Riding together: A scoping review of factors influencing user behaviour in bike-sharing systems

Shima Mafi [a],[*] , Erica McIntyre [a], Jason Prior [a], Ali Mohammadi [b], Pooria Choobchian [c]

[a] *Institute for Sustainable Futures, University of Technology Sydney, 15 Broadway, Ultimo, NSW 2007, Australia*
[b] *Department of Civil, Materials, and Environmental Engineering, University of Illinois Chicago, 842 W Taylor St, Chicago, IL 60607, USA*
[c] *Department of Civil, Materials, and Environmental Engineering, University of Illinois Chicago, 842 W Taylor St, Chicago, IL 60607, USA*

A B S T R A C T

This scoping review systematically synthesises the behavioural factors influencing the use and intention to use bike-sharing systems (BSS), and introduces the first multilevel conceptual framework that integrates user-, BSS provider-, government-, and urban environment-related determinants. Drawing on a systematic search of peer-reviewed literature published in English between 2014 and 2025, the review identified 66 eligible studies. Findings were organised into four overarching categories, with a distinctive novelty in establishing government-related influences and social media narratives as separate domains of analysis—extending behavioural research into institutional and digital realms. Among the factors examined, user-related determinants—particularly psychological dimensions such as attitudes, beliefs, and perceptions—emerged as the most extensively studied. However, these factors were often assessed in broad, generalised terms, with limited attention to the nuanced effects of specific individual-level variables. Urban environment factors were also widely explored, though their interactions with psychological and policy-driven influences remain underexamined. While governmental interventions and provider strategies were less frequently analysed, they were identified as critical levers capable of addressing structural barriers to BSS use. The review further highlights underdeveloped areas, including limited insights into negative behaviours (e.g., misuse, vandalism), the influence of unfavourable social media narratives on public perception, and the complex interplay between psychological, environmental, and policy factors. By mapping current evidence and identifying research gaps, this review advances conceptual understanding and provides actionable insights for policymakers, urban planners, and BSS providers committed to promoting BSS as a sustainable urban mobility solution.

---

* Corresponding author.
E-mail addresses: shima.mafi@student.uts.edu.au (S. Mafi), erica.mcintyre@uts.edu.au (E. McIntyre), jason.prior@uts.edu.au (J. Prior), mohamadi@uic.edu (A. Mohammadi), pchoob2@uic.edu (P. Choobchian).

1. Introduction

Bike-sharing systems (BSS) have become a prominent component of shared mobility, offering a sustainable, accessible, and convenient alternative to private vehicle use (Qiu and He, 2018). These systems provide short-term public access to bicycles—either pedal-powered or electric-assist—through station-based docks or dockless bikes equipped with GPS and smart locks, deployed across urban areas (DeMaio, 2009; Shaheen et al., 2010). BSS models vary widely in scale, governance, and operational design. In many European and North American cities, station-based systems are predominantely municipally regulated, whereas large-scale, privately operated dockless networks have proliferated in China and Southeast Asia (Cao et al., 2021; Parkes et al., 2013). Adoption patterns also differ across regions, influenced by psychological, social, and infrastructural contexts (Zhuang et al., 2025).

Over the past two decades, BSS technologies have evolved from basic coin-deposit mechanisms to smartcard-based docking networks and, more recently, to fully app-integrated dockless models (Shaheen et al., 2010). Today, BSS are widely recognised as integral to low-carbon transport systems: they complement public transit, promote active travel, and address first-mile/last-mile connectivity challenges (Angelidou et al., 2018; Aydın, 2025). As of early 2025, more than 2,800 BSS schemes operate in over 70 countries, collectively facilitating millions of trips each day (Statistica, 2025). The global BSS market, currently valued at USD 9 billion, is projected to grow at an annual rate of 7.6 % through 2034. Increasing integration with Mobility-as-a-Service (MaaS) platforms is accelerating this growth by enabling seamless multimodal journeys and unified fare systems (Coppola et al., 2025). This rapid expansion underscores the importance of understanding the behavioural factors that influence BSS use.

An expanding body of empirical research has explored the determinants of BSS use and intention to use, spanning multiple behavioural domains (e.g., Ji et al., 2021; Machavarapu et al., 2024; Zhang et al., 2021). Studies have examined individual-level factors such as attitudes, perceptions, habits, and lifestyle (e.g., Dill et al., 2022; Gao et al., 2019; Nikitas, 2018; Soltani et al., 2022; Ye, 2022; Zhu, 2021), along with sociodemographic characteristics (e.g., Huang et al., 2020; Macioszek et al., 2020) and user satisfaction (e.g., Chen et al., 2017; Link et al., 2020). Other research has focused on travel characteristics (e.g., Li et al., 2018; Li et al., 2022), environmental conditions such as weather and built environment features (e.g., An and Jang, 2022; Chen and Ye, 2021; Hu et al., 2021; Kim, 2020; Sinha, 2021), and system-related attributes including station density, service quality, and bike availability (e. g., Bao et al., 2018; Wang and Akar, 2019; Yang et al., 2020). Despite these contributions, no review has yet synthesised these findings into a comprehensive multilevel framework that captures the interplay of user-, BSS provider-, government-, and urban environment-related influences.

Although several scoping and systematic reviews have examined cycling behaviour or broader micromobility adoption, none has systematically addressed the full spectrum of behavioural factors influencing BSS use, as this review does. Existing reviews tend to concentrate on related but distinct areas. For example, Bourne et al. (2020) analysed personal e-bikes while explicitly excluding shared systems. Jenkins et al. (2022) investigated access and equity in personal pedal-assist e-bike use, with limited applicability to BSS use or intention to use. Zhu et al. (2022) reviewed built environment determinants of BSS ridership but did not consider psychological, policy, and BSS provider-related factors.

Recent meta-analyses have advanced understanding of micromobility and transport integration but have not provided a behavioural synthesis specific to BSS. Ghaffar et al. (2023), for instance, analysed built environment factors influencing shared micromobility use without addressing behavioural constructs. Aghaabbasi and Chalermpong (2023) explored the integration of rail and bike-sharing systems (RTBS), but their focus remained spatial and infrastructural rather than behavioural. Chevance et al. (2025) focused on e-bike ownership, while Li et al. (2023) synthesised Chinese-language BSS studies but did not develop a global behavioural framework. Similarly, Jayawardhena et al. (2025) compared e-scooter and BSS interactions with public transport, emphasising modal complementarity rather than behavioural drivers.

This review builds most directly on Elmashhara et al. (2022) but advances the field through a more focused and theoretically grounded synthesis centred exclusively on BSS. While their systematic review addressed both bike- and scooter-sharing systems, it offered limited depth on BSS-specific dynamics and excluded post-2021 developments, including behavioural shifts following the COVID-19 pandemic. Moreover, although Elmashhara et al. (2022) identified a range of influencing factors, their review did not establish a dedicated framework for government-related and psychological influences, nor did it attend to emerging behavioural risks or the role of governance structures in shaping user behaviour.

Table 1 provides a comparative overview of recent reviews, highlighting differences in focus, scope, and attention to psychological, governmental, and emerging behavioural factors.

To address these limitations, this review introduces the first multilevel conceptual framework dedicated exclusively to behavioural factors influencing both the actual use of, and intention to use BSS. The framework encompasses both conventional and electric models across docked and dockless systems, systematically integrating user-, BSS provider-, government-, and urban environment-related factors. In doing so, it moves beyond the narrower or fragmented perspectives of earlier reviews. Following the Arksey and O'Malley (2005) framework and adhering to PRISMA-ScR guidelines (Tricco et al., 2018), the review provides a transparent, reproducible, and policy-relevant synthesis of 66 peer-reviewed studies published between 2014 and September 2025. Unlike prior multimodal or infrastructure-centric reviews, this study focuses exclusively on BSS, enabling a more detailed and context-specific examination of behavioural dynamics.

This review makes several advances to the literature. First, it establishes government-related factors—including infrastructure investment, policy support, regulatory frameworks, and promotional initiatives—as a distinct analytical category. Second, it identifies social media narratives and digital perceptions as emerging behavioural drivers. Third, it provides a systematic synthesis of psychological influences, drawing on constructs such as perceived behavioural control, environmental concern, and risk perception, thereby advancing beyond surface-level analyses of attitudes. By incorporating post-2020 literature, the review also captures

Table 1
Comparative overview of this scoping review and recent studies on BSS and micromobility user behaviour.

Study	System type & modal focus	Timeframe	Review type	Behavioural dimensions / framework	Psychological / social factors	Government / policy factors	Emerging behavioural risk	Contribution
Bourne et al. (2020)	Personal e-bikes	Up to 2019	Scoping Review	Barriers, facilitators, substitutions	Limited	Not addressed	Not addressed	Focus on privately owned e-bikes; excludes BSS
Zhu et al. (2022)	BSS (docked + dockless)	Up to 2021	Systematic Review	Built environment (BE) only	Not addressed	Not addressed	Not addressed	Meta-analysis of BE factors; lacks behavioural synthesis
Jenkins et al. (2022)	Pedal-assist e-bikes (PAEBs)	Up to 2021	Scoping Review	Infrastructure, access, equity	Limited	Not addressed	Not addressed	Focus on PAEBs; minimal BSS relevance
Elmashhara et al. (2022)	Micromobility (bikes, scooters)	Up to 2021	Systematic Review	Spatio-temporal, user-related, and system-related	Limited	Not addressed	Mentioned but limited	Broad multimodal scope; limited depth on BSS behaviour
Li et al. (2023)	BSS (China, docked/dockless)	2005–2021	Narrative + bibliometric	Spatial, BE, demand, intention	Limited	Not addressed	Not addressed	Chinese-language only; excludes global literature
Ghaffar et al. (2023)	Shared micromobility (bikes, scooters, e-bikes)	2012–2021	Meta-analysis	Elasticities (BE, socio-demographic, infrastructure)	Not addressed	Not addressed	Not addressed	Quantified determinants; lack behavioural framework
Aghaabbasi and Chalermpong (2023)	RTBS (rail + BSS)	2015–2022	Meta-analysis	BE only	Not addressed	Not addressed	Not addressed	BE–RTBS integration focus; excludes standalone BSS
Jayawardhena et al. (2025)	Shared e-scooters + BSS (public transport interface)	2015–2024	Mixed-method review	Modal interaction (complement vs. compete)	Not addressed	Not addressed	Not addressed	Focus on modal complementarity; not focused on behavioural drivers
Chevance et al. (2025)	E-bikes (owned/loaned)	2015–2024	Systematic + meta-analysis	Mode substitution (car/PT/walk)	Not addressed	Focus on infrastructure incentives	Not addressed	Causal insights into e-bike use; excludes shared systems
This Review (2025)	**BSS only (conventional + electric)**	**January 2014–September 2025**	**Scoping Review**	**Multilevel 4-category framework: user, BSS-provider-related, government-related, urban environment**	**Explicitly integrated via theoretical behavioural framework**	**Dedicated category with sub-categories**	**Conceptually discussed (e.g., misuse, vandalism, social media)**	**First BSS-exclusive scoping review with a structured behavioural synthesis. Introduces government as a standalone category, integrates post-COVID developments, and foregrounds underexplored risks and multilevel interdependencies**

behavioural shifts associated with the COVID-19 era as well as the global expansion of electric BSS. Furthermore, it highlights underexplored themes such as user misconduct and the influence of social media-driven perceptions, which are discussed in greater depth later in the paper.

The review also identifies several persistent research gaps. The geographic concentration of studies—particularly in East Asia—limits understanding of how cultural and institutional contexts shape BSS use. Research on the behavioural implications of integrating BSS within Maas platforms remains limited, despite their growing importance for multimodal travel behaviour and user retention. Finally, the cumulative social and psychological impacts of negative behaviours, including vandalism, misuse, and digital narratives, remain insufficiently theorised.

Guided by the research question, "*What factors are associated with the actual use or intention to use BSS?*", this scoping review provides a systematic and up-to-date synthesis of behavioural determinants across user, system, environmental, and institutional domains. These findings are intended to inform scholars, policymakers, planners, and system operators seeking to design more effective, inclusive, and user-centred BSS in response to contemporary urban mobility challenges.

2. Methodology

This review followed the five-stage framework of Arksey and O'Malley (2005), as refined by Levac et al. (2010), to systematically examine factors associated with BSS use or intention to use. It also adhered to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines, which enhance methodological transparency, rigour, and consistency in study selection, data extraction, and reporting (Tricco et al., 2018). Together, these frameworks provided a robust and replicable structure to guide each stage of the review process, from the formulation of the research question through to the synthesis of evidence.

A scoping review approach was considered most appropriate given the interdisciplinary nature of the topic and the substantial heterogeneity in research designs, behavioural constructs, outcome measures, and analytical methods across the literature (Munn et al., 2018; Peters et al., 2020). Because of this variability, quantitative synthesis or meta-analysis was not feasible. Instead, the review sought to map the breadth of available evidence, identify recurring behavioural domains, and highlight research gaps to inform future investigations (Higgins and Green, 2008; Pham et al., 2014).

2.1. Inclusion/exclusion criteria

The review included peer-reviewed studies published in English between January 2014 and September 2025. Eligible studies examined the association between behavioural factors and either the actual use of, or intention to use, BSS—covering both current and potential users. Studies on actual use considered behavioural outcomes such as trip frequency, ridership levels, travel duration, distance, or intensity of BSS use. Studies on intention to use examined factors influencing the decision to start using BSS, including both general behavioural intentions and more specific motivational subtypes. For example, "green intention" referred to the intention to use BSS for environmental or sustainability-related reasons. For consistency, this review employs the umbrella term "intention to use" for both general and specific motivations, unless otherwise specified by individual studies. To reflect global diversity in BSS design, the review included conventional and electric bikes, as well as docked (station-based) and dockless (free-floating) models. Studies were eligible regardless of geographic location, provided they focused on urban contexts. To maintain analytical depth, only empirical studies employing quantitative, qualitative, or mixed-method designs were included.

Exclusions applied to theoretical or historical overviews lacking methodological analysis; studies focusing exclusively on privately owned bicycles or e-bikes; and investigations targeting highly specific subpopulations (e.g., children, the elderly, tourists, or persons

Table 2
Search strategy overview across databases.

- **"Scopus:**(TITLE-ABS-KEY("factor*" OR "determinant*" OR "bikeability" OR "influence*" OR "driver*" OR "variable*") AND TITLE-ABS-KEY("bike shar*" OR "bike-shar*" OR "bikeshar*" OR "bicycl* shar*" OR "bicycl*-shar*" OR "bicycl*shar*" OR "cycl* shar*" OR "cycl*-shar*" OR "cycl*shar*" OR "shared bike" OR "shared bicycl*" OR "shared cycl*" OR "public bike" OR "public bicycl*" OR "public cycl*" OR "two wheeler* shar*" OR "two wheeler*-shar*" OR "two wheeler*shar*" OR "two-wheeler* shar*" OR "two-wheeler*-shar*" OR "two-wheeler*shar*" OR "bicycl* rental" OR "cycl* rental" OR "bike* rental" OR "rental* bicycl*" OR "rental* cycl*" OR "rental* bike*" OR "bicycl* hire" OR "cycl* hire" OR "bike* hire") AND TITLE-ABS-KEY("behaviour*" OR "behavior*" OR "pattern*" OR "habit*")
)
- **Web of Science:**((TS=("factor*" OR "determinant*" OR "bikeability" OR "influence*" OR "driver*" OR "variable*")) AND TS=("bike shar*" OR "bike-shar*" OR "bikeshar*" OR "bicycl* shar*" OR "bicycl*-shar*" OR "bicycl*shar*" OR "cycl* shar*" OR "cycl*-shar*" OR "cycl*shar*" OR "shared bike" OR "shared bicycl*" OR "shared cycl*" OR "public bike" OR "public bicycl*" OR "public cycl*" OR "two wheeler* shar*" OR "two wheeler*-shar*" OR "two wheeler*shar*" OR "two-wheeler* shar*" OR "two-wheeler*-shar*" OR "two-wheeler*shar*" OR "bicycl* rental" OR "cycl* rental" OR "bike* rental" OR "rental* bicycl*" OR "rental* cycl*" OR "rental* bike*" OR "bicycl* hire" OR "cycl* hire" OR "bike* hire")) AND TS=
  ("behaviour*" OR "behavior*" OR "pattern*" OR "habit*")
- **ProQuest:**summary("factor*" OR "determinant*" OR "bikeability" OR "influence*" OR "driver*" OR "variable*") AND summary("bike shar*" OR "bike-shar*" OR "bikeshar*" OR "bicycl* shar*" OR "bicycl*-shar*" OR "bicycl*shar*" OR "cycl* shar*" OR "cycl*-shar*" OR "cycl*shar*" OR "shared bike" OR "shared bicycl*" OR "shared cycl*" OR "public bike" OR "public bicycl*" OR "public cycl*" OR "two wheeler* shar*" OR "two wheeler*-shar*" OR "two wheeler*shar*" OR "two-wheeler* shar*" OR "two-wheeler*-shar*" OR "two-wheeler*shar*" OR "bicycl* rental" OR "cycl* rental" OR "bike* rental" OR "rental* bicycl*" OR "rental* cycl*" OR "rental* bike*" OR "bicycl* hire" OR "cycl* hire" OR "bike* hire") AND summary
  ("behaviour*" OR "behavior*" OR "pattern*" OR "habit*")

with disabilities) without broader relevance to general BSS user behaviour. Similarly, studies limited to narrowly defined trip purposes (e.g., BSS trips used solely as first-/last-mile connections to public transport) were excluded, as the review aims to synthesise behavioural factors influencing the broader spectrum of urban BSS trips rather than determinants unique to a single trip function. Conference proceedings, technical reports, and other grey literature were also excluded. These inclusion and exclusion criteria ensured conceptual focus, methodological rigour, and alignment with the review's aim of synthesising behavioural factors influencing BSS use.

2.2. Search strategy

A comprehensive search was conducted across three major academic databases—Scopus, ProQuest, and Web of Science—to identify peer-reviewed journal articles examining behavioural factors associated with BSS use or intention to use. These databases were selected for their extensive coverage of transportation, urban studies, and behavioural research.

The search was limited to English-language peer-reviewed publications between January 2014 and September 2025, with no geographical restrictions. The search strategy was developed iteratively and centred on three core concepts: (1) bike-sharing systems, (2) influencing factors (e.g., determinants, variables), and (3) behavioural constructs (e.g., usage patterns, habits). Boolean operators and truncation (*) were used to capture variations in terminology and maximise coverage. Search terms were applied to titles, abstracts, and keywords to improve precision and reduce irrelevant results. Exact search strings for each database are provided in Table 2, with the full query syntax included in Appendix A to ensure transparency and replicability. In addition to the database search, the reference lists of included articles were manually screened to identify additional eligible studies, enhancing the completeness of the
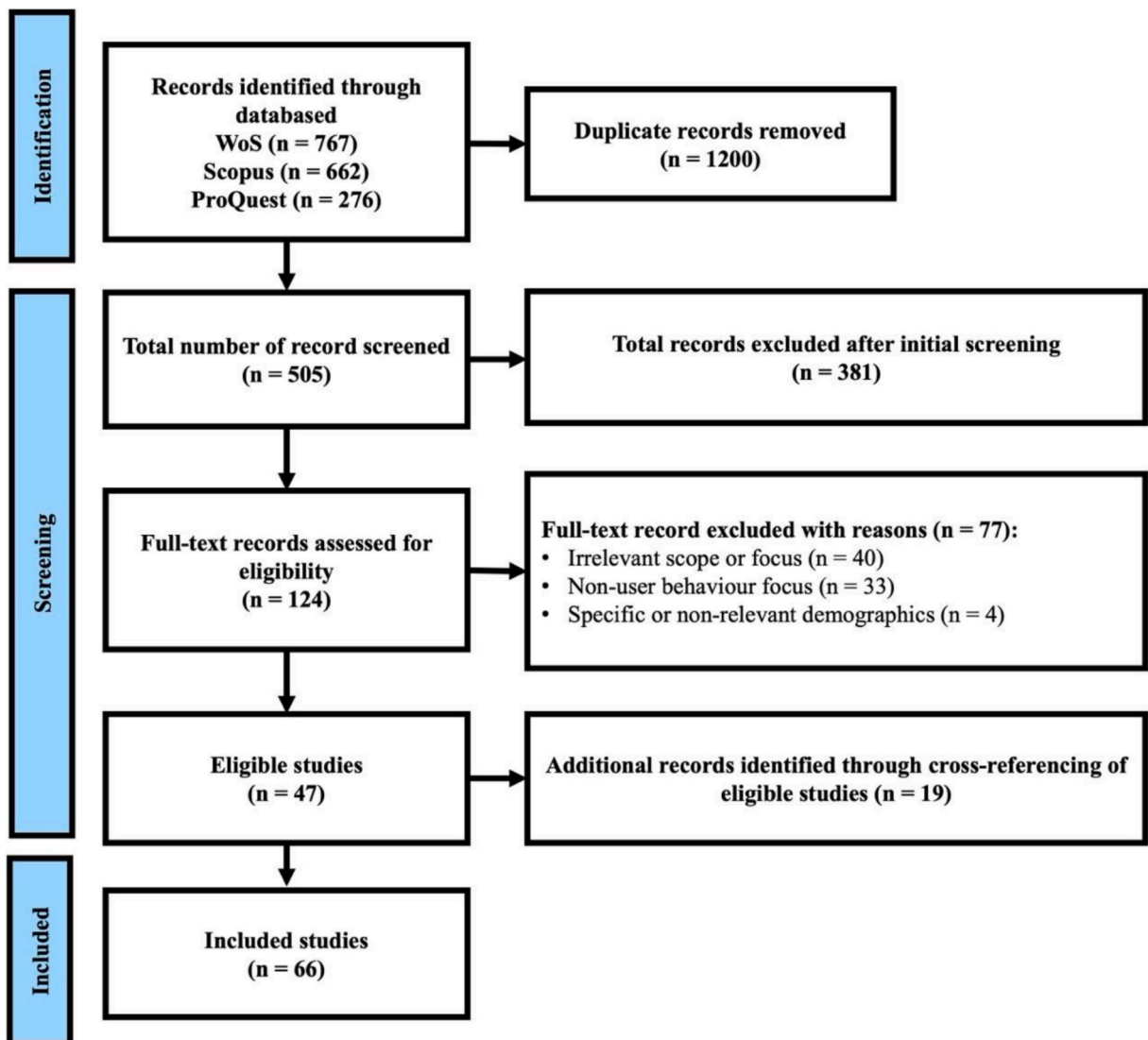

Fig. 1. PRISMA-ScR flow diagram of study selection process.

evidence base.

2.3. Selection process

All identified citations were imported into Covidence, a web-based platform for managing systematic reviews, where duplicates were automatically removed (Covidence, 2025). Title and abstract screening were undertaken independently by two reviewers, guided by a set of predefined inclusion and exclusion criteria. To ensure consistency and minimise the risk of screening bias, a calibration exercise was performed on 5 % of the retrieved records. This process led to minor refinements in operational definitions—for example, clarifying distinctions between actual use and intention to use, and establishing thresholds for excluding narrowly defined user groups (e.g., studies limited exclusively to university students or tourists without broader behavioural relevance).

Screening progressed in iterative stages, with uncertainties flagged and reviewed at the 25 %, 50 %, and 100 % of completion points. Disagreements, such as borderline cases involving intervention studies, ambiguous outcome measures, or unclear system classification, were resolved through discussion. Where consensus could not be reached, a third reviewer adjudicated. All studies meeting the eligibility criteria were retrieved in full text, with reasons for exclusion documented and reported in accordance with PRISMA-ScR guidelines.

2.4 & 2.5. Extraction, charting, and synthesis of data

A structured data extraction template was developed within Covidence to ensure consistency across studies. Extracted information included bibliographic details (author(s), year, title, journal), study characteristics (geographic context, objectives, methodology, and outcomes), behavioural focus (actual use vs. intention to use), and specific factors reported to influence BSS-related behaviour. To enhance reliability, a second reviewer independently assessed a random 20 % sample of included studies. Discrepancies were resolved collaboratively, with unresolved cases adjudicated by a third reviewer. Extracted data were systematically charted into evidence tables to enable cross-study comparison. A combination of descriptive and thematic synthesis was then applied. Behavioural factors were coded and inductively grouped into conceptual categories, supporting the identification of dominant patterns, contextual nuances, and research gaps across different system types and study settings. Findings are presented in a structured narrative, supported by summary tables, to provide a transparent and comprehensive synthesis of current knowledge on behavioural factors associated with BSS use and intention to use.

3. Results

3.1. Study selection

A total of 1,705 records were initially retrieved through systematic searches of the selected databases. The screening process, conducted in accordance with PRISMA-ScR guidelines, is illustrated in Fig. 1. After automated and manual deduplication, 505 records remained for title and abstract screening. Application of the predefined inclusion and exclusion criteria reduced this number to 124 articles for full-text review. Of these, 47 met all eligibility requirements and were included in the final synthesis. Manual screening of reference lists identified an additional 19 relevant studies, yielding a final sample of 66 peer-reviewed journal articles. A complete list of these studies, including study location, methodology, behavioural focus, and outcomes, is provided in Appendix B. To enhance transparency and reproducibility, the raw data extraction spreadsheet has also been made available as Supplementary Material, supporting potential secondary analyses or future meta-analyses.

3.2. Characteristics of the included articles

Table 3 summarises the 66 included studies, outlining author(s), year of publication, study location, research objectives, methodologies, and key outcomes. Geographically, the evidence base is heavily skewed toward East Asia (n = 34), with Mainland China accounting for the majority (n = 27), followed by South Korea (n = 5) and Taiwan Province of China (n = 2). North America contributed 16 studies, primarily from the United States (n = 13), alongside one from Mexico. In Europe, nine studies were identified, including three from Poland and six from other countries. Oceania was represented by a single study from Australia. In terms of research design, most studies adopted single case study approaches, with only five employing comparative multi-city or cross-national designs (Dill et al., 2022; Villarrasa-Sapiña et al., 2024; Waldner et al., 2025; Weschke, 2024; Ye, 2022).

Methodologically, all studies employed quantitative approaches. The most frequently applied were regression-based methods (n = 26), encompassing techniques such as negative binomial regression (n = 4), gradient boosted regression trees (n = 5), and generalised additive models (n = 2), alongside variants including log-linear, multivariable linear, and panel regressions. Structural equation modelling (SEM) was employed in 14 studies, two of which used Partial Least Squares SEM (Huang et al., 2020; Zhu, 2021), reflecting an emerging interest in latent behavioural constructs. Discrete choice models appeared in 12 studies, including binary logistic regression (n = 7), multinomial logit modelling (n = 4), and bivariate ordered probit modelling (n = 1), underscoring the centrality of probabilistic modelling in BSS behavioural research.

A subset of studies incorporated spatial analytical techniques to address geographic heterogeneity in behavioural outcomes. These included geographically weighted regression (n = 2), multi-scale geographically weighted regression (n = 1), and spatial panel regression (n = 3), as demonstrated by Bao et al. (2018) and Wu et al. (2021). Less frequently used methods included Bayesian network

Table 3
Overview of the included articles in the scoping review.

Author(s)	Year	Location	Objective	Methodology	Outcome
Chen and Lu.	2016	Taiwan Province of China	Identifies factors influencing green intention to use BSS	Structural Equation Modelling	Green intention
Wang et al.	2017	Mainland China	Examines factors influencing public bicycle choice	Bayesian Network Modelling	Actual use
Chen et al.	2017	Mainland China	Examines factors influencing public bicycle use frequency	Binary Logistics Regression	Actual use
Gámez-Pérez et al.	2017	Mexico	Examines factors influencing users' intentions to use the system	Binary Logistics Regression	Intention to use
Raux et al.	2017	France	Identifies factors influencing membership in BSS	Binary Logistics Regression	Actual use
Li et al.	2018	Mainland China	Explores factors influencing free-floating bike-sharing behaviours	Binary Logistics Regression	Actual use
Bao et al.	2018	U.S.	Analyses bikeshare ridership across station categories	Geographically Weighted Regression	Actual use
Nikitas	2018	Greece	Examines road users' attitudes toward BSS	Ordinal regression	Intention to use
Abolhassani et al.	2019	Iran	Examines factors influencing public preferences for BSS	Multinomial Logit Modelling	Intention to use
Gao et al.	2019	Mainland China	Investigates users' adoption of BSS	Structural Equation Modelling	Intention to use
Wang and Akar	2019	U.S.	Identifies factors influencing gender differences in BSS use	Negative Binomial Regression	Actual use
Bielinski et al.	2019	Poland	Identifies factors influencing BSS performance	Regression Modelling	Actual use
Chen	2019	Taiwan Province of China	Examines factors influencing green intentions to use BSS	Structural Equation Modelling	Green intention
Yang et al.	2020	U.S.	Explores factors influencing BSS ridership	Multiple Linear Regression	Actual use
Chen et al.	2020	Mainland China	Examines factors influencing shared bicycle use	Regression Modelling	Actual use
Link et al.	2020	Austria	Examines factors influencing free-floating bike-sharing	Binary Logistics Regression	Actual use
Huang et al.	2020	Mainland China	Examines factors influencing green intentions to use DBSS	Partial Least Squares SEM	Green intention
Zhao et al.	2020	Mainland China	Examines the impact of land use on bicycle usage	Spatial Panel Regression	Actual use
Kim	2020	South Korea	Examines the impact of air pollution on BSS use	Negative Binomial Regression	Actual use
Macioszek et al.	2020	Poland	Analyses factors influencing BSS usage and satisfaction	Bivariate Ordered Probit Modelling	Actual use
Hu et al.	2021	U.S.	Analyses BSS usage changes during COVID-19	Generalised Additive Mixed Model	Actual use
Zhang et al.	2021	Mainland China	Examines factors influencing willingness to use BSS	Structural Equation Modelling	Intention to use
Zhu	2021	Mainland China	Examines how personal values influence DBSS adoption	Partial Least Squares SEM	Intention to use
Chen and Ye	2021	Mainland China	Examines nonlinear effect of built environment on BSS use	Gradient Boosted Regression Trees	Actual use
Kumar	2021	U.S.	Analyses weather barriers influencing public bike system usage	Necessary Condition Analysis	Actual use
Podgórniak-Krzykacz and Trippner-Hrabi	2021	Poland	Examines factors influencing public bicycle use	Descriptive Analysis	Intention to use
Ji et al.	2021	Mainland China	Analyses factors influencing intention to use DBSS	Structural Equation Modelling	Intention to use
Maas et al.	2021	Cyprus	Examines factors influencing BSS usage	Spatial Regression Modelling	Actual use
Sinha	2021	U.S.	Analyses how weather affects public bike-share ridership	Regression Modelling	Actual use
Wu et al.	2021	Mainland China	Examines how built environment factors influence BSS use	Geographically Weighted Regression	Actual use
Jiao et al.	2022	South Korea	Examines the impact of COVID-19 on BSS ridership	Negative Binomial Fixed Panel Regression	Actual use
An and Jang	2022	South Korea	Examines the impact of fine dust on BSS usage	Negative Binomial Regression	Actual use
Ye	2022	Estonia, Mainland China	Examines factors influencing BSS adoption	Structural Equation Modelling	Intention to use
Dill et al.	2022	U.S.	Examine disparities in BSS use across income and racial groups	Multinomial Logit Modelling	Intention to use

Table 3 (*continued*)

Author(s)	Year	Location	Objective	Methodology	Outcome
Li et al.	2022a	Mainland China	Identifies factors influencing e-BSS usage intentions	Structural Equation Modelling	Intention to use
Soltani et al.	2022	Australia	Identifies factors differentiating BSS users and non-users	Structural Equation Modelling	Actual use
Li et al.	2022b	Mainland China	Examines factors influencing intention to use shared e-bikes	Multinomial Logit Modelling	Intention to use
Zheng et al.	2022	Mainland China	Investigates determinants of dockless BBS usage	Spatial Panel Regression	Actual use
Gao et al.	2023	Mainland China	Examines the impact of urban greenness on BSS usage	Poisson Regression Modelling	Actual use
Vo et al.	2023	U.S.	Examines the impact of COVID-19 on BSS ridership	Log-linear Regression	Actual use
Zhu et al.	2023	Mainland China	Analyses factors affecting willingness and frequency of BSS	Binary and Multinomial Logistic Regression	Intention to use
Ethier et al.	2024	U.S.	Analyses the association between built environment and BSS use	Multilevel Logistic Regression	Actual use
Gao et al.	2024	Mainland China	Explores users' sustainable usage intention and behaviour in BSS	Structural Equation Modelling	Green intention & Actual use
Guo et al.	2024	Mainland China	Examines how streetscape perceptions influence BSS use	Negative Binomial Regression	Actual use
Jena and Kadali	2024	India	Explores how environmental concern affect public BSS intention to use	Structural Equation Modelling	Intention to use
Su et al.	2024	Mainland China	Examines factors influencing Chinese BSS consumers' intentions	Structural Equation Modelling	Intention to use
Kathait and Agarwal	2024	India	Examines factors influencing the intention to use public BSS	Structural Equation Modelling	Intention to use
Zhang et al.	2024	Mainland China	Evaluates the association between street greening quality and BSS usage	Ordinary Least Squares Regression, Geographically Weighted Regression	Actual use
Machavarapu et al.	2024	India	Analyses factors influencing BSS usage trends	Multinomial Logit Modelling	Actual use
Odoom et al.	2024	U.S.	Explores calendar and weather conditions impact on bike rentals by user type	Generalised Additive Model	Actual use
Wang et al.	2024	Mainland China	Examines the intention and intensive use of DBSS for commuting & errands	Structural Equation Modelling	Intention to use & Actual use
Zhou et al.	2024	Mainland China	Reveals the local effect of the built environment on DBS use	Multiscale Geographically Weighted Regression	Actual use
Shi et al.	2024	Mainland China	Examines how the built environment affects dockless BSS use and idleness	Ordinary Least Squares Regression, Geographically Weighted Regression	Actual use
Villarrasa-Sapiña et al.	2024	Europe & North America	Examines weather impacts on BSS usage using nonlinear methods	Nonlinear Machine Learning Modelling	Actual use
Weschke.	2024	North America	Estimates the impact of a temporary free-rides promotion on bike-share use	Regression Modelling	Actual use
Li et al.	2025a	Mainland China	Identifies city-level factors affecting shared e-bike use	Multivariable Linear Regression Analysis	Actual use
Yoo et al.	2025	South Korea	Examines changes in bike infrastructure and air quality on BBS use	Panel Regression Modelling	Actual use
Cai et al.	2025	Estonia	Examines BSS usage differences by demographics and station environments	Gradient Boosted Regression Trees	Actual use
Li et al.	2025b	Mainland China	Examines how urban thermal conditions affects BSS usage	Gradient Boosted Regression Trees	Actual use
Yang et al.	2025	U.S.	Analyses spatial and nonlinear effects on BSS use by day type	Geographically Weighted Gradient Boosting Decision Trees	Actual use
Yao et al.	2025	U.S.	Examines spatial impacts of weather, epidemic, and urban factors on BSS	Gradient Boosted Regression Trees	Actual use
Guzel et al.	2025	Türkiye	Investigates weather conditions impact on small-scale docked BSS use	Regression Modelling	Actual use
Chen et al.	2025	Mainland China	Investigates street view effect on BSS use during extreme heat	Gradient Boosted Regression Trees	Actual use
Kim et al.	2025	South Korea	Examines bikeshare trips and factors influencing their occurrence and duration	Binary and Multinomial Logistic Regression	Actual use
Mohiuddin et al.	2025	U.S.	Examines factors influencing adoption and frequency of e-bike use	Binary Logistics Regression, Ordinal Regression, SEM	Actual use

modelling, necessary condition analysis, and descriptive statistics, each applied in a single study (Kumar, 2021; Podgórniak-Krzykacz and Trippner-Hrabi, 2021; Wang et al., 2017). An emerging subset of studies also experimented with machine learning approaches, such as those by Chen and Ye (2021) and Villarrasa-Sapiña et al. (2024).

3.3. Overview of factors associated with BSS user behaviour

- Behavioural Theory Foundations

To structure the synthesis of factors influencing BSS user behaviour, this review draws on three foundational behavioural theories widely applied in mobility and technology adoption research: the Technology Acceptance Model (TAM) (Davis, 1989), the Theory of Planned Behaviour (TPB) (Ajzen, 1991), and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). These frameworks share the assumption that behavioural intention mediates the relationship between individual beliefs and actual use. As shown in Fig. 2, TAM highlights perceived usefulness and perceived ease of use as central determinants of acceptance. TPB expands this model by incorporating subjective norms and perceived behavioural control. UTAUT further integrates and extends these constructs through performance expectancy, effort expectancy, social influence, and facilitating conditions, with moderating effects from variables such as age, gender, and user experience.

These models proved instrumental in conceptualising individual-level psychological processes that influence BSS use, particularly attitudes, beliefs, norms, and intentions. However, they demonstrated limited capacity to accommodate the wider determinants identified across the 66 studies. Key influential variables such as household characteristics, trip purposes, system pricing and reliability, governance mechanism, and built or natural environment features extend beyond the explanatory scope of these behavioural models.

To address these broader determinants, the review also drew on planning-oriented and environmental frameworks that provide structural and contextual insights. These include Geurs and van Wee's (2004) accessibility model, Ewing and Cervero's (2010) "7Ds" built environment framework, Giles-Corti et al.'s (2016) healthy cities model, and Robeyns' (2005) capability deprivation approach. These frameworks offer valuable perspectives for understanding how infrastructure, spatial form, and institutional support influence mobility behaviour. However, they often lack the behavioural specificity needed to explain intention-driven decisions or the psychological mechanisms underpinning BSS use. Taken together, the behavioural and contextual frameworks informed the inductive development of the multilevel conceptual framework presented in this review, which categorises the wide-ranging factors identified across the literature.

- A Multilevel Framework of Influencing Factors

To address the limitations of existing behavioural and planning models, this review develops a multilevel conceptual framework that synthesises the diverse range of factors influencing BSS user behaviour. As illustrated in Fig. 3, the framework is organised around four overarching categories: (1) user-related factors, (2) BSS provider-related factors, (3) government-related factors, and (4) urban environment-related factors.

Each category is further divided into subcategories, grouped according to conceptual similarity and patterns of empirical clustering. For example, user-related factors include sociodemographic variables, household characteristics, trip attributes, and psychological factors. BSS provider-related factors capture operator-specific characteristics, such as pricing structures, service quality, and system design. Government-related factors reflect institutional inputs including policy interventions, infrastructure investment, spatial accessibility, and regulatory frameworks. Urban environment-related factors cover built and natural environment features such as land
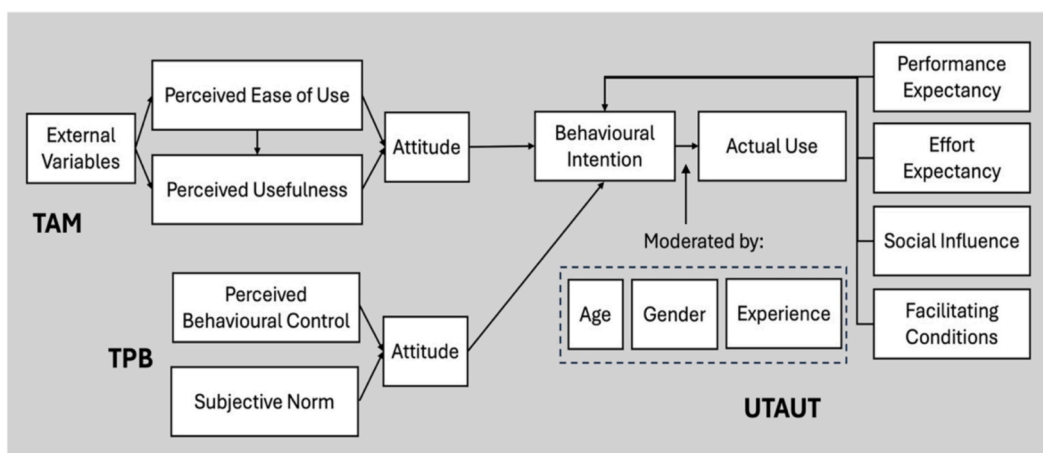

Fig. 2. Key Constructs and pathways across TAM, TPB, and UTAUT behavioural models.
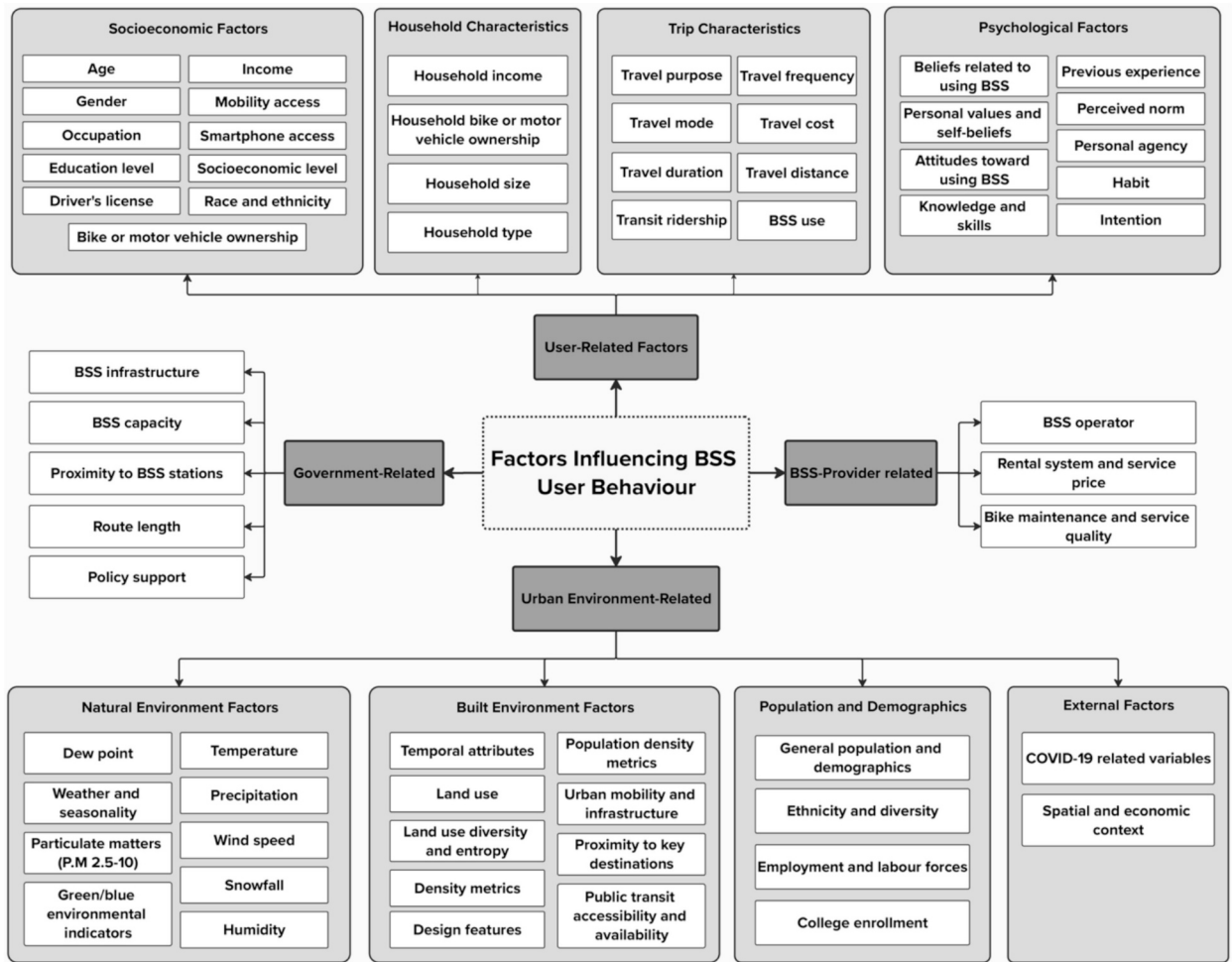
Fig. 3. Categorical overview of factors influencing BSS user behaviour.

use mix, street connectivity, environmental conditions, population density, and pandemic-related disruptions (e.g., COVID-19). To enhance analytical clarity, closely related variables—particularly within the psychological and urban environment sub-categories—were aggregated into higher-order constructs, defined by shared conceptual foundations and observed empirical associations.

Rather than substituting existing behavioural theories, this multilevel framework builds upon and extends them by embedding individual-level intention constructs within a broader spatial, institutional, and systemic context. Consequently, offering a more ho-listic understanding of BSS behaviour that bridges internal motivations with external enablers and constraints. This integrative perspective reflects the real-world complexity of shared micromobility behaviour and provides a conceptual foundation for future interdisciplinary research and policy innovation.

3.3.1. User-related factors

This category emerged as the most extensively examined in the reviewed literature, underscoring the central role of individual-level characteristics associated with either the actual or intended use of BSS. Across the 66 studies, four key subcategories were identified: sociodemographic, household, trip, and psychological factors. A structured overview of these subcategories and their associated variables is provided in Table 4.

Sociodemographic characteristics were examined in 25 of the 66 included studies. The most frequently examined variables were age, gender, occupation and employment status, bike or motor vehicle ownership, education, and income. These variables were often used to explain variaitions in ridership patterns, with several studies identifying significant associations between specifc demographic groups and either BSS use or intention to use. A full inventory of all identified sociodemographic variables, along with their frequency, direction of association, and statistical significance, is provided in the online appendix (A1H1–A106H106).

- **Age and gender** were the two most frequently examined sociodemographic variables, each analysed in 20 of the included studies. Regarding age, 11 studies identified a significant negative association between age and BSS use or intention to use, suggesting that

younger individuals were more likely to use or intend to use BSS (e.g., Kathait and Agarwal, 2024; Soltani et al., 2022). The remaining nine studies found no statistically significant association between age and BSS-related behaviour. For gender, seven studies identified a significant positive association, suggesting that men were more likely than women to use or intend to use BSS (e. g., Dill et al., 2022; Maciosezk et al.,2020; Nikitas, 2018). However, Abolhassani et al. (2019) reported the opposite trend, with women showing higher rates of BSS use. The remaining studies found no gender-based associations.

- **Occupation and employment status** were examined in 11 studies, with eight reporting significant associations with BSS use or intention to use. Three studies found a positive association between employment and BSS use or intention (Abolhassani et al., 2019; Gámez-Pérez et al., 2017; Wang et al., 2017). However, associations varied by employment type. For example, full-time employment was found to be negatively associated with BSS use (Soltani et al., 2022), whereas casual employment, retail work, and being a housewife were positively associated with BSS intention (Zhu et al., 2023). Student status also showed a nuanced pattern: Raux et al. (2017) found that although students initially reported low intention, actual use increased once a membership was obtained, and higher social status was likewise positively associated with BSS use. Consistent with this, Mohiuddin et al. (2025) reported that being a student was positively associated with BSS use, while employment showed a positive association for some groups. The remaining studies found no statistically significant associations.
- **Bike or motor vehicle ownership** was assessed in 11 studies, with eight reporting significant but sometimes contrasting associations with BSS use or intention to use. For bicycles, the evidence pointed in two directions. On one hand, two studies found that not owning a bike was positively associated with the intention to use BSS (Gámez-Pérez et al., 2017; Zhu et al., 2023). On the other hand, Chen et al. (2017) and Mohiuddin et al. (2025) reported that bike ownership itself was positively associated with BSS use. Regarding motor vehicles, three studies identified a negative association between vehicle ownership and BSS use or intention (Wang et al., 2017; Jena and Kadali, 2024; Link et al., 2020). In contrast, Bielinski et al. (2019), found a positive association in highly congested areas. The other studies reported no significant associations.
- **Education and income** were examined in 18 studies, with six reporting statistically significant associations with BSS use or intention to use. Five studies found that higher levels of education or income were positively associated with BSS use or intention (Gao et al., 2023; Hu et al., 2021; Kathait and Agarwal, 2024; Mohiuddin et al., 2025). In contrast, Zhu et al. (2023) reported that intention to use BSS was positively associated with low-to-medium income groups. Most studies, however, found no statistically significant associations.

Household characteristics were analysed in 10 of the 66 included studies, several of which reported significant associations with BSS use or intention to use. The key variables examined included household income, bike or car ownership, and household size. A comprehensive list of all household-related variables, including their frequency, direction of association, and statistical significance, is provided in online appendix (A107H107-A122H122).

- **Household income** was examined in six studies, with four reporting significant associations with BSS use. Three studies found that higher household income was positively associated with BSS use (Bao et al., 2018; Nikitas, 2018; Yang et al., 2025). However, Hu et al. (2021) identified a more nuanced pattern: household income was negatively associated with BSS use during the COVID-19 pandemic, but positively associated under normal conditions. The remaining two studies found no statistically significant association.
- **Household bike or motor vehicle ownership** was examined in three studies, with two reporting significant associations. Macioszek et al. (2020) reported that ownership of bicycles or e-bikes within a household was positively associated with BSS use, whereas Chen et al. (2017) found that household car ownership was negatively associated with BSS use.

Trip Characteristics were explored in 15 of the 66 included articles, with 12 reporting statistically significant associations with BSS use or intention to use. The most frequently examined variables were travel purpose, travel mode, and trip duration. A detailed list of all identified trip-related variables, including their frequency, direction of association, and statistical significance, is available in the online appendix (A123H123-A168H168).

- **Travel purpose** was examined in seven studies, three of which reported significant associations with BSS use or intention to use. Podgórniak-Krzykacz and Trippner-Hrabi (2021) found that intention to use BSS was positively associated with utilitarian purposes such as commuting and social outings but negatively associated with shopping and late-night travel. Wang et al. (2017) similarly reported positive associations with rigid travel needs such as peak-hour commuting, and negative associations with more flexible purposes like shopping or visiting. In contrast, Chen et al. (2017) observed that BSS use among regular users was positively associated with business and shopping trips.
- **Travel mode** was explored in seven studies, with three reporting significant associations with BSS use or intention to use. Macioszek et al. (2020) found that integrating cycling with public transport was positively associated with BSS use. Gámez-Pérez et al. (2017) likewise observed that regular bus commuters were more likely to intend to use BSS. Podgórniak-Krzykacz and Trippner-Hrabi (2021) further noted that limited availability of alternative transport options was positively associated with BSS intention.
- **Travel duration** was examined in seven studies, with two reporting significant non-linear associations. Macioszek et al. (2020) found that BSS use was positively associated with trips up to 35 min but negatively associated with longer durations. Gámez-Pérez et al. (2017) observed a similar pattern: positive associations for trips under 35 min, negative associations for trips between 35 and 55 min, and a rebound in use for trips exceeding 55 min.

Psychological factors were examined in 27 of the 66 the studies, with most reporting significant associations with BSS use or intention to use. These factors were grouped conceptually according to theoretical relevance and empirical patterns (online appendix A169H169-A341H341). The most frequently studied factors and their respective concepts included:

- **Beliefs related to BSS use** were measured in 23 studies, with 21 reporting significant associations with either actual use or intention to use. Key conceptual groupings included:
  - **Usefulness and values**, which capture how travellers perceive the practical, environmental, and intrinsic benefits of BSS, were examined in 16 studies, with 14 reporting significant associations with BSS use or intention to use. Positive associations were observed for perceived usefulness (e.g, Gao et al., 2019; Ji et al., 2021; Kathait and Agarwal, 2024), favourable perceptions of BSS use (e.g., Guo et al., 2024; Link et al., 2020), and trust in mobile app security (Su et al., 2024). Pro-environmental values such as ecological concern and green consciousness were also positively associated with BSS intention (Chen, 2019; Huang et al., 2020). In contrast, two studies reported no significant associations with perceived functional value, perceived security value, or general ecological benefits.
  - **Perceived barriers and challenges** were examined in eight studies, with six identifying significant associations with BSS use or intention to use. Negative associations were identified for issues such as technical malfunctions and ineffective management policies (Li et al., 2018), high costs and limited knowledge about BSS (Dill et al., 2022), and various safety or security risks including financial, physical, psychological, time-related, and privacy concerns (Gao et al., 2019; Soltani et al., 2022). Conversely, individuals who did not perceive infrastructure as a barrier and who believed BSS to be effective in reducing traffic congestion showed positive associations with BSS intention (Gámez-Pérez et al., 2017; Nikitas, 2018).
  - **Perceived ease of use**, referring to how user-friendly individuals perceive BSS to be, was examined in 10 studies, with eight reporting significant associations with BSS use or intention. Five studies identified positive associations with intention, either through direct or indirect mediations (e.g., Ji et al., 2021; Kathait and Agarwal, 2024; Su et al., 2024). Two studies found no significant associations (Chen and Lu, 2016; Gao et al., 2019). Factors like parking convenience (Li et al., 2018) and app usability (Link et al., 2020) were also positively associated with BSS use or intention.
  - **Perceived flexibility and convenience**, reflecting the extent to which BSS is seen as accommodating users' diverse mobility needs, were examined in five studies, with four finding significant associations with BSS use or intention. Factors such as convenient travel and parking options were positively associated with BSS use (Li et al., 2018), while perceived fast mobility mediated the positive association between infrastructure availability and intention to use BSS (Ye, 2022). Route adaptability to individual travel needs also showed positive associations with BSS use (Macioszek et al., 2020). However, one study found negative associations with BSS use when it was perceived as less convenient than private cars or public transit (Soltani et al., 2022).
- **Personal values and self-beliefs** were explored in 15 studies, with eight finding significant associations with BSS use or intention to use. This subcategory captures how internalised motivations, such as value orientations, personal priorities, and evaluative beliefs, influence their behavioural responses to BSS. It reflects the extent to which individuals perceive BSS as aligned with their values, goals, or preferred ways of living. The most commonly studied concepts within this subcategory included:
  - **Health and well-being**, reflecting personal beliefs about the physical benefits of BSS, such as fitness and exercise, were examined in six studies. Five studies found significant positive associations between self-beliefs regarding motivational aspects of BSS use, such as exercise, health functions (Kathait and Agarwal, 2024; Link et al., 2020; Soltani et al., 2022; Ye, 2022), and fun or social interactions (Dill et al., 2022), and BSS use.
  - **Environmental values and sustainability** were examined in eight studies. Two studies found positive associations between personal beliefs about the environmental benefits of BSS and the intention to use it (Chen, 2019; Kathait and Agarwal, 2024). Although not directly measured as environmental attitudes, Mohiuddin et al. (2025) found that bike social environment attitudes were positively associated with BSS use. No significant associations were found between BSS intention and factors such as individual environmental responsibility (Gámez-Pérez et al., 2017), environmental morality (Ye, 2022), and perceptions of cycling's role in sustainability (Huang et al., 2020; Nikitas, 2018).
- **Perceived norms** were found to be significantly and positively associated with BSS use or intention to use in eight of the nine studies. Subjective norms, reflecting perceived social pressure to engage in BSS use, were positively associated with intention to use BSS in several studies (Ji et al., 2021; Li et al., 2022a; Li et al., 2022b). Social influence from close contacts, such as observing friends or family members using BSS, was also positively associated with BSS intention (Dill et al., 2022). Broader normative constructs, including environmental, social, moral, and personal norms, similarly demonstrated positive associations with BSS use or intention (Chen, 2019; Guo et al., 2024; Wang et al., 2024).
- **Attitudes toward using BSS** were positively and significantly associated with the intention to use BSS across all eight studies examined (e.g., Chen and Lu, 2016; Jena and Kadali, 2024; Wang et al., 2024). Positive associations were reported with environmental attitudes, supported by personal values such as self-transcendence and openness to change (Zhu, 2021). Attitudes related to convenience, comfort, and service quality were also positively associated with BSS intention (Li et al., 2022a; Li et al., 2022b).
- **Perceived agency,** defined as the belief in one's ability to act with autonomy and control in a given text, was positively and significantly associated with the intention to use BSS across all six studies examined. This aligns with the concept of perceived behavioural control in the TPB, encompassing physical abilities (e.g., cycling ability), psychological readiness (e.g., confidence or self-efficacy), and operational competencies (e.g., the ability to lock, unlock, or return a bike) showing positive associations with BSS intention (Ji et al., 2021; Li et al., 2022a; Li et al., 2022b; Wang et al., 2024). Moreover, facilitating conditions, such as easy

access to assistance, real-time system information, or user-friendly system interfaces, were also positively associated with BSS intention (Gao et al., 2019).

- **Knowledge and skills related to using BSS** were examined in five studies, with three showing significant positive associations with actual use or intention to use. Familiarity with system logistics, such as rental procedures and the spatial distribution of docking stations, was positively associated with BSS use (Chen et al., 2017). Understanding BSS principles, including rules for renting, maintaining, and bike return procedures, and fee structures, was also positively associated with BSS use (Macioszek et al., 2020). Additionally, accurate knowledge about BSS was positively associated with intention to use (Dill et al., 2022).

3.3.2. BSS provider-related factors

This category—identified as the least frequently examined in the reviewed literature—captures operational and service-related aspects that are directly managed by BSS providers. As summarised in Table 5, it includes three subcategories: BSS operator, bike maintenance and service quality, and rental system and service price, along with their associated factors. Full details of the variables examined in this category are provided in the online appendix (A342H342–A357H357).

- **BSS operator** was examined in four studies, three of which reported significant associations with BSS use or intention. Bielinski et al. (2019) found that systems run by companies employing advanced technology and efficient management practices were positively associated with higher levels of BSS use. Abolhassani et al. (2019) similarly observed a positive association between bicycle safety training programs and intention to use BSS. Waldner et al. (2025) also highlighted that a greater share of e-bikes in a fleet was positively associated with BSS use.
- **Bike maintenance and service quality** were examined in seven studies, with four reporting significant association with BSS intention. Both Abolhassani et al. (2019) and Su et al. (2024) reported that higher service quality was positively associated with intention to use BSS. In contrast, other studies found no significant association between service quality, maintenance standards, or system age (e.g., years since launch) and BSS use or intention to use. In addition, Waldner et al. (2025) reported a negative association between night-time availability and BSS use, as systems without night operations showed higher average trip demand.
- **Rental system and service price** were examined in three studies, with one finding a significant association. Abolhassani et al. (2019) identified lower rental fares as positively associated with BSS intention, while the other study reported no statistically significant associations. Similarly, Weschke (2024) found that a temporary 30-day fare-free promotion was positively associated with BSS use, leading to a 55 % increase in trips during the promotion and a sustained 20 % increase after the promotion ended.

3.3.3. Government-related factors

This category encompasses structural and regulatory conditions shaped or supported by government policy, planning decisions, and public-sector interventions. As outlined in Table 5, the most frequently studied variables include BSS infrastructure, station capacity, proximity to stations, and route length. A full inventory of government-related factors, including their frequency, direction of association, and statistical significance, is provided in the online appendix (A358H358–A407H407).

- **BSS infrastructure** was positively and significantly associated with BSS use and intention to use in all 11 studies examined. Key infrastructure-related variables included the presence of accessible bike stations (Maas et al., 2021; Wang and Akar, 2019), higher densities of bicycles and cycling routes (Chen et al., 2020; Ethier et al., 2024; Hu et al., 2021; Yoo et al., 2025), and the availability of dedicated bike lanes (Abolhassani et al., 2019; Dill et al., 2022). Broader variables, such as the overall availability and spatial integration of bike infrastructure, were also positively associated with BSS use and intention (Podgórniak-Krzykacz and Trippner-Hrabi, 2021; Ye, 2022). Waldner et al. (2025) similarly showed that existing bicycle infrastructure was positively associated with BSS use. More nuanced findings emerged in relation to lane types: the presence of bike-only lanes was positively associated with undirected (leisure) trips, while protected bike lanes were negatively associated with both directed and undirected (destination-oriented) travel (Kim et al., 2025).
- **BSS station capacity,** typically measured by the number of racks and docks, was positively associated with BSS use in all eight studies reviewed. Before the pandemic, larger station capacity was positively associated with BSS use (Bao et al., 2018; Bielinski et al., 2019; Yang et al., 2020, 2025). During the pandemic, however, this pattern reversed in some cases: Hu et al. (2021) reported a negative association, and Jiao et al. (2022) similarly observed that higher dock density per square kilometre was negatively associated with BSS use. Despite these exceptions, broader indicators of system scale—such as larger operating area size and higher bike densities—showed positive associations with BSS use (Waldner et al., 2025).
- **Proximity to BSS stations** was examined in six studies, with five reporting significant associations with BSS use or intention to use. Podgórniak-Krzykacz and Trippner-Hrabi (2021) found that stations within 500 m of key destinations (e.g., homes, workplaces, schools) were positively associated with intention. Zhu et al. (2023) similarly observed positive associations for stations within a 5–10-minute walking distance. However, during the pandemic, Hu et al. (2021) found that more distant stations experienced smaller declines in BSS. In contrast, Link et al. (2020) reported that greater distances from home to docking stations were positively associated with the intention to use free-floating BSS (FFBS).
- **Route length** was positively and significantly associated with BSS use in all six studies reviewed. Longer bike lanes within station service areas (Bao et al., 2018; Cai et al., 2025; Yang et al., 2025), extended off-street cycling infrastructure within 500-meter buffers (Wang and Akar, 2019), and greater cycling path availability within a 300-metre radius (Maas et al., 2021) were all positively associated with higher levels of BSS use. Zhao et al. (2020) further demonstrated that weekday lane availability was positively associated with BSS use.

3.3.4. Urban environment factors

This category—second only to user-related factors in research attention—captures the physical and environmental characteristics of the built environment associated with BSS use. As summarised in Table 5, it comprises four main subcategories: natural environment factors, built environment factors, population and demographics, and related variables. A full inventory of variables, including their frequency, direction of association, and statistical significance, is provided in the online appendix (A408H408–A776H776).

- **Natural environment factors** were examined in 26 studies, 25 of which reported significant associations with BSS use. The most frequently studied groups in this subcategory included temperature, precipitation, snowfall, and green/blue environmental indicators.
  - **Temperature** was significantly associated with BSS use in most studies, although the direction varied depending on thresholds. Positive associations were reported in 17 studies (Bao et al., 2018; Jiao et al., 2022; Kim, 2020; Villarrasa-Sapiña et al., 2024; Zheng et al., 2022; Yao et al., 2025), with Bielinski et al. (2019) observing higher use between 20 °C and 30 °C. Several studies identified threshold effects (e.g., Kumar, 2021; Maas et al., 2021; Li et al., 2025). For instance, Wang and Akar (2019) found a positive association up to 60 °F, beyond which BSS use declined among women, while An and Jang (2022) observed a negative association at temperatures exceeding 22 °C. Guzel et al. (2025) further showed that both cold and hot conditions reduced weekday trips, with stronger effects for cold weather, whereas weekend patterns were less sensitive to heat.
  - **Precipitation and snowfall** were negatively and significantly associated with BSS use in 13 of 14 studies (e.g., An and Jang, 2022; Kim, 2020; Maas et al., 2021). Rainy conditions and snowfall were negatively associated with BSS use (e.g., Bao et al., 2018; Bielinski et al., 2019; Jiao et al., 2022; Vo et al., 2023; Villarrasa-Sapiña et al., 2024; Yao et al., 2025). Wang and Akar (2019) also reported a gender disparity, with women less likely than men to ride in the rain. Similarly, the results of Guzel et al. (2025) showed that rainy conditions were negatively associated with weekday trips, with stronger reductions as rain intensity increased. On weekends, heavy rain was negatively associated with BSS use, while light and moderate rain showed weaker or non-significant associations depending on trip purpose.
  - **Green/blue environmental indicators** were explored in 15 studies, with 12 reporting significant associations. Green spaces—such as parks, green infrastructure, and the green view index—were positively associated with increased BSS use (e.g., Chen et al., 2020; Guo et al., 2024; Jiao et al., 2022; Maas et al., 2021; Yang et al., 2025). Results for public green spaces were mixed: Zhao et al. (2020) found positive associations, while Wang and Akar (2019) observed gender-specific differences, with positive associations for women but negative association for men. By contrast, higher levels of the normalised difference vegetation index were negatively associated with BSS use (Gao et al., 2023; Li et al., 2025). Blue space coverage was positively associated with BSS use (Zhao et al., 2020). Complementary evidence indicated that parks nearby were positively associated with undirected travel, while rivers were positively associated with both directed and undirected trips (Kim et al., 2025).
- **Built environment factors** were examined in 32 studies, with 28 reporting significant associations with BSS use. The most frequently studied groups included public transit accessibility, land use, density metrics, and population density.
  - **Public transit accessibility and availability** showed significant associations with BSS use in 14 of 18 studies. Greater bus stop density, numbers of routes, and ridership were positively associated with BSS use (Chen and Ye, 2021; Jiao et al., 2022; Wang et al., 2024; Zheng et al., 2022; Shi et al., 2024). Gender differences were also observed. BSS use was positively associated with public transit accessibility for men but negatively associated for women (Wang and Akar, 2019). Metro station availability and accessibility were positively associated with BSS use (Chen and Ye, 2021; Zhou et al., 2024; Yang et al., 2025), whereas metro station density was negatively associated (Chen and Ye, 2021). The overall number of public transit stations was positively associated with BSS use (Zhao et al., 2020). Shorter distances to transit hubs were likewise positively associated with BSS use (Gao et al., 2023; Shi et al., 2024; Li et al., 2025). Evidence from a metro line closure further showed that BSS use was positively associated with transit disruption, as daily trips increased in affected areas (Weschke, 2024). In another study, proximity to bus and subway stations was negatively associated with undirected travel, whereas proximity to subway stations was positively associated with directed travel (Kim et al., 2025).
  - **Land use** was examined in 12 studies, with findings showing varied significant associations across land use types. Commercial, residential, and industrial land uses were sometimes positively associated with BSS use (An and Jang, 2022; Chen and Ye, 2021; Maas et al., 2021; Zheng et al., 2022; Shi et al., 2024; Cai et al., 2025), though negative associations were also found for commercial areas (e.g., Zhao et al., 2020; Hu et al., 2021; Zheng et al., 2022). Leisure and tourism land uses, such as cafés, restaurants (e.g., Maas et al., 2021; Shi et al., 2024), hotels (e.g., Chen and Ye, 2021), and recreational areas (e.g., Wang and Akar, 2019), were positively associated with BSS use, as were institutional spaces such as universities (e.g., Chen and Ye, 2021). Land use entropy and diversity were also positively associated with BSS use (Chen et al., 2020; Gao et al., 2023; Jiao et al., 2022).
  - **Density metrics** were examined in 14 studies, all reporting significant associations with BSS use. Employment (Chen and Ye, 2021; Zhou et al., 2024) and job density (Wang and Akar, 2019) were positively associated BSS use, although one study observed a plateau beyond a threshold. Building density (Chen et al., 2020) and floor area ratio (Gao et al., 2023; Cai et al., 2025) were positively associated with BSS use, whereas total building area was negatively associated (Shi et al., 2024). Points of interest were positively associated with BSS use and correlated with higher bicycle density and building intensity (Chen et al., 2020; Li et al., 2025). Road and intersection densities showed mixed associations: several studies reported positive associations up to certain thresholds (e.g., Chen and Ye, 2021; Hu et al., 2021; Zhang et al., 2024), whereas others reported negative associations for road density (Gao et al., 2023) and intersection density (Ethier et al., 2024). Similarly, while network density and road intersection density were positively associated with BSS use in some studies (Chen et al., 2020; Yang et al., 2020; Zhao et al., 2020), negative associations were reported for road network density (Zhao et al., 2020) and transportation node counts (Maas et al., 2021).

– **Population density metrics** were examined in seven studies, with six finding significant positive associations with BSS use. Higher population density was positively associated with BSS use across various spatial scales (Chen and Ye, 2021; Gao et al., 2023; Hu et al., 2021; Wang and Akar, 2019; Zhou et al., 2024), including for free-floating systems when measured using log-transformed density (Gao et al., 2023).

● **Population and demographics** were examined in nine studies, with seven finding significant associations with BSS use. The most frequently studied group in this subcategory was the general population and demographics.

– **General population and demographics** were explored in six studies, with four finding significant associations with BSS use. Positive associations were reported for tourism and larger city populations (Bielinski et al., 2019) and higher telecommunication floating populations (Jiao et al., 2022). Conversely, negative associations were observed in areas with higher proportions of low-income residents or younger populations under 24 years (Jiao et al., 2022; Yang et al., 2020).

4. Discussion

This scoping review synthesised research on factors associated with BSS use and intention to use, introducing the first comprehensive multilevel behavioural framework that integrates user-, BSS provider-, government-, and urban environment-related factors. In contrast to prior reviews, which were often modality-specific, infrastructure-focused, or fragmented in scope, this framework captures cross-level interactions and behavioural interdependencies. By linking individual motivations with structural, institutional, and environmental determinants, it provides a more holistic and policy-relevant understanding of BSS user behaviour.

The existing literature remains geographically concentrated in East Asia, particularly Mainland China, where rapid system expansion and access to detailed usage data have facilitated empirical research. While this regional skew limits generalisability, the framework offers transferable insights across diverse socio-cultural and institutional contexts (Dingil et al., 2019; Yin et al., 2021). For example, collectivist and centrally planned societies often promote BSS use through coordinated infrastructure and normative conformity (Ma et al., 2018; Reddick et al., 2020), whereas individualistic contexts tend to rely on decentralised, incentive-driven strategies (Pucher et al., 2011; Stehlin, 2014). The framework also accommodates moderating factors such as climate, modal integration, regulatory enforcement, and gender norms, providing a stronger theoretical foundation than previous reviews (Goodman and Aldred, 2018; Ricci, 2015). Future research should expand into underrepresented regions—including Africa, Latin America, and Southeast Asia—where BSS systems are emerging but scholarly attention remains limited (Castillo-Manzano et al., 2016).

Methodologically, the evidence base is dominated by quantitative studies employing regression analyses, SEM, and discrete choice experiments. While these methods establish statistical associations, they often provide limited explanatory insight into user motivations, social norms, and contextual dynamics. Despite eligibility, only two qualitative or mixed-method studies reached full-text review, and both were excluded due to insufficient statistical reporting (Akbari et al., 2022; Bejarano et al., 2017). Consequently, aspects such as user perceptions, lived experiences, and socio-spatial influences remain underexplored. Qualitative approaches, including interviews and ethnographies, can reveal barriers overlooked by structured surveys (Teixeira et al., 2022), while mixed-method designs add interpretive depth to quantitative findings (Chopdar et al., 2023; Sajid et al., 2023). Future work should adopt diverse, theory-informed methodologies to better capture the complexity of BSS behaviour.

The under exploration of certain factors often reflects methodological limitations rather than conceptual neglect. Survey and cross-sectional studies provide insight into psychological constructs, sociodemographic variables, and trip-level behaviours, but are limited in temporal and spatial coverage and cannot readily capture household context, governance interventions, or digital and social media influences (e.g., Chen and Lu, 2016; Gao et al., 2024; Zhu, 2021). Conversely, operational datasets—including GPS traces, station-level counts, and system logs—enable large-scale analyses of network structure, land use, and temporal dynamics, yet cannot measure subjective perceptions, social norms, or motivational constructs (e.g., Ethier et al., 2024; Shi et al., 2024; Zhao et al., 2020). Recent advances are beginning to bridge these gaps: integrating street-view imagery, satellite-derived environmental indices, and machine-learning approaches allows fine-grained assessment of micro-level urban features such as bike lane quality, lighting, and vegetation (e.g., Xu et al., 2025; Zhu et al., 2025; Zhu et al., 2025), while spatial econometric models and generalised additive mixed models capture temporal and contextual heterogeneity in operational datasets (e.g., Ji et al., 2023; Venkadavarahan et al., 2023). Such multi-source, hybrid analyses provide a promising pathway to link structural, institutional, environmental, and individual determinants, advancing comprehensive, multilevel behavioural models that clarify the mechanisms through which diverse factors influence BSS use.

Among the most frequently studied variables were user-related factors, particularly sociodemographic characteristics such as age and gender. Although sometimes regarded as basic, these variables reveal structural disparities in BSS access and use. Gender-specific safety concerns, especially among women, are associated with poor lighting, inadequate infrastructure, and harassment risks (Adinarayana et al., 2024; Godber, 2024; Gorrini et al., 2021). Similarly, age-related differences are often associated with inequalities in digital literacy, physical ability, and cycling confidence (Cai et al., 2025; Imanishimwe and Kumar, 2024). These sociodemographic dimensions intersect with system design and policy interventions (Chen et al., 2020), and overlooking them risks obscuring barriers to equitable and inclusive BSS use.

Household- and trip-level factors, though less extensively studied, provide valuable behavioural insights within the multilevel framework. Household characteristics—including car ownership, bicycle availability, income, and caregiving responsibilities—are associated with reliance on BSS and responsiveness to policy or provider incentives. For example, individuals from car-free or lower-income households are more likely to depend on BSS and benefit from subsidies or discounts, whereas those with private vehicles engage more selectively (Lois et al., 2015; Sun et al., 2024). Yet, few studies explicitly consider household context as a moderating or mediating factor (Li et al., 2021; Wang and Lindsey, 2019).

Trip-level attributes such as purpose, duration, and time of day were frequently included in models but seldom interpreted through

behavioural theory. Commuting behaviour, for example, is associated with trip purpose, time constraints, system reliability, and infrastructure quality (Ahmadov, 2024; Kalliga et al., 2025). These dynamics are further moderated by user-specific characteristics (e. g., gender, cycling confidence) and contextual urban conditions (e.g., traffic, lighting) (Rodríguez et al., 2025; Sanjurjo-de-No et al., 2025). Interdependencies among these factors remain under-theorised, and the prevalence of cross-sectional designs limits understanding of behavioural evolution (Elkhouly and Alhadidi, 2025; Zhuang et al., 2025). Longitudinal, theory-driven approaches integrating household and trip-level variables are needed to explain behavioural dynamics more robustly.

Psychological factors were the most frequently examined subcategory within user-related factors, highlighting their conceptual centrality. This review situates psychological constructs, such as attitudes, subjective norms, perceived behavioural control, and perceived usefulness, within broader systemic, spatial, and policy contexts. While many studies reported positive associations with BSS intention or use, effect sizes varied and cross-contextual inconsistencies were common. For example, pro-environmental attitudes and social responsibility values were often positively associated with intention to use, but did not always translate into actual use, illustrating the "intention-behaviour" gap (Brock et al., 2025; Hou et al., 2025). Bridging this gap requires aligning individual-level motivations with structural and institutional supports that facilitate sustained BSS intention and use.

Despite their centrality, psychological factors remian insufficiently integrated with socio-technical influences such as social media (Shahzalal, 2024). In today's digitised mobility landscape, subjective norms are shaped not only by interpersonal networks but also by online narratives (Duran-Rodas et al., 2020). Stories highlighting safety concerns, service breakdowns, or viral incidents of vandalism and misuse can undermine trust, legitimacy, and social acceptability (Wong et al., 2020). Such distributed social cues construct collective norms that influence intention and behaviour, yet they are largely absent from behavioural models (Martínez-de-Ibarreta et al., 2024). Future frameworks should explicitly incorporate digital and social media dynamics to reflect contemporary behavioural drivers.

Negative user behaviour, including vandalism, theft, and misuse, represent another underexplored but consequential domain. These behaviours are associated with reduced safety and eroded institutional trust and symbolic legitimacy (Chan, 2025). They interact with subjective norms and community attitudes, creating feedback loops of disorder, frustration, and declining use (Tang et al., 2024). For instance, repeated vandalism and device dumping in Melbourne and Sydney triggered public backlash and regulatory restrictions, demonstrating how antisocial conduct can reshape public sentiment and policy response. Yet few studies examine the socio-psychological drivers of these behaviours or their cumulative impact on intention, policy, and normative support. Addressing this research gap is critical for developing governance strategies that mitigate reputational risks and ensure long-term system viability (Dzięcielski et al., 2025).

Cultural norms add another layer of complexity, often mediating or overriding individual intentions and perceived behavioural control (Guo and Gao, 2025). In contexts such as Iran and Saudi Arabia, gender-based restrictions and socio-legal norms severely limit women's access to cycling and BSS, regardless of personal motivation (Hasan et al., 2024; Khajehpour and Miremadi, 2024). In societies where cycling is culturally stigmatised or confined to recreational use, normative support for BSS is weak (Oliveira Soares and Glaser, 2025). Conversely, cultures with high social cohesion and collective accountability often display lower rates of vandalism and stronger stewardship of shared systems. Despite their importance, cultural influences remain underexamined in empirical BSS research (Zhang et al., 2024). Cross-cultural comparisons and explicit modelling of cultural values as moderators or mediators would significantly strengthen behavioural frameworks.

Urban environment-related factors, though the second most studied category, have rarely been connected to behavioural mechanisms. Many studies assessed objective urban attributes but overlook how they shape perceptions and psychological responses. Variables such as noise (Wang et al., 2014; Winters et al., 2011), vegetation and shade (Wang and Akar, 2018), lighting (Majumdar et al., 2020; Piatkowski and Marshall, 2015), and surveillance (Lawson et al., 2013) are associated with perceived safety, yet remain underrepresented in behavioural models. Poorly maintained infrastructure, for example, not only creates physical barriers but also generates feelings of insecurity, discouraging use (Buehler and Dill, 2016). Future research should explicitly model how environmental conditions interact with psychological responses in shaping BSS behaviour.

Government-related factors, though least studied, are conceptualised as a distinct behavioural category. Unlike earlier reviews that subsumed policy under environmental or system-level considerations, this review foregrounds government interventions as both structural enablers and psychological influencers. Public-sector actions are associated with perceived behavioural control, institutional trust, and social norms. Fare subsidies, integrated ticketing, and equitable pricing reduce financial barriers and enhance perceived fairness, especially for non-captive or lower-income users (Delbosc and Thigpen, 2024; Guzman and Cantillo-Garcia, 2024). Infrastructure investments in protected lanes, lighting, hygiene, and end-of-trip facilities further reinforce perceptions of safety, convenience, and reliability (Chahine et al., 2025; Frizziero et al., 2024; Roig-Costa et al., 2025).

Yet few studies explicitly model interactions between governance and user-level motivations, and even fewer consider the behavioural consequences of governance failures. Inconsistent enforcement, weak transparency, and limited community engagement erode institutional legitimacy and undermine normative support for BSS. These risks are heightened when issues such as vandalism or system unreliability remain unaddressed, reinforcing perceptions of disorder. In marginalised communities, where institutional trust is already fragile, the absence of inclusive planning or equity-oriented outreach may deepen spatial and social disparities (Guan et al., 2024). By foregrounding government-related factors as a distinct behavioural category, this review highlights how public-sector actions are associated with perceptions and outcomes. Future work should adopt theory-informed, multilevel models to capture both enabling and constraining effects of governance.

BSS provider–related factors, while institutionally distinct from government interventions, directly shape user experiences and outcomes. Attributes such as dynamic pricing, app functionality, system availability, and customer service are associated with perceptions of convenience, reliability, and ease of use—all central constructs in behavioural frameworks (Su et al., 2024). Yet these

elements are often relegated to technical background variables rather than active, modifiable behavioural levers. Their effects are moderated by user characteristics (e.g., digital literacy), environmental features (e.g., network density), and regulatory structures (e. g., subsidies, enforcement), dynamics that remain insufficiently theorised (Bieliński et al., 2024; Li et al., 2025).

An emerging frontier involves integrating BSS within MaaS platforms (Cisterna et al., 2023). Such integration is associated with streamlined multimodal travel, reduced perceived complexity, and enhanced intention and retention, particularly for first- and last-mile connectivity (Hasselwander et al., 2023; Silvestri et al., 2025). Future research could explore how BSS provider performance interacts with governance and infrastructure systems, positioning providers as behavioural levers within an integrated mobility ecosystem.

The framework we developed carries several practical implications. First, sociodemographic disparities highlight the need for equity-oriented strategies, including gender-sensitive safety measures, pricing schemes for low-income or car-free households, and outreach programs targeting older adults and digitally less literate users. Second, BSS provider-related factors underscore the importance of service reliability, technological functionality, and multimodal integration as behavioural levers. Investment in bicycle availability, station density, and app usability is associated with enhanced perceptions of convenience and reliability, which underpin behavioural intention and sustained ridership. Third, government-related factors highlight the central role of public-sector actions in shaping behavioural perceptions and system outcomes. Transparent policies, inclusive planning, and consistent enforcement are associated with institutional trust and positive social norms. Fare subsidies, integrated ticketing, and equitable pricing schemes reduce financial barriers, particularly for non-captive or lower-income users, while infrastructure investments in protected lanes, lighting, hygiene, and end-of-trip facilities strengthen perceptions of safety and reliability. Conversely, governance failures, such as inconsistent enforcement, weak community engagement, or neglect of equity concerns, are associated with eroded institutional legitimacy and widened social disparities, particularly in marginalised communities where trust in public institutions is already fragile. Finally, unmanaged risks, such as vandalism, misuse, or negative social media narratives, can trigger public backlash and regulatory restrictions, as observed in Melbourne and Sydney, highlighting the need for proactive monitoring and responsive governance. Collectively, these implications demonstrate how behavioural insights can be translated into managerial levers that enhance equity, resilience, and user responsiveness in BSS operations.

5. Conclusion

This scoping review synthesised 66 empirical studies published between 2014 and September 2025, examining behavioural factors associated with both the use and intention to use BSS. Following the PRISMA-ScR guidelines, the review introduced a multilevel categorisation framework—encompassing user-related, BSS provider-related, government-related, and urban environment factors—that foregrounds their cross-level interdependencies. Unlike earlier reviews, it explicitly recognises government-related factors as a distinct behavioural category and extends the evidence base by incorporating post-2020 literature, capturing emerging issues such as negative user behaviours and the growing role of social media narratives.

The review also addresses several previously overlooked gaps. It highlights the emotional and psychological underpinnings of BSS use, showing how social norms, digital narratives, and perceived behavioural control shape both intention and actual use—dimensions that were often peripheral in prior reviews. It further draws attention to the socio-psychological consequences of user misconduct (e.g., vandalism, theft), governance failures (e.g., institutional mistrust), and cultural norms that restrict access and legitimacy, particularly in gender-restrictive or cycling-averse contexts. In addition, the review explores the behavioural implications of integrating BSS into MaaS platforms, a rapidly evolving but still underexamined domain.

The findings have significant implications for policy and practice. For policymakers, measures such as equitable pricing, integrated ticketing, and gender-sensitive infrastructure reduce access barriers and foster system legitimacy. For BSS providers, investments in reliable service, intuitive digital platforms, and responsive pricing strategies directly enhance convenience, trust, and sustained engagement. Collaboration between governments and operators is essential to align governance, infrastructure, and service delivery, thereby ensuring that behavioural intentions translate into continued system use.

By addressing neglected influences, clarifying behavioural mechanisms, and broadening the analytical scope beyond previous reviews, this study contributes both theoretically and practically to the advancement of shared mobility. It provides policymakers, planners, and operators with a behaviourally informed and socially attuned roadmap for designing BSS that are more inclusive, equitable, and resilient.

6. Limitations

This scoping review is limited in terms of including only peer-reviewed studies published in English, which may have excluded relevant insights from non-English scholarship and grey literature. The categorisation of factors required interpretive judgement, with similar terms consolidated under broader constructs (e.g., "perceived barriers and challenges"), which may have introduced classification bias. Comparability across studies was limited by variation in terminology, definitions, and measurement approaches, which were not systematically assessed. In addition, the review only includes studies published between 2014 and September 2025, excluding more recent developments. Finally, the review does not provide a meta-analytic synthesis. Given the heterogeneity of study designs, outcome measures, and analytical methods, quantitative aggregation was not feasible. Future reviews could address this byfocusing on subsets of studies that employ consistent definitions, measures, and effect-size reporting, thereby enabling targeted meta-analyses that quantify behavioural influences with greater precision.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author(s) used ChatGPT-4o mini to improve the readability and language of the manuscript. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.

CRediT authorship contribution statement

Shima Mafi: Writing – original draft, Visualization, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Erica McIntyre:** Writing – review & editing, Validation, Supervision, Methodology, Formal analysis, Conceptualization. **Jason Prior:** Writing – review & editing, Validation, Supervision, Methodology, Formal analysis, Conceptualization. **Ali Mohamadi:** Writing – review & editing, Validation, Methodology, Conceptualization. **Pooria Choobchian:** Validation, Methodology, Conceptualization.

Funding

Declaration of competing interest

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

Acknowledgements

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.trf.2025.103413.

Data availability

Data will be made available on request.

References

Abolhassani, L., Afghari, A. P., & Borzadaran, H. M. (2019). Public preferences towards bicycle sharing system in developing countries: The case of Mashhad, Iran. *Sustainable Cities and Society, 44*, 763–773. https://doi.org/10.1016/j.scs.2018.10.032

Adinarayana, B., Ayush Sohal, B. S., Aryan Kumar, R., & Sharma, S. (2024). Development of AI model for gender differences in bicycle mobility of green urban areas for recreational and educational institutions of cycling behaviour, patterns and constraints of regular cyclists for Chandigarh city—An Indian perspective. *Innovative Infrastructure Solutions, 9*(10), 1–26. https://doi.org/10.1007/s41062-024-01709-w

Aghaabbasi, M., & Chalermpong, S. (2023). A meta-analytic review of the association between the built environment and integrated usage of rail transport and bike-sharing. *Transportation Research Interdisciplinary Perspectives, 21*, Article 100860. https://doi.org/10.1016/j.trip.2023.100860

Ahmadov, T. (2024). Understanding the adoption of bike-sharing systems in the Baltic States: A multilevel perspective analysis of online consumer reviews. http://diamond-oa.lib.cam.ac.uk/entities/publication/fb46d3ee-0a0f-4ba4-8f9c-5e19bca3cbf1.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Akbari, M., Zarghamfard, M., Hajisharifi, A., Entekhabi, S., & Goodarzipour, S. (2022). MODELLING the obstacles to using bicycle sharing systems in the Tehran metropolis: A structural analysis. *Quaestiones Geographicae, 41*(2), 109–124. https://doi.org/10.2478/quageo-2022-0011

An, Y., & Jang, S. (2022). An empirical study on the effects of fine dust concentration on the utilisation of shared bicycles. *Applied Spatial Analysis and Policy, 15*(3), 873–889. https://doi.org/10.1007/s12061-021-09424-0

Angelidou, M., Psaltoglou, A., Komninos, N., Kakderi, C., Tsarchopoulos, P., & Panori, A. (2018). Enhancing sustainable urban development through smart city applications. *Journal of Science and Technology Policy Management, 9*(2), 146–169.

Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology, 8*(1), 19–32. https://doi.org/10.1080/1364557032000119616

Aydın, G. E. (2025). Micromobility and urban planning. In S. Dündar (Ed.), *Micromobility* (pp. 41–53). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-77098-2_5.

Bao, J., Shi, X., & Zhang, H. (2018). Spatial analysis of bikeshare ridership with smart card and POI Data using geographically weighted regression method. *IEEE Access, 6*, 76049–76059. https://doi.org/10.1109/ACCESS.2018.2883462

Bejarano, M., Ceballos, L. M., & Maya, J. (2017). A user-centred assessment of a new bicycle sharing system in Medellin. *Transportation Research Part F: Traffic Psychology and Behaviour, 44*, 145–158. https://doi.org/10.1016/j.trf.2016.11.004. Scopus.

Bieliński, T., Czuba, T., Dopierała, Ł., & Tarkowski, M. (2024). Electric bike sharing: Price sensitivity and pricing preferences. *Research in Transportation Business & Management, 56*, Article 101163. https://doi.org/10.1016/j.rtbm.2024.101163

Bielinski, T., Kwapisz, A., & Wazna, A. (2019). Bike-sharing systems in Poland. *Sustainability, 11*(9). https://doi.org/10.3390/su11092458

Bourne, J. E., Cooper, A. R., Kelly, P., Kinnear, F. J., England, C., Leary, S., & Page, A. (2020). The impact of e-cycling on travel behaviour: A scoping review. *Journal of Transport & Health, 19*, Article 100910. https://doi.org/10.1016/j.jth.2020.100910

Brock, C., Lallement, J., Findeisen, L., & Soulat, U. (2025). Bridging the green gap: Understanding the intention-behaviour gap in mobility and urban mobility. *Transport Transitions: Advancing Sustainable and Inclusive Mobility*, 398–412. https://doi.org/10.1007/978-3-031-85578-8_51

Buehler, R., & Dill, J. (2016). Bikeway networks: A review of effects on cycling. *Transport Reviews, 36*(1), 9–27. https://doi.org/10.1080/01441647.2015.1069908

Cai, X., Gu, X., Silm, S., Hadachi, A., Jin, T., & Witlox, F. (2025). Differences in bike-sharing usage and its associations with station-surrounding characteristics: A multi-group analysis using machine learning techniques. *Journal of Transport Geography, 125*, Article 104201. https://doi.org/10.1016/j.jtrangeo.2025.104201

Cao, J., Prior, J., & Moutou, C. (2021). The governance of dockless bike-sharing schemes: A systemic review of peer-reviewed academic journal papers between 2016 and 2019. *Cleaner Engineering and Technology, 4*, Article 100140. https://doi.org/10.1016/j.clet.2021.100140

Castillo-Manzano, J., López-Valpuesta, L., & Sánchez-Braza, A. (2016). Going a long way? On your bike! Comparing the distances for which public bicycle sharing system and private bicycles are used. *Applied Geography, 71*, 95–105. https://doi.org/10.1016/j.apgeog.2016.04.003

Chahine, R., Duarte, J., & Gkritza, K. (2025). Effect of protected bike lanes on bike-sharing ridership: A New York City case study. *Journal of Transport Geography, 123*, Article 104147. https://doi.org/10.1016/j.jtrangeo.2025.104147

Chan, T. H. Y. (2025). How does bike-sharing enable (or not) resilient cities, communities, and individuals? Conceptualising transport resilience from the socio-ecological and multi-level perspective. *Transport Policy, 163*, 247–261. https://doi.org/10.1016/j.tranpol.2025.01.020

Chen, E., & Ye, Z. (2021). Identifying the nonlinear relationship between free-floating bike sharing usage and built environment. *Journal of Cleaner Production, 280*. https://doi.org/10.1016/j.jclepro.2020.124281

Chen, M., Wang, D., Sun, Y., Liu, C., & Bai, Z. (2017). Service evaluation of public bicycle scheme from a user perspective a case study in Hangzhou, China. *Transportation Research Record, 2634*, 28–34. https://doi.org/10.3141/2634-04

Chen, S. (2019). Eco-friendly value or others' environmental norms? Arguing the environmental using psychology of bike-sharing for the general public. *Transportation Letters-the International Journal of Transportation Research, 11*(8), 425–435. https://doi.org/10.1080/19427867.2017.1379722

Chen, S., & Lu, C. (2016). A model of green acceptance and intentions to use bike-sharing: YouBike users in Taiwan. *Networks & Spatial Economics, 16*(4), 1103–1124. https://doi.org/10.1007/s11067-015-9312-8

Chen, Y., Chen, Y., Tu, W., & Zeng, X. (2020). Is eye-level greening associated with the use of dockless shared bicycles? *Urban Forestry and Urban Greening, 51*. https://doi.org/10.1016/j.ufug.2020.126690. Scopus.

Chen, Z., Wu, T., Cao, J., Zhao, J., Li, S., You, Z., Qiao, R., Wu, Z., & Zhou, S. (2025). How street view shapes cycling behaviour during extreme heat: A case study from Shanghai. *Transportmetrica B: Transport Dynamics, 13*(1), Article 2537383. https://doi.org/10.1080/21680566.2025.2537383

Chevance, G., Bourne, J., Foley, L., Green, J., Sundfør, H. B., Fyhri, A., & Bernard, P. (2025). E-bikes and travel behaviour change: Systematic review of experimental studies with meta-analyses. *Transport Reviews, 45*(3), 433–454. https://doi.org/10.1080/01441647.2025.2474556

Cisterna, C., Madani, N., Bandiera, C., Viti, F., & Cools, M. (2023). MaaS modelling: A review of factors, customers' profiles, choices and business models. *European Transport Research Review, 15*(1), 37. https://doi.org/10.1186/s12544-023-00597-y

Coppola, P., Silvestri, F., & Pastorelli, L. (2025). Mobility as a Service (MaaS) for university communities: Modelling preferences for integrated public transport bundles. *Travel Behaviour and Society, 38*, Article 100890. https://doi.org/10.1016/j.tbs.2024.100890

Covidence. (2025). *Covidence systematic review software. Veritas Health Innovation: Melbourne, Australia; 2024*. [Computer software].

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Delbosc, A., & Thigpen, C. (2024). Who uses subsidized micromobility, and why? Understanding low-income riders in three countries. *Journal of Cycling and Micromobility Research, 2*, Article 100016. https://doi.org/10.1016/j.jcmr.2024.100016

DeMaio, P. (2009). Bike-sharing: History, impacts, models of provision, and future. *Journal of Public Transportation, 12*(4), 41–56.

Dill, J., Ma, J., McNeil, N., Broach, J., & MacArthur, J. (2022). Factors influencing bike share among underserved populations: Evidence from three US cities. *Transportation Research Part D-Transport and Environment, 112*. https://doi.org/10.1016/j.trd.2022.103471

Dingil, A. E., Rupi, F., Schweizer, J., Stasiskiene, Z., & Aalipour, K. (2019). The role of culture in urban travel patterns: quantitative analyses of urban areas based on Hofstede's culture dimensions. *Social Sciences, 8*(8), Article 8. https://doi.org/10.3390/socsci8080227

Duran-Rodas, D., Villeneuve, D., & Wulfhorst, G. (2020). Bike-sharing: The good, the bad, and the future: An analysis of the public discussion on Twitter. *European Journal of Transport and Infrastructure Research, 20*(4), Article 4. https://doi.org/10.18757/ejtir.2020.20.4.5307

Dzięcielski, M., Dobruszkes, F., Nikitas, A., & Radzimski, A. (2025). Assessing the impacts of free-floating shared micromobility services on docked bike-sharing: Insights from the case studies of Poznań and Brussels. *Journal of Transport Geography, 128*, Article 104306. https://doi.org/10.1016/j.jtrangeo.2025.104306

Elkhouly, M., & Alhadidi, T. (2025). Ride-sharing determinants: spatial and Spatio-temporal Bayesian analysis for Chicago service in 2022. *IEEE Access, 13*, 61440–61456. https://doi.org/10.1109/ACCESS.2025.3556350

Elmashhara, M., Silva, J., Sá, E., Carvalho, A., & Rezazadeh, A. (2022). Factors influencing user behaviour in micromobility sharing systems: A systematic literature review and research directions. *Travel Behaviour and Society, 27*, 1–25. https://doi.org/10.1016/j.tbs.2021.10.001

Ethier, B. G., Wilson, J. S., Camhi, S. M., Shi, L., & Troped, P. J. (2024). An analysis of built environment characteristics in daily activity spaces and associations with bike share use. *Travel Behaviour and Society, 37*, Article 100850. https://doi.org/10.1016/j.tbs.2024.100850

Ewing, R., & Cervero, R. (2010). Travel and the built environment: A meta-analysis. *Journal of the American Planning Association, 76*(3), 265–294. https://doi.org/10.1080/01944361003766766

Frizziero, L., Donnici, G., Venditti, G., & Freddi, M. (2024). Design of an innovative sanitation system for bike-sharing service. *Heliyon, 10*(4). https://doi.org/10.1016/j.heliyon.2024.e26595

Gámez-Pérez, K., Arroyo-López, P., & Cherry, C. (2017). Defining a primary market for bikesharing programs a study of habits and usage intentions in Leon, Mexico. *Transportation Research Record, 2634*, 50–56. https://doi.org/10.3141/2634-09

Gao, J., Ma, S., Wang, L., Shuai, L., & Du, H. (2023). Does greenness bring more green travelling? Evidence from free-floating bike-sharing in Beijing. *Journal of Transport Geography, 109*. https://doi.org/10.1016/j.jtrangeo.2023.103586

Gao, L., Wang, J., & Wu, X. (2024). Promoting sustainable use behaviour in the sharing economy business model: A study based on bike-sharing. *Research in Transportation Business & Management, 57*, Article 101241. https://doi.org/10.1016/j.rtbm.2024.101241

Gao, S., Li, Y., & Guo, H. (2019). Understanding the adoption of bike sharing systems; by combining technology diffusion theories and perceived risk. *Journal of Hospitality and Tourism Technology, 10*(3), 464–478. https://doi.org/10.1108/JHTT-08-2018-0089

Geurs, K. T., & van Wee, B. (2004). Accessibility evaluation of land-use and transport strategies: Review and research directions. *Journal of Transport Geography, 12*(2), 127–140. https://doi.org/10.1016/j.jtrangeo.2003.10.005

Ghaffar, A., Hyland, M., & Saphores, J. (2023). Meta-analysis of shared micromobility ridership determinants. *Transportation Research Part D-Transport and Environment, 121*. https://doi.org/10.1016/j.trd.2023.103847

Giles-Corti, B., Vernez-Moudon, A., Reis, R., Turrell, G., Dannenberg, A. L., Badland, H., Foster, S., Lowe, M., Sallis, J. F., Stevenson, M., & Owen, N. (2016). City planning and population health: A global challenge. *The Lancet, 388*(10062), 2912–2924. https://doi.org/10.1016/S0140-6736(16)30066-6

Godber, A. (2024). What are the motivators and deterrents that contribute to women's decision to cycle as a mode of transportation: exploring gender differences in cycling behaviour. *Journal of Integrated Studies, 15*(1). https://jis.athabascau.ca/index.php/jis/article/view/380.

Goodman, A., & Aldred, R. (2018). Inequalities in utility and leisure cycling in England, and variation by local cycling prevalence. *Transportation Research Part F: Traffic Psychology and Behaviour, 56*, 381–391. https://doi.org/10.1016/j.trf.2018.05.001

Gorrini, A., Choubassi, R., Messa, F., Saleh, W., Ababio-Donkor, A., Leva, M. C., D'Arcy, L., Fabbri, F., Laniado, D., & Aragón, P. (2021). Unveiling women's needs and expectations as users of bike sharing services: The H2020 DIAMOND project. *Sustainability, 13*(9), Article 9. https://doi.org/10.3390/su13095241

Guan, X., van Lierop, D., An, Z., Heinen, E., & Ettema, D. (2024). Shared micro-mobility and transport equity: A case study of three European countries. *Cities, 153*, Article 105298. https://doi.org/10.1016/j.cities.2024.105298

Guo, F., & Gao, L. (2025). A meta-analysis of shared mobility adoption: The role of cultural moderators and key psychological determinants. *Sustainability, 17*(11), Article 11. https://doi.org/10.3390/su17115216

Guo, H., Zhang, S., Xie, X., Liu, J., & Ho, H. C. (2024). Moderation effects of streetscape perceptions on the associations between accessibility, land use mix, and bike-sharing use: cross-sectional study. *JMIR Public Health and Surveillance, 10*(1), Article e58761. https://doi.org/10.2196/58761

Guo, Y., Li, J., Xiao, L., Allaoui, H., Choudhary, A., & Zhang, L. (2024). Efficient inventory routing for bike-sharing systems: A combinatorial reinforcement learning framework. *Transportation Research Part E-Logistics and Transportation Review, 182*. https://doi.org/10.1016/j.tre.2024.103415

Guzel, D., Altintasi, O., & Korkut, S. O. (2025). Assessment of weather-driven travel behaviour on a small-scale docked bike-sharing system usage. *Travel Behaviour and Society, 38*, Article 100927. https://doi.org/10.1016/j.tbs.2024.100927

Guzman, L. A., & Cantillo-Garcia, V. A. (2024). Exploring the effects of public transport subsidies on satisfaction and ridership. *Research in Transportation Business & Management, 56*, Article 101168. https://doi.org/10.1016/j.rtbm.2024.101168

Hasan, R. A., Alhomaidat, F., & Albdour, M. S. (2024). Social norms and perceptions of Saudis on active transportation. *Frontiers in Built Environment, 10*. https://doi.org/10.3389/fbuil.2024.1369704

Hasselwander, M., Nieland, S., Dematera-Contreras, K., & Goletz, M. (2023). MaaS for the masses: Potential transit accessibility gains and required policies under mobility-as-a-service. *Multimodal Transportation, 2*(3), Article 100086. https://doi.org/10.1016/j.multra.2023.100086

Higgins, J. P., & Green, S. (Eds.). (2008). *Cochrane Handbook for Systematic Reviews of Interventions: Cochrane Book Series* ((1st ed.).). Wiley. https://doi.org/10.1002/9780470712184.

Hou, N., Shollock, B., Petzoldt, T., & M'Hallah, R. (2025). Qualitative insights into travel behaviour change from using private cars to shared cars. *International Journal of Sustainable Transportation, 19*(3), 262–276. https://doi.org/10.1080/15568318.2025.2471773

Hu, S., Xiong, C., Liu, Z., & Zhang, L. (2021). Examining spatiotemporal changing patterns of bike-sharing usage during COVID-19 pandemic. *Journal of Transport Geography, 91*, Article 102997. https://doi.org/10.1016/j.jtrangeo.2021.102997

Huang, D., Liu, Y., Wang, M., Yang, H., Huang, Q., & Li, C. (2020). How to promote users' adoption behaviour of dockless bike-sharing? An empirical study based on extended norms activation theory. *Transportation Letters-the International Journal of Transportation Research, 12*(9), 638–648. https://doi.org/10.1080/19427867.2019.1687195

Imanishimwe, D., & Kumar, A. (2024). Age-based preference analysis between autonomous vehicles and other mobility technologies. *Journal of Transportation Engineering, Part A: Systems, 150*(11), Article 04024070. https://doi.org/10.1061/JTEPBS.TEENG-7805

Jayawardhena, M., Delbosc, A., Currie, G., & Rose, G. (2025). When do shared e-scooters complement or compete with public transport? A mixed-method review and comparison with bike sharing. *Journal of Cycling and Micromobility Research, 3*, Article 100057. https://doi.org/10.1016/j.jcmr.2025.100057

Jena, A., & Kadali, B. R. (2024). What do non-users think about adopting public bicycle sharing systems? *Evidence from India. Innovative Infrastructure Solutions, 9*(7), 1–14. https://doi.org/10.1007/s41062-024-01577-4

Jenkins, M., Lustosa, L., Chia, V., Wildish, S., Tan, M., Hoornweg, D., Lloyd, M., & Dogra, S. (2022). What do we know about pedal assist E-bikes? A scoping review to inform future directions. *Transport Policy, 128*, 25–37. https://doi.org/10.1016/j.tranpol.2022.09.005

Ji, S., Heinen, E., & Wang, Y. (2023). Non-linear effects of street patterns and land use on the bike-share usage. *Transportation Research Part D: Transport and Environment, 116*, Article 103630. https://doi.org/10.1016/j.trd.2023.103630

Ji, W., Lu, C., Lu, C., Mao, J., Liu, Y., Hou, M., & Pan, X. (2021). Public's intention and influencing factors of dockless bike-sharing in central urban areas: A case study of Lanzhou City, China. *Sustainability, 13*(16), 9265. https://doi.org/10.3390/su13169265

Jiao, J., Lee, H. K., & Choi, S. J. (2022). Impacts of COVID-19 on bike-sharing usages in Seoul, South Korea. *Cities (London, England), 130*, Article 103849. https://doi.org/10.1016/j.cities.2022.103849

Kalliga, V., Narayanan, S., & Antoniou, C. (2025). Trip generation dynamics under the introduction of shared mobility. *Journal of Transport Geography, 123*, Article 104135. https://doi.org/10.1016/j.jtrangeo.2025.104135

Kathait, N., & Agarwal, A. (2024). User intention to adopt public bicycle sharing system: A priori acceptance approach. *Transportation Letters*, 1–15. https://doi.org/10.1080/19427867.2024.2375473

Khajehpour, B., & Miremadi, I. (2024). Assessing just mobility transitions in the global south: The case of bicycle-sharing in Iran. *Energy Research & Social Science, 110*, Article 103435. https://doi.org/10.1016/j.erss.2024.103435

Kim, H. (2020). Seasonal impacts of particulate matter levels on bike sharing in Seoul, South Korea. *International Journal of Environmental Research and Public Health, 17*(11). https://doi.org/10.3390/ijerph17113999

Kim, H. J., Jeong, U. H., & Kim, S. H. (2025). How do directed and undirected travel differ? Evidence from year-long bikeshare trips. *Transportation Research Part D: Transport and Environment, 142*, Article 104713. https://doi.org/10.1016/j.trd.2025.104713

Kumar, D. (2021). Meteorological barriers to bike rental demands: A case of Washington D.C. using NCA approach. *Case Studies on Transport Policy, 9*(2), 830–841. https://doi.org/10.1016/j.cstp.2021.04.002

Lawson, A. R., Pakrashi, V., Ghosh, B., & Szeto, W. Y. (2013). Perception of safety of cyclists in Dublin City. *Accident Analysis & Prevention, 50*, 499–511. https://doi.org/10.1016/j.aap.2012.05.029

Levac, D., Colquhoun, H., & O'Brien, K. K. (2010). Scoping studies: Advancing the methodology. *Implementation Science, 5*(1), 69. https://doi.org/10.1186/1748-5908-5-69

Li, C., Xiao, W., Zhang, D., & Ji, Q. (2021). Low-carbon transformation of cities: Understanding the demand for dockless bike sharing in China. *Energy Policy, 159*, Article 112631. https://doi.org/10.1016/j.enpol.2021.112631

Li, H., Yan, L., & Chen, L. (2025b). Riding under heat extremes: Exploring thermal and environmental interactions on bike-sharing. *Transportation Research Part D: Transport and Environment, 145*, Article 104792. https://doi.org/10.1016/j.trd.2025.104792

Li, Q., Qin, Y., & Xu, W. (2025a). Is there a link between city characteristics and shared e-bike utilisation? Evidence from China. *Sustainable Cities and Society, 120*, Article 106008. https://doi.org/10.1016/j.scs.2024.106008

Li, R., Sinniah, G. K., & Li, X. (2022a). The factors influencing resident's intentions on E-bike sharing usage in China. *Sustainability, 14*(9), 5013. https://doi.org/10.3390/su14095013

Li, S., Zhuang, C., Guo, E., Liang, K., & Liang, S. (2023). Research on bike-sharing travel behaviour: A review of the Chinese language literature. *Transactions in Urban Data, Science, and Technology, 2*(2–3), 100–122. https://doi.org/10.1177/27541231231179397

Li, W., Yang, Y., Cheng, L., Meng, X., Zhang, F., & Ji, Y. (2022b). Understanding adoption intent and behavioural response to shared electric bicycles: A survey in Ningbo, China. *Transportation Research Record*. https://doi.org/10.1177/03611981221103874

Li, X., Zhang, Y., Sun, L., & Liu, Q. (2018). Free-floating bike sharing in Jiangsu: Users' behaviours and influencing factors. *Energies, 11*(7), 1664. https://doi.org/10.3390/en11071664

Li, X., Zheng, Q., & Ke, D. (2025). The rich get richer: Derivative revenue as a catalyst for bike-sharing subscription services. *Transportation Research Part E: Logistics and Transportation Review, 193*, Article 103843. https://doi.org/10.1016/j.tre.2024.103843

Link, C., Strasser, C., & Hinterreiter, M. (2020). Free-floating bikesharing in Vienna—A user behaviour analysis. *Transportation Research Part A-Policy and Practice, 135*, 168–182. https://doi.org/10.1016/j.tra.2020.02.020

Lois, D., Moriano, J. A., & Rondinella, G. (2015). Cycle commuting intention: A model based on theory of planned behaviour and social identity. *Transportation Research Part F: Traffic Psychology and Behaviour, 32*, 101–113. https://doi.org/10.1016/j.trf.2015.05.003

Ma, Y., Lan, J., Thornton, T., Mangalagiu, D., & Zhu, D. (2018). Challenges of collaborative governance in the sharing economy: The case of free-floating bike sharing in Shanghai. *Journal of Cleaner Production, 197*, 356–365. https://doi.org/10.1016/j.jclepro.2018.06.213

Maas, S., Nikolaou, P., Attard, M., & Dimitriou, L. (2021). Spatial and temporal analysis of shared bicycle use in Limassol, Cyprus. *Journal of Transport Geography, 93*. https://doi.org/10.1016/j.jtrangeo.2021.103049

Machavarapu, P. K., Ram, S., & Kant, P. (2024). Exploring the factors affecting bike sharing usage in developing countries: A case study on Chandigarh, India. *Urban, Planning and Transport Research, 12*(1), Article Scopus. https://doi.org/10.1080/21650020.2024.2310544

Macioszek, E., Świerk, P., & Kurek, A. (2020). The bike-sharing system as an element of enhancing sustainable mobility—A case study based on a city in Poland. *Sustainability, 12*(8), Article 8. https://doi.org/10.3390/su12083285

Majumdar, B. B., Mitra, S., & Pareekh, P. (2020). On identification and prioritization of motivators and deterrents of bicycling. *Transportation Letters, 12*(9), 591–603. https://doi.org/10.1080/19427867.2019.1671042

Martínez-de-Ibarreta, C., Cifuentes, J. A., Vallez, C. M., & Betancourt, A. (2024). Unveiling the effect of social media communication on urban mobility. *Transportation, 1–45*. https://doi.org/10.1007/s11116-024-10512-6

Mohiuddin, H., Bunch, D. S., Fukushige, T., Fitch-Polse, D. T., & Handy, S. L. (2025). What factors influence the adoption and use of dockless electric bike-share? A case study from the Sacramento region. *Transportation Research Part A: Policy and Practice, 199*, Article 104555. https://doi.org/10.1016/j.tra.2025.104555

Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology, 18*(1), Article 1. https://doi.org/10.1186/s12874-018-0611-x

Nikitas, A. (2018). Understanding bike-sharing acceptability and expected usage patterns in the context of a small city novel to the concept: A story of 'Greek Drama. *Transportation Research. Part F, Traffic Psychology and Behaviour, 56F*, 306.

Odoom, C., Boateng, A., Mensah, S. F., & Maposa, D. (2024). Modeling of the daily dynamics in bike rental system using weather and calendar conditions: A semi-parametric approach. *Scientific African, 24*, Article Scopus. https://doi.org/10.1016/j.sciaf.2024.e02211

Oliveira Soares, B., & Glaser, M. (2025). Beyond infrastructure: Unpacking the complexity of exclusion and implications for just mobility transitions. *Journal of Transport Geography, 126*, Article 104202. https://doi.org/10.1016/j.jtrangeo.2025.104202

Parkes, S. D., Marsden, G., Shaheen, S. A., & Cohen, A. P. (2013). Understanding the diffusion of public bikesharing systems: Evidence from Europe and North America. *Journal of Transport Geography, 31*, 94–103. https://doi.org/10.1016/j.jtrangeo.2013.06.003

Peters, M. D. J., Marnie, C., Tricco, A. C., Pollock, D., Munn, Z., Alexander, L., McInerney, P., Godfrey, C. M., & Khalil, H. (2020). Updated methodological guidance for the conduct of scoping reviews. *JBI Evidence Synthesis, 18*(10), 2119. https://doi.org/10.11124/JBIES-20-00167

Pham, M. T., Rajić, A., Greig, J. D., Sargeant, J. M., Papadopoulos, A., & McEwen, S. A. (2014). A scoping review of scoping reviews: Advancing the approach and enhancing the consistency. *Research Synthesis Methods, 5*(4), 371–385. https://doi.org/10.1002/jrsm.1123

Piatkowski, D. P., & Marshall, W. E. (2015). Not all prospective bicyclists are created equal: The role of attitudes, socio-demographics, and the built environment in bicycle commuting. *Travel Behaviour and Society, 2*(3), 166–173. https://doi.org/10.1016/j.tbs.2015.02.001

Podgórniak-Krzykacz, A., & Trippner-Hrabi, J. (2021). Motives and factors that determine city residents' use of public bicycles. The case of Lodz, Poland. *Case Studies on Transport Policy, 9*(2), 651–662. https://doi.org/10.1016/j.cstp.2021.03.003

Chopdar, P. K., Lytras, M. D., & Visvizi, A. (2023). Exploring factors influencing bicycle-sharing adoption in India: A UTAUT 2 based mixed-method approach. *International Journal of Emerging Markets, 18*(11), 5109–5134. https://doi.org/10.1108/IJOEM-06-2021-0862

Pucher, J., Buehler, R., & Seinen, M. (2011). Bicycling renaissance in North America? An update and re-appraisal of cycling trends and policies. *Transportation Research Part A: Policy and Practice, 45*(6), 451–475. https://doi.org/10.1016/j.tra.2011.03.001

Qiu, L.-Y., & He, L.-Y. (2018). Bike sharing and the economy, the environment, and health-related externalities. *Sustainability, 10*(4), 1145.

Raux, C., Zoubir, A., & Geyik, M. (2017). Who are bike sharing schemes members and do they travel differently? The case of Lyon's "Velo'v" scheme. *Transportation Research Part A-Policy and Practice, 106*, 350–363. https://doi.org/10.1016/j.tra.2017.10.010

Reddick, C. G., Zheng, Y., & Liu, T. (2020). Roles of government in regulating the sharing economy: A case study of bike sharing in China. *Information Polity, 25*(2), 219–235. https://doi.org/10.3233/IP-190207

Ricci, M. (2015). Bike sharing: A review of evidence on impacts and processes of implementation and operation. *Research in Transportation Business & Management, 15*, 28–38. https://doi.org/10.1016/j.rtbm.2015.03.003

Robeyns, I. (2005). The capability approach: A theoretical survey. *Journal of Human Development, 6*(1), 93–117. https://doi.org/10.1080/146498805200034266

Rodríguez, A., Delgado-Lindeman, M., Sipone, S., & dell'Olio, L. (2025). Gender dynamics in electric bike-sharing: Insights on usage and fare structures. *Research in Transportation Economics, 111*, Article 101561. https://doi.org/10.1016/j.retrec.2025.101561

Roig-Costa, O., Miralles-Guasch, C., & Marquet, O. (2025). Unpacking the docked bike-sharing experience. A bike-along study on the infrastructural constraints and determinants of everyday bike-sharing use. *Journal of Transport Geography, 125*, Article 104184. https://doi.org/10.1016/j.jtrangeo.2025.104184

Sajid, M., Midhun, V., Zakkariya, K., Surira, M. D., & Vishnu, K. P. (2023). Pedalling towards sustainability: A mixed-method study of the drivers and barriers to bike-sharing adoption. *Management of Environmental Quality, 34*(6), 1580–1606. https://doi.org/10.1108/MEQ-12-2022-0343

Sanjurjo-de-No, A., María Pérez-Zuriaga, A., Hortelano, C., & García, A. (2025). Analysing micromobility patterns: A gender perspective on behaviour and risk perception. *Transportation Research Part F: Traffic Psychology and Behaviour, 109*, 1365–1382. https://doi.org/10.1016/j.trf.2025.01.044

Shaheen, S. A., Guzman, S., & Zhang, H. (2010). Bikesharing in Europe, the Americas, and Asia: Past, present, and future. *Transportation Research Record: Journal of the Transportation Research Board, 2143*(1), 159–167. https://doi.org/10.3141/2143-20

Shahzalal, M. (2024). Perceived effects of social media use on awareness, social influence, and intention to practice sustainability. *International Journal of Development and Sustainability*. https://isdsnet.com/ijds-v13n12-06.pdf.

Shi, Y., Zhang, Z., Zhou, C., Bai, R., & Li, C. (2024). A study on the spatiotemporal distribution and usage pattern of dockless shared bicycles—the case of Nanjing. *ISPRS International Journal of Geo-Information, 13*(9), Article 9. https://doi.org/10.3390/ijgi13090301

Silvestri, F., Silvestri, F., & Coppola, P. (2025). Mobility as a Service (MaaS) bundle uptake: A case study in Milan, Italy. *European Transport Research Review, 17*(1), 3. https://doi.org/10.1186/s12544-024-00698-2

Sinha, R. (2021). Subscription and casual customers' differential sensitivity to meteorological characteristics. *Journal of Retailing and Consumer Services, 62*. https://doi.org/10.1016/j.jretconser.2021.102663

Soltani, A., Allan, A., Pojani, D., Khalaj, F., & Mehdizadeh, M. (2022). Users and non-users of bikesharing: How do they differ? *Transportation Planning and Technology, 45*(1), 39–58. https://doi.org/10.1080/03081060.2021.2017215

Statistica. (2025). *Bike-sharing—Worldwide | Statista Market Forecast*. Statista. http://frontend.xmo.prod.aws.statista.com/outlook/mmo/shared-mobility/bike-sharing/worldwide.

Stehlin, J. (2014). Regulating inclusion: Spatial form, social process, and the normalization of cycling practice in the USA. *Mobilities, 9*(1), 21–41. https://doi.org/10.1080/17450101.2013.784527

Su, J., Luo, S., Ji, K., & Tian, B. (2024). Perceived value, service quality and behavioural intentions towards bike-sharing services: Using an extended technology acceptance model. *Research in Transportation Business & Management, 57*, Article 101236. https://doi.org/10.1016/j.rtbm.2024.101236

Sun, S., Guo, L., Yang, S., & Cao, J. (2024). Exploring the contributions of E-bike ownership, transit access, and the built environment to car ownership in a developing city. *Journal of Transport Geography, 116*, Article 103834. https://doi.org/10.1016/j.jtrangeo.2024.103834

Tang, Z., Hao, J., & Wang, X. (2024). Park smart or face the music: Understanding users' orderly parking behaviour of dockless shared bikes from the perspective of deterrence theory. *Transportation Research Part F: Traffic Psychology and Behaviour, 107*, 507–520. https://doi.org/10.1016/j.trf.2024.09.017

Teixeira, J. F., Silva, C., & Moura e Sá, F. (2022). The strengths and weaknesses of bike sharing as an alternative mode during disruptive public health crisis: A qualitative analysis on the users' motivations during COVID-19. *Transport Policy, 129*, 24–37. https://doi.org/10.1016/j.tranpol.2022.09.026

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., Moher, D., Peters, M. D. J., Horsley, T., Weeks, L., Hempel, S., Akl, E. A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M. G., Garritty, C., & Straus, S. E. (2018). PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Annals of Internal Medicine, 169*(7), 467–473. https://doi.org/10.7326/M18-0850

Venkadavarahan, M., Joji, M., & Marisamynathan, S. (2023). Development of spatial econometric models for estimating the bicycle sharing trip activity. *Sustainable Cities and Society, 98.* https://doi.org/10.1016/j.scs.2023.104861

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425–478. https://doi.org/10.2307/30036540

Villarrasa-Sapiña, I., Toca-Herrera, J.-L., Pellicer-Chenoll, M., Taczanowska, K., Rueda, P., & Devís-Devís, J. (2024). Effects of meteorology on bike-sharing: Cases of 13 cities using non-linear analyses. *Cities, 155,* Article 105457. https://doi.org/10.1016/j.cities.2024.105457

Vo, T., Barbour, N., Palaio, L., & Maness, M. (2023). Impacts of the COVID-19 pandemic on bikeshare usage by rider membership status across selected US cities. *Transportation Research Record, 2677*(4), 547–561. https://doi.org/10.1177/03611981221131542

Waldner, F., Balke, G., Rech, F., & Lellep, M. (2025). Data-driven insights into (E-)bike-sharing: Mining a large-scale dataset on usage and urban characteristics: Descriptive analysis and performance modelling. *Transportation.* https://doi.org/10.1007/s11116-025-10661-2

Wang, D., Jin, M., Tong, D., Chang, X., Gong, Y., & Liu, Y. (2024). Evaluating the bikeability of urban streets using dockless shared bike trajectory data. *Sustainable Cities and Society, 101,* Article Scopus. https://doi.org/10.1016/j.scs.2024.105181

Wang, H., Dong, Y., & Ma, L. (2024). Determinants of dockless bicycle-sharing adoption and usage intensity for commuting and errands: Evidence from disadvantaged neighborhoods. *Land, 13*(12), 12. https://doi.org/10.3390/land13122055

Wang, J., & Lindsey, G. (2019). Neighbourhood socio-demographic characteristics and bike share member patterns of use. *Journal of Transport Geography, 79,* 1. https://doi.org/10.1016/j.jtrangeo.2019.102475

Wang, J. Y., Mirza, L., Cheung, A. K., & Moradi, S. (2014). Understanding factors influencing choices of cyclists and potential cyclists: A case study at the University of Auckland. *Road & Transport Research: A Journal of Australian and New Zealand Research and Practice.* https://search.informit.com/doi/abs/10.3316/INFORMIT.805624961549739.

Wang, K., & Akar, G. (2018). Street intersection characteristics and their impacts on perceived bicycling safety. *Transportation Research Record, 2672*(46), 41–54. https://doi.org/10.1177/0361198118801349

Wang, K., & Akar, G. (2019). Gender gap generators for bike share ridership: Evidence from Citi Bike system in New York City. *Journal of Transport Geography, 76,* 1–9. https://doi.org/10.1016/j.jtrangeo.2019.02.003. Scopus.

Wang, Q., Sun, H., & Zhang, Q. (2017). A Bayesian network model on the public bicycle choice behaviour of residents: A case study of Xi'an. *Mathematical Problems in Engineering, 2017.* https://doi.org/10.1155/2017/3023956

Weschke, J. (2024). Will temporarily free bike sharing change transport behaviour forever? *Evidence from a free rides' promotion on trip demand. Transportation..* https://doi.org/10.1007/s11116-024-10537-x

Winters, M., Davidson, G., Kao, D., & Teschke, K. (2011). Motivators and deterrents of bicycling: Comparing influences on decisions to ride. *Transportation, 38*(1), 153–168. https://doi.org/10.1007/s11116-010-9284-y

Wong, L., Tan, L., Wong, R., & Yeo, S. L. (2020). News media influence on public trust in bike-sharing operators in Singapore. *Corporate Communications: An International Journal, 26*(1), 143–154. https://doi.org/10.1108/CCIJ-01-2020-0034

Wu, C., Kim, I., & Chung, H. (2021). The effects of built environment spatial variation on bike-sharing usage: A case study of Suzhou. *China. CITIES, 110.* https://doi.org/10.1016/j.cities.2020.103063

Xu, L., Luo, S., O'Hern, S., Delbosc, A., Chen, Z., & Fu, X. (2025). Do protected cycle lanes make cities more bike-friendly? Integrating street view images with deep learning techniques. *Cities, 161,* Article 105890. https://doi.org/10.1016/j.cities.2025.105890

Yang, H., Shi, J., & Tao, T. (2025). Where do built environment attributes most effectively influence bike sharing usage? *Transportation Research Part D: Transport and Environment, 143,* Article 104717. https://doi.org/10.1016/j.trd.2025.104717

Yang, H., Zhang, Y., Zhong, L., Zhang, X., & Ling, Z. (2020). Exploring spatial variation of bike sharing trip production and attraction: A study based on Chicago's Divvy system. *Applied Geography, 115,* Article Scopus. https://doi.org/10.1016/j.apgeog.2019.102130

Yao, J., Jian, Y., Shen, Y., Wen, W., Huang, C., Wang, J., Fu, J., Yu, Z., & Zhang, Y. (2025). Decoding the spatial heterogeneity of bike-sharing impacts: Machine learning model of meteorology, epidemic, and urban factors. *Journal of Urban Planning and Development, 151*(2), Article 04025009. https://doi.org/10.1061/JUPDDM.UPENG-5192

Ye, X. (2022). Bike-sharing adoption in cross-national contexts: An empirical research on the factors affecting users' intentions. *SUSTAINABILITY, 14*(6). https://doi.org/10.3390/su14063208

Yin, Y., Yu, Z., Wang, H., & Ye, J. (2021). Sharing transport in high education area of Ningbo: Examining users' characteristics and driving determinants. *Journal of Cleaner Production, 306,* 127231. https://doi.org/10.1016/j.jclepro.2021.127231

Yoo, E.-H., Eum, Y., Lee, T., & Kang, B. (2025). Impact of bicycle infrastructure and long-term exposure to PM2.5 on cycling. *Cities, 160,* Article 105813. https://doi.org/10.1016/j.cities.2025.105813

Zhang, Q., Rui, J., & Wu, Y. (2024). Encouraging cycling through the improvement of streetscape perception: A bottom-up investigation into the relationship between street greening and bicycling volume. *Applied Geography, 171,* Article 103388. https://doi.org/10.1016/j.apgeog.2024.103388

Zhang, R., Te Brömmelstroet, M., Nikolaeva, A., & Liu, G. (2024). Cycling subjective experience: A conceptual framework and methods review. *Transportation Research Part F: Traffic Psychology and Behaviour, 101,* 142–159. https://doi.org/10.1016/j.trf.2023.12.021

Zhang, X., Wang, J., Long, X., & Li, W. (2021). Understanding the intention to use bike-sharing system: A case study in Xi'an. *China. PLoS One, 16*(12), Article e0258790. https://doi.org/10.1371/journal.pone.0258790

Zhao, Y., Lin, Q., Ke, S., & Yu, Y. (2020). Impact of land use on bicycle usage: A big data-based spatial approach to inform transport planning. *Journal of Transport and Land Use, 13*(1), 299–316. https://doi.org/10.5198/jtlu.2020.1499

Zheng, L., Meng, F., Ding, T., Yang, Q., Xie, Z., & Jiang, Z. (2022). The effect of traffic status on dockless bicycle-sharing: Evidence from Shanghai, China. *Journal of Cleaner Production, 381.* https://doi.org/10.1016/j.jclepro.2022.135207

Zhou, J., Lai, Y., Tu, W., & Wu, Y. (2024). Exploring the relationship between built environment and spatiotemporal heterogeneity of dockless bike-sharing usage: A case study of Shenzhen, China. *Cities, 155,* Article 105504. https://doi.org/10.1016/j.cities.2024.105504

Zhu, B. (2021). Consumer intention to adopt dockless bike sharing scheme in southern China based on value-attitude-behaviour model. *Asia-Pacific Social Science Review, 21*(2), 144–159. Scopus.

Zhu, L., Ali, M., Macioszek, E., Aghaabbasi, M., & Jan, A. (2022). Approaching sustainable bike-sharing development: A systematic review of the influence of built environment features on bike-sharing ridership. *Sustainability, 14*(10), Article 10. https://doi.org/10.3390/su14105795

Zhu, Y., Yang, Z., Feng, X., Cheng, C., Guo, Y., Li, Q., Wu, T., Li, X., & Witlox, F. (2025). Comparing built environment effects on bike-sharing and electric bike-sharing usage: A spatiotemporal machine learning approach. *Transportation Research Part A: Policy and Practice, 200,* Article 104642. https://doi.org/10.1016/j.tra.2025.104642

Zhu, Y., Zhu, Y., Diao, W., Hu, Z., & Hu, Z. (2023). Understanding users' perceptions of bicycle-sharing systems in Chinese cities: Evidence from Beijing and Guangzhou. *Urban Science, 7*(3), 95. https://doi.org/10.3390/urbansci7030095

Zhuang, C., Li, S., & Liu, X. (2025). Exploring socio-spatial differentiation in bike-sharing: A daily activity space analysis of cyclists across different socioeconomic statuses. *Applied Geography, 177,* Article 103536. https://doi.org/10.1016/j.apgeog.2025.103536