

# Factors Influencing Willingness to Purchase Electric Bicycles among Malaysian Private University Students

Mohamed Ikhlas Ardinata., Salfarina Abdul Gapor\*., Muhiadin Abdi Awl., Abdalrawf Mohammed Mohammed Noor Ali., Osaid N. A. Abdaljawwad., Ismail Osman Ismail Abdelgadir

School of Social Business and Social Sciences, Albukhary International University

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## ABSTRACT

Electric bicycles have emerged as a promising sustainable mobility option capable of reducing emissions, alleviating traffic congestion, and promoting healthier transportation choices. However, purchase remains uneven among young adults, and the determinants influencing their purchase intentions are not well established. This study investigates regional differences and key predictors of electric bicycles purchase willingness among students in Malaysian private universities. Quantitative research design was employed using an online survey, comprising a pilot study ( $n = 10$ ) and a main study ( $n = 162$ ). Data analysis included reliability assessment, frequency distribution, and correlation testing. The findings reveal no significant regional variation in students' willingness to purchase electric bicycles. Instead, purchase intentions were positively associated with familiarity with electric bicycles, knowledge of their benefits, affordability, and the availability of charging infrastructure. Demographic and social factors including gender, age, environmental concern, lifestyle, and peer influence did not exhibit significant relationships with purchase intention. These results underscore that practical and structural considerations, rather than demographic attributes, play a more decisive role in shaping students' purchasing behaviour. The study highlights opportunities for Malaysian private universities to promote sustainable mobility by reducing cost barriers, enhancing infrastructure, and increasing awareness of electric bicycle's functionality and maintenance. The findings provide valuable insights for policymakers, industry stakeholders, and educational institutions seeking to advance sustainable transportation initiatives among young adult populations.

**Keywords:** Electric bicycles; sustainable mobility; willingness to purchase; affordability; charging infrastructure.

## INTRODUCTION

Sustainable development has become a central global agenda, necessitating strategies that integrate economic advancement, environmental stewardship, and social well-being. The World Commission on Environment and Development (WCED) (1987) underscores the imperative of addressing present needs without compromising the capacity of future generations to fulfill their own. Within this discourse, the transportation sector has been identified as a critical domain, given its substantial contribution to greenhouse gas emissions and its persistent reliance on fossil fuels. Consequently, the pursuit of sustainable mobility alternatives has garnered scholarly attention, with electric bicycles increasingly recognized as a viable intervention. Electric bicycles have been posited to mitigate carbon emissions, foster healthier lifestyles, and contribute meaningfully to broader environmental objectives (Chen et al., 2025).

The transportation sector is one of the largest contributors to greenhouse gas (GHG) emissions globally, owing to its heavy dependence on fossil fuels (United Nations, 2015). In Malaysia, this dependence is particularly acute, with private car ownership rates among the highest in Southeast Asia, urban congestion worsening in major cities, and fuel subsidies reinforcing reliance on conventional vehicles. These trends not only strain environmental sustainability but also undermine national objectives for livable cities, efficient mobility, and public health. The urgency of addressing these systemic challenges is underscored by Malaysia's policy commitments, notably its pledge to achieve Net Zero emissions by 2050 and the strategic directions outlined in the National Transport Policy (NTP) 2019–2030, which emphasize sustainable, inclusive, and technology-driven

mobility. Bridging the gap between these policy aspirations and actual transport behaviour remains a pressing national concern.

Against this backdrop, electric bicycles have emerged internationally as a viable alternative for short- to medium-distance travel. By combining human and electric power, electric bicycles offer dual advantages of convenience and sustainability. They are increasingly recognized as an innovative mobility solution capable of advancing the Sustainable Development Goals (SDGs), particularly those linked to climate action, sustainable cities, and health (Ibrahim et al., 2022). Global purchase has risen steadily, with evidence suggesting that environmental awareness, economic efficiency, and perceived relative advantages are key determinants of uptake (Yasir et al., 2025).

Yet in Malaysia, the diffusion of electric bicycles remains at a relatively early stage. Market penetration is low, and public awareness, particularly among students, a demographic crucial for shaping future mobility patterns remains limited (Tee et al., 2023). While prior research has examined young Malaysians' acceptance of electric bicycles (Tee et al., 2023) and the sustainability potential of cycling among university students (Ibrahim et al., 2022), little attention has been directed toward students in private universities. This oversight is noteworthy, as private university students may diverge from broader trends due to distinctive socio-economic contexts, the availability of campus infrastructure, and exposure to sustainability-oriented curricula.

Understanding this group's awareness of and willingness to purchase electric bicycles is essential. Students are not only future consumers but also catalysts for cultural change, and their adoption of sustainable commuting modes can accelerate Malaysia's broader transition toward low-carbon mobility. Insights derived from this population can inform policies, infrastructural planning, and marketing strategies that align consumer behavior with Malaysia's Net Zero 2050 ambitions and the transformative agenda of the NTP 2019–2030.

Globally, the electric bicycles market was valued at USD 41.3 billion in 2022 and is projected to grow to USD 77.6 billion by 2028 (BCC Research, 2024). In the Asia-Pacific region, the market reached approximately USD 16.27 billion in 2024 and continues to expand (Grand View Research, 2024). In Malaysia, however, official electric bicycles sales are not yet systematically recorded, and electrified mobility remains in its early stages. Understanding university students' willingness to purchase electric bicycles is therefore essential, as it can inform early policy development and guide campus-level initiatives to support sustainable mobility.

Accordingly, this study pursues three interrelated objectives: (1) to assess the level of awareness of electric bicycles among students in Malaysian private universities, (2) to examine their intentions to acquire electric bicycles, and (3) to identify the determinants of awareness and willingness to purchase, including sustainability attitudes, financial considerations, and infrastructural provisions. In fulfilling these objectives, the study not only contributes to the literature on sustainable mobility but also provides actionable insights for aligning transport behaviour with Malaysia's long-term climate and policy commitments. Private university students in Malaysia represent a particularly relevant consumer segment for electric bicycles. They generally have higher purchasing power, study and live in urban or semi-urban areas where congestion and commuting costs are significant, and belong to younger age groups that are typically more receptive to new technologies. Additionally, they are frequently exposed to sustainability-related discussions through coursework and campus initiatives. Focusing on this population therefore provides useful early-purchaser insights that can inform policy development, campus mobility planning, and market strategies for electric bicycles vendors.

## LITERATURE REVIEW

### Sustainable Mobility and the Role of Electric bicycle

Sustainable mobility is a core component of global sustainable development, emphasizing transport systems that reduce emissions, promote health, and enhance social well-being. Foundational definitions of sustainability, such as the WCED's (1987) emphasis on intergenerational equity and Elkington's (1997) triple bottom line highlight environmental, social, and economic dimensions as interconnected pillars guiding sustainable transport innovation. Within this context, electric bicycles have gained increasing scholarly attention as a practical and scalable low-carbon mobility solution.

International research consistently shows that electric bicycles can lower greenhouse gas emissions, reduce traffic congestion, and encourage active travel by expanding cycling accessibility for longer distances and diverse age or fitness groups (Huang et al., 2022; ITDP, 2024). Lifecycle assessments demonstrate that electric bicycles typically produce far fewer emissions per passenger-kilometer than conventional vehicles and often outperform other motorised modes when charged with low-carbon electricity sources (Huang et al., 2022; Ellingsen et al., 2014). These findings position electric bicycles as a key sustainable mobility technology with strong potential in urban and campus settings.

### **Global Trends in Electric Bicycles Purchase**

Electric bicycles uptake varies substantially by region, shaped by infrastructure, policy environments, affordability, and cultural norms. In regions such as North America, purchasing is strongly linked to long-standing cycling cultures, investments in safe cycling infrastructure, and pro-cycling policy frameworks. MacArthur et al. (2014) found that environmental motivations, lifestyle preferences, and infrastructure availability are major drivers among early purchasers, reflecting value-driven sustainable mobility patterns typical in high-income regions. Their study employed a quantitative approach using an online survey targeting existing electric bicycles users across North America, collecting data on purchase decisions, usage patterns, trip characteristics, reasons for purchase, and demographic profiles. This methodological foundation helped reveal how infrastructural readiness and established cycling cultures create favourable conditions for electric bicycles purchase in Western contexts, in contrast to regions where policy support or cycling norms are less developed.

China represents the world's most mature electric bicycles market, where purchase has been driven less by environmental concerns and more by affordability, government incentives, and integration into existing transport systems. Studies by Cherry & Cervero (2007), Cherry et al. (2009), and Weinert et al. (2007; 2008) show that low cost and strong policy support enabled electric bicycles to emerge as a mainstream transport mode, demonstrating how structural and economic factors can shape mass purchasing.

Early mixed-method research by Cherry and Cervero (2007), which combined surveys and behavioural observations in Chinese cities, showed that low upfront cost was a central motivator for purchasing among urban residents. Building on this, Cherry et al. (2009) used longitudinal household surveys to demonstrate that affordability, together with robust government incentives, enabled electric bicycles to become a mass, non-elite mobility option. Similar patterns were observed in survey-based work by Weinert et al. (2007), who found that affordability and everyday convenience were the dominant factors encouraging users to shift from traditional bicycles to electric bicycles. Complementing these findings, Weinert et al. (2008) conducted a comprehensive policy and market evaluation, concluding that China's regulatory environment and long-term policy direction have been instrumental in sustaining the growth and mainstreaming of electric two-wheelers. Collectively, these studies underscore the decisive roles of low cost and supportive government policies in shaping China's large-scale electric bicycles purchase trajectory.

Extending the comparison beyond Asia, recent studies reveal distinct purchasing dynamics in other world regions. In the Arab states and across MENA cities, electric bicycles expansion faces significant challenges, which include cultural constraints on cycling (especially gender norms in MENA), high import costs, inconsistent infrastructure, and limited consumer purchasing power. Findings from Al-Hajri et al. (2022) and Munene & Owuor (2021) reveal rising interest among youth but slow purchase due to context-specific economic and socio-cultural barriers. These regions illustrate how sustainable mobility innovations often require enabling environments to succeed.

The evidence on Arab states comes from a systematic literature review of mobility attitudes and mode choices across MENA cities, which synthesised findings from 43 regional studies published between 2000 and 2022. Using structured screening and comparative analysis, the review highlights how socio-cultural norms, particularly gendered perceptions combined with limited cycling infrastructure and dependence on fossil-fuel transport, constrain the purchase of cycling and electric bicycles alternatives despite rising interest among youth (Al-Hajri et al., 2022). In the Sub-Saharan Africa, pilot projects and survey-based assessments show that affordability remains the principal barrier, with low purchasing power and inadequate infrastructure slowing the

uptake of sustainable alternatives such as electric bicycles, even where demand for low-cost transport options is growing (Munene & Owuor, 2021).

In Malaysia, research indicates that electric bicycles purchase remains limited compared with regional peers. Existing studies highlight several key constraints, such as low awareness, especially among students (UNITEN, 2019), high upfront costs relative to student purchasing power (Simons et al., 2019), insufficient cycling and charging infrastructure (Tee et al., 2023) and limited integration into urban transport planning.

Malaysia’s National Transport Policy 2019–2030 and Net Zero 2050 commitments emphasise sustainable and technology-enhanced mobility. Yet practical challenges, car dependence, limited cycling lanes, and modest campus-based sustainable transport initiatives continue to shape purchasing behaviour. Notably, existing Malaysian studies largely focus on general youth populations, urban residents, or public university students. Research on private university students, especially those from diverse international backgrounds, is sparse. This remains a notable gap given that private university students may differ in mobility needs, purchasing capacity, and exposure to sustainability discourse.

The Malaysian context presents additional complexities in understanding electric bicycles purchase. A focus group study of young adults by Simons et al. (2019) found that financial concerns and inadequate infrastructure were more influential than environmental considerations in shaping purchase decisions. Similarly, a pilot study by UNITEN (2019), based on a small-scale survey of university students, reported that low awareness and high upfront costs were the main barriers to purchase. Expanding on these insights, Tee et al. (2023) applied regression and structural equation modelling (SEM) to estimate the potential for large-scale electric bicycles uptake among Malaysian youth, identifying affordability and charging infrastructure as key determinants. Complementary findings emerge from Ibrahim et al. (2022), who examined cycling intentions among Malaysian students using SEM and survey data; their study showed that willingness to commute by bicycle was strongly tied to the availability of suitable infrastructure and students’ sustainability attitudes. Despite these emerging contributions, the evidence base for Malaysia and similar developing economies remains limited. Existing studies consistently indicate that financial considerations, particularly affordability, subsidies, and access to charging infrastructure tend to outweigh environmental motivations in shaping willingness to purchase electric bicycles.

Table 1 Comparative factors influencing Willingness to Purchase electric bicycles across regions

Region	Research Methods	Key Enablers of Willingness to Purchase	Key Barriers of Willingness to Purchase	Representative Findings
North America (MacArthur et al., 2014).	Online survey targeting existing electric bicycles users across North America	Established cycling culture; strong policy support; safe and extensive cycling infrastructure	High upfront costs remain for some groups despite subsidies	Cycling culture and infrastructure strongly predict purchasing; environmental motivations are also significant
China Cherry & Cervero (2007) Cherry et al. (2009) Weinert et al. (2007) Weinert et al. (2008)	Cherry & Cervero (2007) - Mixed-method research in Kunming and Shanghai. Cherry et al. (2009) - Travel surveys and GPS-based studies	Government subsidies; affordability of domestic electric bicycles; large-scale infrastructure integration	Safety concerns; regulatory inconsistencies (e.g., restrictions in urban cores)	Mass purchase driven by affordability and strong policy incentives; electric bicycles are mainstream urban transport

	Weinert et al. (2007) – Surveys, Interviews with Chinese manufacturers and urban travel studies  Weinert et al. (2008) – Policy research			
Arab States  (Al-Hajri et al., 2022)	Systematic literature review	Youth interest in sustainable mobility; emerging smart-city initiatives (e.g., UAE, Saudi Arabia)	Cultural perceptions of cycling (esp. gender norms); dependence on fossil-fuel vehicles; limited infrastructure	Purchase is constrained by socio-cultural barriers and lack of supportive infrastructure, though pilot schemes show growing potential
Sub-Saharan Africa  (Munene & Owuor, 2021)	Survey-based assessments	Pilot projects (NGO & donour-led); growing demand for affordable transport	Low purchasing power; high cost of imports; inadequate infrastructure; lack of financing models	Interest is high but purchase lags; affordability and infrastructure are the strongest determinants of willingness to purchase
Malaysia  (Simons et al., 2019; UNITEN, 2019; Tee et al., 2023).	Simons et al., 2019 – Focus Group Study  UNITEN, 2019 – Survey  Tee et al., 2023 – Survey	National policy commitments (NTP 2019–2030; Net Zero 2050); youth/student awareness campaigns; emerging pilots in universities	Limited awareness among students; affordability issues; weak infrastructure for cycling and charging	Financial and infrastructural factors outweigh environmental motivations; research on private university students remains sparse

As summarised in Table 1, willingness to purchase electric bicycles varies considerably across regional contexts. In regions with established cycling cultures, such as North America, purchasing tends to be driven by environmental values and lifestyle preferences. In contrast, studies from Asia and other emerging economies show that affordability, infrastructure availability, and basic awareness of electric bicycles are the dominant determinants of purchase. In Malaysia, existing research largely concentrated in the Klang Valley indicates that financial constraints, limited cycling and charging infrastructure, and low awareness shape purchase decisions far more strongly than environmental motivations. However, research gaps remain, no study has yet examined the willingness to purchase electric bicycles among private university students across Malaysia’s diverse international campuses, leaving an important segment of young consumers underexplored.

### Determinants of Electric Bicycles Purchase: Insights from Theory and Empirical Studies

Across contexts, the factors influencing electric bicycles purchase typically align with broader sustainable mobility and technology-acceptance theories. These determinants include economic, infrastructure, awareness familiarity and knowledge and social and psychological.

Under the economic determinants, affordability is consistently identified as a primary barrier in developing regions (Cherry & Cervero, 2007; Dill & Rose, 2012). Without financial incentives or reduced upfront costs, potential users, even those environmentally aware remain hesitant.

For infrastructure determinants, safe cycling lanes, charging facilities, and secure parking are essential predictors of purchase (Zhang et al., 2024; McQueen et al., 2019). Where enabling infrastructure is weak or absent, purchase remains marginal.

For awareness, familiarity, and knowledge determinants, studies increasingly distinguish between awareness of electric bicycles, general knowledge of their features, and hands-on familiarity (e.g., trying or seeing electric bicycles in use). Research suggests these factors influence perceived usefulness and ease of use, two major constructs in the Technology Acceptance Model (TAM). Yet in many developing contexts, detailed knowledge and actual familiarity remain low, limiting purchase despite rising general awareness (Campbell et al., 2016).

As for the social and psychological determinants, findings from Theory of Planned Behaviour (TPB)-based studies vary by region. In high-income countries, attitudes and subjective norms are strong predictors (Haustein & Møller, 2016). In developing countries, external factors such as price and infrastructure often overshadow attitudinal and normative influences (Weinert et al., 2007; Tee et al., 2023). This variation underscores the need for context-specific analyses.

### **Theory of Planned Behaviour (TPB)**

TPB is an influential social psychology model that predicts an individual's intention to engage in a specific behaviour at a specific time and place (Ajzen, 1991). Developed by Icek Ajzen as an extension of the Theory of Reasoned Action, the TPB posits that behaviour is primarily driven by behavioural intention. According to the theory, this intention is influenced by three key factors:

1. **Attitude** - The individual's overall positive or negative evaluation of performing the behaviour. This involves weighing the perceived benefits and drawbacks (behavioural beliefs).
2. **Subjective Norm** - The perceived social pressure from important others (e.g., family, friends, peers) to perform or not perform the behaviour (Ajzen, 2020). This is based on normative beliefs about what significant people think one should do.
3. **Perceived Behavioural Control (PBC)** - The individual's perception of how easy or difficult it is to perform the behaviour, considering the barriers and resources available. When PBC is accurate, it can also directly influence behaviour alongside intention (Ajzen, 1991).

The model's robustness has been demonstrated through decades of research. A comprehensive meta-analysis by McEachan et al. (2016) confirmed that the combination of Attitude, Subjective Norm, and PBC is a strong predictor of intention and behaviour across various domains, particularly in health. The theory remains highly relevant and continues to be applied to modern contexts, such as understanding green consumer habits (Yadav & Pathak, 2016) and technology purchase. TPB provides a robust foundation for understanding the factors influencing electric bicycles purchase.

Attitude toward electric bicycles purchase refers to the individual's evaluation of electric bicycles as favorable or unfavorable. In this study, positive attitudes were reflected in participants' beliefs about the environmental benefits of electric bicycles, their reliability and safety, and their usefulness for short-distance travel. Concern about climate change further reinforced these attitudes.

Subjective norms encompass the perceived social pressure to engage in electric bicycles purchase. The influence of family, friends, and peers played a moderate role in shaping respondents' views, suggesting that social endorsement can significantly impact behavioral intention. Perceived behavioral control relates to the individual's perception of their ability to purchase electric bicycles. Factors such as affordability, availability of charging stations, maintenance concerns, and knowledge about electric bicycles influenced this construct. Respondents who perceived fewer barriers were more likely to express willingness to purchase. These three constructs collectively influence the intention to purchase e-bike, which is considered the strongest predictor of actual behavior. The conceptual framework developed for this study illustrates the relationships among these variables and provides a basis for analyzing the determinants of e-bike purchasing. Refer to Figure 1.

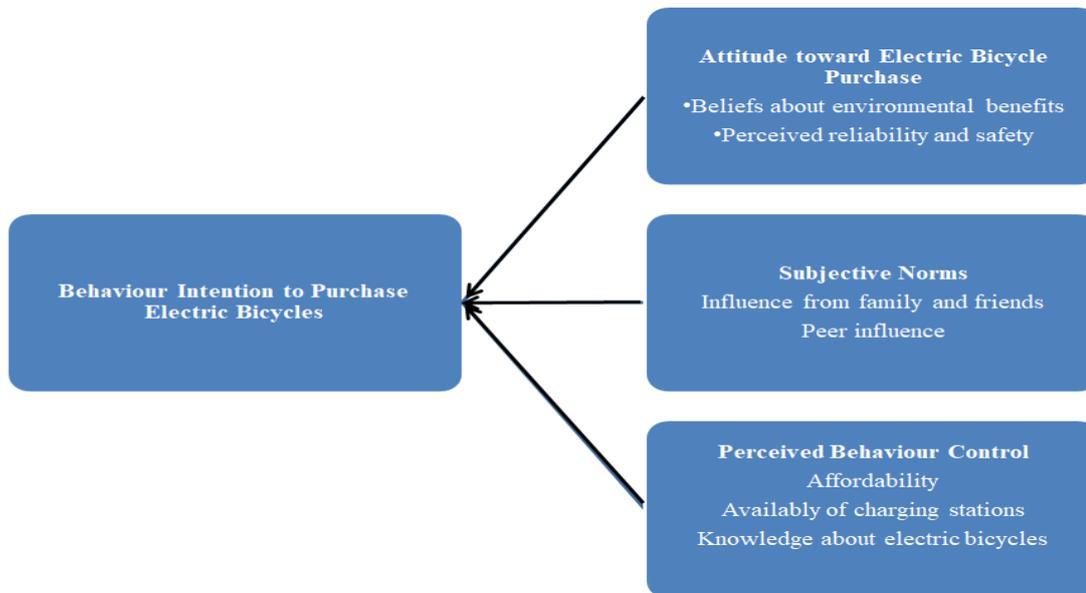


Figure 1 Conceptual framework of the study

## METHODOLOGY

### Research Design

This study employed a quantitative, cross-sectional survey design to examine the determinants of students' willingness to purchase electric bicycles in Malaysian private universities. A survey approach was selected to enable the systematic collection of standardized data across a diverse group of respondents, allowing for statistical examination of relationships among key variables aligned with the Theory of Planned Behaviour (TPB) and technology-purchase literature.

### Sampling Strategy

A combination of stratified sampling and convenience sampling was used. Stratified sampling ensured proportional representation of the three dominant student groups enrolled in private universities in northern Malaysia:

1. Asia (including Malaysia)
2. Arab Region
3. Sub-Saharan Africa

Convenience sampling was then applied within each stratum to recruit participants from university WhatsApp groups and student networks. This strategy ensured adequate representation across regions while maintaining efficient access to respondents.

To ensure sufficient statistical power, a priori power analysis was conducted using G\*Power 3.1. For a two-tailed correlation test ( $\alpha = 0.05$ , power = 0.80, medium effect size  $r = 0.25$ ), a minimum sample of 123 participants was required. The final dataset comprised 162 valid responses, exceeding this benchmark and achieving power above 0.90.

Private-university students were selected as the sampling frame because they represent demographic segments with higher purchasing capability, are situated in predominantly urban settings where mobility challenges are prominent and fall within the 18–30 age range that is generally more receptive to technological and sustainable innovations. Their regular exposure to climate- and sustainability-related discourse further strengthens their suitability as a population for examining electric bicycles purchase intentions.

## Data Collection

Data were collected using an online questionnaire developed in Google Forms. The survey link was distributed through WhatsApp student groups associated with private universities in northern Malaysia, as these channels offer high engagement, rapid dissemination, and broad reach across faculties and year levels. An eligibility item (confirming current enrolment in a Malaysian private university) and a one-response reminder were included to minimise ineligible or duplicate entries; timestamps and metadata were also checked for duplication. A pilot test with 10 students was conducted to assess clarity and timing, resulting in minor wording revisions; pilot responses were excluded from analysis. The final dataset comprised 162 valid responses.

## Research Instrument Development

The questionnaire consisted of six sections, combining demographic items and multi-item scales measuring determinants of electric bicycles purchase. The instrument was informed by TPB constructs (attitude, subjective norm, perceived behavioural control), prior electric bicycles purchase studies, and sustainability behaviour literature.

The development process involved item generation. Survey items were adapted from validated scales in previous studies and refined to suit the electric bicycles context among university students. For examples:

- *“Electric bicycles are better for the environment”* (attitude)
- *“My friends and family influence my views on electric bicycles”* (subjective norm)
- *“The availability of charging stations would influence my decision to buy an electric bicycle”* (PBC)
- *“Students like me can afford to buy an electric bicycle”* (affordability)

Measurement scales include two main category. Willingness to purchase was measured using a 3-point ordinal scale (“No,” “Not sure,” “Yes”), coded 1–3. This format was chosen to capture directional intent while avoiding false precision in a behaviour not yet widespread. Other constructs used five-point Likert scales ranging from “Strongly disagree” (1) to “Strongly agree” (5), allowing sufficient variability for correlation analysis.

Reliability and validity were done twice, after the pilot test and for the actual survey result. A pilot test yielded a Cronbach’s alpha of 0.687, acceptable for exploratory research. After revisions, reliability analysis using the full dataset demonstrated alpha values  $\geq 0.67$  for the multi-item constructs, meeting the threshold commonly applied in social-science exploratory studies. These steps ensured clarity, internal consistency, and content validity of the instrument.

## Data Analyses

### Data Preparation and Screening

Data were screened for missing values, out-of-range responses, and inconsistencies. Procedures included removal of incomplete responses, verification of coding accuracy for ordinal and categorical variables and examination for potential outliers or unnatural response patterns. After screening, 162 usable responses remained.

### Data Analysis

All analyses were conducted using SPSS, which includes univariate and a bi-variate analyses. The univariate analysis is run through descriptive statistics. Descriptive measures (frequencies, percentages, means, and standard deviations) were used to summarize demographics, familiarity with electric bicycles, awareness levels, and attitudinal factors. The bi-variate analysis is done through a correlation analysis. Relationships between willingness to purchase and the main predictor variables, such as, familiarity, knowledge, affordability, and

perceived importance of charging infrastructure were examined using Pearson's product-moment correlation coefficient.

Although several variables were ordinal, Pearson correlation was used because Likert-based variables with  $\geq 5$  categories approximate continuous distributions. Moreover, Pearson offers robust performance with ordinal data in behavioural research, and the analytical objective was to assess linear relationships among variables. Spearman's rho was considered, but Pearson was retained due to its suitability for exploratory analysis and the sufficient distributional properties of the data.

Regression and SEM were not employed because the study's primary aim was relationship exploration, not prediction or modelling of latent constructs. Additionally, the sample size while adequate for correlations was insufficient for more complex structural modelling.

Ethical considerations were included by the fact that participation was voluntary, and students were informed of the study's purpose, anonymity, and confidentiality. No personally identifiable information was collected. Consent was implied through questionnaire completion.

## RESULTS AND FINDINGS

### Demographic Profile of Respondents

A total of 162 respondents participated in the study. The gender distribution revealed a significant imbalance, with males constituting the majority at 85.2% ( $n = 138$ ), while females accounted for only 14.8% ( $n = 24$ ) of the sample. This indicates that male perspectives were more prominently represented in the dataset. In terms of regional background, the respondents were relatively well distributed across three geographical clusters. Participants from Sub-Saharan Africa comprised the largest group (35.8%,  $n = 58$ ), followed closely by those from Asia (34.0%,  $n = 55$ ), while respondents from the Arab region represented 30.2% ( $n = 49$ ) of the sample. This distribution demonstrates that although all three regions were represented, the highest proportion of participants originated from Sub-Saharan Africa. Overall, the demographic profile highlights a predominance of male respondents and a balanced regional representation across Sub-Saharan Africa, Asia, and the Arab region.

In terms of educational background, most respondents were enrolled at the undergraduate level (98.1%,  $n = 159$ ), while only a small proportion were pursuing postgraduate studies (1.9%,  $n = 3$ ). This indicates that the dataset is predominantly reflective of undergraduate perspectives. The age distribution of respondents shows a concentration in the younger demographic. Most participants fall within the 20 to 25 years age range, with the highest frequency observed by around 45 individuals. The mean age is 22.77 years, and the standard deviation is 1.728, indicating a relatively tight clustering around the mean. This suggests that the survey primarily reflects the views of young adults, which may influence attitudes toward purchase of electric bicycles and related factors.

### Willingness to Purchase Electric Bicycles

The findings show that a substantial proportion of respondents were familiar with electric bicycles, with 75.9% ( $n = 123$ ) indicating awareness of the technology, while 24.1% ( $n = 39$ ) reported no prior familiarity. This suggests that three-quarters of the sample already possessed some knowledge of electric bicycles, providing a strong basis for potential market acceptance.

Familiarity with electric bicycles is a crucial precursor to willingness to buy, as awareness often shapes consumer attitudes and purchasing intentions. The relatively high level of familiarity observed in this study indicates a favourable context for future purchase. Nevertheless, the presence of nearly one-quarter of respondents who were not familiar highlights the need for targeted awareness campaigns and educational initiatives to bridge the knowledge gap and expand the potential consumer base.

When asked about their willingness to purchase an electric bicycle in the future, 47.2% of the 161 valid respondents expressed interest, while 13.7% were not willing, and 39.1% remained uncertain. These results

suggest promising market potential for electric bicycles, supported by high awareness and moderate interest in future purchase.

The main barriers to the purchase of electric bicycles were related to cost, infrastructure, and awareness. A significant proportion of respondents (30.9%) identified the high cost as the primary obstacle, while 24.7% pointed to inadequate charging stations as a major concern. Maintenance issues were highlighted by 22.2% of respondents, and 16.7% reported low levels of knowledge about electric bicycles as a limiting factor. Only a small percentage of participants mentioned a lack of interest or the perception that electric bicycles are ineffective as reasons for not purchasing. These findings suggest that while there are strong awareness and moderate interest in electric bicycles, practical concerns such as cost, infrastructure, and maintenance need to be addressed to encourage broader purchasing.

Table 2: Statistical findings related to perceptions and attitudes toward electric bicycles

Item	Mean	Median	Mode	Std. Dev.
Perceived Behaviour Control (Charging stations influence decision)	3.27	3.00	3.00	1.18
Attitude (Electric bicycles are better for the environment)	3.53	4.00	4.00	0.62
Attitude (Electric bicycles are reliable and safe)	3.25	3.00	3.00	1.09
Subjective Norms (Family/friends influence electric bicycles views)	2.94	3.00	3.00	1.06
Perceived Behaviour Control (Knowledge about electric bicycles)	2.97	3.00	3.00	1.07
Perceived Behaviour Control (Students can afford electric bicycles)	2.91	3.00	3.00	0.99
Subjective norms (Willingness to spend on electric bicycles)	1.27	1.00	1.00	1.06
Attitude (Worried about climate change)	3.44	4.00	4.00	1.13

Table 2 illustrates respondents' attitudes, subjective norms, and perceived behavioural control (PBC) regarding electric bicycles purchase. Overall, attitudes toward electric bicycles were moderately positive. The highest mean score was observed for the perception that electric bicycles are better for the environment ( $M = 3.53$ ,  $SD = 0.62$ ), indicating strong and relatively consistent agreement among respondents. Concern about climate change was also high ( $M = 3.44$ ,  $SD = 1.13$ ). In contrast, perceptions of electric bicycles reliability and safety were more moderate ( $M = 3.25$ ,  $SD = 1.09$ ).

Perceived behavioural control variables showed moderate levels. The influence of charging station availability on decision-making recorded a mean of 3.27 ( $SD = 1.18$ ), suggesting infrastructure considerations play an important role. Perceived knowledge about electric bicycles ( $M = 2.97$ ,  $SD = 1.07$ ) and affordability among students ( $M = 2.91$ ,  $SD = 0.99$ ) were slightly below neutral to moderate levels, indicating potential practical and financial constraints.

Subjective norms were comparatively weaker. Family and friends' influence on electric bicycles views yielded a mean of 2.94 ( $SD = 1.06$ ), reflecting neutral social pressure. Notably, willingness to spend on an electric bicycle recorded the lowest mean score ( $M = 1.27$ ,  $SD = 1.06$ ), with both median and mode at 1.00, indicating strong reluctance toward financial commitment. Taken together, the findings suggest that while environmental attitudes toward electric bicycles are generally positive, economic considerations and limited social influence may act as key barriers to purchase.

### Factors influencing willingness to purchase electric bicycles

The correlation analysis indicated that willingness to purchase an electric bicycle was not significantly associated with any of the demographic or attitudinal variables examined. Specifically, no significant relationships were

found between willingness to purchase with origin of the respondent (region), gender, age, willingness to spend, perceptions of environmental benefits, concern about climate change, beliefs about electric bicycles reliability and safety, or the influence of family and friends (Refer to Table 3).

Table 3. No Significant Correlation

Independent Variable	Dependent Variables	Pearson Correlation (r)	P value	Result
Willingness to purchase electric bicycles	Region	0.043	0.588	Not significant
	Willingness to spend on electric bike	0.005	0.949	
	Gender	-0.001	0.988	
	Age	-0.051	0.534	
	Electric bicycle is better for the environment	-0.037	0.638	
	Worried about climate change	-0.052	0.515	
	Electric bicycle is reliable and safe	-0.142	0.073	
	Family/friends influence	-0.127	0.110	

However, the analysis identified several significant factors correlated with purchase willingness. A positive correlation was found with familiarity with electric bicycles ( $r = 0.253$ ,  $p = 0.001$ ), indicating that higher familiarity is associated with greater purchase intent. Conversely, significant negative correlations were found with knowledge about electric bicycles ( $r = -0.269$ ,  $p = 0.001$ ), perceived affordability ( $r = -0.158$ ,  $p = 0.045$ ), and the perceived availability of charging stations ( $r = -0.258$ ,  $p = 0.001$ ). This suggests that higher levels of knowledge, perceived cost, and perceived infrastructure challenges are associated with lower willingness to purchase an e-bike (Refer to Table 4).

Table 4. Significant Correlation

Independent Variable	Dependent Variables	Pearson Correlation (r)	P value	Result
Willingness to purchase electric bicycles	Familiarity with electric bicycles	0.253	0.001	Significant at 0.01 level
	Knowledge about electric bicycles	-0.269	0.001	Significant at 0.01 level
	Affordability to buy electric bicycles	-0.158	0.045	Significant at 0.05 level
	Availability of charging station	-0.258	0.001	Significant at 0.01 level

The findings have significant implications for established theoretical models used to predict technology purchase, such as the Theory of Planned Behavior (TPB). However, the findings can also be discussed in the context of Diffusion of Innovations (DOI) theory and Technology Acceptance Model (TAM).

## DISCUSSION

The purpose of this study was to examine the determinants of willingness to purchase electric bicycles among private university students in northern Malaysia, with specific attention to awareness, knowledge, affordability,

and infrastructure-related factors. The findings provide several important insights that both reinforce and extend existing research on sustainable mobility and electric bicycles adoption.

### **Awareness–Intention Gap in Sustainable Mobility**

The study revealed a substantial awareness–intention gap: while 76% of students were familiar with electric bicycles, only 47% expressed willingness to purchase one, and nearly 40% remained uncertain. This pattern reflects a widely observed challenge in sustainable mobility research, where awareness of environmentally friendly transport modes does not automatically translate into behavioural commitment. Studies in China and Malaysia have similarly highlighted this discrepancy, noting that users often understand the benefits of sustainable transport but remain hesitant to purchase due to practical barriers such as cost or infrastructure (Cherry & Cervero, 2007; Tee et al., 2023).

This finding suggests that diffusion-based models, which assume a linear progression from awareness to purchase, may be insufficient to explain electric bicycles uptake in emerging markets. Awareness is merely a baseline condition while actionable knowledge and practical feasibility appear more decisive.

### **Dominant Influence of Practical and Structural Factors**

Consistent with prior research in emerging economies, the present study found that practical constraints outweigh attitudes and social influences. Cost, charging infrastructure, familiarity, and detailed knowledge all showed significant correlations with willingness to purchase.

### **Cost and Affordability**

Affordability emerged as a significant negative predictor of purchase intention, aligning with global and regional findings that electric bicycles adoption is highly price-sensitive. Prior studies in Malaysian contexts (Simons et al., 2019; UNITEN, 2019) and among youth populations worldwide (Dill & Rose, 2012) similarly report that high upfront costs deter adoption even when environmental attitudes are favourable. This suggests that students, despite being aware of sustainability issues lack financial capacity to convert interest into action.

### **Infrastructure Availability**

Infrastructure concerns, particularly the perceived availability of charging stations, were also negatively associated with purchase intention. This reflects broader literature asserting that supportive infrastructure is a precondition for sustainable mobility adoption (Zhang et al., 2024). Without accessible charging points or safe cycling lanes, potential users perceive electric bicycles as impractical, reducing their intention to shift from conventional modes of transport.

### **Familiarity and Knowledge as Distinct Constructs**

Interestingly, higher general knowledge about electric bicycles correlated negatively with willingness, while familiarity correlated positively. This distinction is consistent with research showing that superficial or partial knowledge may increase perceived risks (e.g., concerns related to battery lifespan, cost of maintenance, or safety), while hands-on familiarity reduces uncertainty and improves perceived usefulness, which are key predictors in the Technology Acceptance Model (TAM). These results point to the importance of direct exposure or trial experiences, such as campus demonstration programmes, in fostering adoption.

### **Weak Influence of Attitudes and Social Norms**

In contrast to studies in Western contexts where attitudes and subjective norms significantly shape electric bicycles purchase (Haustein & Møller, 2016; MacArthur et al., 2014), this study found no significant association between willingness to purchase and environmental attitudes, concern about climate change, or social influence. This divergence highlights the contextual nature of the TPB, while attitudes and norms can drive purchase in high-income, cycling-friendly settings, while their influence diminishes where cost and infrastructure barriers dominate.

These findings also reflect broader trends in Southeast Asia, where environmental motivations play a secondary role compared to economic and practical considerations (Ibrahim et al., 2022; Yasir et al., 2025). This suggests that TPB-based analyses of sustainable mobility must consider the heightened role of Perceived Behavioural Control in contexts with higher structural constraints.

### **Positioning the Study in the Broader Sustainable Mobility Literature**

When situated within global research, the study reinforces several key themes in sustainable mobility as below:

- Emerging economies face structural and infrastructural barriers that overshadow personal attitudes toward sustainability.
- Youth populations, although typically sustainability-aware, exhibit cost-sensitive adoption patterns, consistent with studies from China, Sub-Saharan Africa, and Southeast Asia.
- Electric bicycles purchase depends strongly on institutional support, such as campus infrastructure, subsidies, or awareness campaigns, echoing global calls to integrate micro-mobility into sustainable transport plans.

Crucially, the study contributes new empirical insights into a population underrepresented in existing Malaysian studies, the private university students from diverse regional backgrounds. Given their higher purchasing potential and exposure to sustainability discourse, their perspectives are valuable for shaping early-stage market strategies and campus mobility planning.

### **Theoretical Implications**

The findings offer several insights into theoretical models of technology and sustainable mobility adoption.

- TPB: Perceived behavioural control appears to be a stronger predictor than attitudes or norms, suggesting TPB should be applied with context-specific weighting in developing regions.
- TAM: Familiarity and detailed knowledge should be treated as separate antecedents influencing perceived usefulness and ease of use.
- DOI: The results challenge the assumption that increasing awareness alone drives early adoption; structural conditions mediate the transition from awareness to intention.
- UTAUT: Facilitating conditions (e.g., infrastructure, affordability) should be treated as core, not peripheral, determinants.

### **Implications for Policy and Practice**

The findings suggest several opportunities to accelerate electric bicycles' adoption as part of sustainable campus mobility strategies. Universities can play a transformative role by introducing on-campus charging stations, bike lanes, and electric bicycle sharing schemes. Awareness programmes should go beyond general information, focusing instead on hands-on demonstrations, trial rides, and technical knowledge. Policymakers and manufacturers should explore financial incentives, student discounts, or subscription-based models to reduce upfront cost barriers. These interventions are aligned with Malaysia's National Transport Policy 2019–2030 and Net Zero 2050 goals, positioning campuses as early adopters of micro-mobility innovations.

## **CONCLUSION**

This study examined the key determinants influencing private university students' willingness to purchase electric bicycles in northern Malaysia, focusing on awareness, familiarity, knowledge, affordability, and infrastructure availability. The findings reveal that although awareness of electric bicycles is relatively high, indicating substantial exposure to sustainable mobility concepts but actual willingness to purchase remains

moderate. The presence of a sizeable “not sure” group underscores the uncertainty and practical concerns that still accompany electric bicycles purchase among young adults. Familiarity with electric bicycles emerged as a positive predictor of intention, while higher knowledge levels, affordability constraints, and concerns about charging infrastructure were associated with lower purchase willingness. These results suggest that practical and structural barriers outweigh attitudinal and demographic factors, reflecting broader trends in emerging-economy sustainable mobility research.

Theoretically, the study highlights the dominant role of Perceived Behavioural Control within the TPB, emphasizing that external conditions, such as cost and infrastructure often constrain behavioural intentions more strongly than attitudes or social influences. This challenges assumptions from Western contexts where attitudes and subjective norms typically play stronger roles in sustainable transport adoption. The findings further contribute to ongoing discussions in TAM and DOI theory by demonstrating that general awareness does not directly translate into purchase; instead, direct experience and enabling conditions are central to shaping behavioural outcomes.

From a practical perspective, the results indicate that universities and policymakers can play a transformative role in accelerating electric bicycles adoption by addressing affordability barriers, improving campus-based infrastructure, and offering experiential learning opportunities such as electric bicycles trials. Such interventions support Malaysia’s wider efforts under the National Transport Policy 2019–2030 and Net Zero 2050 aspirations by positioning campuses as early purchasers of low-carbon mobility innovations.

### **Limitations of the Study**

Several limitations are to be acknowledged when interpreting the findings. These include sampling imbalance, geographical scope, cross-sectional design, self-reported measures and limited behavioural metrics. In terms of sampling imbalance, the sample comprised predominantly male respondents (85%), limiting the ability to generalize findings across genders. Geographical scope limitation is due to the study focused exclusively on private universities in the northern region of Malaysia. Mobility patterns and infrastructure levels may differ in other regions, potentially limiting broader generalization.

The limitation of cross-sectional design is due to behavioural intentions were captured at a single point in time, preventing causal inferences or assessment of changes in attitudes over time. In addition, all data were self-reported, introducing the possibility of social desirability, recall bias, or misinterpretation of items. The study measured willingness to purchase rather than actual purchasing or usage behaviour, which may differ under real-world conditions.

### **Suggestions for Future Research**

Building on these limitations, future studies may consider several directions. The first one is to adopt mixed methods approaches by incorporating interviews, focus groups, or observational methods could provide deeper insights into the motivations, concerns, and contextual nuances behind electric bicycles purchase decisions.

A comparative study can also be employed in future research, such as to compare private and public university populations or examine regional differences across Malaysia to better understand contextual variations in mobility behaviour. Moreover, longitudinal research tracking students over time would enable the examination of how exposure, trial experiences, or campus infrastructure developments influence actual purchase.

Future work could incorporate variables such as income, cycling experience, perceived risk, environmental identity, or campus infrastructure quality to expand the explanatory power of current models. An experimental or intervention-based studies can also be done by implementing electric bicycles trial programmes, subsidies, or awareness campaigns and evaluating their effects on purchase intention could provide actionable evidence for policymakers and institutions. In addition, behavioural outcome studies can also be implemented to move beyond intentions and to examine actual purchase as well as usage behaviour, which would help bridge the gap between stated and revealed preferences in sustainable mobility research.

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