as consumers increasingly prioritize sustainability and cost-effectiveness, insights into their perceptions of EVs can guide manufacturers in developing products that meet market demands (McKinsey & Company, 2023).

Moreover, addressing challenges such as charging infrastructure and supply chain limitations for battery materials is essential for facilitating a smoother transition to electric mobility (U.S. Department of Energy, 2023). This study aims to shed light on the factors driving the adoption of EVs, the barriers to their acceptance, and the implications for the future of the automotive industry. Understanding these elements will enable stakeholders to adapt to the changing landscape and capitalize on the growth potential of the electric vehicle market.

2. THEORETICAL BACKGROUND

Understanding consumer preferences between gasoline vehicles and electric vehicles (EVs) involves examining the theoretical frameworks influencing consumer behavior, such as the Theory of Planned Behavior (TPB) and the Technology Acceptance Model (TAM). The TPB posits that consumer intentions are shaped by attitudes, subjective norms, and perceived behavioral control (Ajzen, 1991), which, in the context of vehicles, translates to how individuals weigh the benefits and drawbacks of EVs versus gasoline vehicles. The TAM emphasizes perceived ease of use and perceived usefulness as critical determinants of technology adoption (Davis, 1989), suggesting that consumers evaluate operational costs and convenience when considering EVs. Additionally, the Diffusion of Innovations Theory highlights the role of early adopters and social networks in shaping broader acceptance (Rogers, 2003). Environmental psychology theories like the Norm Activation Model and Value-Belief-Norm theory explain how personal norms and values drive pro-environmental behaviors, including EV adoption (Schwartz, 1977). Economic theory further elucidates consumer preferences by assessing the total costs associated with vehicle ownership, incorporating initial purchase price, fuel costs, and maintenance expenses (Deloitte, 2023). Collectively, these frameworks offer a comprehensive understanding of the complexities surrounding consumer choices in the evolving automotive market.

3. LITERATURE REVIEW

Research into consumer preferences regarding electric vehicles (EVs) has identified several barriers and motivations influencing adoption. Egbue and Long (2012) found that range anxiety, high initial costs, and limited charging infrastructure significantly impede EV acceptance, despite increasing interest among consumers. Hidrue et al. (2011) demonstrated that consumers are willing to pay more for EVs with longer ranges and shorter charging times, although these premiums do not fully offset the higher purchase costs. Vidhi and Shrivastava (2018) highlighted that the environmental benefits of EVs depend on the energy mix used for electricity generation and battery manufacturing. Carley et al. (2013) noted that early adopters tend to be higher-income, environmentally conscious individuals motivated by fuel savings and technology advancements, but that widespread adoption necessitates addressing concerns about range and infrastructure. Rezvani et al. (2015) and Carrese et al. (2017) emphasized the importance of economic incentives, environmental awareness, and social influences, suggesting that policymakers should consider behavioral biases when crafting interventions. Wang et al. (2017) found that a combination of monetary and non-monetary incentives, such as subsidies and access to dedicated lanes, effectively encourages EV adoption in China. Peters and Dutschke (2014) revealed distinct consumer perceptions, where early adopters prioritize environmental impact, while the general public focuses on cost and convenience. Furthermore, Bühler et al. (2014) demonstrated that direct experience with EVs significantly enhances consumer acceptance. Finally, Plötz et al. (2014) identified early adopters in Germany as typically high-income, environmentally aware individuals, suggesting targeted marketing strategies for this demographic to accelerate EV adoption.

Research on consumer preferences for electric and hybrid vehicles reveals several key insights into the factors influencing adoption. Axsen and Kurani (2013) found that U.S. consumers favor plug-in hybrids over full electric vehicles due to concerns about range and charging infrastructure, suggesting that policymakers should promote plug-in hybrids as a transitional technology. Liu et al. (2023) and Neshat et al. (2023) demonstrated that economic incentives, such as purchase subsidies and tax credits, significantly impact EV adoption, alongside income levels and fuel prices. Plötz et al. (2014) identified environmental benefits, cost savings, and government incentives as major factors affecting consumer choices, while also noting the barriers of high initial costs and limited range. Sovacool and Hirsh (2009) assessed plug-in hybrid electric vehicles (PHEVs) and found that while they offer significant environmental and economic benefits, challenges such as battery technology and consumer acceptance must be addressed. Horne et al. (2005) emphasized the importance of integrating social insights into policy design to enhance EV adoption by aligning consumer preferences with economic incentives. Zhang et al. (2011) highlighted the role of social and network effects in the diffusion of alternative fuel vehicles, indicating that early adopters are critical for accelerating market penetration. Beresteanu and Li (2011) found that rising fuel costs and government incentives significantly increase demand for hybrid vehicles, with fuel prices having a more pronounced impact than incentives. Jensen et al. (2013) noted that experiencing EVs through test drives significantly improved participants' perceptions and acceptance, suggesting that providing hands-on experiences can enhance consumer adoption. Graham-Rowe et al. (2012) conducted qualitative research that explored consumer reactions to plug-in vehicles, indicating that practical experiences shape attitudes toward adoption. Finally, Ahmed et al. (2022) argued for a transition to zero-emission vehicles (ZEVs) to reduce emissions and highlighted the need to consider economic, social, and technological factors to support sustainable development goals in the transportation sector.

The literature on consumer preferences for electric vehicles (EVs) reveals several gaps that motivate further research in this area. Firstly, while existing studies have identified economic incentives and environmental benefits as significant factors influencing EV adoption (Liu et al., 2023; Neshat et al., 2023), there is a lack of comprehensive understanding of how these factors interact with social influences and consumer behavior over time. Rezvani et al. (2015) highlight the complexity of consumer decision-making processes but do not provide longitudinal insights into how preferences evolve as consumers gain more experience with EVs.

Secondly, many studies have focused on early adopters, often overlooking the attitudes and motivations of mainstream consumers (Carley et al., 2013; Plötz et al., 2014). This gap is critical because the widespread adoption of EVs will depend on addressing the concerns of non-early adopters, who may have different priorities and apprehensions regarding EV technology.

Furthermore, while various models, such as the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB), have been applied to understand EV adoption, there is insufficient exploration of how these theoretical frameworks can be integrated or expanded to better capture the nuances of consumer preferences and behaviors (Rezvani et al., 2015). For instance, the role of perceived risk and consumer experience has been underexplored, despite its relevance in shaping attitudes toward new technologies (Jensen et al., 2013).

Additionally, existing research often emphasizes quantitative approaches, leaving a gap in qualitative studies that explore the subjective experiences and narratives of consumers regarding EV ownership (Graham-Rowe et al., 2012). Such insights could enrich our understanding of consumer motivations and barriers, ultimately informing more effective marketing and policy strategies.

Finally, while recent studies have examined the implications of government policies on EV adoption (Wang et al., 2017), there remains a need for research that evaluates the long-term effectiveness of these policies and their impact on different demographic groups (Hidrue et al., 2011). Understanding how policy measures resonate with various consumer segments will be crucial for tailoring interventions that foster broader EV adoption.

4. RESEARCH METHODOLOGY

The research methodology employed in this study utilized a quantitative approach, focusing on the factors influencing electric vehicle (EV) adoption through a cross-sectional survey design. Data were collected via a structured online questionnaire that targeted individuals aged 18 and older who currently own or plan to own a vehicle. The final sample consisted of 303 respondents, primarily recruited through social media platforms, ensuring diverse representation by age, gender, occupation, and education. The questionnaire assessed three primary constructs—**Price**, **Performance**, and **Sustainability**—which were hypothesized to influence EV purchase decisions. Each construct included items rated on a 5-point Likert scale to capture respondents' perceptions. The survey instrument was developed based on existing literature and underwent validation through a pilot test with 30 participants. Data analysis involved descriptive statistics to summarize demographic distributions and Exploratory Factor Analysis (EFA) to identify the underlying structure of the items, with strong sampling adequacy indicated by a Kaiser-Meyer-Olkin (KMO) score of 0.959 and significant Bartlett's test results. Confirmatory Factor Analysis (CFA) was conducted to validate the extracted factors, demonstrating satisfactory model fit with indices such as a CMIN/DF ratio of 2.508 and RMSEA of 0.071. Ethical considerations included voluntary participation and assurance of confidentiality. However, limitations such as reliance on self-reported data and the demographic composition of respondents may affect the generalizability of the findings. Overall, this methodology aimed to provide robust insights into the factors influencing EV adoption, contributing valuable knowledge for policymakers and researchers in promoting sustainable transportation solutions.

4.1 Descriptive statistics

The data collected were categorized according to key demographic characteristics of the respondents, including age, gender, and educational level. The table 1 below presents a summary of these respondent demographics.

Table1. Demographic distribution of respondents

Demographic characteristics		No of Respondents	Percentage
Gender	Male	196	64.7
	Female	107	35.3
Age	Under 25	139	45.9
	25-30	130	43.1
	30-35	25	8.3
	35 and above	14	4.6
Occupations	Student	127	41.9
	Professional	130	42.9
	Self employed	42	13.9
	Others	4	1.3
Education level	Bachelor Degree	127	55.4
	Master Degree	122	40.3
	PhD	4	1.3
	Others	9	3
Types of vehicles owned	Petroleum vehicle	176	58.1
	Electric vehicle	127	41.9

Gender Distribution: The majority of respondents are male, representing 64.7% of the sample, while females make up 35.3%. This indicates a notable gender imbalance in the sample, skewed towards male respondents.

Age Distribution: The largest age group among respondents is under 25 years, making up 45.9% of the sample. This is closely followed by those aged 25-30, who constitute 43.1%. Respondents aged 30-35 represent 8.3%, and only 4.6% of respondents are 35 or older. The data shows a younger demographic concentration, with nearly 90% of respondents under the age of 30.

Occupational Distribution: The respondents are almost evenly split between students (41.9%) and professionals (42.9%). Self-employed individuals make up 13.9%, and a small percentage (1.3%) fall into the 'Others' category. This distribution highlights a focus on respondents who are either pursuing education or employed in professional roles.

Educational Level: Most respondents hold a Bachelor's degree (55.4%) or a Master's degree (40.3%). PhD holders are minimal at 1.3%, while 3% have other qualifications. This suggests that the sample primarily consists of individuals with higher educational attainment, with 95.7% of respondents holding at least a Bachelor's degree.

Vehicle Type Distribution: The majority of respondents (58.1%) own petroleum vehicles, while 41.9% own electric vehicles. This indicates that traditional petroleum vehicles are still the predominant choice among respondents, although electric vehicles also hold a significant share.

Shift Toward Electric Vehicles: With nearly 42% of respondents owning electric vehicles, the data suggests a substantial shift towards alternative energy sources. This may reflect growing interest in sustainable transportation options among the population surveyed, indicating a potential trend towards increased adoption of electric vehicles in the future.

The demographic distribution reflects a predominantly young, male-dominated sample, with high educational qualifications and a strong representation of students and professionals. This demographic may influence the overall perspectives and responses in further analyses.

5. VALIDATION OF THE SCALE

Data were collected using structured questionnaires, which were first validated through Exploratory Factor Analysis (EFA) and further confirmed with Confirmatory Factor Analysis (CFA).

5.1 Sample adequacy test

The adequacy of the data for conducting Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) was assessed using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity, which are commonly applied to evaluate sampling adequacy (Field, 2013; Hair et al., 2019). The results of these tests are presented in Table 2.

Table 2. KMO and Bartlett's Test statistics

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.959**
Bartlett's Test of Sphericity	Approx. Chi-Square	3968.340
	df	153
	Sig.	.000

Sampling Adequacy: The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy is 0.959, which is well above the commonly accepted threshold of 0.60 for conducting factor analysis (Field, 2013). This high value indicates that the sample size is more than adequate for reliable factor analysis.

Sphericity: Bartlett's Test of Sphericity, with a Chi-Square value of 3968.340, degrees of freedom (df) of 153, and a significance level (Sig.) of 0.000, is highly significant ($p < 0.001$). This result suggests that there are patterned relationships among the variables, making them suitable for factor analysis (Hair et al., 2019).

These statistical indicators confirm that the data is appropriate for both Exploratory and Confirmatory Factor Analysis, as high KMO values and significant Bartlett's Test results are standard prerequisites for factorability.

5.2 Exploratory Factor analysis:

To reduce the number of items and the dimensions EFA were conducted , the table 3 shows the total variance explained during the EFA analysis.

Table 3. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.60	58.886	58.886	10.600	58.886	58.886	4.378	24.324	24.324
2	.867	4.815	63.701	.867	4.815	63.701	3.913	21.740	46.064
3	.706	3.923	67.624	.706	3.923	67.624	3.881	21.559	67.624
4	.668	3.712	71.335						
5	.652	3.621	74.957						
6	.572	3.175	78.132						
7	.479	2.659	80.791						
8	.455	2.530	83.321						
9	.418	2.321	85.643						
10	.384	2.135	87.778						
11	.374	2.077	89.855						
12	.358	1.987	91.842						
13	.307	1.707	93.549						
14	.281	1.561	95.109						
15	.261	1.450	96.559						
16	.242	1.346	97.905						
17	.209	1.158	99.064						
18	.169	.936	100.000						
Extraction Method: Principal Component Analysis.									

The data analysis results reveal that three components were retained based on the Eigenvalues, with each exceeding the threshold value of 1, indicating their statistical significance and supporting retention under the Kaiser Criterion (Field, 2013). Together, these components account for a cumulative variance of 67.624%, which reflects a substantial proportion of the data's underlying structure (Hair et al., 2019). Notably, the first component explains 58.886% of the total variance, showing its dominant role. However, after Varimax rotation, the variance is more equitably distributed across the three components, with the first, second, and third components explaining 24.324%, 21.740%, and 21.559% of the variance, respectively, bringing the cumulative variance explained back to 67.624%. This rotation enhances the interpretability of the components, ensuring that each captures distinct aspects of the dataset (Tabachnick & Fidell, 2013). The use of Principal Component Analysis with Varimax rotation also simplifies the interpretation by clarifying the unique contribution of each component, as Varimax rotation minimizes the complexity of component loadings while improving the overall model's clarity (Field, 2013; Hair et al., 2019). These results indicate that a three-component solution is optimal, accounting for a considerable amount of variance while providing a clear structure for understanding the primary factors in the data.

Table 4. Rotated Component Matrix

Components	Questions	Questions	Factor loading
Price	Q16	How important is the overall price of an electric vehicle in your purchase decision?	.719
	Q14	How much do you agree with the statement, "Electric vehicles are more affordable in the long run"?	.716
	Q18	How influential are government incentives (e.g., tax credits, rebates) in motivating you to consider an electric vehicle?	.707
	Q12	How much would monthly savings on fuel influence your decision to purchase an electric vehicle?	.658
	Q17	Would the upfront cost of an electric vehicle deter you from purchasing one, even with anticipated long-term savings?	.619
	Q15	How significant is the cost of installation of charging equipment at home in your purchase decision?	.577
	Q19	How willing are you to pay a premium for an electric vehicle compared to a traditional fuel vehicle?	.510
Performance	Q4	How important is the acceleration and overall driving experience of an electric vehicle in your purchase decision?	.779
	Q2	How satisfied are you with the range (distance per charge) offered by most electric vehicles on the market?	.681
	Q6	How concerned are you about the availability of charging stations when considering an electric vehicle?	.649
	Q8	How much does the reliability of electric vehicles influence your decision to purchase one?	.618
	Q1	How much would lower maintenance requirements in an electric vehicle positively impact your decision?	.575
	Q3	How important is it that the electric vehicle’s battery has a long lifespan?	.528
Sustainability	Q7	How important is the environmental impact of a vehicle in your purchase decision?	.764
	Q11	How much do you agree with the statement, "I feel responsible for reducing my carbon footprint by choosing an electric vehicle"?	.673
	Q5	How influential is the potential reduction in air pollution by driving an electric vehicle in your decision?	.664
	Q9	How significant is the use of sustainable and eco-friendly materials in the manufacturing of electric vehicles to you?	.626
	Q13	How much would the option to recycle or reuse vehicle parts affect your decision to purchase an electric vehicle?	.591

The Rotated Component Matrix presented in Table 4 reveals the loadings of various items (questions) on three distinct components following Principal Component Analysis with Varimax rotation. Each item demonstrates a clear association with a specific component, indicating that they collectively measure related underlying constructs. Component 1, which includes items Q16, Q14, Q18, Q12, Q17, Q15, and Q19, shows high loadings ranging from 0.510 to 0.719. This strong alignment suggests that these items represent a common theme or construct (Field, 2013). Similarly, Component 2 is characterized by items Q4, Q2, Q6, Q8, Q1, and Q3, which load significantly, with values from 0.528 to 0.779, indicating they collectively capture another distinct dimension within the dataset (Hair et al., 2019). Lastly, Component 3 comprises items Q7, Q11, Q5, Q9, and Q13, all of which load heavily, ranging from 0.591 to 0.764, further confirming that they measure a separate construct from the previous components (Tabachnick & Fidell, 2013).

The clear differentiation of items across the three components supports the selection of a three-factor solution, highlighting the effectiveness of the rotation in maximizing the interpretability of the data. The Varimax rotation with Kaiser Normalization enhances the clarity of each component's contributions, ensuring that items align closely with their respective factors, thus validating the unique nature of each component (Field, 2013; Hair et al., 2019).

The extracted three factors were named based on the relevance of the measurable items, they are

1. Price ,
2. Performance
3. Sustainability

5.3 Confirmatory factor analysis

To verify the extracted five dimensions and the 18 items confirmatory factor analysis was done using SPSS Amos software, the figure 1 show the confirmed measurement model.

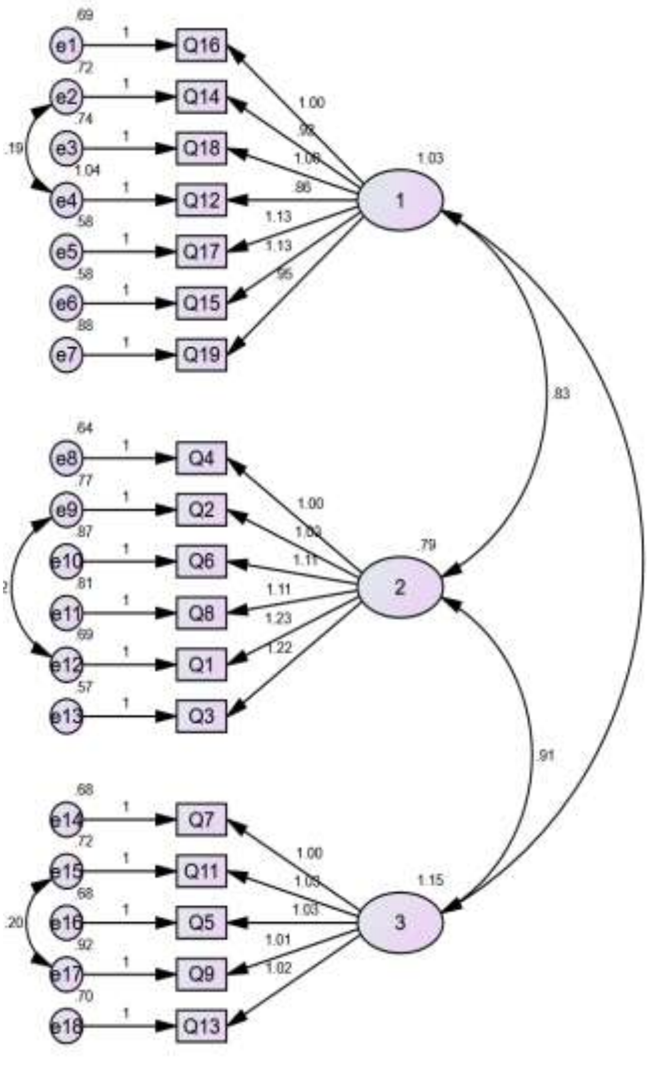

Figure 1. Measurement model

Table 6. Model Fit Summary

1.1.1.1.1 CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	42	323.559	129	.000	2.508
Saturated model	171	.000	0		
Independence model	18	4060.210	153	.000	26.537

1.1.1.1.2 RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.063	.902	.869	.680
Saturated model	.000	1.000		
Independence model	.970	.155	.055	.139

1.1.1.1.3 Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.920	.905	.951	.941	.950
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

1.1.1.1.4 RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.071	.061	.080	.000
Independence model	.291	.283	.299	.000

The model fit summary indicates the overall goodness-of-fit of the specified model, revealing important insights into its adequacy and reliability. The Default Model shows a CMIN (chi-square) value of 323.559 with 129 degrees of freedom (df) and a p-value of 0.000, resulting in a CMIN/DF ratio of 2.508. This ratio is below the recommended threshold of 3, suggesting an acceptable fit (Schumacker & Lomax, 2016). In contrast, the Independence Model demonstrates a significantly higher CMIN value of 4060.210 and a CMIN/DF ratio of 26.537, indicating poor model fit and reflecting the lack of relationships among the variables.

In terms of residuals and goodness-of-fit indices, the Default Model yields a Root Mean Square Residual (RMR) of 0.063 and a Goodness of Fit Index (GFI) of 0.902, both of which suggest a satisfactory fit, as values above 0.90 are generally considered acceptable (Hu & Bentler, 1999). The Adjusted Goodness of Fit Index (AGFI) of 0.869 and Parsimony Goodness of Fit Index (PGFI) of 0.680 further support the adequacy of the model, as AGFI values above 0.80 are indicative of good fit (Hair et al., 2019).

The Baseline Comparisons demonstrate robust fit indices for the Default Model, with a Normed Fit Index (NFI) of 0.920 and Comparative Fit Index (CFI) of 0.950. These values exceed the acceptable threshold of 0.90, indicating strong model performance. In contrast, the Independence Model scores poorly across all indices, reinforcing its unsuitability.

The Root Mean Square Error of Approximation (RMSEA) for the Default Model is 0.071, with a 90% confidence interval ranging from 0.061 to 0.080. This RMSEA value is below the recommended cutoff of 0.08, suggesting a good fit (Browne & Cudeck, 1993). Conversely, the Independence Model exhibits a significantly high RMSEA of 0.291, further confirming its inadequate fit.

These findings indicate that the Default Model demonstrates a satisfactory fit to the data, while the Independence Model fails to provide an adequate representation, highlighting the necessity of the relationships established within the Default Model.

5.4 Relationship between demographical factors and consumers preference

To assess the relationship between demographic factors—Gender, Age group, and Education Level and preferences for EV selection, chi-square tests can be performed for each demographic variable in relation to EVs preference. This analysis helps determine whether these demographic factors have a statistically significant association with EVs preference. The test statistics for the chi-square analysis are presented in Table 6, illustrating the influence of demographic characteristics on customer preferences in EVs purchase.

H_0: Demographical factor of the respondents will not influence on the consumers preference in EVs purchase

H_1: Demographical factor of the respondents will influence on the consumers preference in EVs purchase

Table 7. Relationship between demographical factors and customer preference

Demographic characteristics		Considered	Not considered	Chi Square Output	Significance
Gender	Male	150	46	Chi-Sq = 27.397, DF = 1, P-Value = 0.000	5%
	Female	50	57		
Age	Under 25	99	40	Chi-Sq = 7.108, DF = 3, P-Value = 0.069	NS
	25-30	103	27		
	30-35	20	5		
	35 and above	7	7		
Occupations	Student	100	27	Chi-Sq = 19.612, DF = 3, P-Value = 0.000	5%
	Professional	121	9		
	Self employed	34	8		
	Others	3	1		
Education level	Bachelor Degree	101	26	Chi-Sq = 23.112, DF = 3, P-Value = 0.000	5%
	Master Degree	112	10		
	PhD	4	0		
	Others	5	4		
Types of vehicles owned	Petroleum vehicle	166	10	Chi-Sq = 0.135, DF = 1, P-Value = 0.713	NS
	Electric vehicle	121	6		

The analysis of the relationship between demographic factors and consumer preferences for electric vehicles (EVs) reveals significant insights. The chi-square test results presented in Table 7 indicate that gender, occupation, and education level significantly influence consumers' preferences for EVs, while age and the type of vehicles owned do not show a statistically significant association.

Gender: The chi-square statistic for gender indicates a strong relationship, with a value of 27.397 and a p-value of 0.000, which is less than the 5% significance level. This suggests that male respondents are more likely to consider purchasing EVs compared to female respondents.

Age: The chi-square test for age shows a statistic of 7.108 with a p-value of 0.069. Although the p-value is close to the conventional threshold of 0.05, it does not reach statistical significance, indicating that age may not have a substantial influence on EV preferences among the different age groups.

Occupation: The occupation of respondents significantly affects their preferences for EVs, as evidenced by the chi-square statistic of 19.612 and a p-value of 0.000. This indicates that students and professionals are more inclined to consider EVs compared to self-employed individuals and those in other occupations.

Education Level: The analysis shows a significant relationship between education level and EV preferences, with a chi-square statistic of 23.112 and a p-value of 0.000. Higher educational attainment appears to correlate with a greater likelihood of considering EVs for purchase.

Types of Vehicles Owned: The relationship between the type of vehicles owned and EV preferences is not significant, as indicated by a chi-square statistic of 0.135 and a p-value of 0.713. This suggests that current vehicle ownership does not substantially influence the consideration of EVs.

In summary, demographic factors such as gender, occupation, and education level have a significant impact on consumer preferences for electric vehicles, supporting the alternative hypothesis (H1). In contrast, age and type of vehicles owned do not demonstrate significant associations with EV purchase preferences, leading to the acceptance of the null hypothesis (H0) for these factors. These findings highlight the importance of understanding demographic influences when analyzing consumer behavior in the context of electric vehicle adoption.

6. RESULTS

The analysis of the data collected from 303 respondents revealed significant insights into the factors influencing electric vehicle (EV) adoption. **Demographic characteristics** indicated a predominantly young and male sample, with 64.7% identifying as male and 45.9% being under 25 years old. The educational background of the respondents showed that 95.7% held at least a Bachelor's degree, suggesting a highly educated sample. In terms of vehicle ownership, 58.1% owned petroleum vehicles, while 41.9% owned electric vehicles, indicating a notable interest in alternative energy options among respondents.The **Exploratory Factor Analysis (EFA)** yielded three distinct components: **Price**, **Performance**, and **Sustainability**, which accounted for a cumulative variance of 67.624%. The **Confirmatory Factor Analysis (CFA)** confirmed the model's fit, with the CMIN/DF ratio at 2.508 and an RMSEA of 0.071, indicating an adequate fit for the hypothesized model. The Rotated Component Matrix indicated strong loadings for items related to each factor, with price-related items showing loadings between 0.510 and 0.719, performance items ranging from 0.528 to 0.779, and sustainability items loading between 0.591 and 0.764.

7. DISCUSSION

The results emphasize the critical role of **price** in influencing the decision-making process of potential EV buyers, aligning with existing literature that underscores the importance of cost considerations in technology adoption. Items related to government incentives and long-term savings were particularly influential, suggesting that financial factors significantly impact consumer choices. Furthermore, the strong emphasis on **performance**, particularly regarding driving experience and reliability, highlights consumer concerns about the practicality and efficiency of EVs.

The factor of **sustainability** emerged as a noteworthy component, indicating a growing awareness and concern for environmental issues among consumers, which may drive their interest in adopting electric vehicles. This trend reflects broader societal shifts towards sustainability and suggests that marketing strategies emphasizing the environmental benefits of EVs could resonate with a significant segment of the population.

The demographic analysis also revealed a substantial interest in electric vehicles among younger, well-educated individuals. This could signal a generational shift in transportation preferences, with younger consumers being more open to sustainable options. However, the gender imbalance, with a higher representation of male respondents, indicates a potential area for further research and targeted outreach to encourage diverse participation in the EV market.

8. CONCLUSION

In conclusion, this study provides valuable insights into the demographic characteristics and factors influencing electric vehicle adoption. The findings underscore the importance of price, performance, and sustainability in shaping consumer attitudes towards electric vehicles. As the automotive industry continues to evolve, understanding these factors will be crucial for manufacturers and policymakers aiming to promote sustainable transportation. The study's limitations, including its reliance on self-reported data and the specific demographic profile of respondents, suggest that further research is needed to explore the diverse motivations for EV adoption across different populations. Future studies could expand on these findings by incorporating qualitative methodologies to capture deeper insights into consumer attitudes and perceptions, ultimately contributing to more effective strategies for increasing electric vehicle adoption.

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