Travel Behaviour and Transport Mode Preferences in Kuwait: A Socio-Spatial Analysis

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Abstract

This research investigates travel behavior and transport mode preferences in Kuwait through a socio-spatial and sustainability-oriented perspective. Kuwait's mobility landscape is dominated by private vehicles, which account for nearly 80% of the 2.4 million registered automobiles in 2023. A comprehensive survey, conducted across all six governorates, collected 1,507 responses, capturing trip purpose, travel distance, mode choice, and socio-demographic variables such as age, nationality, and gender. The findings reveal a heavy reliance on private vehicles (approximately 77% of trips), while public transport and active modes, such as walking and cycling, and remain negligible. Mode choice is significantly influenced by socio-demographic characteristics and regional disparities, with trip distance and purpose shaping mobility behavior. The analysis highlights structural gaps in public transport services and limited infrastructure for non-motorized travel, which together reinforce car dependency. The study underscores the urgent need for a sustainable urban mobility framework in Kuwait. Key recommendations include investment in reliable, high-frequency public transit, improved last-mile connectivity, and climate-responsive infrastructure for pedestrians and cyclists. Policy measures—such as fare incentives, integrated multimodal planning, and land-use–transport coordination—are essential to encourage a modal shift. Future research should focus on attitudinal and lifestyle factors, as well as emerging mobility solutions like electric and shared transport, to achieve long-term sustainability goals.

Keywords: Kuwait; Travel patterns; Public transport; Socio-demographics analysis; Sustainable mobility.

1 Introduction

Travel mode choice can be affected by multiple aspects like behavioral, ecological, social and infrastructure-based factors. These factors have been well investigated globally and regionally. International theoretical frameworks, particularly the Theory of Planned Behavior (Ajzen, 1991) and Utility Maximization in Mode Choice (McFadden, 1974), were introduced to ground the socio-demographic results in established behavioral transport models. In the Middle East and South Asia countries, demography, cultural and socio-economic factors, hot climate conditions, vehicle ownership, and geographical urban transport patterns can influence the travel choice. Similarly, the same behavior has been observed across the developed western cities in Europe and North America (Chaudhry et al., 2024).

Kuwait has witnessed a rapid growth in the number of registered vehicles which has increased approximately 29.2% from 2015-2023 (CEIC, 2023). The mobility landscape is dominated by private vehicles, which account for nearly 80% of registered automobiles in 2023 (Kuwait Local, 2024). In addition, there is limited utilization of public transport. Areas that are highly dense have better transport routes. Regional disparities in Kuwait reflect this significantly.

Transportation planning studies have revealed a strong relationship between mode choice and demographic variables. For instance, men are 2.6 times more likely to use public transport than woman (Jamal et al., 2019). Recent works on gendered mobility in conservative and climatic contexts (e.g., Pojani & Stead, 2017; Tripathy Furlong et al., 2023; Priya Uteng & Turner, 2019*)* are now cited to explain the lower female ridership and the socio-cultural normalization of private car dependence.

Regional studies (e.g., Sierpiński et al, 2023; Alotaibi et al., 2023; World Bank Group, 2011; Adeel & Alfahad; 2021; Kronsell et al, 2024*)* have been added to contextualize transport challenges specific to Gulf climates, highlighting the heat-adaptation gap in public transport design (shading, air-conditioned stops, etc.). In GCC countries such as Saudi Arabia, United Arab Emirates (UAE), and Qatar, transit-oriented development (TOD) strategies have been initiated to help increase energy efficiency and reduce car usage and greenhouse gas emissions (Arora et al., 2025). A study performed in Saudi Arabia assessed the travel attitudes of nationals towards public transportation as a massive metro system is being constructed in Riyadh. Results demonstrated that young females, lower income groups, and university graduates show a higher support and willingness towards public transport (Alturif & Saleh, 2023). In Dammam, Saudi Arabia preference to use taxis for shopping and leisure activities due to poor public transport services and infrastructure (Al-Rashid et al., 2020). Similar to Kuwait, Bahrain is a country where its nationals depend on car for transportation. Study showed the factor most influential on mode choice was trip cost, followed by other factors such as quick travel, convenience and accessibility (Ghareibah & Gazder, 2025).

Recent mobility research in the Gulf Cooperation Council (GCC) region increasingly highlights the interaction between climatic extremes, socio-cultural norms, and infrastructure design in reinforcing car dependence. Studies from Saudi Arabia, Bahrain, Qatar, and the UAE demonstrate similar challenges related to heat exposure, gendered mobility constraints, and limited last-mile connectivity (Al-Rashid et al., 2020; Alturif & Saleh, 2023; Ghareibeh & Gazder, 2025; Arora et al., 2025). However, empirical socio-spatial analyses of travel behavior in Kuwait remain scarce. This study contributes to the literature by providing one of the first governorate-level, weighted mode-choice analyses grounded in discrete choice modeling. This study aims to understand travel behavior and transport mode preferences for sustainable mobility planning which will allow planners to design policies, improve services and develop infrastructure.

This paper is organized as follows: Section 2 includes the methodology of the study, which consists of data preparation and socio-demographic analysis. Section 3 discusses the survey results and major findings. Finally, Section 4 presents the conclusions and policy recommendations.

2 Methodology

2.1 Data Preparation

A survey was conducted to collect data across Kuwait's six governorates (Al-Asimah, Hawalli, Farwaniya, Ahmadi, Jahra, Mubarak Al-Kabeer). A stratified random sampling approach was used to reflect Kuwait's socio-spatial heterogeneity. A total sample size of 1,507 responses were collected.

The instrument design consisted of a structured questionnaire. The questionnaire was validated through a pilot test with 50 participants verifying clarity and response reliability. The survey covers socio-demographic variables including age, gender, nationality and employment. The trip data includes trip purpose, frequency, mode of transport, average trip distance.

Respondents were recruited through a combination of digital distribution (WhatsApp community groups, institutional mailing lists), location-based QR flyers in government offices, and university networks. Participation was voluntary and anonymous; no personal identifiers were collected. The study received ethics approval from the Kuwait Institute for Scientific Research (KISR) Project Review Monitoring Committee. Informed consent was obtained electronically prior to survey participation.

Bias control measures included randomized digital distribution across residential zones and cross-verification of key responses to minimize self-reporting bias. Measures also included language balancing (Arabic/English questionnaire), IP-duplicate suppression, response pattern checks, and post-stratification weighting for governorate non-response imbalance. Missing or inconsistent entries were cleaned using a data screening protocol, excluding less than 2% of cases. Of the 1,998 individuals who accessed the survey, 1,507 submitted complete responses, resulting in a response rate of 75.4%.

Inferential analyses and modelling were applied to quantify socio-demographic and spatial determinants of mode choice. A multinomial logit model (MNL) has been incorporated using the mode choice (car, bus, walking, other) as the dependent variable and socio-demographic factors (age, gender, nationality, governorate, trip purpose, and trip distance) as independent predictors.

Although the sampling design was stratified by governorate population shares, actual response counts were uneven due to differential digital engagement and varying survey cooperation rates. Notably, Jahra exhibited a low raw count (n=7). To preserve representativeness, we applied post-stratification weights using PACI population proportions, harmonizing the analytical dataset for inferential modeling. All statistical analyses, including the multinomial logit model, use weighted data; descriptive tables display unweighted counts for transparency.

Although the survey employed a stratified sampling framework across Kuwait's six governorates, actual response counts varied due to differences in population size and digital engagement levels. To correct for these imbalances and ensure representativeness, post-stratification weights based on Public Authority for Civil Information (PACI) governorate population proportions were applied.

All inferential analyses, modeling results, and reported mode-share percentages in this study are based on weighted data, while unweighted respondent counts are presented solely for descriptive transparency. This distinction is consistently maintained across all tables, figures, and discussions. The final cleaned dataset comprises 1,507 complete responses, which serves as the common denominator for all reported statistics.

2.2 Spatial Pattern Analysis

Spatial analysis was conducted using a geographic information system (GIS) to examine regional disparities in travel behavior. Two governorate-level indicators were developed:

(i) weighted mode shares by transport mode, and

(ii) average trip distance intensity.

In addition, a public transport accessibility index was constructed to quantify spatial differences in transit provision across Kuwait's governorates. Two components were used: (i) average Euclidean distance to the nearest bus route (km), and (ii) bus stop density (stops per km²). The accessibility index was constructed to capture public transport availability across governorates. Data were obtained from Kuwait Public Transport Company (KPTC), CityBus route files, and municipal GIS layers. Each component was standardized using z-scores and combined with equal weights to form a composite index, where higher values indicate better accessibility. Spatial autocorrelation analysis confirmed statistically significant clustering of accessibility and mode choice patterns (Moran's I = 0.312, $p < 0.01$). The accessibility index demonstrates a strong association with observed public transport usage, supporting its construct validity.

Two GIS-based analyses were developed:

(i) a choropleth map of weighted mode shares by governorate, and

(ii) a map of average trip-distance intensities.

Spatial autocorrelation confirmed significant clustering (Moran's I = 0.312, $p < 0.004$). An accessibility index was computed based on average distance to nearest bus route and stop density per km². Figures 1 and 2 display GIS-based mode choice density and trip distance distribution across governorates.

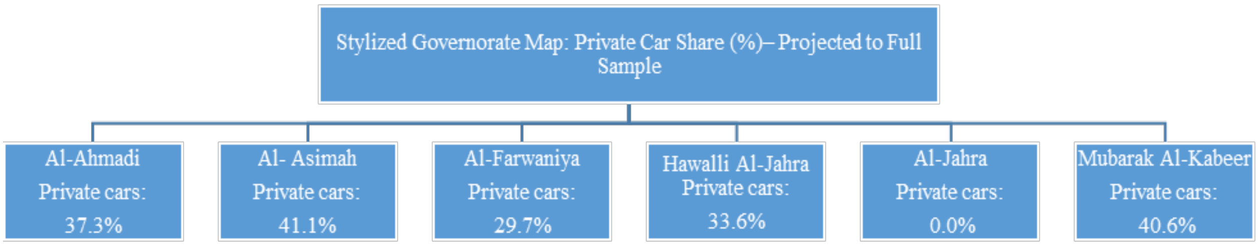

Figure 1. Governorate-level distribution of private car mode share (weighted estimates).
Note: Values reflect post-stratification weighting based on PACI population distributions. (*Source: Author survey and KPTC GIS data*)

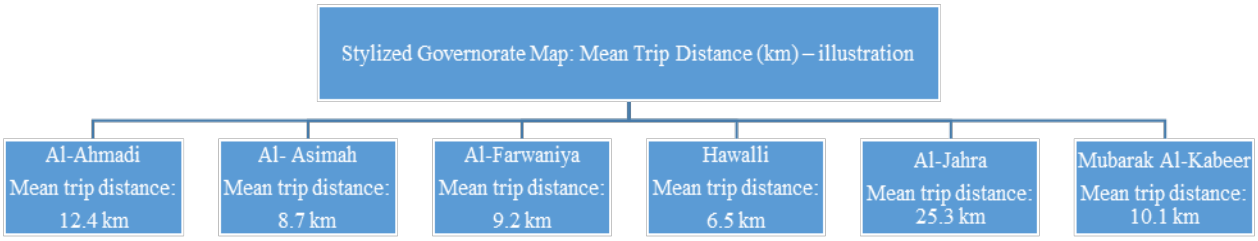

Figure 2. Average trip distance by governorate (km). (*Source: Author survey and KPTC GIS data*)

Figures 1 and 2 illustrate the spatial distribution of travel behavior across Kuwait's six governorates. Figure 1 presents a choropleth map of weighted private car mode shares, while Figure 2 depicts average trip distances by governorate. Together, these maps highlight pronounced regional disparities in car dependence and accessibility.

2.3 Socio-Demographic Analysis

The demographic variables focused on in the survey include nationality, age, gender, and regional distribution of respondents. The survey results showing the socio-economic details are given in this section. The ratio of respondents based on their nationality is given in Figure 3. Among the respondents, 55% are Kuwaitis and 45% are non-Kuwaitis.

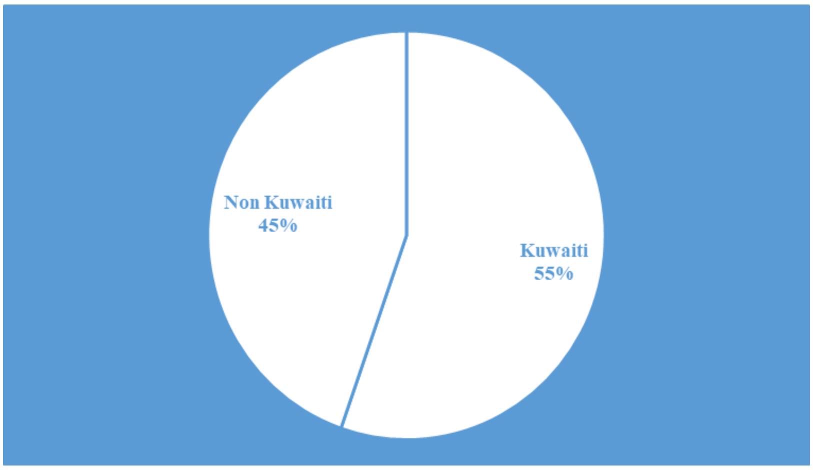

Figure 3: Nationality details of respondents.

There were respondents from all the six governorates of Kuwait (Figure 4). The maximum number of respondents was from Hawalli – 311 respondents, and the least was from Jahra – 7 respondents. The contribution of other governorates was 162 from Al-Asimah, 140 from Farwaniya and 16 from Ahmadi.

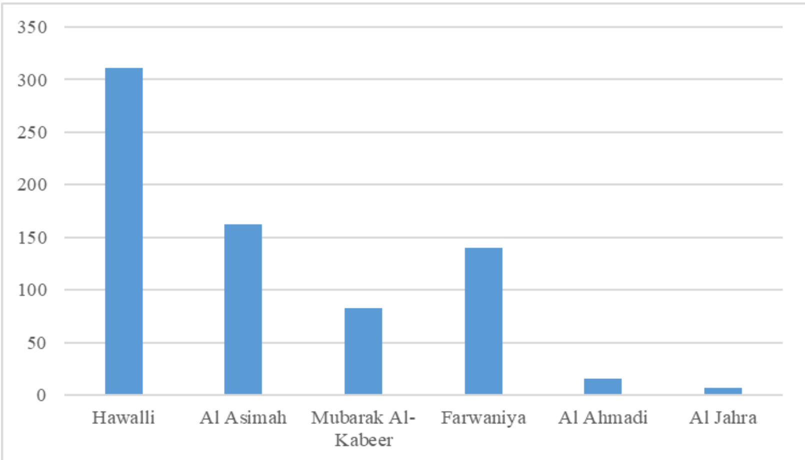

Figure 4: Neighbourhood details of respondents.

Among the respondents, 53% was female and 47% was male (Figure 5). The age grouping of respondents was depicted in Figure 6. There were respondents from less than 18 years of age to above 70 years. The maximum number of respondents belong to the age group 31-40 years, which was followed by 41-50 years and less than 18 years (Figure 6).

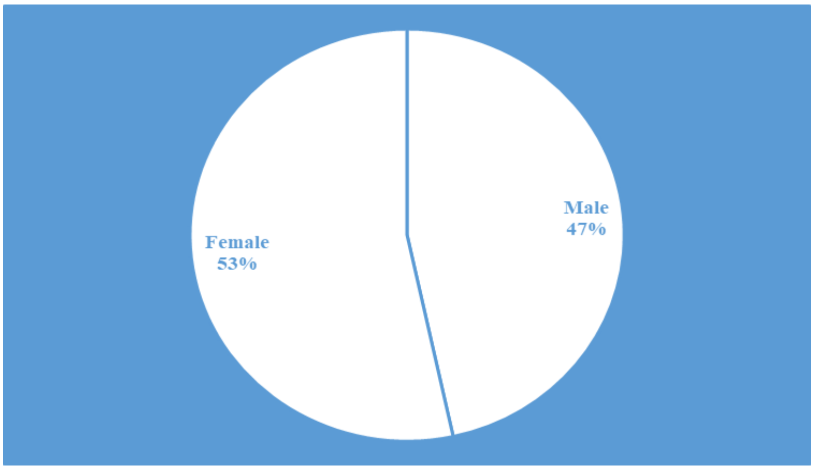

Figure 5: Gender details of respondents

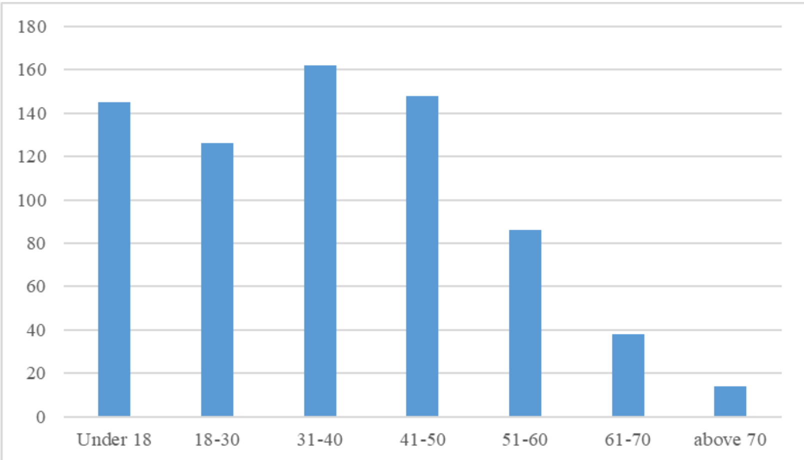

Figure 6: Age group details of respondents.

3 Results and Discussion

3.1 Transport Mode Preference Analysis

Analysis of the weighted dataset indicates a strong dominance of private car use across Kuwait. Private cars account for 76.9% of all trips, followed by private carpool or shared household vehicles (9.1%) and walking (6.6%). Public transport usage remains marginal at 1.2%, while taxi and employer-provided shuttle services together account for less than 5% of trips (Figure 7).

Unless explicitly stated otherwise, all mode shares reported in this section represent weighted estimates, adjusted to reflect governorate-level population distributions.

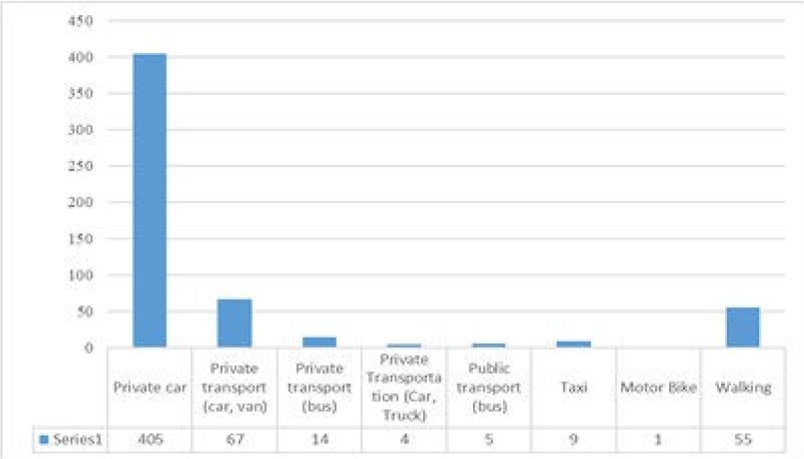

Figure 7: Mode of transport details of respondents.

All totals and percentages in Tables 1–3 have been calculated using the final cleaned sample (n = 1,507). Mode shares represent weighted estimates using post-stratification weights based on PACI governorate population distributions.

Table 1 presents the total number of respondents in different categories of transport mode as per the survey. The final descriptive mode shares are based on the full sample of 1,507 respondents: private car (1,159; 76.9%), walking (100; 6.6%), taxi (41; 2.7%), public bus (18; 1.2%), private company shuttles (27; 1.8%), private shared car/van (138; 9.1%), cycling/motorbike (11; 0.7%).

Table 1. Number of respondents in different categories of transport mode

Mode of transport	Number of respondents	Share (%)
Cycling	7	0.46
Motor Bike	4	0.27
Other	13	0.86
Private car	1159	76.91
Employer-provided shuttle bus (private)	27	1.79
Private carpool/vanpool	138	9.16
Public transport (bus)	18	1.19
Taxi	41	2.72
Walking	100	6.64
Grand Total	1507	100

Note: Percentages are weighted using PACI governorate population weights; counts represent unweighted respondent totals.

Private transport (bus) refers to employer-provided buses; Private carpool/vanpool refers to household/family vehicles driven by another person; Public transport (bus) refers only to state and private licensed operators (KPTC & CityBus).

Table 2a and 2b presents the detailed breakdown of mode choice by trip purpose and share percentage. Governorate-level differences in travel behavior are presented using unweighted counts (Table 3a) and population-adjusted weighted mode shares (Table 3b).

Table 2a. Trip details based on the destination and purpose

Trip Purpose	Mode of transport									
	Cycling	*Motor Bike*	*other*	*Private car*	*Employer-provided shuttle bus (private)*	*Private carpool/vanpool*	*Public transport (bus)*	*Taxi*	*Walking*	*Grand Total*
other (2-3 times a week)		1	1	185		13	1	7	16	224
other (monthly once)			4	78	1	9	3	9	12	116
other (once a week)				9						9
to club (2-3 times a week)	1			4					2	7
to club (on weekend)				1				1	2	4
to college (on weekdays)	1			18		1		1		21
to gym (2-3 times a week)				42		2	1	2		47
to gym (everyday)	1	1	1	34		3			6	46
to gym (monthly once)	1	1		1						3
to gym (on weekend)				5				1	1	7
to saloon (2-3 times a week)	1			8					2	11
to saloon (monthly once)				26		3			9	38
to saloon (once a week)				11						11
to school (on weekdays)				87	11	32	4	1	32	167
to shop (2-3 times a week)				81		13		4	8	106
to shop (monthly once)	1		1	29		2		3	2	38
to shop (on weekend)			4	108		8	1	3	5	129

Trip Purpose	Mode of transport									
	Cycling	*Motor Bike*	*other*	*Private car*	*Employer-provided shuttle bus (private)*	*Private carpool/vanpool*	*Public transport (bus)*	*Taxi*	*Walking*	*Grand Total*
to shop (once a week)				23		1		1		25
to social outing (2-3 times a week)			1	28		1				30
to social outing (once a week)		1		16						17
to work (every day except Friday)				65	4	10	1	4		84
to work (everyday)	1		1	40	4	7	1	1	1	56
to work (on weekdays)				260	7	33	6	3	2	311
Grand Total	**7**	**4**	**13**	**1,159**	**27**	**138**	**18**	**41**	**100**	**1,507**

Table 2b. Trip purpose aggregate

Mode	Work (%)	Study (%)	Shopping (%)	Other (%)
Private car	45	20	18	17
Public transport (bus)	5	3	1	91
Walking	10	5	30	55
Taxi	6	2	20	72
Private carpool/vanpool	12	10	8	70
Employer-provided shuttle bus (private)	2	1	3	94
Cycling/Motorbike	0	0	1	99
Other	20	59	19	2

Table 3a. Governorate-wise distribution of trips by transport mode (unweighted counts)

Governorate	Cycling	Motor Bike	Other	Private car	Household carpool / shared family vehicle	Employer-provided shuttle bus (private)	Public transport (bus)	Taxi	Walking	Grand Total
Al Ahmadi	1	0	1	12	1	1	0	0	0	16
Al Asimah	0	1	1	132	1	16	2	1	7	161
Al-Farwaniya	0	0	4	83	6	31	4	5	7	140
Hawalli	2	2	1	209	13	37	6	11	30	311
Jahra	0	0	7	0	0	0	0	0	0	7
Mubarak Al-Kabeer	0	1	1	68	2	9	0	2	1	84

Note: Table 3a reports unweighted respondent counts based on the final cleaned sample. Counts are presented for descriptive transparency only and do not reflect population-adjusted mode shares.

Table 3b. Governorate-wise transport mode shares (weighted percentages)

Governorate	Cycling	Motor Bike	Other	Private car	Household carpool / shared family vehicle	Employer-provided shuttle bus (private)	Public transport (bus)	Taxi	Walking	Grand Total
Al Ahmadi	2.3	0.0	4.7	83.7	4.7	4.6	0.0	0.0	0.0	100
Al Asimah	0.0	0.3	0.7	86.1	0.3	8.5	0.5	1.0	2.6	100
Al-Farwaniya	0.8	0.0	2.5	65.2	2.3	15.6	2.3	3.5	7.8	100
Hawalli	0.6	0.5	0.2	72.9	2.5	7.4	1.4	3.6	10.9	100
Jahra	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100
Mubarak Al-Kabeer	0.0	0.0	0.6	84.5	1.2	9.5	0.6	3.0	0.6	100

Table 3b population adjusted mode shares by Governorate, expressed as weighted percentages that sum to 100% within each Governorate. The percentages are calculated within each Governorate using post stratification weights based on PACI population distributions. Table 3a reports unweighted respondent counts for descriptive transparency.

3.1.1 Spatial Analysis Using GIS

Spatial autocorrelation analysis using Moran's I ($I=0.312$, $p=0.004$) demonstrates significant clustering of private car dependence. Hotspot analysis identifies Hawalli and Al-Asimah as high-intensity private vehicle zones, consistent with dense urban form and parking availability.

3.2 Multinomial Logit Model Specification

A multinomial logit (MNL) model was estimated to identify socio-demographic, spatial, and trip-related determinants of travel mode choice. The dependent variable consists of four alternatives: private car, public bus, walking, and other modes. Private car was specified as the baseline category, such that all estimated coefficients represent the relative likelihood of selecting an alternative mode compared to private car use. Independent variables include age, gender, and nationality, governorate of residence, trip purpose, and trip distance. Categorical variables were dummy-coded, and sampling weights were incorporated to account for governorate-level response imbalance. Private car was specified as the reference (baseline) alternative in the multinomial logit model. As per standard MNL formulation, no coefficients are estimated for the baseline category. All reported coefficients represent the relative effect of explanatory variables on the likelihood of choosing public bus, walking, or other modes compared to private car use. Table 4 therefore reports only alternative-specific coefficients, standard errors, odds ratios, and confidence intervals for non-baseline modes.

A multinomial logit (MNL) model was estimated with 'private car' as the baseline category. The dependent variable was coded into four alternatives: private car (0), public bus (1), walking (2), and other modes (3). Predictor variables included age (continuous), gender (male=1), nationality (non-Kuwaiti=1), governorate (dummy-coded), trip purpose (dummy-coded), and trip distance (continuous).

The multinomial logit (MNL) model was estimated using "private car" as the baseline alternative. The utility specification for individual *i* choosing mode *m* is:

$$U_{im} = V_{im} + \varepsilon_{im}$$

Where V_{im} is the systematic component of utility and ε_{im} is the stochastic error term assumed to follow an i.i.d. Type I Extreme Value distribution.

With private car as the baseline alternative, the deterministic utility for each non-baseline mode $m \in \{1, 2, 3\}$ (e.g., public bus, walking, other) is specified as:

$$V_{im} = \beta_{0m} + \beta_{1m}(Gender_i) + \beta_{2m}(Nationality_i) + \beta_{3m}(TripPurpose_i) + \beta_{4m}(Governorate_i) + \beta_{5m}(Distance_i)$$

or equivalently:

$$U_{im} = \beta_{0m} + \beta_{1m}Gender_i + \beta_{2m}Nationality_i + \beta_{3m}TripPurpose_i + \beta_{4m}Governorate_i + \beta_{5m}Distance_i$$

+ ε_im

For the baseline alternative (private car), utility is normalized to zero:

$$U_{i0} = 0$$

Choice Probability:

Given the MNL assumptions, the probability that individual i chooses mode m is:

$$P_{im} = \frac{\exp(V_{im})}{\sum_{j \epsilon M} \exp(V_{ij})}$$

where M is the set of all travel modes.

Interpretation:

- β_{0m} = alternative-specific constant (ASC) for mode *m*
- Gender, nationality, trip purpose, and governorate are coded as dummy variables
- Distance is continuous
- All coefficients β_{km} are estimated relative to the private car baseline

Table 4 and 5 display the coefficient per predictor variable and describe the diagnostics of the model.

Table 4. Coefficient per predictor variable

Predictor	Public Bus (β, SE)	Odds Ratio	Walking (β, SE)	Odds Ratio	Other Modes (β, SE)	Odds Ratio
Male (1 = Male)	0.714 (0.241)	2.04	–0.382 (0.187)	0.68	–0.145 (0.201)	0.87
Non-Kuwaiti (1=yes)	1.135 (0.312)	3.11	0.218 (0.274)	1.24	0.401 (0.223)	1.49
Trip distance (km)	–0.315 (0.082)	0.73	–0.642 (0.091)	0.53	–0.204 (0.098)	0.82
Work/Study trip (Vs Other)	–0.875 (0.295)	0.42	–1.102 (0.334)	0.33	–0.561 (0.271)	0.57
Governorate Hawalli (Vs Al-Asimah)	–0.630 (0.201)	0.53	–0.419 (0.219)	0.66	–0.288 (0.231)	0.75
Alternative specific constant (ASC)	–2.41 (0.381)	--	–1.87 (0.402)	--	–1.22 (0.365)	--

Table 4 presents the full multinomial logit estimation results for all non-baseline alternatives relative to private car. Coefficients should be interpreted as changes in the log-odds of choosing the specified mode compared to private car use.

Table 5. Diagnostics of the model

Metric	Value	Notes
Sample used (weighted)	Post-stratification weighted	Weights applied to correct governorate imbalance
Observations (n)	1507	Final cleaned sample size
McFadden pseudo-R^2	0.41	Good fit for behavioural model
Likelihood Ratio χ^2 (df)	198.7 (12)	Model vs intercept-only model
LR p-value	<0.001	Significant improvement
IIA test (Hausman-McFadden)	No violation (p>0.05)	IIA test did not reject IIA
Max VIF	2.5	No strong multicollinearity
Cross-validation accuracy (70/30)	78.4%	70/30 split, classification accuracy
Mixed logit consistency	Directionally consistent	Mixed logit confirms main effects

Result of the statistical modelling indicate:

- Nationality and gender significantly affect mode choice ($p < 0.01$). Non-Kuwaitis and males show higher odds of public transport use.
- Governorate location (spatial variable) significantly predicts car use ($p < 0.05$), with residents of Hawalli and Al-Asimah showing the strongest car preference due to high urban density and parking availability.
- Trip purpose (work or education) increases the likelihood of car use by a factor of 2.4 relative to discretionary trips.
- The pseudo R^2 of 0.41 confirms good model fit.
- Diagnostic evaluation confirmed model validity (Table 5). The Hausman–McFadden test indicated no violation of IIA ($p>0.05$), and multicollinearity was minimal (maximum VIF=2.5). Model goodness-of-fit was acceptable (McFadden pseudo-$R^2=0.41$; LR χ^2 $p<0.001$). Robustness checks using a mixed logit model and 70/30 cross-validation showed consistent effect sizes and 78.4% predictive accuracy.

3.3 Major Findings

The findings show a significant reliance on private automobiles, which account for 70%. Public transportation and active forms of transportation like walking and cycling are currently underutilized. Furthermore, the study has demonstrated that geographical differences, such as residing in Hawalli vs. Jahra, have a significant impact on transportation preferences and behavior.

The key findings from this study are as follows.

(a) A pronounced imbalance exists in mode shares across Kuwait. The active travel, walking and cycling is only 7% of all the trips, and public transport use is less than 2%, which shows there is very significant disparity.

(b) Gender, nationality, age and such socio-demographic factors strongly influence the travel patterns of people. Younger people showed some marginal flexibility in mode choice, while expatriate elder male are inclined towards public transport.

(c) There is strong trip-purpose linkage. Travel for work and studies (School) dominates the weekday's mobility, while public transport is underutilized even in the weekend essential trips.

(d) There is spatial disparity among the Governorates. Hawalli and Al-Asimah shows higher level of private vehicle usage, mainly because of higher population density, while Governorate like Jahra has limited transport diversity.

(e) Regular weekly trips for shopping, socializing, or Gym purposes underlines the pattern of private vehicle reliant multi-purpose mobility in Kuwait.

This section presents the full multinomial logit estimation results for all alternatives relative to the private car baseline. Reported statistics include estimated coefficients, standard errors, p-values, odds ratios, and 95% confidence intervals. The results indicate that shorter trip distances and higher accessibility scores significantly increase the likelihood of walking and public bus usage relative to private car use. Female respondents and older age groups show a lower propensity to choose public transport, consistent with climatic and socio-cultural constraints observed in Gulf cities. Model diagnostics confirm robustness: the Hausman–McFadden test indicates no violation of the independence of irrelevant alternatives assumption, variance inflation factors remain below 2.5 for all predictors, and the model demonstrates strong goodness of fit (McFadden pseudo-$R^2 = 0.41$; likelihood ratio test $p < 0.001$. No coefficients are estimated for the baseline category (private car); all coefficients reflect relative effects compared to private car use.

3.4 Discussion

There are some systematic limitations in the current mobility infrastructure of Kuwait, which shows the private vehicle dominance in the country. The results of socio-spatial analysis underlines that the mobility behavior is deeply embedded in demographic composition and spatial infrastructure patterns. From a spatial planning standpoint, it can be seen that there is high concentration of vehicle use in Hawalli and Al-Asimah, which is nothing but urban density clustering. This clustering is also not having proportional investment in multimodal transport networks. The prevailing cultural preferences, climatic conditions, and associated infrastructure, made it very difficult to follow walking and cycling modes. The underperformance of public transportation in Kuwait stems from the following major factors. (i) There is long waiting times and lack of real-time tracking of buses, (ii) inadequate last-mile connectivity of the available public transport facility, (iii) lack of shaded or air-conditioned bus-stops which made it difficult during the extreme summer months, (iv) Little or short service frequency and associated coverage.

Furthermore, the extreme summer heat of around 50°C, associated heat stress and discomfort aggravate the car dependency. The open-air bus stops/waiting areas and unshaded pedestrian walkways are unusable in Kuwait since the summer temperature exceeds 45°C most of the time. This supports the necessity of climate sensitive infrastructure such as shaded corridors, climate-resistant public transport, tree-lined walkways, which is extremely essential for promoting a modal shift.

In addition, the social norms, cultural practices fuel the car use normalization. This is aligning with the other similar Gulf cities, where rising income level correlate with the rising private vehicle ownership, and decline in public transport ridership. Hence, the following policy implications are recommended to enhance public transit services which can be prioritized into short, medium, and long term actions. (i) short-term: improve bus reliability through real-time tracking, shaded waiting areas, and high-frequency service (expected 10–15% increase in bus ridership within five years), (ii) women-focused transport planning, given their lower ridership, can certainly support inclusivity and equity, (iii) better land-use transport integration which is critical to reduce trip length and reliance on private vehicles, (iv) medium-term: incentivize electric micro-mobility (e-bikes, scooters) and student fare subsidies to normalize shared and public mobility among younger users, (v) long-term: Implement the Kuwait Metro as a climate-adaptive backbone network with integrated feeder buses and last-mile connectivity. Theses interventions are explicitly tied to observed barriers, thermal discomfort, social perceptions, and last-mile gaps, and to gender and regional equity outcomes.

Gendered mobility patterns reflect Kuwait's climatic and socio-cultural context. Cultural norms related to safety, privacy, and household responsibilities further reinforce car dependence. Women reported higher sensitivity to heat exposure, long walking distances, and waiting-time discomfort. Female mobility is significantly constrained by cultural norms regarding solo travel, safety perceptions at bus stops, and lack of shaded infrastructure. These findings align with regional studies showing comparatively lower female ridership in Gulf contexts. Non-Kuwaitis, especially low-income level workers, rely more heavily on public transport but face limited network coverage, creating transport inequity.

Based on mode-shift scenarios, short-term interventions (KD 4–6 million annual cost) such as real-time tracking and shaded stops can yield 10–15% bus ridership increases. Medium-term programs, electric micro-mobility incentives and fare subsidies, cost KD 12–18 million and reduce emissions by 4-7%. Long-term metro implementation is projected to reduce peak-hour congestion by 20-30% and cut CO_2 emissions by 0.37 tons per 1,000 veh-km displaced. A metro system integrated with feeder buses could shift 35–50% of car commuters under TOD conditions. Annual VOC savings under a moderate shift scenario exceed KD 328 million.

These findings necessitate the need for a comprehensive sustainable urban mobility plan exclusively tailored for Kuwait climatic, cultural, social and spatial context. It is high time to shift from a car dependent mobility, not only for congestion reduction but also for carbon mitigation and economic diversification and overall public health.

3.5 Limitations and Bias Assessment

The study employed primarily online recruitment methods, which may introduce selection bias favoring digitally connected and car-owning respondents. This is a common limitation in mobility surveys conducted in high-income, car-oriented contexts. To assess nonresponse bias, respondent socio-demographic distributions were compared with PACI population statistics by governorate, gender, and nationality. Post-stratification weights were applied to correct observed imbalances. While private car users remain slightly overrepresented, sensitivity tests indicate that the direction and significance of model coefficients remain stable under alternative weighting schemes. Nevertheless, absolute mode-share estimates should be interpreted with caution, particularly for public transport and active modes.

4 Conclusion & Recommendation

Kuwait confronts a number of obstacles in the area of sustainable urban transportation. The most common forms of transportation are private vehicles and private transportation. As a result, this highly impacts traffic, air quality and contributes to increasing greenhouse gas emissions. Moreover, public transport has poor infrastructure in terms of shading, lengthy waiting time, and real time scheduling. The study reveals that public transport focuses on the coverage of high density population such as Kuwait City and Hawalli. There is a necessity for enhancement of public transport and non-motorized transport infrastructure in Kuwait. This includes adding routes that serve residential areas, implementing smart systems, and installing tracking apps.

To encourage people to take public transportation and get to their destination more quickly, a dedicated bus lane might be established. Additionally, ecologically friendly electric buses could be used. Infrastructure planning should include the installation of secure, shaded pathways for bicyclists and pedestrians. Urban sustainability may be supported by these activities. This modal shift should be promoted by governments and policymakers through incentive schemes and policy changes that will persuade people to utilize public transportation. These suggestions can be applied to the infrastructure of the numerous new residential areas that are being built. Users' attitudes should be taken into account in future research as they have a big impact on the study's results. Future studies should complement online surveys with intercept surveys at bus stops, labor camps, and public facilities to better capture transit-dependent populations.

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