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Determinants of On-Demand Mobility Use among Older Adults in the Klang Valley, Malaysia

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Abstract: *Population ageing has intensified the need for transport systems that support independent and inclusive mobility among older adults. In urban environments, mobility challenges often arise from declining health, driving cessation, and structural barriers within public transport systems. While on-demand mobility (ODM) services have emerged as flexible alternatives, empirical evidence on their adoption among older adults remains limited, particularly in developing contexts. This study examines the determinants of ODM usage among older adults in the Klang Valley, Malaysia. Using cross-sectional survey data from 497 respondents aged 60 years and above, binary logistic regression was employed to estimate the probability of ODM adoption. The findings reveal that perceived public transport barriers are the most significant determinant of ODM use. Older adults facing difficulties related to accessibility, waiting time, and boarding conditions are substantially more likely to rely on ODM services. Driving ability also plays a significant role, with active drivers being less likely to adopt ODM, indicating a substitution effect following driving reduction or cessation. In contrast, socio-demographic and health-related factors do not show independent significant effects. Overall, the results suggest that ODM functions as a compensatory mobility mechanism in response to structural deficiencies in public transport systems, highlighting the importance of age-friendly and integrated transport strategies in rapidly ageing urban regions.*

Keywords: On-demand mobility, Older adults, Public transport barriers, Driving cessation, Age-friendly transport, Urban ageing

1. Introduction

Population ageing represents one of the most profound demographic transformations of the 21st century. Rising life expectancy coupled with declining fertility rates has accelerated the growth of older populations worldwide, affecting not only advanced economies but increasingly developing nations (United Nations 2020; World Health Organization 2002). In Malaysia, this transition is particularly evident in highly urbanised regions such as the Klang Valley, where the proportion of older adults continues to rise steadily (Department of Statistics Malaysia 2020). As Malaysia moves toward aged-nation status, ensuring that older adults remain mobile, socially connected, and independent has become an urgent policy priority.

Mobility in later life extends beyond physical movement. It is closely linked to autonomy, social participation, and overall well-being (Musselwhite 2018; Siren & Hakamies-Blomqvist 2009). The ability to travel enables older adults to access healthcare, fulfil religious obligations,

maintain family and social ties, and meet essential daily needs. However, when mobility becomes constrained—due to declining health, functional limitations, or structural deficiencies in the transport system—the risk of social isolation and reduced quality of life increases significantly (Kerschner & Silverstein 2017; Prohaska et al. 2011). Recent empirical evidence from the Klang Valley indicates that travel frequency declines progressively with advancing age, particularly among the "old-old" group (75 years and above), highlighting the growing vulnerability of older adults within Malaysia's urban transport environment. These findings suggest that mobility challenges in later life are not merely individual issues but are deeply embedded within the broader transport system structure.

Traditionally, private car driving has served as the primary source of mobility independence for older adults. Driving provides flexibility, control, and door-to-door accessibility. Yet ageing is often accompanied by health-related constraints, reduced confidence, and safety concerns that eventually lead to driving reduction or cessation (Luiu and Tight 2021; Newbold et al. 2005). The cessation of driving is widely recognised as a critical turning point in later-life mobility trajectories (Bernal et al. 2019). At the same time, public transport systems frequently present barriers that limit their suitability for older users. Inadequate station accessibility, long walking distances, extended waiting times, and difficulties in boarding and alighting remain persistent challenges (Zakaria et al. 2024; Boschmann and Brady 2013). In highly car-dependent urban regions such as the Klang Valley, these structural constraints may create a "mobility gap" when older adults are no longer able to drive but face difficulties using conventional public transport.

In this evolving urban mobility landscape, on-demand mobility (ODM) services—including e-hailing and platform-based taxi services—have emerged as a potentially transformative component of transport systems (Song 2024). By offering flexible, door-to-door travel, ODM may reduce dependence on private car driving and compensate for shortcomings in public transport provision (Acheampong et al. 2020; Kim and Ulfarsson 2014). However, despite its rapid growth, empirical evidence on the adoption of ODM among older adults remains limited, particularly in developing country contexts where transport infrastructures and ageing trajectories differ substantially from Western settings (Daud 2022).

Existing research on transport and ageing has largely examined travel frequency, mode choice, and the role of socio-demographic and health factors in shaping mobility (Luiu et al. 2018; Schmöcker et al. 2008). While these studies offer important insights, a critical question remains insufficiently addressed: do older adults adopt ODM primarily due to individual characteristics such as age, income, or health status, or as a response to structural barriers within the public transport system? In other words, does ODM function mainly as a substitute for private driving after driving cessation, or does it operate as a complementary mobility option within the broader urban transport ecosystem?

Against this backdrop, this study examines the determinants of ODM use among older adults in the Klang Valley, Malaysia. Specifically, it investigates how socio-demographic characteristics, driving ability, health-related mobility constraints, and perceived public transport barriers influence the likelihood of ODM adoption. Using a binary logistic regression approach, the study seeks to clarify whether ODM serves primarily as a compensatory mechanism in response to mobility loss and transport system limitations.

This study contributes to the literature in three important ways. First, it shifts analytical attention from purely individual determinants toward the role of structural transport barriers in shaping mobility decisions. Second, it provides empirical evidence on whether ODM acts as a substitute for private driving or as a complementary mobility option within a rapidly ageing urban context. Third, it offers policy-relevant insights to support the integration of emerging mobility services into age-friendly transport strategies in Malaysia and other rapidly ageing cities.

2. Literature Review

Mobility has long been recognised as a fundamental component of active ageing, extending beyond physical movement to encompass autonomy, social participation, and overall well-being in later life (Musselwhite 2018; Kerschner and Silverstein 2017). As populations age, the ability to travel independently becomes increasingly important, particularly in urban environments where access to healthcare, social networks, religious activities, and essential services is strongly dependent on transport systems. Empirical research consistently demonstrates that mobility constraints are closely associated with social isolation, reduced life satisfaction, and declining psychological health among older adults (Prohaska et al. 2011; Siren and Hakamies-Blomqvist 2009). Consequently, the development of age-friendly and accessible transport systems has become a central pillar of inclusive urban planning and active ageing strategies (World Health Organization 2002).

Previous studies have identified a range of socio-demographic factors that shape travel behaviour in later life. Age, gender, education, and income level are commonly found to influence travel frequency and transport mode choice among older adults (Luiu et al. 2018; Schmöcker et al. 2008). Advancing age is typically associated with declining travel frequency and a shift toward less physically demanding modes of transport. Income influences the affordability of private vehicles and paid mobility services, while gender differences often reflect broader social roles, caregiving responsibilities, and disparities in access to resources (Boschmann and Brady 2013). Nevertheless, emerging scholarship suggests that socio-demographic characteristics alone are insufficient to fully explain mobility variations in later life. Rather than being determined solely by personal attributes, mobility outcomes are increasingly understood as the product of interaction between individual capacity and the structural conditions of the transport environment (Musselwhite and Murray 2024). In this perspective, demographic characteristics may shape mobility preferences, but structural constraints often determine whether those preferences can be realised.

Driving ability represents a particularly critical dimension of mobility in older age. Private car use has traditionally provided flexibility, independence, and door-to-door accessibility, making it a dominant mode of travel among older adults. However, advancing age is frequently accompanied by health limitations, declining reaction time, visual impairments, and safety concerns, which may lead to driving reduction or eventual cessation (Bernal et al. 2019; Newbold et al. 2005). Driving cessation is widely recognised as a major turning point in later-life mobility trajectories, often resulting in reduced out-of-home participation and increased dependence on others (Luiu and Tight 2021). In response, older adults may adopt substitution strategies, such as relying on family members, increasing public transport use, or exploring alternative mobility services (Acheampong et al. 2020). Yet the success of such adaptation depends heavily on the availability, accessibility, and reliability of alternative transport options.

In contexts where public transport systems are poorly designed or inaccessible, the loss of driving ability may lead not to successful substitution but to a substantial decline in mobility. Health-related mobility constraints further complicate travel behaviour in later life. Walking difficulties, chronic illness, sensory impairments, and the need for assistive devices can significantly restrict the ability to use conventional transport modes (Zakaria et al. 2024; Prohaska et al. 2011). Public transport, in particular, often requires physical endurance, balance, and navigation through complex environments, which may present challenges for older individuals with functional limitations. Importantly, the impact of health constraints does not occur in isolation. Kerschner and Silverstein (2017) emphasise that functional limitations translate into mobility disadvantages primarily when transport systems and built environments fail to accommodate physical vulnerability. In supportive and accessible environments, the negative effects of health limitations can be mitigated; in poorly designed systems, they become amplified. This interactional understanding reinforces the need to examine internal characteristics and external structural conditions simultaneously when analysing mobility decisions.

Within this structural context, perceived public transport barriers have emerged as a key determinant of mobility behaviour among older adults. Empirical studies document a range of commonly cited barriers, including long walking distances to stations, lack of lifts or ramps, insufficient seating, unreliable schedules, extended waiting times, and difficulties in boarding or alighting vehicles (Zakaria et al. 2024; Boschmann and Brady 2013). Beyond physical infrastructure, subjective perceptions of safety, reliability, and ease of use also play an important role in shaping transport choices (Schmöcker et al. 2008). When public transport is perceived as inconvenient or inaccessible, older adults may reduce their travel frequency or seek alternative modes that offer greater flexibility and comfort. Such behavioural shifts can be interpreted not merely as personal preference but as adaptive responses to structural inadequacies within the transport system (Musselwhite and Murray 2024). In this sense, public transport barriers may act as "push factors" that influence the adoption of alternative mobility solutions.

Against this backdrop, the emergence of on-demand mobility (ODM) services—including e-hailing and app-based taxi services—has introduced a new dimension to urban mobility systems (Song 2024). By providing flexible, door-to-door services without fixed routes or schedules, ODM has the potential to reduce physical demands associated with walking and waiting, while offering an alternative to private driving (Kim et al. 2014). For older adults facing driving cessation or public transport limitations, ODM may represent a compensatory mechanism that sustains mobility and social participation. However, despite its theoretical promise, empirical evidence on ODM adoption among older adults remains limited, particularly in developing country contexts and Southeast Asian cities where urban transport systems differ substantially from Western settings (Daud 2022). Most existing studies focus on travel frequency, general mode choice, or health-related mobility constraints, with relatively little attention to how structural transport barriers shape the uptake of emerging mobility services.

Furthermore, few empirical investigations explicitly examine whether ODM functions primarily as a substitute for private driving following driving cessation, or as a complementary mobility option used alongside existing transport modes. This distinction is analytically important. If ODM operates mainly as a substitute, its adoption would likely be strongly associated with driving cessation and transport system barriers. Conversely, if it functions as a

complement, socio-demographic characteristics and lifestyle preferences may play a more dominant role. Clarifying this distinction is particularly relevant in rapidly ageing, car-dependent urban contexts such as the Klang Valley, where structural transport constraints and functional limitations may jointly influence mobility decisions.

Taken together, the literature suggests that mobility in later life is shaped by a complex interplay between socio-demographic characteristics, driving capability, health-related constraints, and structural transport barriers. Yet the role of emerging mobility services within this interaction remains insufficiently understood, especially in developing urban settings. Addressing this gap, the present study examines the determinants of ODM use among older adults in the Klang Valley by integrating individual and structural factors within a unified analytical framework. In doing so, it seeks to provide clearer empirical evidence on whether ODM serves primarily as a compensatory substitute for lost driving independence or as a complementary component of the broader urban mobility ecosystem.

3. Methodology

3.1 Research design

This study adopts a quantitative cross-sectional research design to examine the determinants of on-demand mobility (ODM) use among older adults in the Klang Valley, Malaysia. A cross-sectional approach is appropriate for capturing mobility behaviour, perceptions of transport accessibility, and individual characteristics at a specific point in time (Cummings 2018). In rapidly ageing urban contexts, such a design allows for the empirical assessment of how prevailing structural transport conditions interact with individual-level factors in shaping mobility decisions. Cross-sectional survey designs are widely applied in research on older adults' travel behaviour, particularly when examining associations between socio-demographic characteristics, health conditions, and transport system attributes (Boschmann and Brady 2013; Schmöcker et al. 2008).

Rather than seeking to establish causal dynamics over time, this study aims to identify statistically significant associations between internal mobility capacity and external transport system constraints, thereby providing a structured empirical test of the compensatory mobility framework discussed in the literature.

3.2 Data collection

Data were collected through a structured questionnaire survey conducted between January and September 2022. The target population consisted of individuals aged 60 years and above, consistent with Malaysia's official definition of older adults (Department of Statistics Malaysia 2020). Respondents were drawn from various locations within the Klang Valley to reflect diverse urban mobility contexts.

The questionnaire was designed to capture five key domains: (i) socio-demographic characteristics (gender, age group, household income), (ii) driving status and mobility resources, (iii) health-related mobility constraints, (iv) perceived public transport barriers, and (v) use of transport modes, including ODM.

The structure of the survey instrument aligns with established approaches in studies of older adults' mobility, which integrate personal, functional, and environmental dimensions within a unified analytical framework (Zakaria et al. 2024; Kerschner and Silverstein 2017).

To enhance data reliability and minimise response bias, trained enumerators provided assistance where necessary, particularly for respondents with physical limitations or difficulties interpreting questionnaire items. Assisted survey administration has been shown to improve response accuracy in research involving older populations (Bowling 2005). After data screening, consistency checks, and removal of incomplete responses, a total of 497 valid observations were retained for analysis.

3.3 Measurement of key variables

The dependent variable in this study is ODM usage, operationalised as a binary indicator coded as 1 if the respondent reported using on-demand mobility services and 0 otherwise. This specification enables the estimation of the probability that an older adult adopts ODM as part of their mobility strategy within the urban transport environment.

Socio-demographic characteristics are incorporated as baseline explanatory variables to capture potential structural differences in mobility behaviour. Gender is coded as a dichotomous variable, with female serving as the reference category. Age is grouped into three categories—young-old (60–64 years), middle-old (65–74 years), and old-old (75 years and above)—to reflect functional differences that may emerge across stages of later life. Household income is categorised into three groups to represent economic capacity, which may influence access to private transport resources and paid mobility services.

Driving ability is measured using a categorical variable that distinguishes between respondents with no driving licence, those who possess a licence but no longer drive, and those who are actively driving. This variable is particularly important in testing whether ODM functions as a substitute for private car use following driving reduction or cessation. By differentiating between licence ownership and active driving status, the analysis is able to capture nuanced variations in mobility capacity rather than treating driving as a simple binary condition.

Health-related mobility constraints are measured through two indicators: self-reported walking difficulty and the use of assistive mobility equipment. Walking difficulty captures functional limitations that may affect the ability to access public transport infrastructure, while assistive device usage reflects more severe mobility impairment. These measures allow the analysis to examine whether functional decline independently influences ODM adoption once structural transport barriers are accounted for.

Perceived public transport barriers are operationalised through a composite index constructed from four commonly reported constraints: the absence of lifts or ramps at stations, long distance between residence and station, long waiting times, and difficulty boarding or alighting from vehicles. These components were selected based on prior empirical research identifying them as key accessibility barriers for older adults (Zakaria et al. 2024; Boschmann and Brady 2013). The items were aggregated into a continuous index representing the overall level of perceived public transport constraints. A higher index value indicates greater perceived structural barriers within the transport system. By constructing an index rather than analysing each barrier separately, the study captures the cumulative burden of accessibility limitations, which more accurately reflects the multidimensional nature of transport disadvantage experienced by older adults.

3.4 Analytical strategy

Data analysis proceeded in two stages. First, descriptive statistics were used to summarise respondent characteristics and examine preliminary patterns of ODM usage across demographic and mobility-related variables. Second, binary logistic regression was employed to estimate the determinants of ODM adoption.

Given that the dependent variable is dichotomous, logistic regression is the appropriate modelling technique for estimating the probability of event occurrence (Hosmer et al. 2013). The model estimates the log-odds of ODM use as a function of socio-demographic characteristics, driving ability, health-related mobility constraints, and perceived public transport barriers. The empirical specification is expressed as:

$$\text{"logit"}\ (P(ODM_i=1))=\beta_0+\beta_1\ SocioDem_i+\beta_2\ Mobility_i+\beta_3\ Health_i+\beta_4\ PTBarrier_i+\varepsilon_i$$

where P(ODM_i=1) represents the probability that individual uses ODM; SocioDem_i captures socio-demographic characteristics; Mobility_i represents driving ability; Health_i denotes health-related mobility constraints; and PTBarrier_i corresponds to the public transport barrier index.

Estimated coefficients are reported in odds ratio form to facilitate interpretation of effect magnitudes (Chotib 2019). Odds ratios greater than one indicate increased likelihood of ODM use, while values below one indicate reduced likelihood.

3.5 Conceptual Framework

The methodological approach of this study is guided by a conceptual framework that integrates internal and external determinants of mobility behaviour among older adults. As illustrated in Figure 1, the framework distinguishes between internal factors—comprising socio-demographic characteristics, driving ability, and health-related mobility constraints—and external factors, represented by perceived public transport barriers. This distinction reflects theoretical perspectives emphasising the interaction between individual capacity and environmental conditions in shaping mobility outcomes (Prohaska et al. 2011; Musselwhite and Murray 2024).

Internal factors represent the personal and functional capacity of older adults to maintain independent mobility. These include demographic attributes that may influence mobility patterns, the availability of private driving as a mobility resource, and physical or functional limitations that affect transport accessibility. External factors, in contrast, capture the structural characteristics of the transport system that may either enable or constrain mobility. In this study, perceived public transport barriers constitute the primary system-level variable representing structural constraints within the urban mobility environment.

The operationalisation of these internal and external factors is summarised in Table 1, which presents the descriptive distribution of all key variables included in the empirical analysis. Table 1 provides an overview of respondents' socio-demographic composition, driving status, health-related mobility constraints, ODM usage, and the public transport barrier index. This summary not only contextualises the sample characteristics but also demonstrates how the conceptual framework is translated into measurable variables within the statistical model.

The framework assumes that ODM usage emerges from the interaction between declining individual mobility capacity and structural transport constraints. Specifically, ODM is expected to function as a compensatory mobility option when older adults experience reduced internal capacity—such as driving cessation or functional limitations—and simultaneously perceive public transport as insufficient or difficult to access. In this configuration, ODM adoption represents an adaptive response to structural inadequacies within the transport system rather than a purely preference-driven choice.

By structuring the empirical model in accordance with the relationships depicted in Figure 1 and operationalised through the variables summarised in Table 1, the study ensures alignment between theoretical assumptions, measurement strategy, and statistical estimation. This integrated approach strengthens the analytical coherence of the research design and allows for a systematic examination of whether ODM serves primarily as a substitute for declining private mobility or as a complementary component within the broader urban mobility ecosystem.

Table 1: Summary of data on older adult respondents

Variable	Description	% per category			
		0	**1**	**2**	**3**
ODM use	Uses on-demand mobility (0 = no, 1 = yes)	84.1	15.9		
Gender	0 = female, 1 = male	57.14	42.86		
Age group	0 = YO, 1 = MO, 2 = OO	59.56	34	6.44	
Household income	0 = <RM1000, 1 = RM1001-RM4000, 2 = >RM4000	36.42	50.50	13.08	
Driving licence & status	0 = No driving licence, 1 = Has driving licence but does not drive, 2 = Actively driving	27.77	59.96	12.27	
Walking difficulty	0 = no, 1 = yes	67.2	32.8		
Assistive equipment	0 = no, 1 = yes	95.57	4.43		
		Mean	**Std. Dev.**	**Min**	**Max**
Public transport barrier index	Continuous index (0≈2.5)	0.276	0.445	0	2.50

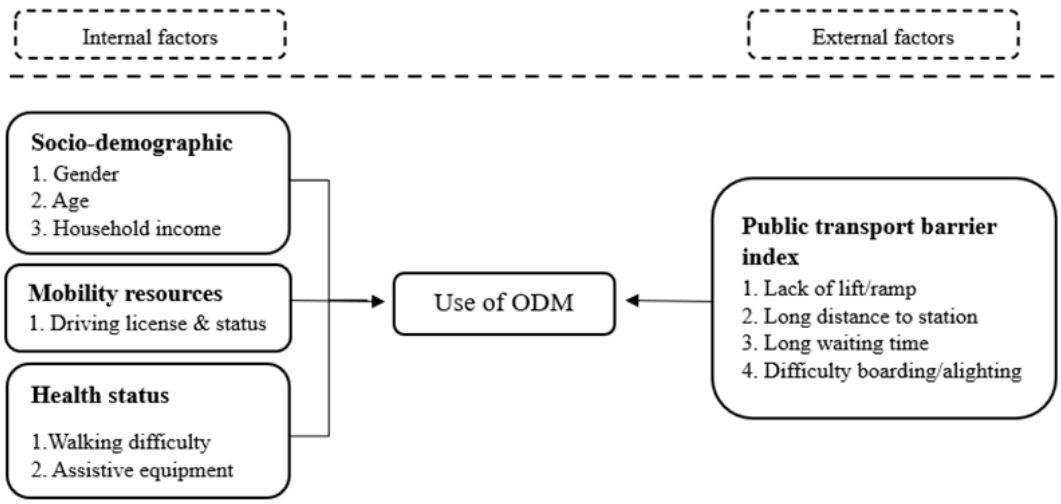

Figure 1: Conceptual model

4. Results

4.1 Description Analysis

4.1.1 ODM use by Gender

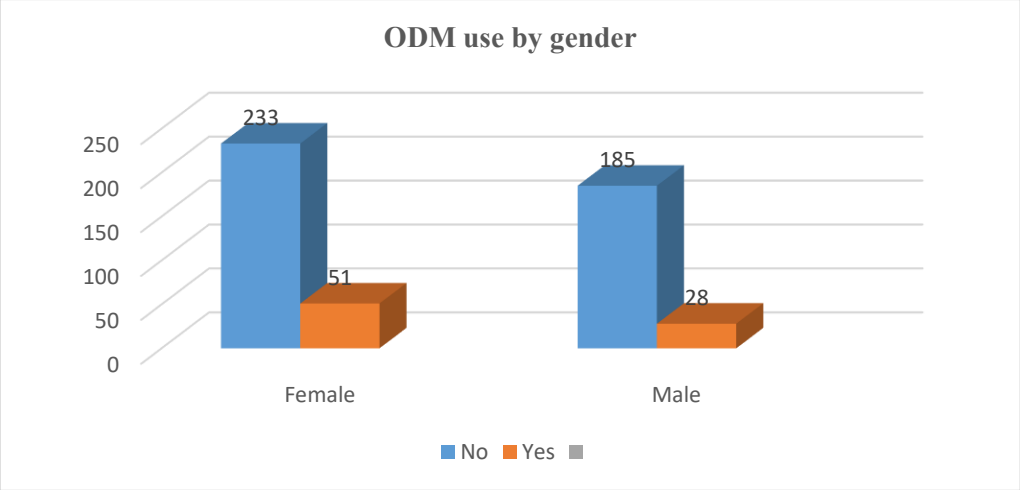

Figure 2: ODM use by gender

Descriptively, Figure 2 indicates that ODM usage is relatively higher among female respondents compared to males. Approximately 64.6% of ODM users are women, whereas women account for 55.7% within the non-user group. Although the difference is not substantial, the pattern suggests that older women may demonstrate a slightly greater reliance on alternative mobility options.

This tendency may reflect gender-based differences in lifetime car access, driving participation, or post-retirement mobility resources. In many urban contexts, older women are less likely to remain active drivers in later life, which may increase their dependence on flexible mobility services such as ODM. However, as will be demonstrated in the multivariate analysis, this descriptive difference does not translate into a statistically significant gender effect once structural and functional factors are controlled for.

4.1.2 ODM use by Age Group

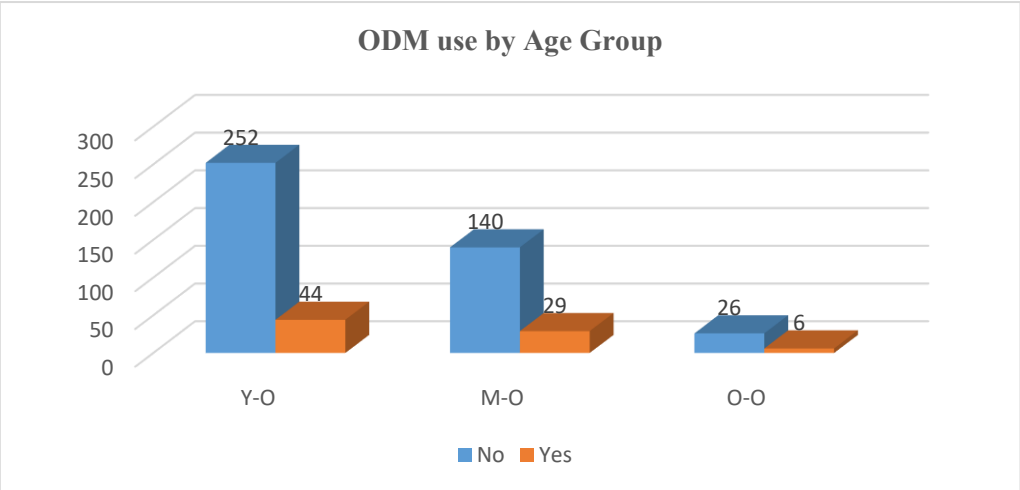

Figure 3: ODM use by age group

Figure 3 illustrates the distribution of ODM usage across age categories. The proportion of users appears slightly more concentrated among the middle-old (65–74 years) and oldest-old (75+ years) groups compared to non-users. For instance, the oldest-old group represents 7.6% of ODM users compared to 6.2% among non-users.

This pattern is consistent with the expectation that reliance on alternative mobility services may increase as age advances and internal mobility capacity gradually declines. Older age groups are more likely to experience driving reduction, functional limitations, or increased dependence on external transport systems, which may encourage the adoption of flexible mobility services.

Nevertheless, the observed differences across age groups remain relatively modest. This descriptive observation aligns with the logistic regression results, which indicate that chronological age does not exert a statistically significant effect once driving ability and perceived transport barriers are accounted for. The implication is that functional capacity and structural constraints may matter more than age itself in explaining ODM usage.

4.1.3 ODM use by Household Income

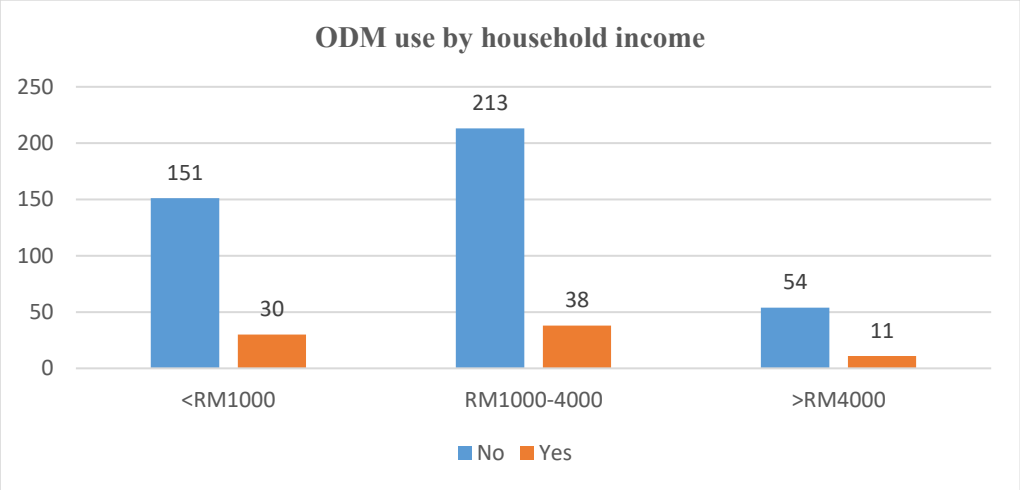

Figure 4: ODM use by household income

Figure 4 presents the distribution of ODM usage across household income categories. The pattern shows that ODM users are distributed relatively evenly across low-, middle-, and higher-income groups. The majority of users originate from low- and middle-income households (B40 and M40 categories), rather than being concentrated exclusively among higher-income respondents.

This distribution suggests that ODM usage is not purely a function of financial capacity. If ODM were primarily a premium or discretionary service, one would expect a stronger concentration among higher-income groups. Instead, the relatively even distribution across income levels indicates that ODM adoption may be driven more by mobility necessity than by economic advantage.

This interpretation is reinforced by the regression analysis, which shows that household income does not significantly predict ODM usage once other factors are controlled. Hence, ODM appears to function less as a luxury transport alternative and more as a practical mobility response to constraints within the existing transport system.

4.2 Binary logistic regression analysis

Given that the dependent variable—on-demand mobility (ODM) usage—is dichotomous (used vs. not used), binary logistic regression was employed to estimate the probability of ODM adoption among older adults in the Klang Valley. This approach allows for the examination of how internal mobility capacity and external transport system constraints jointly influence the likelihood of ODM usage.

The overall model demonstrates satisfactory fit. The likelihood ratio test is statistically significant (LR $\chi^2 = 107.68$, $p < 0.001$), indicating that the explanatory variables collectively contribute to explaining variations in ODM usage. The Pseudo R^2 value of 0.247 suggests a relatively strong explanatory capacity for a behavioural transport model, particularly in studies examining individual-level mobility decisions (Niken et al. 2024). Furthermore, multicollinearity diagnostics confirm the robustness of the estimates, with all variance inflation factor (VIF) values remaining well below critical thresholds, indicating no evidence of serious collinearity among predictors.

Table 2: Result for the binary logistic regression model per person per week

Variable	Odds Ratio	Std. Error	z-statistic	p-value
Gender (ref = female)	0.92	0.28	−0.26	0.792
Age group (ref = 60-64 years old)	1.02	0.25	0.08	0.939
Household income (ref = <RM1000)	1.26	0.29	1.02	0.306
Driving licence & status (no driving license)	0.63	0.15	−1.97	0.049
Use of assistive device (ref = no)	2.34	1.42	1.40	0.162
Walking difficulty (ref = no)	1.62	0.49	1.58	0.114
Public transport barrier index (continuous index)	12.50***	3.74	8.44	0.000
Constant	0.05***	0.03	−4.39	0.000

The results indicate that the public transport barrier index is the most influential determinant of ODM usage. The effect is positive and highly significant (OR = 12.50, $p < 0.001$), implying that as perceived public transport barriers increase, the likelihood of ODM adoption rises substantially. In practical terms, older adults who perceive greater difficulties related to station accessibility, long walking distances, waiting times, and boarding or alighting conditions are markedly more inclined to rely on ODM services. The magnitude of this odds ratio suggests that structural transport constraints exert a disproportionately strong influence relative to other variables in the model.

This finding reinforces the argument that ODM usage among older adults is primarily driven by system-level deficiencies rather than personal demographic attributes. Consistent with prior research highlighting the role of environmental barriers in restricting older adults' mobility (Zakaria et al. 2024; Prohaska et al. 2011), the results indicate that perceived inadequacies in public transport infrastructure function as a powerful "push factor" toward alternative mobility services. Notably, the magnitude of this effect appears larger than those reported in many developed-country contexts, suggesting that in rapidly urbanising regions such as the Klang Valley, structural weaknesses in public transport may intensify reliance on flexible, door-to-door services. In this regard, ODM appears to function not merely as an optional supplement but as a compensatory response to structural transport constraints.

Driving ability also emerges as a statistically significant determinant. The odds ratio for driving licence and active driving status (OR = 0.63, $p < 0.05$) indicates that older adults who are still able to drive are significantly less likely to adopt ODM services compared to those without driving capacity. This negative association provides empirical support for the substitution hypothesis proposed in the conceptual framework. Rather than being used concurrently with private driving, ODM appears to replace private car use when driving capacity declines. This pattern aligns with mobility substitution theory in later life, which identifies driving cessation as a critical transition point in older adults' mobility trajectories (Musselwhite and Murray 2024; Boschmann and Brady 2013).

In contrast, health-related mobility indicators—walking difficulty and assistive device usage—exhibit positive but statistically insignificant effects. While individuals with functional limitations appear descriptively more inclined to use ODM, these effects diminish once structural transport barriers and driving ability are controlled for. This suggests that functional limitations alone do not directly drive ODM adoption. Instead, their influence may operate indirectly through interaction with environmental constraints. In other words, health-related limitations become consequential primarily when public transport systems fail to accommodate physical vulnerability.

Similarly, traditional socio-demographic variables—including age, gender, and household income—do not exert statistically significant effects on ODM usage. Although minor descriptive differences were observed in the crosstab analysis, these differences dissipate in the multivariate model. This indicates that demographic attributes, when considered independently of mobility resources and structural barriers, have limited explanatory power in predicting ODM adoption. The absence of significant income effects further challenges the assumption that ODM primarily functions as a premium or discretionary service reserved for higher-income groups.

Taken together, the regression results underscore the central role of structural transport barriers and mobility resource availability in shaping ODM usage among older adults. The findings suggest that ODM adoption is less a function of who older adults are (in demographic terms) and more a reflection of the mobility constraints they experience within the urban transport system. In this sense, ODM operates as an adaptive mechanism that enables older adults to sustain mobility and social participation in the face of declining driving capacity and inadequate public transport accessibility.

Overall, the binary logistic regression analysis confirms that environmental constraints and individual mobility resources are the primary determinants of ODM usage in the Klang Valley. The limited influence of socio-demographic characteristics reinforces the need for policy approaches that prioritise improvements in public transport accessibility and infrastructure design, while also recognising the strategic role of ODM as a compensatory mobility solution within rapidly ageing urban environments.

5. Discussion

The findings of this study provide clear empirical evidence on the factors influencing on-demand mobility (ODM) usage among older adults in the Klang Valley. Overall, the results indicate that ODM adoption is shaped more strongly by structural constraints within the transport system than by individual socio-demographic characteristics. This reinforces the

argument that mobility challenges in later life should be understood as systemic and environmental issues rather than purely personal or demographic ones.

The most prominent finding is the strong and statistically significant effect of perceived public transport barriers on ODM usage. Older adults who experience greater difficulties related to accessibility, long waiting times, and challenges in boarding or alighting public transport are substantially more likely to rely on ODM services. This suggests that ODM functions primarily as a compensatory mobility mechanism, enabling individuals to maintain daily activities when conventional public transport fails to meet their needs. In rapidly urbanising environments such as the Klang Valley, this effect appears particularly pronounced, indicating that weaknesses in the public transport system act as a strong "push factor" towards alternative mobility services.

Driving ability also emerges as a key determinant. Older adults who continue to drive are significantly less likely to use ODM, supporting the interpretation that ODM serves mainly as a substitute for private car use rather than a complementary mode. This aligns with the notion that driving cessation represents a critical turning point in later-life mobility, after which individuals actively seek alternative transport solutions to sustain independence.

In contrast, health-related variables and socio-demographic characteristics do not exhibit independent significant effects once structural constraints and driving ability are accounted for. This suggests that physical limitations alone do not directly determine ODM usage. Instead, mobility behaviour in later life is shaped by the interaction between individual capacity and the surrounding transport environment. Similarly, the lack of significant effects for age, gender, and income highlights that functional needs and accessibility conditions play a more decisive role than demographic identity alone.

Taken together, these findings highlight the importance of adopting a system-oriented perspective in understanding older adults' mobility. ODM should be viewed not merely as an emerging transport option, but as part of a broader adaptive response to structural limitations within urban transport systems.

6. Future Directions

Several avenues for future research can be identified based on the findings of this study. First, future research should adopt longitudinal or mixed-methods approaches to better understand the causal mechanisms underlying ODM usage. While this study provides strong cross-sectional evidence, longitudinal data would allow researchers to track mobility transitions over time, particularly before and after driving cessation, and to examine whether ODM adoption is a proactive choice or a reactive response to declining transport accessibility.

Second, greater attention should be given to the disaggregation of public transport barriers. Although this study employs a composite index to capture overall perceptions, future studies could analyse specific components—such as accessibility, waiting time, and service reliability—in greater detail. This would provide more nuanced insights into which aspects of the transport system most strongly drive the shift toward ODM.

Third, future research should incorporate additional factors related to technology adoption, including digital literacy, familiarity with mobile applications, and trust in platform-based

services. These factors are likely to play an increasingly important role in shaping ODM usage among older adults, particularly as digital mobility services become more prevalent.

Finally, expanding the geographical scope of research is essential. Comparative studies across different urban and rural contexts in Malaysia, as well as across countries in Southeast Asia, would help to identify how variations in transport infrastructure and socio-cultural conditions influence mobility behaviour among older populations.

7. Limitations

Despite its contributions, this study is subject to several limitations. First, the use of a cross-sectional research design limits the ability to establish causal relationships between public transport barriers, driving ability, and ODM usage. The findings should therefore be interpreted as associative rather than causal. Future studies employing longitudinal data would provide a more robust understanding of mobility transitions over time.

Second, the measurement of public transport barriers is based on a composite index reflecting respondents' overall perceptions. While this approach is useful for capturing aggregate effects, it may mask the relative importance of individual barrier components. More detailed measurement could provide deeper insights into specific constraints affecting mobility decisions.

Third, the study focuses exclusively on the Klang Valley, a highly urbanised metropolitan region. As such, the findings may not be fully generalisable to rural areas or smaller cities where transport systems, infrastructure, and mobility needs differ significantly.

Finally, the study does not explicitly incorporate variables related to digital capability or platform accessibility, which may influence the adoption of ODM services. This represents an important area for further investigation.

8. Conclusion

This study provides empirical evidence on the determinants of on-demand mobility (ODM) usage among older adults in the Klang Valley. The findings demonstrate that ODM adoption is driven primarily by structural constraints within the public transport system rather than by individual socio-demographic characteristics.

Perceived public transport barriers emerge as the most significant determinant, indicating that ODM functions as a compensatory mobility mechanism that enables older adults to maintain independence when conventional transport options are inadequate. Driving ability also plays a crucial role, with ODM serving as a substitute for private car use following driving reduction or cessation.

The results further suggest that mobility behaviour in later life is shaped by the interaction between individual capacity and environmental conditions, rather than by age or demographic characteristics alone. This highlights the importance of shifting from demographic-based approaches to need-based and accessibility-oriented transport policies.

Overall, the study underscores the need for a balanced strategy that combines improvements in public transport systems with the integration of alternative mobility services such as ODM. Such an approach is essential for supporting inclusive and sustainable mobility in rapidly ageing urban societies.

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Conflict of Interest Statement
The authors declare that they have no known competing financial or personal interests that could have appeared to influence the work reported in this paper.

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