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Research Article

Exploring the Impact of Work from Home on Sustainable Transport and Car Ownership: A Leeds Case Study

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ABSTRACT

Leeds City Council (LCC) aims to reduce car dependency by decreasing annual car travel by 30% (approximately 900 miles per person) by 2030. Heavy reliance on private vehicles is unsustainable, contributing to pollution, traffic congestion, and increased traffic accidents—issues that disproportionately impact vulnerable communities and raise social equity concerns. This study investigates how Working from Home (WFH) and non-WFH groups influence car ownership reduction and the willingness to adopt sustainable transportation options. An online survey was conducted in Leeds, gathering data on socio-demographics, travel behaviours, and perceptions of public transport. The survey data was analysed using Chi-Square and Binary Logistic Regression to assess the relationship between WFH and travel demand management, focusing on shared mobility schemes and public transport adoption as ways to discourage car ownership. Results indicate that WFH can reduce car ownership and promote sustainable transport usage. These findings suggest that encouraging WFH could help boost participation in shared mobility schemes, enhance public transport utilisation, and ultimately lower car ownership.

Keywords: Car Ownership, Public Transport, Shared mobility, Travel Demand Management, Working from home.

1. INTRODUCTION:

Leeds City Council (LCC) has set an ambitious goal to reduce car dependency by 30% by cutting car travel by 900 miles per person annually by 2030, which is targeted in its Decarbonising Transport Strategy [1]. This approach prioritises minimising travel demand, transitioning away from private car usage, and advancing the adoption of alternative fuel vehicles and supporting infrastructure [1]. LCC also aims to foster economic opportunities and create a healthy, inclusive city by offering diverse travel choices while addressing the climate emergency [1]. The vision is to shift from personal car ownership (CO) to a shared, low-carbon transport network that ensures mobility for all. Leeds City Council [1] highlighted that cars in Leeds are used only 5% of the time, which aligns with Morency, et al. [2], who found that cars are typically parked for over 95% of their lifespan. This lower utilisation suggests that car sharing could effectively reduce the quantity of vehicles in urban areas, reducing the demand for parking areas [2]. The Cramer and Vos model 1985 demonstrated that CO is shaped by vehicle expenses, income levels, and changes in the perceived worth of CO over time [3]. Owning a car provides significant mobility benefits, especially for commuting, and individuals with greater mobility needs are more likely to own cars if they have the financial means [4]. Furthermore, increased CO and economic growth lead to more car trips, worsening energy consumption, traffic congestion, and air pollution, which will be significantly impacted, especially in big cities [4] [5]. Additionally, CO and trip generation are interconnected, influencing each other and creating simultaneity and endogeneity [4]. On the other hand, telework, or working from home (WFH), allows employees to work remotely using technology to perform tasks and communicate with colleagues [6]. WFH meaningfully alters travel behaviour, lowering the frequency of work commutes, especially in urban areas[7].

Studies show that remote working lowers the transport demand, reduces petroleum-based fuel consumption and waste gases, and decreases automobile emissions, especially in congested urban areas. WFH can substantially decrease peak traffic and reduce the demand for office space and operational resources [8]. This study focuses on WFH's impact on CO and the tendency of working individuals in Leeds to utilise more sustainable transportation options. The study investigates how individuals in both WFH and non-WFH groups influence the reduction of CO and their willingness to transition to more sustainable transportation modes. Ultimately, the study must find whether WFH strategies reduce travel by discouraging CO and promoting more sustainable transportation options. Thus, the research questions (RQs) in this study are as follows:

RQ_1: Are WFH and non-WFH groups associated with the effectiveness of optimising Transport Demand Management (TDM)?

RQ_2: Do WFH and non-WFH groups influence individuals' desire to sell their cars?

2. LITERATURE REVIEW:

Working from home (WFH) has significantly reduced work trips, helping to alleviate peak-hour traffic, particularly in the mornings when commuting is a major contributor [9]. During the COVID-19 pandemic, UK trips dropped by 29%, with a 23% reduction in Leeds [10]. Despite this, personal cars remained the dominant mode of transport, with cars and taxis accounting for over 80% of transport modes in the UK and Leeds [10] [11] [12]. If this trend continues, it may worsen traffic congestion and increase costs, pollution, and accidents, negatively impacting liveability [13] [14]. Although WFH successfully reduced trips during the pandemic and maintained economic productivity, personal car use remained high [15]. In 2020, 46.6% of UK workers worked from home; in Leeds, the figure was 35.6% [16] [17]. WFH is expected to continue post-pandemic, especially among well-educated professionals, with employers planning an average of 0.7 WFH days per week [18].

CO significantly influences commuting patterns, with individual perceptions often favouring personal cars over public transport (PT), which is less flexible and convenient [19]. In addition, income, education, employment status, and proximity to PT affect car usage [11]. Moreover, life events and family dynamics, such as child-related activities, also drive car use [20] [21]. In Leeds, CO has risen by 46% between 2011 and 2021, contributing to increased car commuting and reduced PT use [22] [23] [24]. On the other hand, Travel Demand Management (TDM) strategies like car clubs, ride-hailing, and bike-sharing aim to curb car use by offering flexible alternatives [11]. Encouraging car owners to consider the total costs of ownership, including environmental charges, can further promote sustainable transport modes [25] [26] [27]. This study explores whether WFH policies can help reduce CO and increase PT use post-pandemic, addressing gaps in prior research conducted during the pandemic [11] [24].

3. METHODOLOGY:

This study used a deductive approach to test theories or hypotheses using empirical data, also known as the positivist approach [28]. Quantitative data collection was selected for its cost-effectiveness, ability to reach larger samples, and generalizability [29]. The survey, which was conducted and comprised questions on three main areas, was designed to collect nominal data (e.g., WFH = 1, non-WFH = 0) and closed on 29 August 2024, with 116 responses. After data cleaning, 104 valid responses were analysed. The data was primarily categorical and analysed using descriptive and inferential statistics to summarise relationships and test hypotheses [28].

The Central Limit Theorem supports inferential statistics, showing that the sampling distribution approaches normality as the sample size increases, allowing more accurate estimates of the population mean [30]. The Chi-Square test is a robust tool for analysing categorical data, commonly used in nominal variables with contingency tables, provided the expected counts are at least 5 [31] [32]. Additionally, Binary Logistic Regression categorises and predicts outcomes based on independent variables, ensuring assumptions of independence, non-multicollinearity, and a linear relationship are met. Odds ratios are computed to assess how well the model predicts the outcomes [33].

4. RESULT AND DISCUSSION:

(a) Statistics Approach

This study utilises descriptive statistics for analysis to deduce the attributes of a population based on a sample [34]. For that, a survey is used to gather primary data, consisting of nominal and ordinal data focusing on key aspects of socioeconomic characteristics, travel behaviour, and experiences with PT. Therefore, the descriptive statistics are displayed using frequencies or percentages.

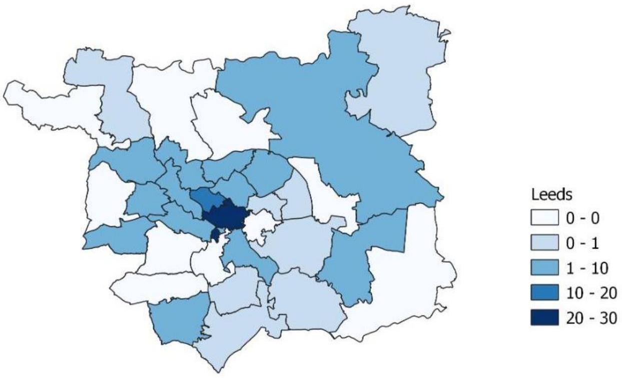

Fig. 1 Participant distribution by residential area

As illustrated in Fig. 1, the survey respondents are spread across Leeds, with 29 participants residing in the Little London & Woodhouse area, followed by 20 participants in the Headingley & Hyde Park area. However, the respondents' work locations are more concentrated, with approximately half the respondents working in the Little London & Woodhouse area, with the full map shown in Fig. 2.

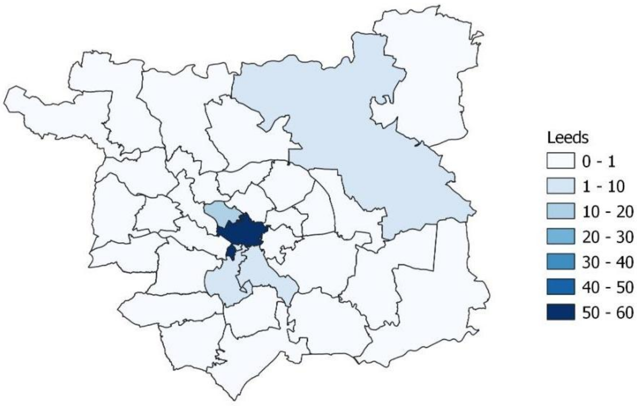

Fig. 2 Participant distribution by working area

The socio-demographic profile of contributors, primarily individuals aged 25 to 49, included around 76 individuals, accounting for 73.08% of all participants. Additionally, the gender distribution is nearly balanced among men and women. Moreover, 76 individuals, representing 73.08% of the total participants, are full-time workers, constituting the largest group concerning employment status. In addition, travel expenditures account for fewer than 10% of overall revenue for two-thirds of those surveyed. Furthermore, household revenue differs among respondents, with most consisting of couples. Approximately half of the respondents are couples, while around 33.65% live in single-person households. For further details, refer to Table I.

Table I Socio-demographic profile of respondents

Sociodemographic	**Frequency**	**Percentage**
Gender		
Female	51	49.04
Male	53	50.96
Age		
18 – 24 years	14	13.46
25 – 34 years	38	36.54
35 – 49 years	38	36.54
50 – 64 years	10	9.62

Sociodemographic	Frequency	Percentage
65+ years	4	3.85
Household income per month		
less than £658	8	7.69
£659-£1,316	8	7.69
£1,317-£1,974	17	16.35
£1,975-£2,632	23	22.12
£2,633-£3,290	12	11.54
£3,291-£3,948	17	16.35
More than £3,949	19	18.27
Family structure		
Couples with adult children	24	23.08
Couples with underage children	28	26.92
Lone parent with children	2	1.92
Lone person household	35	33.65
Other	15	14.42
Transport cost proportion from the total income		
<10%	70	67.31
10%-20%	27	25.96
20%-30%	7	6.73
Employment Status		
Regular employment	76	73.08
Flexible employment	22	21.15
Pensioner and Caregiver	3	2.88
Entrepreneurship	2	1.92
Voluntary work	1	0.96

The pie chart in Fig. 3 further illustrates the three biggest transportation costs, primarily allocated 25.66% to PT tickets, 20.75% to fuel, and 18.49% to car insurance. Moreover, Table II outlines the work trip characteristics of the respondents. Over 80% of participants in this survey commuted below 20 km to their working space, while the rest of the respondents travelled over 20 km and worked remotely.

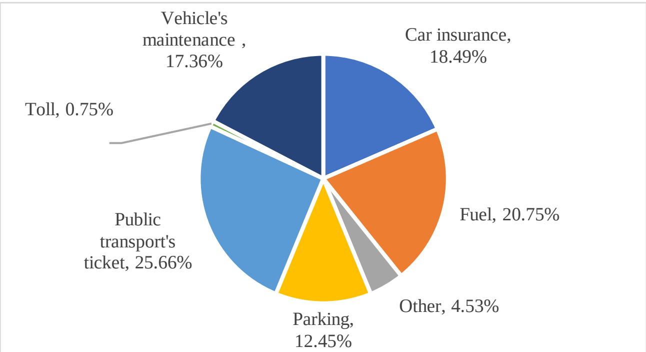

Fig. 3 Composition of Transportation Expenses

In addition, approximately 87.5% of participants in the WFH group, including individuals who WFH full-time, those who do so on specific days, and those working remotely due to strike actions or inclement weather. The three most frequently used commuting options selected by contributors are bus at 25.00%, driving a car or van at 24.04%, and walking at 19.23%. Moreover, about 37.5% of respondents are non-car owners, and the remainder possess at least a private vehicle. Furthermore, 28 respondents disclosed that they never drive a car, and 38 participants used it two times weekly for personal activities, as shown in Table II. In general, car usage is mainly for leisure, visiting relatives, and working purposes, as shown in Fig. 4.

Table II Travel characteristics profile of respondents

Travel characteristics	Frequency	Percentage
Commuting methods		
Foot travel	20	19.23
Pedal bike	11	10.58
City bus	26	25.00
Passenger train	17	16.35
Uber and Taxi	1	0.96
Driving private vehicles	25	24.04
Passengers in private vehicles	2	1.92
Other	2	1.92
Company Protocols		
Flexible working/WFH	91	87.50
In-person employees/Non-WFH	13	12.50
Journey length		
<2km	16	15.84
Between 2km - 5km	27	26.73
Between 5km - 10km	27	26.73
Between 10km - 20km	14	13.86
Between 20km - 30km	7	6.93
Between 30km - 40km	4	3.96
Between 40km - 60km	2	1.98
>60km	1	0.99
Works mainly from home	3	2.97
Cars in a household		
No cars*	39	37.50
1 car	48	46.15
2 cars	17	16.35
Non-commuting car use in a week		
Never	28	26.92
Once – twice	38	36.54
Three – four times	21	20.19
Five – six times	10	9.62
Always	7	6.73

*The higher percentage of non-car owners (38.46%) residing in Little London and Woodhouse aligns with the 2021 census data, which shows that 60.4% of households in this area do not own a car or van [35]. Office for National Statistics. "Census Map 2021." https://www.ons.gov.uk/census/maps/choropleth/housing/number-of-cars-or-vans/number-of-cars-3a/no-cars-or-vans-in-household?lad=E08000035 (accessed.

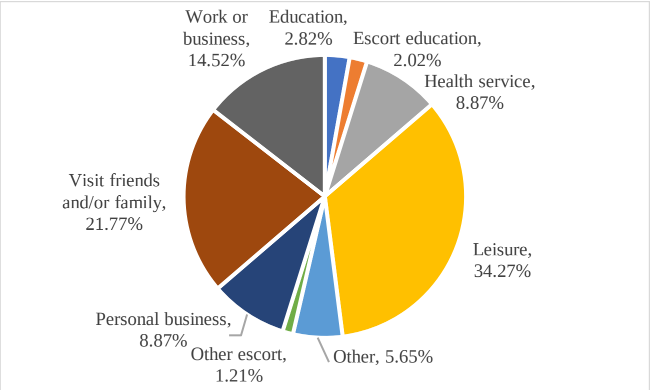

Fig. 4 Car Usage for various activities

Error! Reference source not found. provides a summary of respondents' attitudes and habits regarding TDM. Approximately 49.04% are open to joining a car club, whereas a slightly higher percentage, 50.96%, is not. Additionally, approximately 44.23% of respondents contemplate selling their car, while 55.77% are uninterested. Experiences with buses vary, with some respondents expressing dissatisfaction. About 58.65% indicated they would switch to bus transportation if the service enhancements were implemented. In contrast, train experiences tend to be more favourable, with slightly less than half or 48.97% of the total respondents reporting satisfaction or high satisfaction, while negative perceptions were reported only 16.34%. The percentage of respondents willing to shift to train travel is nearly the same as those not willing.

Table III Respondents' Perceptions of TDM

Travel Demand Management	**Frequency**	**Percentage**
Joining a car club		
Yes	51	49.04
No	53	50.96
Considering selling car		
Yes	46	44.23
No	58	55.77
Bus services		
Very dissatisfied	6	5.77
Dissatisfied	25	24.04
Neutral	36	34.62
Satisfied	34	32.69
Very satisfied	3	2.88
Willing to shift to bus		
Yes	61	58.65
No	43	41.35
Train services		
Very dissatisfied	3	2.88
Dissatisfied	14	13.46
Neutral	36	34.62
Satisfied	47	45.19
Very satisfied	3	2.88
Willing to shift to train		
Yes	50	48.08
No	54	51.92

(b) Data Inference

Processing the data using inferential statistics minimises personal biases and preferences, aiming to reach objective conclusions through data-supported parameter estimation and hypothesis testing to obtain conclusions [34].

Statistical testing conducted within this research aims to identify the correlation between the variables. The statistical tests for the nominal data are typically non-parametric, analysing categories or labels without inherent order or ranking and do not assume a normal distribution [36]. The subsequent sections will outline how inferential statistics address the RQs in this study.

(c) Interconnection between WFH and non-WFH groups in Adopting TDM Practices

Chi-square analysis is employed in the hypothesis to overcome the RQ because it organises count data and enables the comparison of the frequency distribution of one qualitative variable compared to other qualitative variables in a contingency table [37]. Moreover, the TDM is divided into the desire to join a shared mobility mechanism and the willingness to shift to PT.

(1) Shared Mobility

Shared mobility refers to participating in a car club, car-sharing, or similar systems instead of owning a private car or a van. The hypothesis for $RQ_{1.1}$ is as follows:

$H_{0.1.1}$: There is no notable correlation between WFH and non-WFH groups and their willingness to engage in shared mobility options.

$H_{1.1.1}$: A substantial association exists between WFH and non-WFH groups and their interest in participating in shared mobility options

Table IV Pearson's Chi-square Test Comparing Willingness to Join Share Mobility in WFH and Non-WFH Groups

	Shared Mobility						Total	Pearson Chi-square
	No			Yes				
	n	%	EC	n	%	EC		
Non-WFH	10	9.6	6.6	3	2.9	6.4	13	0.048
WFH	43	41.3	46.4	48	46.2	44.6	91	
Total	53	51	53.0	51	49	51.0	104	

Each variable's Expected Count (EC) should be greater than 5 to allow for the Chi-Square analysis. Additionally, as shown in **Error! Reference source not found.**, a p-value scored 0.048, which is less than 0.05, indicates that null hypotheses should be rejected, suggesting a relationship between WFH and non-WFH groups regarding their willingness to participate in the shared mobility option. Therefore, the conclusion for $RQ_{1.1}$ is to reject H_0 at the 5% significance level.

(2) Public Transport

Another option for maximising the use of more sustainable transport involves PT. In this study, PT usage includes buses and trains, with individuals willing to switch to either or both categorised as willing to shift to PT. Conversely, respondents unwilling to use either buses or trains are grouped under "no." Thus, the hypothesis for $RQ_{1.2}$ is as follows:

$H_{0.1.2}$: No substantial association exists between the WFH and non-WFH groups and their shift to PT.

$H_{1.1.2}$: A substantial association exists between the WFH and non-WFH groups and their shift to PT.

Table V Chi-square Test Comparing Willingness to Shift to PT in WFH and Non-WFH Groups

	Public Transport						Total
	No			Yes			
	n	%	EC	N	%	EC	
Non-WFH	8	7.7	**04.4**	5	4.8	08.6	13

WFH	27	26.0	30.6	64	61.5	60.4	91
Total	35	33.7	35.0	69	66.3	69.0	104
Pearson Chi-square							0.023
Fisher's Exact Test							0.031

In Table V, the p-value is 0.023, below 0.05, suggesting that the null hypotheses should be rejected and indicating a relationship between WFH and non-WFH groups regarding their tendency to utilise PT. Despite this, the EC score for non-WFH groups resistant to shifting to PT is 4.4 (<5) and fails to meet the standards set by Fisher and Cochran. Therefore, Fisher's Exact test was employed to address this, yielding a result of 0.031. Thus, this $RQ_{1.2}$ concludes by rejecting H_0 at a 5% significance level, demonstrating a considerable relationship exists between the WFH and non-WFH groups and their willingness to engage with PT.

(3) Optimise Bus Usage

Since the Chi-square test combines shifting to both bus and train as a single shift to the PT category, some participants are willing to shift to only one specific mode of PT. Consequently, $RQ_{1.2}$ is divided into two parts to examine whether a substantial association is found between WFH and non-WFH groups regarding their readiness to optimise the usage of the specific PT modes, either bus or train only. Therefore, $RQ_{1.2.1}$ for the willingness to employ bus is as follows:

$H_{0.1.2.1}$: WFH and non-WFH groups show no considerable relationship with their shift to bus usage.

$H_{1.1.2.1}$: WFH and non-WFH groups show a considerable relationship with their shift to bus usage

Table VI Chi-square Test Comparing Willingness to shift to the bus in WFH and Non-WFH Groups

	Bus						Total	Pearson Chi-square
	No			Yes				
	n	%	EC	n	%	EC		
Non-WFH	9	8.7	5.4	4	3.8	7.6	13	0.029
WFH	34	32.7	37.6	57	54.8	53.4	91	
Total	43	41.3	43.0	61	58.7	61.0	104	

Table VI shows a p-value of 0.029 or <0.05, rejecting the null hypotheses and indicating a relationship between WFH and non-WFH groups to shift to bus usage. Therefore, the conclusion for $RQ_{1.2.1}$ rejects H_0 at the 5% significance level.

(4) Optimise Train Usage

The same statistical tool examines the relationship between individuals in the WFH and non-WFH groups and the respondents' propensity to optimise train usage. Therefore, $RQ_{1.2.2}$ is as follows:

$H_{0.1.2.2}$: No meaningful connection is found between WFH and non-WFH groups and their adoption of train travel.

$H_{1.1.2.2}$: A meaningful connection exists between WFH and non-WFH groups regarding their shift to using a train.

Table VII Chi-square Test Comparing Willingness to shift to the train in WFH and Non-WFH Groups

	Train						Total	Pearson Chi-square
	No			Yes				
	n	%	EC	n	%	EC		
Non-WFH	12	11.5	6.8	1	0.9	6.3	13	0.002

WFH	42	40.3	47.3	49	47.1	43.8	91	
Total	54	51.9	54.0	50	48.0	50.0	104	

Table VII presents the p-value for respondents' willingness to use a train, which is 0.002, indicating significance at the 0.05 level. This suggests rejecting the null hypotheses and indicating a connection between individuals in the WFH and non-WFH groups and their shift to using a train. Therefore, the conclusion of $RQ_{1.2.2}$ rejects H_0 at the 5% significance level.

(d) Exploring Car Ownership Patterns in WFH and Non-WFH Groups

The RQ_2 examines the correlation between the willingness of individuals in the WFH and non-WFH groups to get rid of their cars. In RQ, the dependent variable is CO, measured by the intention to sell their cars as a binary variable. In contrast, the independent variable encompasses individuals from both WFH and non-WFH groups, which tests the null hypothesis as follows:

$H_{0.2}$: Individuals in the WFH and non-WFH groups show no considerable relationship with their intent to sell their cars.

$H_{1.2}$: Individuals in the WFH and non-WFH groups show a considerable relationship with their intent to sell their cars.

Table VIII Chi-square Test Comparing Willingness to Sell a Car in WFH and Non-WFH Groups

	Selling Car						Total	Pearson Chi-square
	No			Yes				
	n	%	EC	n	%	EC		
Non-WFH	9	8.7	5.8	4	3.8	7.3	13	0.052
WFH	37	35.6	40.3	54	51.9	50.8	91	
	46	44.2	46.0	58	55.8	58.0	104	

In Table VIII a p-value of 0.052, slightly higher than 0.05, provides weak evidence against the null hypothesis. Consequently, we do not reject the null hypothesis at the 0.05 significance level, as the result is close to the significance threshold, meaning the relationship between the variables is not strong enough for statistical significance. Therefore, the conclusion for this RQ does not reject the null hypothesis (H0) at the 5% significance level.

Additionally, other variables may influence individuals' likelihood of selling their cars. Therefore, a multivariate analysis was performed using Binary Logistic Regression to examine the interaction between WFH status and TDM strategies. In this analysis, TDM is represented by the likelihood of joining shared mobility and shifting to PT. The partial assessment is conducted with $\alpha = 5\%$. Therefore, the hypothesis testing is as follows:

$H_{0.2.1}$: Shared mobility does not significantly affect the likelihood of an individual selling their car.

$H_{1.2.1}$: Shared mobility significantly affects the likelihood of an individual selling their car.

$H_{0.2.2}$: Using a bus does not notably influence the chance of an individual selling their car.

$H_{1.2.2}$: Using a bus significantly affects the likelihood of an individual selling their car.

$H_{0.2.3}$: Adopting train transportation does not have a significant effect on the likelihood of an individual selling their car.

$H_{1.2.3}$: Adopting train transportation has a significant effect on the likelihood of an individual selling their car.

$H_{0.2.4}$: Being in the WFH group does not have a significant impact on the likelihood of an individual selling their car.

$H_{1.2.4}$: Being in the WFH group has a significant impact on the likelihood of an individual selling their car.

Table IX Binary Logistic Regression Findings

	B	Wald	P Value	CI 95%		
				OR	Lower	Upper
WFH	1.730	5.816	0.016	5.639	1.382	22.997
Shared mobility	-0.858	3.881	0.049	0.424	0.180	0.996
Shift to bus	-0.871	2.838	0.092	0.419	0.152	1.153
Shift to train	0.220	0.195	0.659	1.246	0.469)	3.308
Constant	-0.426	0.458	0.498	0.653		
P Value Hosmer and Lemeshow test				0.470		
Nagelkerke R^2				0.145		
Cox & Snell R^2				0.108		
Percentage Correct				55.8		

Table IX shows that, within the WFH group, a positive and statistically significant coefficient (Sig. 0.016, < 0.05) supports rejecting the null hypothesis. This indicates that WFH individuals are more likely to sell their cars than those who do not. In addition, the odds of an individual in the WFH group is 5.639 times more likely to sell their car compared to those in the non-WFH group. Secondly, the propensity to join shared mobility shows a statistically significant negative coefficient (Sig. 0.049, < 0.05), suggesting rejecting the null hypothesis, which indicates that people who express interest in shared mobility are less likely to sell their vehicles. Additionally, individuals not joining a car club have 0.424 times lower odds of selling their car. Furthermore, regarding the move to bus and train usage variables, the coefficients are negative but not significant, with significance values of 0.092 for the bus and 0.569 for the train, both greater than 0.05, leading to rejecting the alternative hypothesis (H_1). This indicates that moving to bus or train transportation does not have a significant effect on the decision to sell a car. In addition, with a Hosmer and Lemeshow Test score of 0.470, above 0.05, we do not reject the null hypothesis, permitting the analysis to proceed. In the Hosmer and Lemeshow Test, the significance level (α) is 5%, meaning the p-value needs to be greater than 0.05 for a good fit. Therefore, the statistical testing is as follows:

H_0: The model closely corresponds to the data

H_1: The model shows poor correspondence with the data.

Moreover, R-squared (R^2) denotes the coefficient of determination. The Nagelkerke R^2 value of 0.145 surpasses the Cox & Snell R^2 value of 0.108. This indicates that the independent variables can determine approximately 14.5% of the variance in the dependent variable, while the remaining 85.5% is influenced by other factors affecting car sales. Additionally, the model's overall accuracy in predicting car sales is around 55.8%. The model logistics are calculated based on the equation below:

$$Logit\ ((n(x))\ = [n(x)/(1 - n(x))] \quad (1)$$

The model is applied to analyse the relationship between WFH and TDM in the context of car selling, with the following results:

$Logit\ ((n(x)) = 1.730 - 0.858x_1 - 0.871x_2 + 0.220x_3 - 0.426$

The logistic regression equation shows that WFH has a positive coefficient (1.730), indicating a higher likelihood of the event, while being part of shared mobility, represented by X_1, has a negative coefficient (-0.858), suggesting a decreased likelihood. The coefficients for shift to bus denoted by X_2 (-0.871) and shift to train expressed by X_3 (0.220) are not significant predictors in this model. The constant is -0.426, and these coefficients reflect the changes in log odds for each predictor.

(e) Descriptive Analysis

The data collection concluded that PT tickets, fuel, and car insurance are the three most spent on transport costs. The analysis of these three variable costs shows that PT tickets account for over 50% of total transport costs. Interestingly, the fuel costs of household transportation budgets comprise approximately 85% of transport costs [38]. To be precise, fuel and PT ticket costs demonstrate opposing trends in household transportation spending; while fuel costs are generally elevated in low-density areas with higher dependence on personal vehicles, public transport fares are more expensive in densely populated urban areas due to the wider availability and greater utilisation of PT services [38].

Participants further revealed that car owners prefer driving for travel primarily due to convenience and concerns related to travel time, including time spent in the vehicle, access time, and transfer wait time. It has been established that car owners heavily rely on their vehicles, particularly for leisure travel, due to limited PT options and entrenched habits [39].

(f) Inferential Analysis of the Relationship between Changes in TDM Adoption Between WFH and non-WFH Groups

In this study, the Chi-square analysis is applied to address RQ_1, which examines whether individuals in the WFH and non-WFH groups are inclined to transition to more sustainable transport options. Similar to RQ_1, WFH and non-WFH groups are the independent variable, while willingness to adopt more sustainable options, such as joining a car club or car sharing and switching to PT, act as the dependent variable, with each option analysed separately.

(1) Relationship Between Individuals in the WFH and non-WFH Groups and Shared Mobility Option

The Pearson Chi-Square value is significant at 0.048, below the 0.05 threshold, suggesting that the null hypothesis should be rejected. This suggests a relationship between individuals in the WFH group and their interest in joining a shared mobility scheme. Therefore, the conclusion for this RQ supports the rejection of H0 at a 5% significance level, indicating that WFH influences individuals in the WFH group to utilise shared mobility transportation options, which is aligned with the theory that the adaptability of WFH increases the appeal of shared mobility options, particularly for personal car users [41].

(2) Relationship Between Individuals Within the WFH and non-WFH Groups and Transition to PT

In this analysis, the Pearson Chi-Square value is 0.089, above 0.05, which suggests the null hypothesis should be rejected, indicating no significant relationship between individuals in the WFH group and their readiness to shift to PT. However, the Pearson Chi-Square values for specific PT modes are below 0.05, where shift to the bus scored 0.027 and shift to train scored 0.033. In other words, the analysis concludes by rejecting H_0 at the 5% significance level for this RQ.

As the independent variable for this RQ, WFH motivates individuals in the WFH group to transition to PT more consistently. This result corresponds with recent research showing that WFH arrangements can facilitate PT usage by lessening the necessity for daily car commutes. Firstly, WFH reduces car usage and encourages dependence on PT for critical journeys, especially in regions with robust transit options [42]. Moreover, Even though Belgian teleworkers commute less often, they are more inclined to use PT when they travel [42]. Additionally, telecommuters frequently organise their non-work travel to align with efficient PT routes, further facilitating the transition to PT [42]. These findings collectively indicate that WFH can encourage working people to use PT.

(g) Inferential Examination of the Connection Between WFH and Non-WFH Groups and the Decision to Sell a Car

Chi-square analysis is employed to investigate the relationship between individuals in the WFH and non-WFH groups and CO. In this analysis, the WFH and non-WFH groups are independent variables, while CO is the dependent variable. Furthermore, this analysis's p-value from the Pearson Chi-Square test is 0.052, just below the 0.05 threshold. This indicates a rejection of the null hypothesis and suggests the link between individuals in the WFH and non-WFH groups and their inclination to sell a car. Therefore, the conclusion for this RQ rejects the null hypotheses at a 5% significance level.

Surprisingly, this result contradicts [11] that educated individuals with substantial incomes who can work remotely are more likely to decrease their car usage as their requirement for daily commuting diminishes. Additionally, an increase in the total number of on-site days is positively accompanied by greater CO, as individuals who returned to work at their working space more frequently after WFH during the pandemic were more inclined to purchase private cars [24]. This indicates that while WFH prompted some individuals to sell their cars during COVID-19, the return to on-site work heightened the demand for personal vehicles [24]. This differing result is likely due to research conducted during the pandemic when the demand for private vehicles was heightened as people sought defence against the infectious virus.

In addition, a study conducted in Basel, Switzerland, shows that easy access to shared mobility services may result in decreased CO [40]. Moreover, the convenience and adaptability of shared mobility programs offer them an appealing choice for city inhabitants, particularly those who do not own cars for their daily commute. Eventually, the car-sharing initiative provides individuals with a viable alternative to CO, prompting some to sell the cars or discourage them from purchasing new ones [40].

5. CONCLUSION:

(a) Summary

This research, the Leeds case study, was used to establish that individuals in the WFH group are more inclined to reduce their commuting, shaping their opinions on CO and readiness to switch to PT. The study developed a statistical model to assess how the implementation of WFH among Leeds residents has encouraged changes in CO and a shift toward more sustainable transport options. It offers insights into individuals' socio-demographic traits and attitudes toward selling a car due to reduced usage and how their commuting habits impact their willingness to adopt more sustainable transport methods, including shared mobility and PT.

The demographic distribution of respondents' residential and workplace areas corresponds with the sampling approach, which focused on promoting the data collection within the campus grounds. The participants are primarily faculty and staff members, making the findings potentially representative of the broader population of Leeds. Moreover, the results of this research are pertinent and consistent with the university's policy, which emphasises environmental concerns.

(b) Recommendation

The University of Leeds is one of the largest institutions in the city, offering greater flexibility in the implementation of WFH, and the findings of this research may apply to comparable populations at other university campuses or in cities across the UK.

(c) Study Limitations and Direction for Future Study

Given the constraints of available resources, this research utilised an online survey aimed at Leeds residents, most of whom were associated with the university. While the findings could be generalisable, they may also be biased since the respondents share a similar level of environmental awareness. Therefore, a larger sample size is necessary for future research to enhance the study's representativeness.

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8. CONFLICT OF INTEREST:

The authors declare that there is no conflict of interest.

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