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Compounded barriers: the intersection of gender and age in ride-hailing usage

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Abstract
Urban mobility disparities are shaped by the intersection of gender and age, yet their combined effects on the adoption of emerging mobility services remain insufficiently understood. This study applies an intersectional framework to examine how gender, age, and their interaction influence ride-hailing usage across different travel purposes, with a focus on the mediating role of socioeconomic and environmental factors. Using structural equation modelling and data from 1006 surveys conducted in Chengdu, China, this study suggests that neither gender nor age alone sufficiently explains mobility disparities in adopting ride-hailing. Age exerts a stronger and more consistent effect than gender on ride-hailing adoption. The negative impact of older age is evident for all trip purposes, while gender differences are primarily indirect and mediated through income, especially for commuting. When considering interaction terms, older women face compounded disadvantages: while income generally increases with age due to seniority, older women experience slower income growth compared to older men, leaving them at a relative economic disadvantage.

Keywords Gender mobility · Intersectionality · Generational difference · Travel behaviour · Social justice

Introduction

Over the past decade, platform-based on-demand mobility services which is often called ride-hailing including Uber, Lyft, Grab, and DiDi, have spread globally, offering the potential to enhance mobility for women (Group 2020). Ride-hailing services are often viewed

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through the lens of technological determinism, which suggests that these technologies can address longstanding gender gaps in urban mobility by lifting the time–space constraints that women face daily (Wajcman 2007). Features such as location reporting, tracking, and women-only fleet are claimed to enhance women's sense of security and enable greater freedom for night-time travel (Farina et al. 2022; Qiao et al. 2023b). The on-demand flexibility of ride-hailing also complements women's fragmented travel chains, which are not adequately supported by traditional public transit systems that focus on connecting hotspots on fixed routes and time schedule (Qiao et al. 2023a, b, c). This has led to expectations of gender convergence in travel behaviour and mobility access, particularly for younger generations (Tilley and Houston 2016).

However, despite these optimistic projections, ride-hailing remains unevenly accessed across different demographic groups. Typical users of ride-hailing platforms continue to predominantly represent younger, male, well-educated, or higher-income segments of society (e.g., Deka and Fei 2019; Gomez et al. 2021; Kong et al. 2020; Sikder 2019; Young and Farber 2019), and are influenced by alternative transport services deeply (Qiao 2025). Scholars have also questioned the neutrality of ride-hailing technologies (Lenz 2019; Singh 2020; Uteng et al. 2019; Bian and Qiao 2024). The consumer-centric market strategy of ride-hailing is fuelled by algorithms that primarily prioritise commuting and long-distance trips that differ from what women need (Singh 2020). Furthermore, algorithmic technologies reflect the biases of the societies in which they are developed, often reproducing patriarchal norms (Faulkner and Arnold 1985; Wajcman 1991, 2000, 2010). For older adults, data-driven platformization and smart urbanism create additional barriers, such as reduced technological familiarity and access, further limiting participation in ride-hailing services. Therefore, digital technology in mobility services also (re)produces social inequalities as a continuation of social power relations.

In this context, the intersection of age and gender deserves closer examination to understand whether ride-hailing empowers or inhibits women's capability to move daily(e.g., Hancock 2016; Hopkins 2018; Valentine 2007). How does the intersection of age and gender contribute to multidimensional social exclusion in ride-hailing usage? Age as a critical dimension of mobility inequality shapes how individuals experience urban transportation systems, access resources, and interact with digital platforms (Zheng and Walsham 2021). Younger generations may adapt more easily to the demands of digitalized mobility, whereas older individuals often face barriers such as reduced technological familiarity, physical constraints, and social expectations that limit their participation in platform-based mobility (Zhang et al. 2020). For women, these age-related barriers intersect with gendered constraints, potentially creating compounded disadvantages that influence mobility behaviours and choices, thereby triggering women's disadvantages in digital technology-based mobility services.

While prior studies have examined gender and generational differences separately, the compounded disadvantages arising from their intersection remain largely unexamined. Older women, in particular, may face unique barriers due to a combination of slower income growth, caregiving responsibilities, and limited digital familiarity. These factors jointly constrain their ability to adopt ride-hailing services, even as such platforms gain popularity among younger users. As digitalisation and platformisation restructured the constraints of space and time for urban mobility, all of the power relations nested in space and time reshaped the means of mobility. Therefore, when discussing whether women can widely

benefit from ride-hailing, returning to society-constructed intersected gender symbols is necessary to gain understanding.

So we develop an intersectional framework, rooted in feminist geography, to explore how the overlapping dimensions of gender and age shape ride-hailing usage. By examining commuting, chauffeuring, and night travel, it moves beyond treating gender and age as independent factors to uncover the nuanced pathways through which income, car access, and societal structures mediate mobility disparities, by using data from 1,006 surveys conducted in Chengdu, China.

In what follows, Section "Background" revisits the literature on how the past studies examining the gender and age gaps in ride-hailing. Section "Analytic framework" elaborates on the analytic framework and Section "Methodology" thereby explain the adopt methodology. Section "Results" follows a presentation and Section "Discussion" discusses the analysis results. Last, section "Conclusions" closes this study with potential implications and limitations.

Background

Intersectionality in urban mobility

Inherent gender relations of power produced under patriarchy unfold women's disadvantages in mobility (Hanson 2010). Marxist feminism acknowledges that gender is a central category and symbolic code that reflects social structures, resource access and social norms under the "dual institutional oppression" brought about by capitalism and patriarchy (McDowell 1993a, b). Observed gender differences in mobility are thus constrained by power relations, in particular by women's weak position in the household or the labour market, and are exacerbated by intersecting with culture, age, race, motherhood and body (e.g., Crane 2007; Fan 2017; Law 1999; Massey 1994; Schwanen 2007; Valentine 2007).

The economic power hypothesis critique of gender differences in mobility comes from women's income disadvantages. The gendered division of productive and reproductive labour leads to women's subordination in the labour market. This division results in women's preference for unpaid domestic work or precarious casual employment and contributes to the persistent issues of women being often paid less than men (Hartmann 1976; McDowell 1993a, b). Income disadvantages, in turn, reinforce the limit of women's capability to access urban resources and job opportunities. Thus, in an expanded form, the economic power hypothesis collectively refers to "access to resources", in which case mobility differences are represented as disparities in access to transportation resources, such as cars or other forms of mobility, beyond the economy itself (Law 1999).

The social roles hypothesis emphasises that social norms for different roles may regulate the "female role" to assume more unpaid housework and family responsibilities that limit their economy and mobility more than the "male role" (Eagly and Steffen 1984). In other words, traditional gender roles require women, especially employed wives, to coordinate housework-related travel or activities with commuting trips, generating more fragmented and shorter travel chains, more spatial constraints and less regular visit points (Gauvin et al. 2020; Kwan 2000; Schwanen 2007; Schwanen et al. 2008). As a response to changes in social roles of employment and maintenance activity obligations (housework, childcare),

men and women may be in different stages of their life cycles when they begin car ownership (Oakil 2016; Scheiner and Holz-Rau 2012).

Research focusing on the intersectionality of gender and age points to the fact that sociocultural norms changing between different generations are able to drive different attitudes, abilities, willingness or preferences to travel, thereby affecting the capability to move (Crane 2007; Cresswell and Uteng 2016; Siren and Hakamies-Blomqvist 2006; Zhang et al. 2020). Ride-hailing services, like other emerging mobility modes, such as shared bikes, e-scooters and car-sharing, are often associated with popularity among younger generations (Brown 2019; Misra et al. 2022; Vivoda et al. 2018; Young and Farber 2019). This generational preference may form intergenerational differences within subgroups of men and women, potentially exacerbating or moderating existing gender differences in mobility patterns.

Observed gender differences in ride-hailing usage

Mixed evidence indicates that women's disadvantages in mobility are changing under the shock of new smart mobility technologies. With the worldwide popularity of on-demand mobility services, scholars noticed that the social equity issue behind its rise has become increasingly prominent. This is especially true as regards the gender gap in ride-hailing usage when adopting binary gender as a control variable: men are often observed to be more likely to adopt and frequently use ride-hailing services in various cities worldwide. This trend has been observed in cities in the United States (Deka and Fei 2019; Sikder 2019), Canada (Young and Farber 2019) and Europe (Gomez et al. 2021). Kong et al. (2020) argue that the user difference in ride-hailing users in the United States, who tend to be male, young, well-educated and high-income, is consistent with characteristics of information and communications technology (ICT) users, suspecting unequal access to ICT, sensitivity to the private concern of location-based service and pre-requisite digital skills typically referred to as the "digital divide." These factors may contribute to gender barriers in ride-hailing usage (Singh 2020; Zhang et al. 2020).

Few studies have focused on the mechanisms underlying gender differences in ride-hailing use. Some studies indirectly examine the associations between gendered activity space, income and ride-hailing users, indicating that the need for a large activity space is the major factor associated with women adopting ride-hailing, while lower income may constrain the ride-hailing usage, instead of directly answering whether ride-hailing serves women more or less compared with men (Qiao et al. 2023a, b, c). A follow-up study highlights that women are more likely to use ride-hailing services for their night-time travel than men (Qiao et al. 2023b), implying that ride-hailing could alleviate time constraints on women's travel by enhancing the safety sense (Farina et al. 2022) and compensate for the lack of night-time public transit service in suburban areas where women may have limited access to private cars (Qiao and Yeh 2021).

When gender intersects with age

How the older adults adopt ride-hailing, a service that has only emerged in the last decade, is an imperative part of research on social inequality. Recent estimates in the United States reveal that roughly 4 in 10 adults aged 65 and over do not own a smartphone capable of ordering ride-hailing services (Anderson and Perrin 2017). Canada appears to display a

similar divide; only 2% of ride-hailing users in Toronto are 60 and above (Young and Farber 2019). With a special focus on Millennials in 10 American cities, ride-hailing services were more popular among middle-aged Millennials (30–34 years old) and Millennials with higher incomes (Asgari et al. 2022). Similar studies have shown that Millennials are more likely to use ride-hailing compared with Generation X, and the elderly population has the least exposure to ride-hailing services (Ahmed and Hyland 2022; Alemi et al. 2018; Dias et al. 2017; Lavieri and Bhat 2019).

The intersection between age and gender may illustrate the existence of multi-discrimination in current daily mobility, as evidenced by current research. Vivoda et al. (2018) found younger age and male gender are characteristics associated with higher ride-hailing usage in Michigan, although sex and age are applied as parallel factors without an intersection test. Mitra et al. (2019) analysed the 2017 National Household Travel Survey and found that, in the elderly population in the US, men use ride-hailing services more than women. Studies have also found that the synergies between age and other variables, such as higher income and better education among older age groups, are positively associated with ride-hailing usage (Ahmed and Hyland 2022; Alemi et al. 2018). However, in the gender symbols constructed by the patriarchal society, high income and educational opportunities also represent gender differences (Bobbitt-Zeher 2007), resulting from selection-distortion effects in education and labour markets (being students or workers facing gender discrimination when selected on the basis of gender rather than ability) (Klasen and Lamanna 2009). Therefore, understanding the intersectionality of gender and age in ride-hailing usage remains a fundamental yet unanswered question.

Other socioeconomic factors related to gender and age

Understanding the disparities in ride-hailing usage requires an exploration of key socioeconomic factors: economic affordability, access to private cars, career status, and parenting responsibilities. These factors are not merely economic or demographic but are deeply influenced by social constructions, including historical and cultural norms.

Gendered labor market practices, influenced by historical and cultural norms, often result in significant income disparities between men and women (Acker 1990). These disparities are further compounded by intersecting with age, as older women may face both gender and age discrimination in the labor market, causing a lower wage ceiling than the male cohort or being forced to interrupt their career paths due to childbearing. Similarly, car ownership has been associated with social norms and autonomy beyond economic status, with men more likely to have greater access to private cars due to gendered expectations and societal roles (Zhang and Qiao 2023). For women, particularly those who are older, restricted access to private cars can be a result of accumulated disadvantages over their lifetimes, influenced by social norms that prioritize men's mobility due to their traditional roles as primary breadwinners.

Economic affordability is a fundamental determinant of ride-hailing adoption. Studies consistently show a positive relationship between income and ride-hailing usage (Asgari et al. 2022; Dias et al. 2017; Li et al. 2022; Qiao and Yeh 2023; Young and Farber 2019). Asgari et al. (2022) found that unemployed millennials are less likely to use ride-hailing services. Although these studies did not directly explore gender roles, gender differences in affordability could be attributed to higher unemployment rates among women (Klasen

and Lamanna 2009). This is because the feminisation of unpaid domestic responsibilities, coupled with the temporal rhythm of childcare and household chores, collectively create a higher possibility of unemployment and longer career interruption for women (Del Bono and Vuri 2011). Women's subordination in the labour market usually leads to less pay (Hartmann 1976), even in on-demand gig work, where women typically earn fewer wages than men (Cook et al. 2021; Qiao et al. 2023a, b, c). Thus, women's economic disadvantages in affording ride-hailing services may contribute to gender differences in ride-hailing usage.

Women in Chinese cities also face widespread gender-specific inequality in the labour market, with their wages being 75.4% of men's and lower labour force participation rates (71% for women compared with 84% for men) (Bank 2022; Xiu and Gunderson 2013). In terms of time composition, women spend more time on unpaid work, with an average of 228 min per workday compared with 92 min for men, resulting in longer total work hours for women (459 min for women and 428 min for men) (China 2019). These gaps vary across different age groups along with the rapid urbanisation, the process of marketisation and the recent relaxation of the one-child policy in China (He and Wu 2018). The average monthly salary for employees ranges from CNY 7700 in enterprises above a designated size to CNY 5500 in private firms (China 2022), while the cost of an average ride-hailing trip ranges from a CNY 22 for an economy car and CNY 93 for a luxury car (Qiao et al. 2023a, b, c). Compared with the price of CNY 1–4 for a single bus trip, ride-hailing cannot be treated as a widely affordable travel mode in Chinese cities. Women's income disadvantages may restrict their access to ride-hailing services, preventing them from using these services to overcome their fragmented travel needs (Ahmed and Hyland 2022; Qiao et al. 2023a, b, c).

Access to private cars may also shape ride-hailing usage, given that ride-hailing is considered an alternative to car driving and forms a new trend of active "car-free" households, distinct from passive "zero-car" households (Brown 2019). Individuals in households with insufficient vehicles are more likely to adopt and frequently use ride-hailing services (Sikder 2019). A study focused on the elderly population found that car-free older adults rely more on using ride-hailing as a travel alternative to a car-free lifestyle (Mitra et al. 2019). The car ownership also interweaved with life stages. Women with children may have fragmented travel chains, requiring multiple trips for caregiving purposes, which changes the attitudes to own a car for flexible travel needs (Zhang and Qiao 2023). However, owning a private car does not contradict using ride-hailing. High-income households intend to use cars primarily for daily commuting but prefer ride-hailing for other daily trips like entertainment purposes (Qiao and Yeh 2023).

Although the gender gap in driving resources has narrowed rapidly in Western cities over the past few decades (Fan 2017), it remains substantial in Chinese cities (Shen et al. 2016; Zhang and Qiao 2023). One study analysed the changes in travel behaviour for three years in a Chinese city and found that women had significantly lower car access for commuting, and no significant improvement was observed over time (Feng et al. 2017). Therefore, the existing disparities in car access between men and women in China likely play a significant role in shaping gender differences in the use of ride-hailing services.

Overall, economic affordability, car ownership, employment status, and parenting responsibilities are deeply intertwined with gender and age. These factors do not operate independently but transition discontinuously across the lifespan, reflecting how societal norms and power structures shape mobility rights and opportunities.

Analytic framework

Building on insights from feminist writings and theories, this study argues that patriarchal power relations shape women's access to resources and social roles, resulting in disparities in socioeconomic factors such as personal income, car access, employment status, and parenting responsibilities. These disparities, influenced by both gender and age, may fully or partially explain differences in ride-hailing usage. To investigate this, we propose a gender- and age-centred conceptual framework that incorporates these socioeconomic factors as endogenous variables, challenging the prevailing view that treats gender and other influencing factors as parallel exogenous variables that operate independently.

The framework positions gender and age as exogenous variables[1] in the SEM analysis, recognizing them as predetermined characteristics that influence other variables, including income, car access, employment status, and parenting responsibilities. Additionally, environmental factors that may affect mobility behaviours are included as control variables to enhance the robustness of the model. Figure 1 illustrates how these relationships can be conceptualized and the influence pathways based on the below hypotheses.

Hypothesis 1 (Direct Path): The disparities of ride-hailing usage are directly influenced by gender, age, and their intersection

- **Hypothesis 1a (Gender)**: Women are less likely to use ride-hailing compared to men
- **Hypothesis 1b (Age)**: Older adults are less likely to use ride-hailing compared to the younger

[1] However, this study acknowledges that gender is not static but a socially constructed and dynamic system

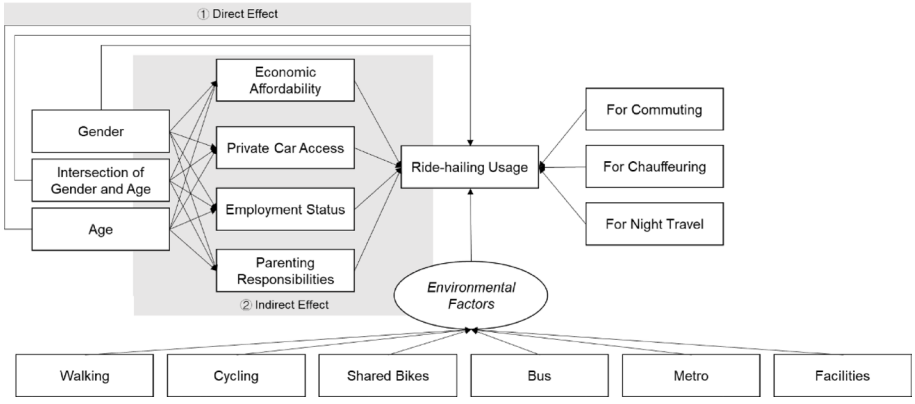

Fig. 1 Framework for understanding the intersectionality of gender and age on ride-hailing mobility

of differences, shaped by geographic, cultural, and historical contexts (Hanson 2010). Similarly, age reflects both biological and social dimensions, transitioning discontinuously across life stages and interacting with gendered roles and responsibilities.

- **Hypothesis 1c (Intersection)**: Among women, those older are less likely to use ride-hailing compared to younger women

Hypothesis 2 (Mediating Path): The disparities of ride-hailing usage are mediated influenced by the mediating factors which are shaped by gender, age and their intersection. These mediating factors include personal income, car access, employment status, and parenting responsibilities

- **Hypothesis 2a (Gender)**: Women are less likely to use ride-hailing compared to men, mediated by disadvantages in income, car access, employment status and parenting responsibilities
- **Hypothesis 2b (Age)**: Older adults are less likely to use ride-hailing compared to the younger, mediated by disadvantages in income, car access, employment status and parenting responsibilities
- **Hypothesis 2c (Intersection)**: Among women, those older are less likely to use ride-hailing compared to younger women, via the accumulated disadvantages over their lifetime

Methodology

City context

Chengdu city is the capital city of Sichuan Province and the largest city in southwestern China. Six urban central districts (Jinjiang District, Qingyang District, Jinniu District, Wuhou District, Chenghua District, Tianfu New District) were included in the study area. Similar landscapes and urban infrastructure would not produce huge differences in residents' travel behaviour. In sum, the urban central area comprises a population of 6.4 million, with 3.1 million men and 3.2 million women, for a sex ratio of 0.967, and female workers account for 44.8% of the total working population (Bureau 2021). As a case study city, Chengdu represents a highly modernised and urbanised city with a relatively high female labour force participation rate.

Ride-hailing has developed rapidly into a popular mobility mode in Chengdu since its introduction in 2012. In 2016, at least one in six residents was a ride-hailing user, reaching 130 million orders in the third quarter of 2016, attracting 8.5 million registered users, and the total order volume ranks second in all Chinese cities (CBNData 2016). Since 2018, Chengdu has become a model city for promoting legislation on the development of ride-hailing (Government 2018). A dynamic ride-hailing market, inclusive citizens, and a government that actively promotes the development of the industry together constitute the driving force behind choosing Chengdu as the case study city to examine gender differences in ride-hailing usage.

Data description

The data for this study were collected through an intercepted street interview conducted in Chengdu in September 2021. The target respondents were residents aged 18–60 who had

lived or worked in Chengdu for at least six months. Students, due to their highly rigid travel behaviours, were excluded from the sample. A stratified sampling method was employed, proportionate to three dimensions: region, gender, and age.

According to the seventh national census in Chengdu, the ratio of male to female residents is approximately 1:1, and the ratios for age groups 16–29, 30–39, 40–49, and 50 and above are 6:4:4:3. To ensure representativeness, interviews were conducted in six districts with sampling ratios of 5:7:6:4:6:4. Ultimately, 1006 questionnaires were retained for analysis, as these respondents answered all confirmatory questions correctly.

Questions of travel behaviour include: In the past month, did you have any commuting, chauffeuring, night travel trips? If yes, have you completed your commuting, chauffeuring, night travel trip using ride-hailing? In addition, respondents' gender, age, whether they live with their offspring (children or grandchildren), whether they have a regular job (excluding gig work) and their personal income (including monthly wages, salaries, pensions, and personal investment income, shares and dividends) are also recorded. The perceived travel environment in respondents' neighborhoods was also assessed to account for spatial effects. This included evaluations of walkability, bikeability, access to shared bikes, proximity to bus stops and metro stations, and the availability of local facilities. Respondents rated these factors using a 5-point Likert scale, from 1 ("strongly disagree") to 5 ("strongly agree").

To further validate the representativeness of the data, comparisons with population-level statistics from the seventh national census in Chengdu were conducted. These comparisons assessed the sample's alignment with key demographic characteristics, such as age, gender, and income. additional details about the survey design and administration are available in the Supplementary Appendix. While the sample broadly aligns with the census data, some potential biases were observed. The sample has a slight overrepresentation of respondents with regular employment and those living with children or grandchildren.

A summary of the statistical description of variables used in the analysis is provided in Table 1.

Variable selection

In this study, we selected a final set of 12 variables based on theoretical relevance, data availability, and the results of a correlation analysis to minimize multicollinearity (Appendix Figure A1). These variables reflect demographic, socioeconomic, and environmental factors that influence ride-hailing behaviour.

Gender: Gender is central to this study, as it directly impacts mobility behaviour and access to ride-hailing services. It is important to note that we collected self-reported gender data, with "female" and "male" as the only selectable options. We acknowledge the diversity of gender perceptions, thus respondents who felt that these options did not represent them could opt out of the survey.

Age: Age groups (18–30, 31–49, 50+) were defined based on generational differences and key life stages. This classification was informed by key societal milestones relevant to Chengdu, including the average age of first marriage (31 years for women) and retirement ages (50–55 years for women). These age groups also align with distinct life stages—early adulthood, midlife with family and career responsibilities, and later adulthood, often associated with caregiving roles or reduced workforce participation. Additionally, the division

Table 1 Statistical description of variables

Variable	Description	Obs.	Male	Female
Socioeconomic status				
Gender	1: Male 2: Female	1006	481	525
Age				
18–30	Younger generation	325	162	163
31–49	Midlife generation	496	207	289
50–65	Older generation	185	112	73
Employment				
No/Flexible job	Unemployment, retirement, gig job, or self-employment	204	82	122
Regular job	Being hired by enterprises, firms, and governments with contracts	802	399	403
Parenting				
No child	Single or couples have no child or parents live without children	188	88	100
Children	Respondents live with children or grandchildren	818	393	425
Car access				
No access	The respondent has no car or cannot drive household car	662	185	477
With access	Has at least one car in household and the respondent is able to drive the car	344	296	48
Personal income				
Level 1	Personal income equals 0 per month	8	1	7
Level 2	Personal income is between 1–2000 per month	3	2	1
Level 3	Personal income is between 2001–4000 per month	63	10	53
Level 4	Personal income is between 4001–6000 per month	429	182	247
Level 5	Personal income is between 6001–8000 per month	286	162	124
Level 6	Personal income is between 8001–10,000 per month	109	61	48
Level 7	Personal income is between 10,001–20,000 per month	79	47	32
Level 8	Personal income is above 20,001 per month	29	16	13
Commuting	The respondent has taken commuting trips in the past month	969	475	494
Commuting by RH	The respondent has taken ride-hailing to commute at least once in the past month	239	113	126
Chauffeuring child	The respondent has chauffeuring trips in the past month	535	252	283
Chauffeuring by RH	The respondent has taken ride-hailing to chauffeur children at least once in the past month	41	16	25
Night travel	The respondent has traveling at night at least once in the past month	851	411	440
Night travel by RH	The respondent has taken ride-hailing for traveling at night at least once in the past month	491	232	259
Perceived travel environment		Obs.	Avg.	Std.
Walking	5-point Likert scale: Living in a neighbourhood with a suitable walking environment; From 1 (disagree) to 5 (strongly agree)	1006	3.64	0.852
Cycling	5-point Likert scale: Living in a neighbourhood with a suitable cycling environment; From 1 (disagree) to 5 (strongly agree)	1006	2.36	0.829
Shared bikes	5-point Likert scale: Living in a neighbourhood with sufficient shared bikes; From 1 (disagree) to 5 (strongly agree)	1006	2.27	0.865
Bus	5-point Likert scale: Living in a neighbourhood close to bus stops; From 1 (disagree) to 5 (strongly agree)	1006	2.21	0.866

Table 1 (continued)

Perceived travel environment		Obs.	Avg.	Std.
Metro	5-point Likert scale: Living in a neighbourhood close to metro stations; From 1 (disagree) to 5 (strongly agree)	1006	2.24	0.863
Facilities	5-point Likert scale: Living in a neighbourhood with sufficient facilities; From 1 (disagree) to 5 (strongly agree)	1006	2.32	0.772

RH denotes ride-hailing

reflects the observed age distribution in the sample, ensuring sufficient representation within each category.

Personal Income (Income): Personal income is a critical factor influencing affordability and access to ride-hailing, supporting the economic selection hypothesis. Individual-level income, rather than household income, was used as a proxy for affordability to present the gender differences. The questionnaire captured all income types, including wages, investments, and assets. This variable is central to testing *Hypothesis 1*.

Car Access (Car): Car access represents a primary mobility resource, with significant implications for ride-hailing usage. According to the substitution hypothesis, private cars and ride-hailing services exhibit a competitive relationship (Brown 2019). Limited car access may increase reliance on ride-hailing, while greater car access may reduce it. Given the long-standing gender-unequal car access in Chinese society, we use individual car access as a proxy for the usual household car access, to capture the disparities in car access between genders more effectively, particularly within the context of family dynamics and resource allocation (Zhang and Qiao 2023). This is a key variable for *Hypothesis 2*.

Parenting Children or Grandchildren (Child): Parenting responsibilities, particularly the presence of children, are included to capture their impact on mobility behaviour, such as chauffeuring trips. In Chinese society, the prevalence of dual-income families often shifts childcare responsibilities to grandparents, who play a significant role in raising grandchildren and undertaking caregiving trips.

Employment Status (Job): Employment status reflects work-related mobility needs, such as commuting. This variable helps to examine gendered divisions of labour and their impact on ride-hailing behaviour.

Walking Environment (Walking): Perceptions of walkability in neighbourhoods are included to reflect the spatial context and alternatives to motorized transport.

Cycling Environment (Cycling): Cycling infrastructure and perceptions of bike-friendliness influence mobility choices and the potential for ride-hailing to substitute for cycling.

Shared Bikes: Shared bike availability was included to capture the role of micro-mobility in urban transport. In Chengdu, shared bikes are a widely used mode of travel that complements metro services and may compete with ride-hailing.

Bus Access (Bus): Proximity to bus stops reflects public transport accessibility and its competition with or complementarity to ride-hailing.

Metro Access (Metro): Metro access represents a high-capacity transit option, particularly relevant for longer-distance trips in urban areas. In dense urban areas, metro services may compete with ride-hailing, while in suburban areas, they may serve as complementary modes (Qiao and Yeh 2023).

Neighbourhood Facilities (Facilities): Perceived access to sufficient facilities such as shopping centres, retails, catering, and parks, reflects neighbourhood quality and its influ-

ence on mobility. Due to high correlations between shopping centre and park variables, we excluded them to avoid redundancy.

Education and **occupation** are excluded due to high correlation. Education is highly correlated with age because the expansion of higher education in China has boosted opportunities for all social groups increasing with generations. Occupation and employment are highly correlated (r=−0.773). Occupational breakdowns are excluded to avoid multicollinearity, given the correlation between specific occupations and high income.

Statistical models

In this study, we employed a two-step analytical approach to examine the factors influencing ride-hailing usage and uncover the deeper mechanisms of how gender and age impact behaviour under societal gender roles.

Step 1 Multivariate Probit Model.

We first applied a multivariate probit model to establish baseline outcomes by treating all variables (gender, age groups, income, car access, and environmental factors) as parallel exogenous predictors. This approach allowed us to estimate the likelihood of ride-hailing usage, accounting for correlations between dependent variables and predictors, providing a robust baseline analysis for direct effects.

The general formula for the multivariate probit model is:

$$y_{ij}^{*} = \beta_0 + \sum\nolimits_{k=1}^{K} \beta_k x_{ijk} + \epsilon_{ij}$$

where y_{ij}^{*} is the variable representing the propensity to use ride-hailing for individual *i* and purpose *j*. x_{ijk} are observed explanatory variables of gender, age group, income, car access and other control factors. β_k are coefficients representing the effect of explanatory variables on the latent propensity. ϵ_{ij} is the error term, assumed to follow a multivariate normal distribution.

The observed binary outcomes (y_{ij}) are defined as:

$$y_{ij} = \begin{cases} 1 if y_{ij}^{*} > 0 \\ 0 otherwise \end{cases}$$

Step 2 Structural Equation Modelling (SEM).

To explore the deeper mechanisms underlying ride-hailing behaviour, we applied SEM which is a powerful tool for estimating complex relationships between unobserved structures and observed variables in travel behaviour studies (Acock 2013), allowing for the representation, estimation and testing of theoretical frameworks with mediated relationships, mediating effects and direct/indirect paths of effects.

In this study, we hypothesize that gender and age influence ride-hailing usage both directly and indirectly through mediating variables, including personal income, car access, employment status, and parenting responsibilities. The SEM framework facilitates the decomposition of the total effects on ride-hailing usage into direct pathways (e.g., gender and age directly influencing usage) and indirect pathways (e.g., mediated through socioeconomic factors).

Three types of travel behaviours were analysed: commuting, chauffeuring for children, and night travel. As discussed in section "Background", commuting and household-related trips are strongly shaped by gendered social roles. Additionally, night travel was included to capture safety-sensitive behaviour, which disproportionately concerns women and may influence their ride-hailing adoption patterns.

Results

Baseline results of multivariate probit models

Table 2 presents the results of the multivariate probit models, offering an essential foundation for understanding the direct effects of key variables on ride-hailing usage across different trip purposes, including commuting, chauffeuring, and night travel. Gender does not emerge as a statistically significant predictor of ride-hailing usage across all trip purposes. This indicates that the differences in ride-hailing usage between men and women are not direct but may be mediated or moderated by other factors such as income and car access.

Specifically, for commuting purpose, age groups significantly affect ride-hailing usage. Middle-aged adults (31–49) are less likely to use ride-hailing for commuting compared to younger adults (18–30), while older adults (50+) are even less likely. Higher income significantly increases the likelihood of using ride-hailing. Additionally, a better shared bike environment and perceived access to metro increases ride-hailing usage, suggesting a complementary relationship.

In terms of chauffeuring for children, only middle-aged adults (31–49) are significantly more likely to use ride-hailing for chauffeuring compared to younger adults (18–30), while older adults (50+) have no significant difference. Similar to commuting, income is a positive predictor. But higher metro access correlates with a lower likelihood of chauffeuring by ride-hailing, suggesting a competitive effect.

Last, for traveling at night, both middle-aged adults (31–49) and older adults (50+) are less likely to use ride-hailing for night travel compared to younger adults, mirroring the results for commuting. Unlike the previous two trip purposes, income does not significantly impact night travel. However, having a job significantly increases the likelihood of using ride-hailing for night travel. Easier access to bus services contributes to lower ride-hailing usage for night travel. This may be attributed to the early closure of metro systems, making buses a more accessible alternative, and suggest a competitive relationship between ride-hailing and bus at night.

After including intersection terms between gender and age groups, no significant effects were observed. This indicates that the interaction between gender and age may not directly affect ride-hailing usage but could operate through indirect mechanisms.

Therefore, while the probit models provide valuable baseline insights, these models are insufficient to capture the complex mechanisms underlying mobility behaviour. Across travel purposes, the insignificant direct effects of gender highlight the need to explore indirect pathways through which gender influences ride-hailing usage. Furthermore, the intersection of gender and age, particularly for groups such as older women, requires explicit modelling to understand compounded disadvantages and indirect effects. These findings

Table 2 Results of multivariate probit regression

	Commuting by RH		Chauffeuring by RH		Night travel by RH	
	Coef	Coef	Coef	Coef	Coef	Coef
Socioeconomic status						
Gender (base = Male)						
Female	0.120	0.237	0.133	0.169	0.044	0.021
	(1.10)	(1.53)	(0.80)	(0.50)	(0.44)	(0.14)
Age (base = Younger)						
Middle-aged	−0.463***	−0.358**	0.487**	0.522	−0.516***	−0.535***
	(−4.19)	(−2.33)	(2.14)	(1.53)	(−5.09)	(−3.73)
Older	−0.808***	−0.686***	0.135	0.127	−0.978***	−0.998***
	(−5.56)	(−3.80)	(0.48)	(0.33)	(−7.66)	(−5.99)
Intersection						
Female × Middle-aged		−0.195		−0.061		0.035
		(−0.98)		(−0.14)		(0.18)
Female × Older		−0.301		0.036		0.044
		(−0.98)		(0.06)		(0.17)
Income	0.192***	0.188***	0.185***	0.187***	0.034	0.035
	(4.70)	(4.61)	(2.98)	(3.12)	(0.95)	(0.96)
Car	0.118	0.090	−0.067	−0.070	0.025	0.029
	(1.03)	(0.77)	(−0.38)	(−0.38)	(0.23)	(0.27)
Child	0.198	0.218*	0.183	0.181	−0.038	−0.041
	(1.56)	(1.73)	(0.77)	(0.76)	(−0.34)	(−0.36)
Job	0.160	0.146	−0.169	−0.164	0.179*	0.181*
	(1.35)	(1.22)	(−0.95)	(−0.91)	(1.70)	(1.69)
Perceived travel environment						
Walking	0.064	0.068	−0.010	−0.008	−0.143**	−0.143***
	(1.02)	(1.09)	(−0.10)	(−0.09)	(−2.58)	(−2.58)
Cycling	−0.019	−0.016	0.092	0.093	−0.041	−0.041
	(−0.30)	(−0.24)	(0.87)	(0.87)	(−0.70)	(−0.71)
Shared Bikes	0.144**	0.148**	0.063	0.065	−0.058	−0.059
	(2.30)	(2.37)	(0.63)	(0.66)	(−1.00)	(−1.01)
Metro	0.115*	0.115*	−0.167*	−0.167*	−0.012	−0.012
	(1.80)	(1.78)	(−1.68)	(−1.68)	(−0.21)	(−0.20)
Bus	0.019	0.012	−0.003	−0.004	−0.145**	−0.143**
	(0.29)	(0.19)	(−0.03)	(−0.04)	(−2.40)	(−2.37)
Facilities	0.040	0.037	0.091	0.092	0.005	0.005
	(0.59)	(0.53)	(0.91)	(0.91)	(0.08)	(0.09)
Constant	−2.728***	−2.657***	−3.382***	−3.289***	1.178***	1.186***
	(−5.67)	(−5.82)	(−4.69)	(−4.58)	(2.96)	(2.93)
Number of obs	1006	1006	1006	1006	1006	1006
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000
Mean dependent var	0.238	0.238	0.041	0.041	0.488	0.488
SD dependent var	0.426	0.426	0.198	0.198	0.500	0.500
Akaike crit. (AIC)	1054.067	1056.752	341.222	345.165	1333.808	1337.765
Bayesian crit. (BIC)	1122.859	1135.372	410.014	423.785	1402.600	1416.385

t statistics in parentheses; $^{*}p<0.05$, ** $p<0.01$, *** $p<0.001$

justify the use of SEM for deeper exploration of the indirect and moderated pathways driving ride-hailing adoption.

Table 3 Results of mediation effects on ride-hailing without and with intersection term for commuting by ride-hailing

	Without intersection term			With intersection term		
	Direct effects	Indirect effects	Total effects	Direct effects	Indirect effects	Total effects
Commuting by Ride-hailing						
Socioeconomic factors						
Gender	0.032	−0.037*	−0.005	0.097	0.009	0.106
Age	−0.111***	0.018**	−0.093***	−0.059	0.052**	−0.007
Gender × Age				−0.036	−0.023*	−0.060
Income	0.053***		0.053***	0.052***		0.052***
Car	0.026		0.026	0.021		0.021
Job	0.035		0.035	0.029		0.029
Child	0.053		0.053	0.057		0.057
Environmental factors						
Walking	0.018		0.018	0.018		0.018
Cycling	−0.008		−0.008	−0.007		−0.007
Shared Bikes	0.044*		0.044*	0.044*		0.044*
Bus	0.035		0.035	0.034		0.034
Metro	0.004		0.004	0.003		0.003
Facilities	0.013		0.013	0.012		0.012
Income						
Gender	−0.409***		−0.409***	0.353		0.353
Age	0.243***		0.243***	0.838***		0.838***
Gender × Age				−0.410***		−0.410***
Car						
Gender	−0.518***		−0.518***	−0.245***		−0.245***
Age	0.082***		0.082***	0.295***		0.295***
Gender × Age				−0.147***		−0.147***
Child						
Gender	0.000		0.000	−0.219**		−0.219**
Age	0.116***		0.116***	−0.055		−0.055
Gender × Age				0.118**		0.118**
Job						
Gender	−0.068**		−0.068**	0.277***		0.277***
Age	−0.097***		−0.097***	0.173**		0.173**
Gender × Age				−0.186***		−0.186***
CFI	0.926			0.922		
SRMR	0.027			0.026		
RMSEA	0.039			0.042		
CD	0.422			0.460		

*$p<0.05$, ** $p<0.01$, *** $p<0.001$; CFI is an index such that a value close to 1 indicates a good fit (CFI stands for comparative fit index); RMSEA reports the root mean squared error of approximation and labels a good fit if less than 0.05; SRMR refers to standardized root mean squared residual and CD means the coefficient of determination (A perfect fit corresponds to an SRMR of 0. A good fit is a small value, considered by some to be limited to 0.08, while concerning CD, a perfect fit corresponds to a CD of 1)

Gender and age disparities in commuting by ride-hailing

Table 3 presents the mediation effects on ride-hailing usage for commuting. The table compares results with and without the inclusion of intersection term between gender and age to

assess the further influence.

From the model without intersection term, gender has a small, non-significant direct effect on commuting by ride-hailing, indicating that if there is any difference in usage between men and women, it should be primarily mediated through other variables. Both middle-aged (31–49) and older adults (50+) have significant negative direct effects on ride-hailing usage for commuting compared to younger adults (18–30). This aligns with the findings from the probit models and reflects generational differences in adoption.

Income, as the only significant mediator, significantly mediates the relationship between both gender and age on ride-hailing usage. The indirect effects indicate that women who are associated with lower income levels indirectly reduces their likelihood of commuting by ride-hailing (−0.037*) but older adults experienced with higher income levels contributing to higher ride-hailing adoption (0.018**). In terms of total effects, age remains significantly negative (−0.093***), driven by both direct and indirect pathways. This highlights that, gender only indirectly affects ride-hailing usage through income, while the impact of age is more complex. Although the older adults may have higher income, it is not enough to offset the direct negative effect of age.

Thus, it is important to involve intersection term to check whether gender and age create compounded disadvantages. The model with intersection term indicates that, older women (Gender × Age) have a significant negative indirect effect on ride-hailing usage (−0.023*), mediated primarily through income, suggesting older women may face unique barriers due to compounded gender and age-based disadvantages. Specifically, when investigating the effects on income, the negative coefficient (−0.409***) indicates that women, on average, earn significantly less than men, highlighting a persistent gender income gap. The positive coefficient (0.243***) suggests that older individuals earn more than younger individuals, reflecting typical age-income dynamics where earnings increase with experience and seniority up to a certain point in the lifecycle. After including the interaction term (−0.410***), the dynamics shift, indicating that the combined effect of being female and older adults resulting in significantly lower income compared to other groups.

Gender and age disparities in chauffeuring by ride-hailing

Table 4 examines the mediation effects on chauffeuring trips by ride-hailing, comparing models with and without the inclusion of intersection terms. The results indicate that the mediating pathway remains relatively straightforward, as the intersection term is insignificant across direct, indirect, and total effects. This suggests that the interaction between gender and age does not directly or indirectly influence chauffeuring trips by ride-hailing. Instead, the disparities of age groups are primarily mediated through income, which plays a significant but small role. Meanwhile, the environmental factors are marginal when considering use ride-hailing for chauffeuring.

Gender and age disparities in night travel by ride-hailing

The results for night travel by ride-hailing, as shown in Table 5, highlight the significant effects of age on the likelihood of using ride-hailing for nighttime travel. Similar to previous model, the intersection term is insignificant across direct, indirect, and total effects, suggesting that compounded disadvantages of gender and age do not directly or indirectly influence

Table 4 Results of mediation effects on ride-hailing without and with intersection term for chauffeuring by ride-hailing

	Without intersection term			With intersection term		
	Direct effects	Indirect effects	Total effects	Direct effects	Indirect effects	Total effects
Chauffeuring by ride-hailing						
Socioeconomic factors						
Gender	0.020	−0.004	0.015	0.008	−0.001	0.008
Age	0.003	0.009**	0.012	−0.006	0.012	0.006
Gender × Age				0.006	−0.002	0.004
Income	0.021***		0.021***	0.021***		0.021***
Car	−0.005		−0.005	−0.004		−0.004
Job	−0.020		−0.020	−0.019		−0.019
Child	0.020		0.020	0.019		0.019
Environmental factors						
Walking	−0.000		−0.000	−0.000		−0.000
Cycling	0.008		0.008	0.008		0.008
Shared Bikes	0.006		0.006	0.005		0.005
Bus	−0.014		−0.014	−0.014		−0.014
Metro	−0.002		−0.002	−0.001		−0.001
Facilities	0.006		0.006	0.006		0.006
Income						
Gender	−0.409***		−0.409***	0.353		0.353
Age	0.243***		0.243***	0.838***		0.838***
Gender × Age				−0.410***		−0.410***
Car						
Gender	−0.518***		−0.518***	−0.245***		−0.245***
Age	0.082***		0.082***	0.295***		0.295***
Gender × Age				−0.147***		−0.147***
Child						
Gender	0.000		0.000	−0.219**		−0.219**
Age	0.116***		0.116***	−0.055		−0.055
Gender × Age				0.118**		0.118**
Job						
Gender	−0.068**		−0.068**	0.277***		0.277***
Age	−0.097***		−0.097***	0.173**		0.173**
Gender × Age				−0.186***		−0.186***
CFI	0.919			0.916		
SRMR	0.027			0.026		
RMSEA	0.039			0.042		
CD	0.396			0.434		

*$p<0.05$, ** $p<0.01$, *** $p<0.001$; CFI is an index such that a value close to 1 indicates a good fit (CFI stands for comparative fit index); RMSEA reports the root mean squared error of approximation and labels a good fit if less than 0.05; SRMR refers to standardized root mean squared residual and CD means the coefficient of determination (A perfect fit corresponds to an SRMR of 0. A good fit is a small value, considered by some to be limited to 0.08, while concerning CD, a perfect fit corresponds to a CD of 1)

Table 5 Results of mediation effects on ride-hailing without and with intersection term for night travel by ride-hailing

	Without intersection term			With intersection term		
	Direct effects	Indirect effects	Total effects	Direct effects	Indirect effects	Total effects
Night travel by ride-hailing						
Socioeconomic factors						
Gender	0.013	−0.013	0.013	0.003	0.025	0.028
Age	−0.186***	−0.005	−0.186***	−0.193**	0.025	−0.169*
Gender × Age				0.005	−0.020	−0.015
Income	0.011		0.011	0.012		0.012
Car	0.007		0.007	0.008		0.008
Job	0.066		0.066	0.067		0.067
Child	−0.018		−0.018	−0.018		−0.018
Environmental factors						
Walking	−0.053**		−0.053**	−0.053**		−0.053**
Cycling	−0.017		−0.017	−0.017		−0.017
Shared bikes	−0.021		−0.021	−0.021		−0.021
Bus	−0.003*		−0.003*	−0.003*		−0.003*
Metro	−0.055		−0.055	−0.055		−0.055
Facilities	0.003		0.003	0.003		0.003
Income						
Gender	−0.409***		−0.409***	0.353		0.353
Age	0.243***		0.243***	0.838***		0.838***
Gender × Age				−0.410***		−0.410***
Car						
Gender	−0.518***		−0.518***	−0.245***		−0.245***
Age	0.082***		0.082***	0.295***		0.295***
Gender × Age				−0.147***		−0.147***
Child						
Gender	0.000		0.000	−0.219**		−0.219**
Age	0.116***		0.116***	−0.055		−0.055
Gender × Age				0.118**		0.118**
Job						
Gender	−0.068**		−0.068**	0.277***		0.277***
Age	−0.097***		−0.097***	0.173**		0.173**
Gender × Age				−0.186***		−0.186***
CFI	0.928			0.924		
SRMR	0.027			0.026		
RMSEA	0.039			0.042		
CD	0.436			0.472		

*$p<0.05$, ** $p<0.01$, *** $p<0.001$; CFI is an index such that a value close to 1 indicates a good fit (CFI stands for comparative fit index); RMSEA reports the root mean squared error of approximation and labels a good fit if less than 0.05; SRMR refers to standardized root mean squared residual and CD means the coefficient of determination (A perfect fit corresponds to an SRMR of 0. A good fit is a small value, considered by some to be limited to 0.08, while concerning CD, a perfect fit corresponds to a CD of 1)

ride-hailing adoption for night travel. But unlike previous trip purposes (i.e., commuting and chauffeuring), income does not play a significant role in mediating ride-hailing usage for night travel. Instead, environment plays an important role. Better environment for walking and easier access to bus relate to lower likelihood for using ride-hailing travel at night. Besides, the negative and significant direct effect of age (−0.186***) indicates that older adults are less likely to use ride-hailing for night travel when other factors hold constant. This finding aligns with broader trends where older individuals tend to rely less on digital or platform-based services for mobility.

Discussion

The rapid popularity of ride-hailing has sparked countless debates over the past decade. The vision of ride-hailing and the derivative concept of the sharing economy that will bring equal opportunities to people, promote economic and social efficiency and promote social development, is welcomed by the public. However, a growing number of scholars have begun to challenge this view, revealing the exclusivity and unevenness in daily ride-hailing use (Young and Farber 2019). These studies call attention to the unequal distribution of benefits and negative externalities among different social groups and the reproduction of inequalities induced by the growing ride-hailing industry. This study thereby contributes to this debate by constructing a gender and age centred analytical framework to unravel the complex role in ride-hailing usage.

The findings offer a threefold explanation of the gender ang age differences in ride-hailing usage. First, the results highlight that gender alone does not have a direct effect on ride-hailing usage for commuting, chauffeuring, or night travel. Instead, gender disparities are primarily mediated through income. This finding rejects hypothesis 1a but supports 2a. Women earn significantly less than men on average, consistent with previous studies (Bobbitt-Zeher 2007; Chen et al. 2013; Del Bono and Vuri 2011). This income gap indirectly reduces their likelihood of using ride-hailing services, particularly for commuting trips where affordability plays a critical role. These results underscore the broader societal issue of income inequality as a structural barrier to mobility for women.

Second, age groups have significant direct and indirect effects on ride-hailing usage across all trip purposes, which support both hypotheses 1b and 2b. Middle-aged (31–49) and older adults (50+) are less likely to adopt ride-hailing compared to younger adults (18–30). Middle-aged (31–49) and older adults (50+) are less likely to adopt ride-hailing compared to younger adults (18–30). This reflects generational differences in familiarity with and access to digital platforms.

Last, the intersection of gender and age creates compounded disadvantages, particularly for older women when commuting, only via accumulated income disadvantages. It thus supports the hypothesis 2c but rejects 1c. While income increases with age due to seniority and experience, the rate of growth is slower for older women compared to older men, further limiting mobility options. This finding echoes the “glass ceiling effect” for women’s career development (Bobbitt-Zeher 2007; Chen et al. 2013; Cook et al. 2021; Del Bono and Vuri 2011; He and Wu 2018). The slower growth leaves older women at a relative economic disadvantage, which, combined with societal and technological barriers could potentially reduce their likelihood of using ride-hailing services. This finding aligns with most stud-

ies examining how older adults faced barriers to new smart mobility services (Ahmed and Hyland 2022; Alemi et al. 2018; Dias et al. 2017; Lavieri and Bhat 2019; Mitra et al. 2019; Singh 2020; Vivoda et al. 2018). The digital barriers may additionally exclude them by lack of physical access to smartphones and online payment, uneven distribution of ICT services, lack of essential digital knowledge for individuals and privacy concerns of location-based smart mobility services (Kong et al. 2020; Misra et al. 2022; Zhang et al. 2020). While older women's income increases compared to younger women, it does not grow enough to offset the negative direct effects of age, thus present a total negative effect of age and age intersecting with gender.

Conclusions

By centring the intersectionality of gender and age in the analytical framework, this study advances the debate on social justice in ride-hailing usage. Our findings reveal that neither gender nor age alone sufficiently explains mobility disparities; instead, compounded disadvantages arise from their intersection.

Intersection of gender and age: compounded disadvantages

Unlike previous studies that observed significant sign of gender alone, this study finds that age plays a critical role in shaping gender disparities. While women face well-documented economic disadvantages due to the gender pay gap (Schwab et al. 2017), these disadvantages accumulate over a lifetime, disproportionately affecting older women's mobility options. Income emerges as a key mediator: although older individuals tend to have higher incomes than younger adults due to career progression, older women's income growth is insufficient to offset structural barriers, such as caregiving responsibilities, digital barriers, and limited mobility resources. This highlights the intersectional nature of mobility inequalities, where gender and age jointly exacerbate exclusion from equitable access to ride-hailing services.

"De-Genderized Yet Generationally Differentiated"

While ride-hailing is shaped by broader societal power structures, its adoption is less influenced by traditional gender roles compared to private car driving. Private car ownership often reinforces gendered identities, symbolizing power, status, and masculinity through attributes such as brand, price, or aesthetics in Chinese society (Zhang and Qiao 2023). These symbolic associations perpetuate societal expectations that disproportionately exclude women from driving. In contrast, ride-hailing services function as a form of mobility service leasing, which dispels the symbolic gender coding of private vehicle ownership. Ride-hailing diminishes the influence of gendered perceptions by offering a service that prioritizes convenience and utility over status. Thus, women's adoption of ride-hailing could be less constrained by societal norms around driving, allowing for a more equitable experience. However, ride-hailing travel remains a fashionable, digitally native, and modern life option that appeals predominantly to younger generations. Its reliance on smartphone applications, real-time booking, and cashless payments aligns with the preferences and digital

fluency creates a significant generational disparity, where younger adults disproportionately use ride-hailing services, framing it as a symbol of modernity and accessibility.

Potential for gender and age-inclusive urban mobility

The flexibility of on-demand ride-hailing services offers a transformative opportunity to challenge entrenched gender and age-based inequalities in mobility. By addressing women's unique mobility needs—such as fragmented travel chains and safety concerns—ride-hailing can complement traditional public transport systems, particularly for short and last-mile trips (Qiao et al. 2023a, b, c). The future integration of on-demand travel into public transport systems is expected to contribute towards the development of a gender and age-inclusive urban environment. Especially as ride-hailing becomes more widespread, older generations may gradually adopt it, driven by increasing, active learning, digital familiarity, and the growing availability of user-friendly interfaces. In this context, the higher income of older women compared to younger women may shift usage trends. Older women, particularly those with higher disposable incomes, may increasingly use ride-hailing for daily activities and thus enhance their autonomy on mobility.

As Willard described, the advent and popularity of bicycles was a way of advancing the cause of feminism, more than just a tool restoring lost mobility for women who were trapped in their modest middle-class lives for years (Willard 1895). Similarly, ride-hailing could be modern "bicycles" offering them free movement, representing an inspiring sense of self-confidence and accomplishment, possibilities of life and opportunities to realise aspirations and personal growth, releasing them from the masculine automobile culture. Gender convergence in ride-hailing usage among younger generations, especially compared with private car access, provides a vision for changing the underrepresented status of women's capability to move (Tilley and Houston 2016).

Limitations and future direction

This study acknowledges several limitations. First, the study was data- and hypothesis-driven and conducted in a large, safe at night, economically developed city in China with high female labour force participation rate and extremely low female driving behaviour. Religious constraints on travel are also excluded from our scope. Thus, the results in other regions may vary differently according to gender norms, cultural constraints, or socioeconomic conditions. Second, we only interviewed about the ride-hailing choices rather than the frequency of ride-hailing trips. Future research should examine usage intensity, as economic constraints may limit frequent adoption of ride-hailing among low-income groups, potentially underestimating disparities. Next, non-unidirectional causal relationships may exist between the introduced assumptions and the relevant explanatory variables. The limitation of cross-sectional data introduces difficulties in testing causal models, although we start from feminist theory to structure the mechanism of gender and age differences. Last, while this study treats gender as exogenous in the SEM framework, we acknowledge that gender is shaped and reshaped by everyday mobility practices and societal structures. Future research could explore these dynamic processes through mixed methods that integrate qualitative insights.

We also emphasize that, despite our efforts to control for all possible influencing factors, the observed differences in ride-hailing usage may reflect multiple underlying pathways influenced by factors not accounted for in the current models. While this study advances understanding of compounded mobility inequalities by employing intersectional statistical models, we acknowledge an important limitation inherent in this approach. Quantitative analyses using interaction terms between gender and age risk oversimplifying the complexity of intersectionality by treating it as merely additive or multiplicative, potentially overlooking the qualitative and ontological nuances of lived experiences at these intersections.

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Data availability Aggregated datasets used in this study are available from the corresponding author upon reasonable request. However, access to the raw datasets is restricted to protect participant privacy.

Declarations

Competing interests The authors declare no competing interests.

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