

Mobility as a service and gender: A review with a view

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ABSTRACT

The extent to which MaaS might contribute to gender equity in transport has been considered by some; however, the level of attention paid to the topic varies enormously, and there is significant variation in the data regarding how perceptions and use (or intended use) of MaaS systems might differ between men and women. This research reviews the MaaS literature published in academic journals and draws attention to where gender has been considered, what was found, and what this means for researchers, practitioners, and policymakers in their efforts to address gender inequity in transport. A document set of 420 peer-reviewed articles was analysed with respect to the perspectives taken (e.g., technology, user uptake and experience, business and governance) and the approaches or methods used (e.g., case studies, questionnaires, simulation). A series of questions adapted from the Sex and Gender Equity in Research (SAGER) guidelines were asked of each of the 171 articles that were identified as referencing gender in some way. The results and discussions of those works were considered together and framed in terms of the SWOT strategic analysis approach in order to highlight where and in what ways the fundamental nature of MaaS contributes to gender equitable mobility (strengths) or not (weaknesses), the potentially fruitful aspects on which MaaS might capitalise (opportunities), and the challenges and barriers to overcome, as well as the dangers to avoid, in the application of MaaS for gender equity (threats).

1. Introduction

Mobility as a Service (MaaS) is a term used to describe digital transport service platforms (i.e., smartphone apps) that enable users to access, pay for, and get real-time information on a range of public and private transport options, integrating 'traditional' transport options (such as ferries, buses, and trains), with on-demand services (such as ride hailing and lift share), support for active modes (such as walking and cycling), and access to electric shared mobility (such as eBikes and eScooters). No single definition exists, with Hensher et al. (2021a,b) providing one of the more recent and comprehensive definitions of MaaS; however, it is generally considered in terms of levels, with the lowest level of MaaS combining a journey planner with timetable data from different operators and services, higher levels including ticketing and subscription contracts, and the highest level also incorporating societal goals (Hensher et al., 2021a,b; Lyons et al., 2019; Sochor et al., 2018).

By offering travellers mobility solutions based on their journey needs on a trip-by-trip basis, MaaS contributes to its core aim of providing an alternative to using the private car that is as convenient, more sustainable, and cheaper in the long term. At least, this is the aspiration. In

practical terms, MaaS is an immature transportation concept, with relatively few and in the most part limited real-world schemes having been tested (Arias-Molinares et al., 2022). How MaaS will support the travel of different individuals or groups across settings is not yet clear. This is especially important given the extant inequalities in mobility. In this article, just one of those inequalities is the focus: gender.

Transport and mobility are gendered domains. Transport infrastructure has been designed predominately by men and (in the majority of settings) predominately for the benefit of users of private cars, a transport mode favoured by men (Parnell et al., 2022). Women are more likely to walk and use public transport and taxis (Ng and Acker, 2018), they are more likely to trip-chain (Scheiner and Holz-Rau, 2017), and they tend to make more short walking trips and make shorter trips overall (DfT, 2022). Women are also more willing to reduce their private car use (Polk, 2003, 2004) and are impacted differently by schemes intending to encourage the uptake of active and public modes (AitBihiOuali and Klingens, 2022). These patterns exist in high-, middle-, and low-income countries alike (e.g., Uteng, 2011) and have persisted for decades (e.g., Rakodi, 1991).

Among the various purposes and goals of Mobility as a Service (MaaS) described in the literature, one relates to improving access to

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Table 1
Categorisation scheme for the articles' perspective.

Category	Description
Routing and travel demand	Measuring, simulating, or predicting service demand, including vehicle routing and coordination, and optimisation and management of routing, demand, and/or transfers.
Definitions, business, and governance	Relating to how MaaS is defined and how it will impact or be impacted by business models, legal frameworks, policy, and governance structures
User uptake and experience	End-user focussed research exploring observed or reported behaviours, attitudes, experiences, and satisfaction, whether experienced or perceived/expected.
Technology and information architectures	Research concerning technology and/or information integration, security, privacy, and the structures of data systems and end-user apps
Impact assessment	Research assessing the impact of MaaS on society, including (but not limited to) emissions, resource and energy use, social cohesion, health, and economics

mobility, particularly for those currently under-served by traditional or existing transport systems (Durand et al., 2018). This has clear implications for gender equity, for example by improving access to mobility services not owned by the user and better supporting usage outside of the traditional commuting hours; however, although MaaS has the *potential* to contribute to gender equity (just as smart mobility does more widely; Singh, 2020), the extent to which this has been considered in the MaaS literature has not been explored. It is therefore unclear where MaaS-focussed researchers, practitioners, and policy makers might direct their efforts to address gender inequity, how novel MaaS schemes might be designed to best cater for the needs of women, and how MaaS offerings might be positioned to encourage uptake of sustainable mobility options in ways that reduce the transport gender gap.

The current research therefore reviews the state-of-the-art in the MaaS scientific literature since its first appearance in an academic article (Sochor et al., 2015; though I acknowledge that Sonja Heikkilä's master's thesis appeared before this, in 2014). Beginning descriptively with a broad view of all mentions of MaaS in academic publications, categorising the perspectives taken and the methods adopted, focus is then narrowed to explore where and how gender has been considered alongside MaaS, in terms of the results generated and the discussions presented by authors. The Strengths, Weakness, Opportunities, and Threats (SWOT) framework is then used to structure a discussion of the gender-related findings found in the MaaS literature in a way that is intended to facilitate strategic thinking in research, practice, and policy design. In doing so it is hoped that the potential for MaaS to contribute to gender equity in transport can be capitalised on, and the dangers of widening the gender gap can be avoided.

2. Review method

A search in Elsevier's Scopus for the term "Mobility as a Service" revealed 819 documents (as of 15/03/2023). In Clarivate's Web of Science, 587 results were returned from the same search. No other terms were searched. Results were refined by including only those articles published in journals, resulting in a document set of 463 peer-reviewed articles. These were screened to include only those written in English, relating to the MaaS transport concept, for which full text was available. Editorials were removed where they did not provide more than a summary of the papers published in a special issue; however, those that offered stand-alone contributions were retained. This resulted in a set of

Table 2
Categorisation scheme for the articles' approach.

Category	Description
Field data	Studies using real-world data, whether from MaaS trials or other transport use data
Questionnaires (choice modelling)	All questionnaire research that includes aspects of stated and/or revealed preferences in a choice modelling context
Questionnaires (all other)	All other questionnaire research (not involving choice modelling), including experiential, attitudinal, and behavioural, whether observed, self-reported, or projected
Hypothetical scenario	Explorations and discussions of possible future scenarios under different physical, technological, governance, social, or economic conditions
Stakeholder interview	Interviews with stakeholders at any level of the system, from current or potential end user through to management and policy
Focus groups and workshops	Focus groups and workshops with stakeholders at any level of the system, from current or potential end users through to those at management and policy levels
Modelling, simulating, and optimising	Research on optimising, simulating, and/or modelling any aspect of system behaviour (excl. choice modelling, see above), including algorithm development.
Case study	Application of article findings, modelling techniques, or analysis techniques to a real-world case study, or use of a case study to frame discussions
Review	A dedicated review of literature, academic or otherwise (beyond the summary of relevant literature expected in an article's introduction).
Other	Methods or article types not included under the above categories, including stand-alone editorials, notes to editors, discussion pieces, and research protocols.

Table 3
Questions used to categorise the extent to which gender is included and discussed in MaaS research.

Question	Description (Answered yes if...)
Has user or stakeholder data been collected or used?	The study has involved human participation, collecting data or using secondary data that has been collected from users, potential users, or stakeholders.
Has a sample breakdown been reported?	The study has reported the gender splits (i.e., percentage or proportion of females / males) of the sample.
Has gender been included in the analysis?	The study includes gender as a variable of interest, whether in mathematical models or in qualitative results.
Have results concerning gender been reported?	The study reports the numerical results of the inclusion of gender in the analysis (relevant to quantitative research only)
Have those results been described?	The study describes the impact or influence of or on gender, without further discussion (i.e., purely descriptive without critique, discussion of implications, or reference to literature).
Has gender been further discussed?	The study further interprets gender-related results in terms of their implications and/or relation to findings previously reported in the literature
Has gender only been included in discussion of others' work?	The study only includes discussions of gender in relation to the work of others (whether the study has collected/used human data or not).
Has gender been mentioned only in passing?	The study's mention(s) of gender is (are) not related to MaaS or mobility.

420 articles.

Those 420 articles were then categorised based on the domain of application (herein termed *perspective*; Table 1) and the type of article (herein termed *approach*; Table 2). The two categorisation schemes were developed iteratively from the literature itself and each article could be assigned to more than one perspective category and more than one approach category.

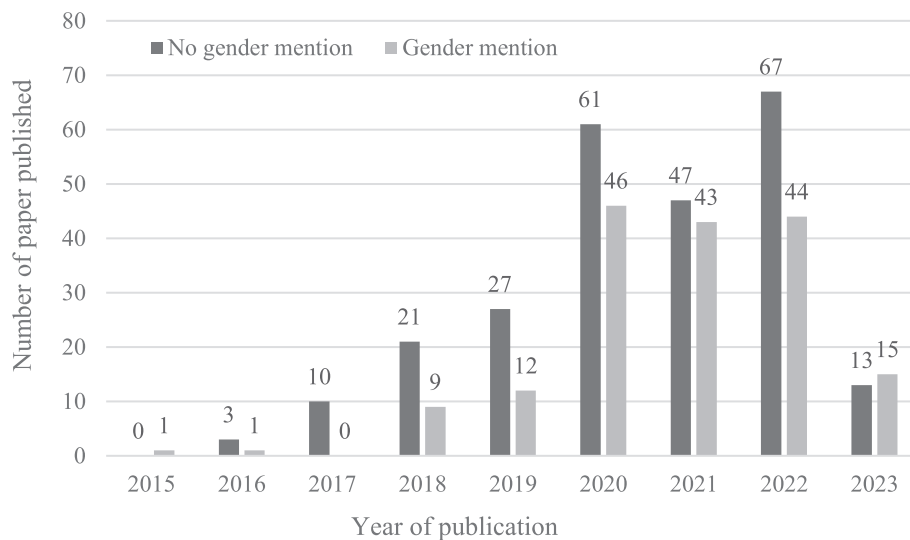


Fig. 1. Total number of MaaS journal articles published each year (as of 15/03/2023) referencing gender (light grey sections) or not (dark grey sections).

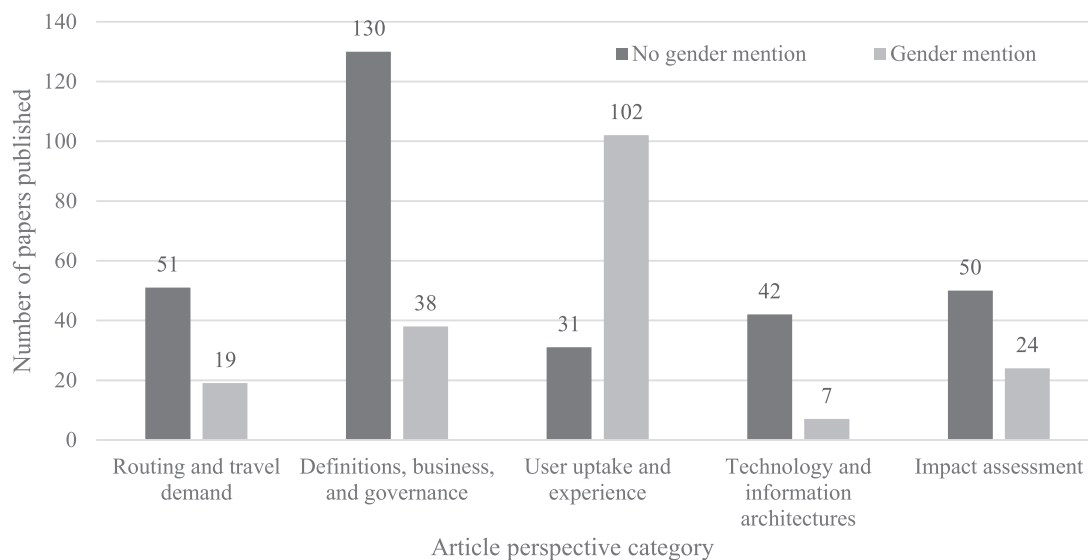


Fig. 2. Number of articles assigned each of the categories describing the research domain or perspective taken ('perspective').

Each article’s full text was searched for the terms “sex”, “gender”, “woman”, “women”, “man”, “men”, “female”, and “male”, with 171 articles identified as referring to gender in some way. A series of questions were asked of each article to categorise the extent to which gender was included as a research variable or topic of discussion. These are described in Table 3. The questions were based on research undertaken by the *Close the Data Gap: Gender Equity in Transport Research* working group (CtDG, 2022) on ensuring gender equitable practices in academic settings. Question wording was also informed by the Sex and Gender Equity in Research (SAGER) guidelines (Heidari et al., 2016), a comprehensive procedure for the reporting of sex and gender information in scientific publishing.

3. Results and discussion

3.1. MaaS research in numbers

The MaaS literature has grown rapidly since the first mention of the concept in the academic literature (Sochor et al., 2015), as can be seen in Fig. 1. That figure displays the number of publications that reference

gender (the light grey sections of the bars in Fig. 1) and those that do not (the dark grey sections).

Figs. 2 and 3 show the numbers of papers assigned each of the categories summarised in Table 1 and 2, i.e., the articles’ perspective (its domain of application; Fig. 2) and its approach (the type of article or methods used in the reported research; Fig. 3). These are again separated into those articles that reference gender and those that do not. The reader will note that the totals in the figures are greater than the total number of articles included. This is due to the possibility that a single article may take more than one perspective and use more than one approach (most were assigned just one perspective or approach category, with a maximum of four categories assigned to a single article).

3.2. The extent to which gender is considered

Figs. 2 and 3 provide a visual overview of the types of MaaS research that has been published to date. They also give an indication of the types of research in which gender is most often considered, with (perhaps unsurprisingly) end user focussed research featuring highly and technology and business or governance focussed work less so. Much of the

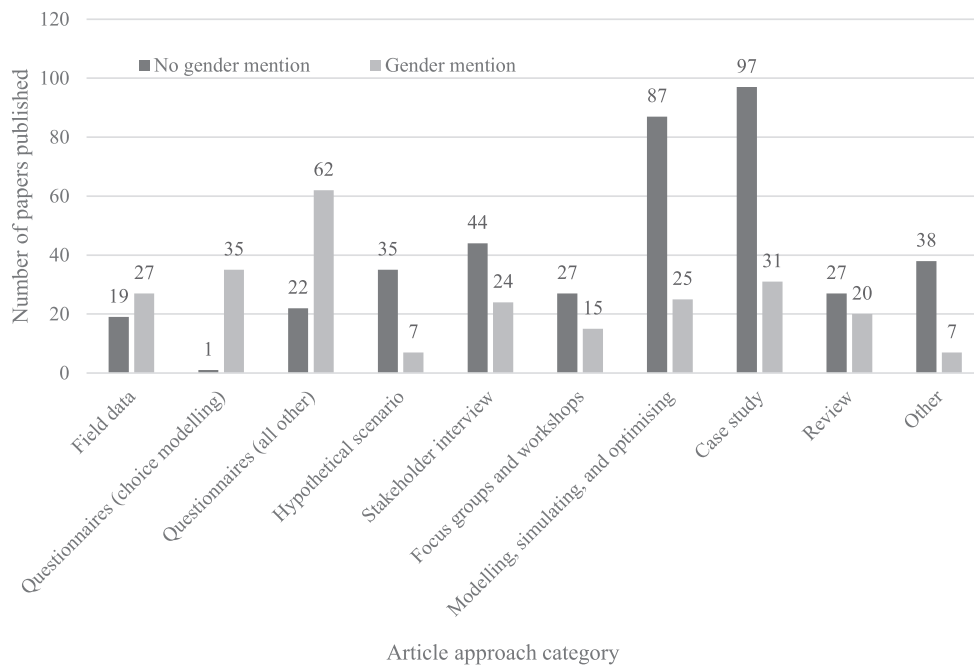


Fig. 3. Number of articles assigned each of the categories describing the methods used or the type of article presented ('approach').

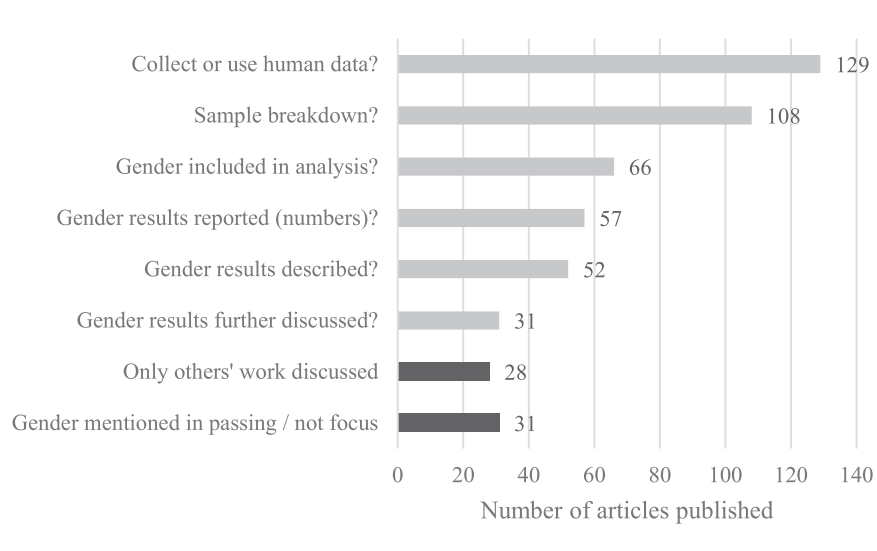


Fig. 4. Indicating the extent to which gender is discussed in the 171 articles referencing gender.

work referencing gender used questionnaires, with the papers using simulation and modelling or taking a case study approach dominating the research that makes no mention of gender. Regarding the extent to which gender is considered in those works, Fig. 4 displays the results of the questions asked (see Table 3) of each of the 171 articles that mention gender in some way. Note that answers to the first six questions give an indication of a progressively more detailed treatment of gender. For example, a study may collect user data, report the sample breakdown, and include gender in analyses without then reporting gender results, or it could then also provide the quantitative or qualitative results of gender analyses and then go on to make inferences, referring to literature or making some interpretation of why such results have been found. The last two questions were applicable to articles that may or may not have collected user or stakeholder data but whose reference to gender was tangential to the research or was not related to the data collected (e.g., only in an introduction section). In Fig. 4, below, these have been

shaded dark grey to distinguish them from the papers in which user data was used and/or gender was more central to the research.

Of these 171 articles, 31 only discussed gender in passing, meaning that although a search word was found within the text, the theme did not guide research design or focus, it was not included as a variable of interest, and was not central to discussions. In 28 articles, gender was discussed only in terms of the work of others, i.e., not in terms of results generated by the research described in the article. These works could have collected data from users (or potential users) or not. In seven cases, a gender-related issue was raised, but in a way not central to the research (e.g., “Women, poorer, and lower educated adults are more likely to be unbanked.” being the only mention in a discussion of societal implications of MaaS in lower income countries; Pangbourne et al., 2020a). These were categorised under both *Gender mentioned in passing* and *Only others' work discussed*. Four of the 28 articles in which gender featured only in discussions of others' research did actually use or collect user or

stakeholder data (Bastos et al., 2021; Biehl and Stathopoulos, 2020; Mulley et al., 2020; Savastano et al., 2023). In Savastano et al. (2023), customer generated and publicly available app reviews were analysed, with no information on gender available. The remaining three reported male/female sample splits but did not include gender as a variable in the analysis, referring to gender only in the introduction (i.e., when discussing the extant literature). One article (Tran and Draeger, 2021) specifically highlighted the lack of gender as a limitation, while another singled out gender as an issue of importance but one that could not be included due to sample size limitations (Johansson et al., 2019). Similarly, neither Mouratidis et al. (2021) nor Kubik (2022) focus on gender, but both highlight the issue as a necessary focus in future work.

Three studies were identified that did not use or collect user or stakeholder data but did offer discussions on gender. Loubser et al. (2021), in their discussion piece on potential MaaS users in a developing country, drew attention to the influence of gender on mode choice. They discussed gender differences in travel behaviours and then summarised the impact of gender on MaaS uptake thus far reported in the literature. Orozco-Fontalvo et al. (2022) offered a detailed summary of gender-related findings in the shared electric scooters literature, collating reported gender effects and pointing out that most e-scooter users are young, male, high-income adults. The article makes explicit mention of the gender gap several times. Similarly, in Zhang and Kamargianni's (2022) review of the factors influencing transport technology adoption, gender effects are highlighted several times.

Finally, it is worth noting that two articles reported analyses using simulated or synthetic populations (hence not user or stakeholder data in the sense described in Table 2 and Fig. 4). One of these included gender in analyses (without reporting sample splits or results; Knopp et al., 2021). The other gave a breakdown of the synthetic sample, including gender in analyses, and describing gender results in words (though without reporting numerical results; Agriesti et al., 2022).

Of the 171 articles, 129 collected or used user or stakeholder data. Of those, 21 did not report the number of men or women (or those not identifying as male or female) included as participants in their research. This is one of the simplest steps in reducing the gender data gap in transport research (Madeira-Revell et al., 2021) hence is a concerning omission. Of those 21, seven did subsequently include gender in analyses and results, after having omitted sample information, making conclusions difficult to draw.

In addition to those 21 articles, 62 of the 225 articles not referring to gender in any way did also involve research with human participants. Of those 62, 48 were categorised under the 'Definitions, business, and governance' perspective. In the very large majority of cases, the research involved stakeholder interviews, focus groups, or workshops to inform business model design, provide input into case studies, or to discuss policy or governance issues. Some might suggest that the gender of the respondents (typically business leaders or industry stakeholders) is unimportant in discussions of governance and business models pertaining to MaaS; however, I would argue that gender-blind politics cannot persist in a domain that is inherently gendered, impacting differently upon the everyday lives of women and men (Joelsson and Scholten, 2019).

3.3. Gender results in MaaS research

Of the 129 articles that report on the use of user or stakeholder data, 108 gave sample splits, 66 included gender in analyses, 57 reported numerical results, and 52 described gender results in the text. The findings of 51 of these articles (excluding Agriesti et al. (2022), where a synthetic sample was used) are summarised in Table A1 in the Appendix (it is not presented here due to its size).

The extent to which individuals have used MaaS (in real-world trials), report an intention to use MaaS (in behavioural and attitudinal questionnaire research), or demonstrate a willingness to pay for MaaS (in choice modelling questionnaires) are commonly studied outcome

Table 4
SWOT analysis main findings. See text for details.

	Positive for gender equity	MaaS unlikely to help
Inherent to MaaS	Strengths <ul style="list-style-type: none"> MaaS already supports women's current travel behaviours: <ul style="list-style-type: none"> Use public transport more. More likely to combine modes. Less likely to commute 'traditionally'. Aligns with women's higher environmental values. Aligns with women's lower value placed on car ownership. 	Weaknesses <ul style="list-style-type: none"> MaaS unlikely to counter entrenched division of family care and stereotyped societal roles. MaaS cannot take away all the difficulties associated with being 'encumbered'. MaaS is not about bike lanes (or other infrastructure). MaaS unlikely to change biases in desire to engage with vehicle technologies.
Potential for the future	Opportunities <ul style="list-style-type: none"> To capitalise on strengths and facilitate access to mobility modes and behaviours already favoured by women. Differences in MaaS package preferences imply that subscription models could be designed to reduce inequity. MaaS could help with perceptions of safety by including shared and on-demand services. In-app information on security and safety (safety from attack, safety from collisions) can help address mobility security issues. 	Threats <ul style="list-style-type: none"> Getting bundle design wrong could increase inequity. A focus on micromobility could favour men. MaaS could push women into less sustainable travel. MaaS uptake highly influenced by existing habits. Inappropriate technology (app) design could represent an additional barrier to women. Going for low hanging fruit (for mode shift) could be at the cost of equity.

variables in MaaS research. A potential challenge for planners and decision makers is that there is little consensus in the academic literature regarding these outcome measures. Where some research has suggested females to be more likely to adopt MaaS (e.g., Hasselwander et al., 2022; Caiati et al., 2020), others have suggested that males may be more likely to do so (e.g., Chmiel et al., 2023; Kim et al., 2021c; Ko et al., 2022). More common is the finding that gender has no impact on willingness to pay for MaaS or the propensity or intention to use it (e.g., Ho et al., 2018; Schikofsky et al., 2020; Weckström et al., 2018; Hoerler et al., 2020; Fioreze et al., 2019; Lopez-Carreiro et al., 2021b); however, differences in results across research applications are of interest, with inconsistencies even having been reported within a single article (i.e., with a greater intention to adopt MaaS found among females compared to males in Madrid, but no such differences in Randstad; Lopez-Carreiro et al., 2021a).

Not all the articles reporting gender-related results went on to discuss them in the text. Thirty-one articles did provide some further interpretation, offering detail on how findings compared to those reported elsewhere in the literature, and/or on the results' implications for research and/or policy and practice. Further to those 31 articles, two papers in which data from human participants were not used or collected also provide in-depth discussions of MaaS and gender: Orozco-Fontalvo et al.'s (2022) review of the literature on dockless eScooter use, and Loubser et al.'s (2021) work on a framework for a potential MaaS userbase. The discussions presented in these 33 articles have been considered together with the results reported in the 51 articles summarised in Table A1 (in the Appendix) in terms of a modified version of the SWOT (strengths, weaknesses, opportunities, threats) framework.

It is important to highlight at this point that all mentions of gender were in terms of females and males. There is a complete lack of reference in the MaaS literature to gender beyond this binary distinction. This

research gap is discussed to a greater extent in the limitations section to this article; however, the reader is also encouraged to consider the SWOT analysis results presented below in terms of non-binary gender identities.

3.4. SWOT analysis of MaaS for gender equity in transport

The SWOT strategic management framework typically identifies an organisation or system's internal factors in terms of strengths and weaknesses, with external factors considered in terms of opportunities for or threats to success. This review starts from the viewpoint that existing transport systems support men's mobility to a greater extent than women's (Parnell et al., 2022), and that the goal of attaining gender equity in transport is, in immediate and practical terms, a goal of better supporting women's mobility.

Given this starting point, this analysis considers the internal factors, i.e., the strengths and weakness of MaaS, as being what MaaS inherently *is* and *is not* in terms of its potential to contribute to gender equity in transport. In other words, how the basic MaaS idea already lends itself to improving gender equity in transport (strengths), and where MaaS alone is unlikely to have a significant impact (weaknesses). The external factors in this case are those factors which MaaS has the potential to capitalise on, or contribute towards (opportunities), and the barriers and challenges that must be overcome if MaaS is to be successful in reducing the transport gender gap (threats). There may well be more themes that could fit into each of the categories below; however, analyses are limited to only the results and discussions found in literature reviewed above. Table 4 summarises the main findings of SWOT analysis.

3.5. Strengths: How the MaaS concept already aligns with gender equity

The MaaS literature points to women being less car-orientated (Kim and Rasouli, 2022), more likely to use public transport (Bellone et al., 2021), and more likely to combine multiple modes into one journey (Polydoropoulou et al., 2020). Conversely, males have been found to be more car focussed (e.g., Alonso-González et al., 2020; Lopez-Carreiro et al., 2021a, b; Liljamo et al., 2021). This highlights an existing strength of MaaS insofar as it already facilitates women's current behaviours to a greater extent (i.e., facilitating those multi-modal, non-car-based trips), with private car use discouraged.

The reasons behind these differences are complex, relating to deeper issues of entrenched structures and norms, culture, power, and the division of care and labour (Parnell et al., 2022). In Crawford's (2020) work segmenting travellers based on their work-related travel behaviour (citing implications for MaaS), the uneven distribution of self-employment and home working between genders is discussed, as is the less frequent nature of women's work-related travel needs. Despite their increasing presence in the labour market, Crawford (2020) emphasises that women are still less likely to commute in the traditional sense. Narayanan and Antoniou (2023) also highlight differences in mobility patterns, drawing attention to the trip chaining behaviours more often exhibited by women. MaaS should take this into account, with the opportunity here being in supporting women's less structured travel patterns with greater trip-planning support and better integration of different transport services.

MaaS may also appeal more to women's values (or at least to people with the values that are more common among women). Finding that woman report a greater propensity to subscribe to MaaS, Caiati et al. (2020) suggest that the gender difference "could be related to the fact that women tend to have a greater pro-environmental responsibility". Another potential explanation relates to differences in values attached to car use and ownership (Hasselwander et al., 2022; also posited by Caiati et al., 2020). The greater value males attach to private car ownership, and their greater propensity (or desire) to drive fast and take risks (Bellone et al., 2021; likely related to sensation seeking; Jonah, 1997), may act as a barrier to MaaS-facilitated sustainable travel. For women, this may

represent a route to the synergistic benefits to gender parity and decarbonisation that arise from mode choice, vehicle purchase decisions, travel times, and travel distance (Ng and Bassan, 2022).

Qiao and Yeh (2021) cite lower individual income as a factor for lower private car ownership among women. This has implications for MaaS insofar as women rely to a greater extent on other means of travel. Qiao and Yeh (2021) distinguish between the needs of women living in central versus peripheral areas of a city, stating that for women living in the outskirts, ride hailing services have "the potential to provide them an additional option to access broader life service and work opportunities as a possibility of extending activity space". These types of services are not always included within MaaS schemes; however, by including them, MaaS can preferentially support women's mobility.

3.6. Weaknesses: Where MaaS is unlikely to help

Mobility as a Service alone is unlikely to impact dramatically upon entrenched norms and practices. Louber et al. (2021) point out that females tend to travel shorter distances "because they are more likely to travel for shopping purposes or taking children to school". Qiao and Yeh (2021) cite gender differences in the usage of the household car (as well as ownership patterns) as a reason for women's greater ride-hailing use in peak hours. The allocation of the car to the male member of the household is discussed as relating to stereotypes such as males being better drivers or having jobs requiring more car driving, with women more likely to be employed and undertake non-work activities closer to their home (Qiao and Yeh, 2021). It is hard to imagine how MaaS will contribute to changing these stereotyped views or how it would impact upon the unequal division of care in the family setting (or, indeed, whether it should).

Cooper and Vanoutrive (2022) specifically address the family roles issue in their research with mothers of children under 12. They discuss the need to carry additional baggage or equipment when travelling with children, the need to carry this equipment up and down stairs and the reliance on help from strangers (e.g., at rail or metro stations), and the physical effort associated with such trips (compared to when using the private car). Cooper and Vanoutrive (2022) also point to constraints around arrival times (at school or day care, for example) and the greater impact of service disruption on family travel, in terms of the risk of getting stranded somewhere with small children. Although MaaS has the potential to provide information about some of these issues (e.g., informing the user, in real time, of vehicle delays), it is again hard to imagine how a MaaS system alone (without wider system reform) will reduce the physical barriers to use of active, public, and multi-modal travel with small children.

Improvements to infrastructure are likely to be required to overcome such barriers, a point highlighted by Matyas (2020) in an interview study. In that work, female interviewees expressed safety concerns when discussing cycling in London. Matyas cited research pointing to the importance of cycle tracks and separated cycle lanes for improving women's perceptions of safety. This is outside the scope of a MaaS system.

MaaS is not inherently about electric mobility; however, the two have been considered together in the literature several times (e.g., Hensher et al., 2022; Brezovec and Hampl, 2021). Indeed, one of the first uses of the term "mobility as a service" appeared in a report on electric mobility (Alku and Kosonen, 2012). The MaaS literature points to a difference in the way women and men value such technology. Khattak and Khattak (2021) reported a gender bias in using alternative fuel vehicles, Corazza and Carassiti (2021) found that males are more familiar with electric mobility, and Alonso-González et al., (2020) categorised more males as 'technological car-lovers' than females. Relatedly, Narayanan and Antoniou (2023) cite rejection of technology as a potential reason for women's lower propensity to use shared mobility. Although a MaaS app may facilitate more equal access to such vehicles and technologies, it is not realistic to expect MaaS in isolation to address biases in

the desire to engage with these technologies.

3.7. Opportunities: What MaaS could do right

Inconsistencies in reports of men's and women's propensity to use or willingness to pay for MaaS do little to guide strategy. Nevertheless, [Loubser et al. \(2021\)](#) suggest that although the extent to which MaaS will be used will not differ between males and females, differences may exist in the way in which it is used. The specifics of the packages or subscription models on offer will therefore matter. This is where the opportunity therefore arises; to design MaaS packages that reduce gender inequality in transport. This conclusion is lent support by evidence provided by [Matyas and Kamargianni \(2021\)](#), who found gender to influence the type of MaaS package preferred (with packages varying in terms of cost and the levels of active, public, and shared transport included in the subscription models presented to participants). That said, it is worth pointing out that [Krauss et al. \(2023\)](#) found gender to have no impact on bundle preferences.

In their work on tourists' MaaS preferences, [Kim et al. \(2021b\)](#) found women to prefer shared vans and taxis and men to prefer buses. Kim et al. suggested that women's preference for private modes may arise from women experiencing greater feelings of discomfort when sharing with strangers. A similar explanation can also be found in [Suatmadi et al.'s \(2019\)](#) MaaS-focussed research on the use of motorcycle taxis in Indonesia. They found women to be more likely to switch from public transport to motorcycle taxi use, explaining their finding in terms of safety perceptions of public transit ([Suatmadi et al., 2019](#)). [Wang et al. \(2022\)](#) also cited women's safety concerns to explain their finding that females were less likely to use mobility on demand services: "*transportation agencies should consider measures to improve the sense of safety among females.*"

The opportunity for MaaS here is in the inclusion of security information in the customer-facing app (e.g., about services, stations and stops, and the approaches to stations and stops). Such information could be drawn from existing sources such as those that collect end user input on women's perception of safety (e.g., the Safetipin app, available in 65 cities across 16 global south countries: safetipin.com). Alternatively, a MaaS app could collect this data itself, and then present it back to users through its route recommendations. There may also be potential to pair a MaaS app with apps designed to support women's personal safety, or to incorporate women-focussed safety features within the app itself (such as periodic check-ins, face-to-face assistance, and automatic notification of emergency contacts, e.g., [Tozzo et al., 2021](#)).

Although [Kim et al. \(2021b\)](#) specifically discuss discomfort with strangers as the safety concern, [Suatmadi et al.](#) and [Wang et al.](#) do not make explicit the distinction between the safety (or security) of interacting with other people and safety in terms of collision risk. Although one might assume that it is the former (given the way in which comments are made in those publications), the latter is also of importance, as highlighted by [Matyas' \(2020\)](#) research into perceptions of safety when cycling or driving in London. That research is discussed above in terms there being little that a purely digital MaaS offering could do to allay safety fears associated with a specific route. Nevertheless, there is potential for MaaS to offer 'safe' and 'comfortable' route options (for, e.g., hired cycle trips, or routes to or from train stations) alongside suggestions for the fastest, cheapest, or most energy efficient routes. This is not a new concept, with 'safe' route-finding the focus of several research works (see [Sohrabi et al., 2022](#), for a review). Combining with a MaaS app therefore represents a significant opportunity.

[Cooper and Vanoutrive's \(2022\)](#) work with mothers of children under 12 was discussed above in terms of a weakness of MaaS (insofar as MaaS cannot completely remove the difficulties involved in encumbered travel). MaaS nevertheless does have the potential to facilitate such travel. [Cooper and Vanoutrive \(2022\)](#) themselves discuss the high value women place on access to car-sharing options as this supports the kind of flexibility required when undertaking complex trips with children. They

also highlight the potential for family-oriented bike-share to support women's mobility. Given evidence that families benefit from the inclusion of electric cargo bikes in MaaS ([Smith et al., 2022](#)), this represents a real opportunity for sustainable, gender-equitable travel. [Narayanan and Antoniou \(2023\)](#) go further to recommend females in families (and other care givers) be offered monetary incentives (such as special rates) to support their more complex travel patterns. This could be linked with care giving settings. Corporate MaaS is a MaaS scheme linked with a specific employer and has shown promise in the literature ([Hesselgren et al., 2020](#)); perhaps this idea could be extended to care settings and schools to develop a form of 'family MaaS'.

3.8. Threats: What MaaS must overcome or avoid

MaaS can include any combination of various public, shared, and private transport services. The extent to which these services are included in a MaaS offering can have a significant impact on overall uptake and on the extent to which it contributes to or threatens transport gender equity. For example, micromobility (including e-scooters as well as shared bikes and e-bikes) can contribute to car trip reductions in cities ([Meroux et al., 2022](#)) and aligns well with the goals of MaaS. It is therefore a common inclusion of MaaS schemes; however, some MaaS literature points to gender differences in the way these options are likely to be taken up. [Orozco-Fontalvo et al. \(2022\)](#) summarised research that consistently showed males to be more likely to use e-scooters, and [Corazza and Carassiti \(2021\)](#) found women to report owning a micromobility mode to a lesser extent and to report a lower preference for MaaS bundles that contained micromobility options.

Although cycling is also male dominated (e.g., [Grudgings et al., 2021](#)), the MaaS literature on this is mixed. [Jang et al. \(2021\)](#) found women to include shared e-bikes in subscription models to a greater extent than males; however, the details are important, as the design of the subscription model itself (i.e., the bundles on offer) influence women's propensity to select bike share ([Feneri et al., 2022](#)). Women are more sensitive to travel time increases in the selection of bike share, with trip duration increases having a greater impact on women's choice to cycle ([Feneri et al., 2022](#)).

Ensuring the most successful bundle design and presenting the most suitable information for encouraging low-carbon trips will be especially important given the potential for MaaS to push women into making less sustainable journeys. As mentioned above, [Suatmadi et al. \(2019\)](#) found women in Indonesia to be more likely to switch from public transit to private motorcycle taxis when given the option. Relatedly, [Kim et al. \(2021b\)](#) found women to prefer smaller shared vans or private taxis whereas men preferred buses, citing discomfort with strangers as a potential reason (though note [Acheampong and Siiba's \(2020\)](#) contradictory finding that highlighted males are more likely to participate in car sharing). Additionally, [Dzisi et al.'s \(2021\)](#) found that women tend to perceive the service quality of minibus taxis in Ghana as lower than men. This may exacerbate the issue.

Explorations of ride hailing (as part of MaaS) also provide us with mixed results. While [Corazza and Carassiti \(2021\)](#) found women to prefer this option and [Qiao and Yeh \(2021\)](#) found women to use it more than males, [Wang et al. \(2022\)](#) found women less likely to use such services, and [Bhaduri and Goswami \(2022\)](#) found women to perceive ride hailing as less useful. There may be some perceived safety benefits of including ride hailing in MaaS; however, doing so without compromising potential sustainability benefits represents a challenge for MaaS.

Another challenge for MaaS are existing habits and practices. [Liljamo et al. \(2020\)](#) found gender to have little impact beyond current mobility habits on willingness to pay for MaaS. This was also found by [Lopez-Carreiro et al. \(2021a, b\)](#): "*travel habits and attitudes towards transport modes are stronger predictors for the uptake of MaaS than sociodemographic variables (e.g., gender, age or education level).*" [Kim et al \(2021a\)](#) found that females who currently use public transport have different preferences to females who currently use the car, arguing that "*preference for*

transportation modes is heterogeneous depending on peoples' habitual travels, even if they are of the same socio-demographics".

It may be that MaaS can contribute to the formation of new habits and thereby support a transition to more sustainable and more equitable mobility; however, strong incentives (beyond providing joined up ticketing and journey planning) may be required to help people make the initial move away from the private car and towards multi-modal travel. This will be especially important for women given they have been shown to be later adopters of MaaS systems compared to men (Keller et al., 2018).

This latter issue may stem from differences in the ways in which men and women interact with technology, a factor highlighted by Ye et al. (2020). Huang (2022) also focussed on this issue, finding women to report lower experience with and knowledge of data systems. Although Aman and Smith-Colin (2022) found no differences in satisfaction with a particular MaaS app (suggesting the issue to be complex with significant scope to expand the knowledge base in this regard), these issues need to be considered when designing MaaS, in terms of the app's interface, the services offered, and the way it is publicised and advertised. Therein lies the challenge; to ensure the user-facing technology on which MaaS rests does not present a greater barrier to women than to men. The extent to which this is a factor of importance will likely depend on the setting in which a MaaS scheme is rolled out, with significant global variety in digital literacy rates among men and women (GSMA, 2021; Wiley, n.d.).

A final threat to consider is evident in Ko et al. (2022) and Gössling et al. (2023). Ko et al. (2022) suggest that policymakers might focus on those more willing to use services (to use limited resources most efficiently). Notably, they found that males were more likely to use integrated transportation services. This implies that policymakers should focus on further supporting male users (or potential users). Similarly, Gössling et al. (2023) suggest that males represent a suitable target group for autonomous transport services as it is males that report a higher likelihood of using those services. The danger for MaaS is that by focussing on those currently more predisposed to using a given service we miss the opportunity to change the views or habits of those that currently are not. To combine metaphors, by going after low hanging fruit we may end up preaching to the converted, and in so doing perpetuate the gender differences (and miss the sustainability benefits) that MaaS (in combination with other systems reforms) has the potential to address.

4. Limitations and future work

As briefly mentioned above, a notable limitation of the MaaS literature is the omission of any consideration of gender beyond the binary male/female distinction. This omission reflects a wider lack of transport and mobility research with gender diverse individuals and groups. The research that does exist largely focusses on the challenges and barriers faced by LGBTQ+ travellers on public transport, particularly in terms of the harassment, discrimination, and violence they face (e.g., Lubitow et al., 2017, 2020; Weintrob et al., 2021), and how this impacts mobility justice (Shakibaei and Vorobjovas-Pinta, 2021).

Given that some of the challenges identified in that research are similar to those faced by women (resulting in heightened fear in public spaces) we might expect opportunities for MaaS in this area to be similar (e.g., in providing safety information and easy access to ride-hailing services). There are also likely to be differences, however, with the impact of traditional gender roles (e.g., the female acting as primary care giver to dependent relatives) on transport inequalities an aspect that may manifest differently in LGBTQ+ individuals or groups. Just as MaaS presents a potential facilitator of male and female gender equity in transport it may also do so for non-binary individuals; however, targeted research in this area is needed for their voices to be heard. This represents a major avenue for future research on MaaS and on shared and smart mobility more generally.

A limitation of this review is that it includes only academic

publications. A detailed review of different types of literature was not within the scope of the research presented above; however, it is important to acknowledge at least some of the work reported outside of academic channels. Although discussions of gender and MaaS together are not yet forthcoming in the grey literature, there is a relative wealth of material on gender and transport more broadly, with reports on the topic published by the International Transport Forum (e.g., Ng and Bassan, 2022; Duchène, 2011), the World Bank (e.g., Babinard et al., 2010; Kurshitashvili et al., 2022), the Asian Development Bank (ADB, 2013), and many other governmental and non-governmental organisations (e.g., DfT, 2012; Muhoza et al., 2021). Expand the search to the popular media and one can find reports that deal expressly with how MaaS might contribute to gender parity (or inequity) in transport (e.g., Catulli, 2022; Kalms, 2019), with some of the issues discussed in those works also considered in this review. MaaS is gaining traction beyond the academic domain and it would be both interesting and potentially enlightening to analyse the way it is discussed in different publication types, for example via media content analysis (Macnamara, 2005).

A potentially influential factor that has not been explored in this review is the setting in which the research was undertaken. Lopez-Carreiro et al.'s (2021a) finding of a greater intention to adopt MaaS among females compared to males in Madrid, and no such difference in Randstad, gives an indication of the potential impact of context on the relationships between MaaS and gender. Table A1 (in the Appendix), which summarises the work that reports gender-related results, lists the countries in which the research was undertaken. Mirroring broader biases towards Europe and North America, these two regions are over-represented in MaaS research; however, one can find studies of MaaS outside of these regions (e.g., Acheampong and Siiba, 2020; Bhaduri and Goswami, 2022; Dzisi et al., 2021; Gandia et al., 2021; Suatmadi et al., 2019). That said, there is a conspicuous lack of work making any type of cross-cultural comparisons (Lopez-Carreiro et al. (2021a) being the exception).

It is possible that some of the differences in results across articles could be indicative of cross-country differences. For example, Matyas and Kamargianni (2021) found gender to influence the type of MaaS package in the UK whereas Krauss et al. (2023) found gender to have no impact on bundle preferences in Germany. There are, however, many potential factors at play. Not only is the country within which research undertaken likely to be an influential factor, but the specific population of study within that country is also likely to affect results. For example, research undertaken with student-based samples taken from university areas (e.g., Merlin et al., 2022) is likely to highlight different factors compared to research focussing on older, more rural populations (e.g., Gössling et al., 2023). To make a detailed exploration of these complexities is beyond the scope of this review; however, given the importance of culture on stereotypes, social roles, identity, and mobility, this represents an interesting, very broad, and likely fruitful avenue for future work.

In this review, the focus has been on gender equity at the level of those that use transport services. We must also strive for gender equity at the level of those that plan transport services, i.e., in the wider MaaS developer ecosystem and in policy and governance structures. Although less attention has been directed to these levels, the lack of women working in the transport sector is a long-recognised issue (e.g., Turnbull, 2013). As was shown above (see Fig. 2), a significant amount of the extant MaaS literature has taken a business and governance perspective (being the category to which the largest number of articles was assigned). Only 38 of the 168 articles taking this perspective mention gender in some way, yet many more than those 38 included human participants in the research (as, e.g., interviewees or survey respondents).

There is an over-representation of males in decision making roles across countries and domains (Profeta, 2017), with the pay gap especially pronounced in the transport sector (Christen, n.d.). Given the worrying data bias towards men (Criado Perez, 2019), reporting sample

demographics in studies involving decision makers in transport would be a small but important, and very easy step towards gender equity in transport research. Moreover, the extent to which women are represented in MaaS governance may or may not mirror women's broader involvement in transport planning (or general lack thereof). To this author's knowledge, this issue has not been explored or discussed in the MaaS literature. Given the potential for MaaS to impact upon gender equity, this represents a major limitation to the literature and an important avenue for future study and advocacy.

It is worth re-iterating that this research has focussed only on the findings and discussions presented in the literature reviewed here, and only on those findings that pertain to gender in some way. There are many other topics that will impact upon and/or be impacted by MaaS that have been considered in the literature but not included here (for example the impact of Covid, e.g., [Hensher, 2020](#); [Lindberg et al., 2022](#)). Further, the literature reviewed above is only that which explicitly discusses mobility as a service (i.e., that contained the search term "mobility as a service"). This excludes the wider (and very large) body of literature on smart and shared mobility. There are many ways in which smart or shared mobility and MaaS will impact gender equity in transport that have not been discussed above (see, e.g., [Singh, 2020](#)). One of the most pertinent of these is cost. Financial barriers to the use of shared mobility systems disproportionately impact low-income groups ([Kodransky and Lewenstein, 2014](#)). With women earning less than men (on average) this has clear gender equity implications. Despite the assertion by some MaaS proponents that it represents a cheaper alternative to private car ownership, the issue is complex and highly dependent on an individual's travel patterns ([The Nexus, n.d.](#)). The cost issue has been touched upon in the MaaS literature ([Mola et al., 2020](#)), but not in terms of gender, hence represents an avenue for further study.

5. Conclusions

This review of the academic MaaS literature published since the first mention of the concept in an academic article ([Sochor et al., 2015](#)) has provided an overview of the domains of study, or the perspectives of MaaS taken, as well as the types of methods used to investigate it. Further, it has shed light on the extent to which gender is considered in that research. Although there appears to be no consensus yet on whether females or males will use MaaS to a greater or lesser extent (and indeed there may never be consensus, given the multiple and complex factors of influence), there is agreement that usage will likely differ.

The MaaS literature in which gender was referenced was considered in terms of the SWOT framework in order to provide insight into how and where MaaS might contribute (or not) to gender equity in transport. A strength of MaaS is in the way it is already suited to supporting women's travel patterns (accepting the significant variation therein) through its focus on multi-modal, non-car travel. A weakness of MaaS is in its limited ability to address the broader social and cultural norms that underly the differences in the way women and men travel. It is also outside of the scope of MaaS (hence expressed here as a weakness) to bring about the improvements to infrastructure that would contribute to improved perceptions of security and safety, particularly for women.

Nevertheless, there is a significant opportunity for MaaS in the provision of information to overcome some of those security and safety barriers, for example through offering safety ratings for suggested routes or the environments they travel through. A MaaS app could also offer a platform to combine mobility options with features found in dedicated women's safety apps. The threats, or challenges, for MaaS and gender include the care that will need to be taken with subscription package or bundle design and the inclusive design of the technology itself. MaaS will also need to avoid the risk of encouraging a shift towards less sustainable travel. Finally, there is a danger that by focussing on the journeys that are easier to move from car to active or public transport (many of which are typically taken by men), MaaS could contribute to increased gender inequity in transport.

Table A1

Summary of gender-related findings in MaaS studies. Results are numbered where more than one distinct gender-related finding was reported (they do not imply order or importance).

Article	Data type	Study location	Results
Ditmore and Deming (2018)	Questionnaire	USA	<ol style="list-style-type: none"> 1. Females experience greater stress associated with commuting 2. Males get greater stress-reduction benefits from changing from driver to passenger in a ride share compared to females 3. Females' stress levels more affected by commute distance than males' stress levels
Ho et al. (2018)	Questionnaire	Australia	Gender has no impact on MaaS subscription propensity
Keller et al. (2018)	Questionnaire	Germany	Females are later adopters of MaaS systems compared to males
Weckström et al. (2018)	Questionnaire	Finland	No gender differences in MaaS uptake
Fioreze et al. (2019)	Questionnaire	Netherlands	No gender differences in intention to use MaaS
Suatmadi et al. (2019)	Questionnaire	Indonesia	<ol style="list-style-type: none"> 1. Majority of motorcycle taxi users are female 2. Females more likely to switch from public transport to motorcycle taxi use.
Acheampong and Siiba (2020)	Questionnaire	Ghana	Females are less likely to participate in car sharing
Alonso-González et al. (2020)	Questionnaire	Netherlands	Males over-represented in more car-focussed user segments
Caiati et al. (2020)	Questionnaire	Netherlands	<ol style="list-style-type: none"> 1. Females more likely to subscribe to MaaS 2. Ride sharing more likely to be chosen by females 3. Males more likely to subscribe to e-car sharing
Crawford (2020)	Questionnaire	UK	<ol style="list-style-type: none"> 1. Females are more likely to travel infrequently 2. Males are more likely to travel to a variety of places for work 3. Females have less variability in the times they travel to work
Hoerler et al. (2020)	Questionnaire	Switzerland	No gender differences in intention to use MaaS
Liljamo et al. (2020)	Questionnaire	Finland	<ol style="list-style-type: none"> 1. Males report greater expenditure on mobility 2. Gender does not influence a person's awareness of their current mobility expenditure 3. Absolute willingness to pay for MaaS differs between males and women, but this is accounted for by gender differences in current mobility expenditure

(continued on next page)

Table A1 (continued)

Article	Data type	Study location	Results
Matyas (2020)	Interviews	UK	Females express safety concerns to a greater extent, particularly in relation to cycling and interacting with car drivers
Merkert and Beck (2020)	Questionnaire	Australia	Females more willing to pay for an integrated bus and air travel service than men
Pangbourne et al. (2020b)	Questionnaire	UK	Gender has no impact on the perception of persuasiveness of messages aimed at encouraging walking
Polydoropoulou et al. (2020)	Questionnaire	UK	Females are more likely to be predisposed to combining multiple modes of transport into one journey
Schikofsky et al. (2020)	Questionnaire	Germany	No gender differences in intention to use MaaS
Ye et al. (2020)	Questionnaire	China	The ease with which people report using information systems influence females' intention to adopt MaaS but not males'
Zijlstra et al. (2020)	Questionnaire	Netherlands	Mixed results (inconclusive)
Bellone et al. (2021)	Questionnaire	Finland, Estonia, Norway, Poland	1. Females use public transport more than males 2. Females report better experiences on public transport than males
Corazza and Carassiti (2021)	Questionnaire	Italy	1. Females report "errands" as a travel purpose more so than males 2. No gender differences in car ownership rates 3. Females less likely to own a micromobility mode 4. Males more familiar and experienced with electric and shared mobility 5. Females state greater willingness to learn about electric and shared mobility 6. Females report using ride-hailing services to a greater extent 7. Females have preference for MaaS bundles comprising 'traditional' modes (including buses, parking, and ride-hailing), with males more willing to use paratransit and micromobility
Dzisi et al. (2021)	Questionnaire	Ghana	Females perceive the quality of minibus taxi services to be lower compared to males
Hensher et al. (2021a, b)	Questionnaire and travel data	Australia	1. Males more likely to choose pay-as-you-go for MaaS (versus a subscription model) compared to females

Table A1 (continued)

Article	Data type	Study location	Results
Ho et al. (2021)	Travel data	Australia	2. Males drive fewer kilometres per month than females Males more likely to choose pay-as-you-go for MaaS (versus a subscription model) compared to females
Jang et al. (2021)	Questionnaire	Netherlands	Females include shared e-bikes in MaaS subscription models to a greater extent than males
Khattak and Khattak (2021)	Questionnaire	USA	Males are more likely to use shared alternative fuel vehicles
Kim et al. (2021a)	Questionnaire	Korea	Females less likely to adopt multi-modal MaaS plans Gender effects are dependent on current travel habits: Female drivers more likely to be punctual compared to males, but female public transport users less likely to be punctual. Female drivers show a lower preference for intermodal options compared to males, but female public transport user show a higher preference for intermodal options compared to males
Kim et al. (2021b)	Questionnaire	Korea	Females prefer shared taxis or vans over buses; males report the opposite pattern.
Kim et al. (2021c)	Questionnaire	Korea	Males more likely to adopt MaaS
Liljamo et al. (2021)	Questionnaire	Finland	Females report a lesser need or desire to own a car across hypothetical mobility scenarios
Lopez-Carreiro et al. (2021a)	Questionnaire	Spain, Netherlands	1. Males report higher private car modal share use 2. Females report greater intention to adopt MaaS in Madrid, with no difference in Randstad
Lopez-Carreiro et al. (2021b)	Questionnaire	Spain	Gender has no impact on intention to adopt MaaS
Matyas and Kamargianni (2021)	Questionnaire	UK	Males most likely to purchase MaaS mobility packages, though females may be interested in exploring smaller MaaS packages
Qiao and Yeh (2021)	Travel data	China	1. New developments have a higher male population than inner city areas 2. Neighbourhoods with higher proportions of females use more ride hailing services during morning and afternoon peaks
Song et al. (2021)	Questionnaire	China	Segmentation of traveller types based in part on gender, with males linked with a preference for cars,

(continued on next page)

Table A1 (continued)

Article	Data type	Study location	Results
Aman and Smith-Colin (2022)	Customer app review analysis	USA	higher income, and greater sensitivity to travel time but lower sensitivity to cost 1. No gender differences in satisfaction with mobility apps 2. Women less engaged, but more satisfied with trains than men 3. Women rate their walking experiences more negatively 4. Fare and MaaS app issues more important for men than women
Bhaduri and Goswami (2022)	Questionnaire	India	1. Women report lower perceived usefulness of ride hailing services 2. Women report lower propensity to use ride hailing services
Cooper and Vanoutrive (2022)	Interviews	Belgium	Reveals experiences of mothers in Brussels and the lack of support by Brussels MaaS offering for their needs
Feneri et al. (2022)	Questionnaire	Netherlands	1. Subscription model design influences females' propensity to select bike share. 2. Females are more sensitive to journey time increase when considering bike sharing
Hasselwander et al. (2022)	Questionnaire	Philippines	Females report a higher intention to use MaaS
Huang (2022)	Interviews and questionnaire	Norway	Women report lower experience and knowledge about information privacy and data security than men.
Kim and Rasouli (2022)	Questionnaire	Netherlands	1. Females are less likely to have a car-orientated modality style 2. Females are more likely to be involved in non-routine leisure, social, and shopping activities
Ko et al. (2022)	Questionnaire	Korea	Males report a higher intention to use MaaS
Li et al. (2022)	Questionnaire	China	Males choose public transport over ride sharing more so than females
Paweloszek (2022)	Customer app review analysis	Poland	1. Females underrepresented in car-sharing scheme 2. Women rate car-sharing app and services more highly
Wang et al. (2022)	Questionnaire	USA	1. Females are less likely to use mobility-on-demand services 2. Females are less likely to use shared mobility
Chmiel et al. (2023)	Questionnaire	Poland	Men use MaaS to a greater extent
Gössling et al. (2023)	Questionnaire	Germany	1. Men more interested in autonomous transport services (ATS) and more likely to use ATS when they

Table A1 (continued)

Article	Data type	Study location	Results
Krauss et al. (2023)	Questionnaire	Germany	can no longer drive (in older age) Gender has no impact on MaaS bundle preferences
Narayanan and Antoniou (2023)	Questionnaire	Spain	1. Males more likely to use bike and car share 2. No gender difference in ride hailing
Soria et al. (2023)	Questionnaire and transit data	USA	1. Women more likely lapse in transit ridership (due to Covid) 2. Women less likely to return to transit ridership in future 3. Women have more limited access to household, private vehicles

CRedit authorship contribution statement

Rich C. McIlroy: Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing.

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.

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Appendix

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