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An Integrated Toolkit for Equality in Daily Urban Mobility in Saudi Arabia: Advancing Gender Mobility Indicators

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ABSTRACT

The significance of unimpeded mobility in everyday activities, including commuting, shopping, and social interactions, cannot be overstated. However, many people, particularly women, face challenges that restrict their ability to move freely because of various circumstances, such as gender-related concerns and socio-economic inequalities. The absence of a well-defined framework and comprehensive indicators for addressing gender-related mobility concerns is a notable challenge in the Kingdom of Saudi Arabia (KSA) and other similar regions. This article comprehensively analyses several mobility indicators and dimensions from diverse literature, specifically emphasizing their applicability in promoting gender equality in urban mobility within the Kingdom of Saudi Arabia (KSA). A comprehensive framework is established through rigorous analysis and comparison, taking inspiration from the "Four A's" concept introduced by the World Bank in 2020. The approach offers valuable help in navigating the complex interplay between gender dynamics and urban mobility. The comparison underscores the significance of including privacy, security, availability, and diversity of public transportation indicators in the toolkit. This inclusion is necessary to address the unique requirements, safety considerations, and cultural contexts of women when designing public transportation systems. The primary objective of these initiatives is to advance gender equality in the context of urban transportation in Saudi Arabia.

Index-words: *SDGs, Goal 5, Goal 11, Gender Equity, Urban Design, Mobility Pattern, Travel Behavior, Saudi Arabia.*

I. INTRODUCTION

About 53% of the global population lives in cities, a steadily increasing trend. Projections suggest this proportion could reach 67% by 2050. Urban travel accounts for 64% of all journeys and is expected to triple by 2050 [1]. Women comprise 50% of the world's population, occupy many jobs, and head one-third of families [2].

Population growth and rising travel demand cause mobility difficulties, including changing travel patterns and higher expectations for efficient, convenient, and dependable services. Schafer and Victor (2000) state that Goal #11 of the U.N. Sustainable Development Goals (SDGs) emphasizes safe, inclusive, and sustainable urban settings. Gender equality is a significant issue, especially in the context of the SDGs. Goal #5, "Gender Equality" [3], emphasizes women's empowerment in the SDGs. It is crucial to note that women have historically faced prejudice and inequity in urban planning and development [4], [5] and [6]. Thus, urban development must be "gender-neutral" [7], allowing equal access and services to both genders.

After introducing the SDGs in 2015, Saudi Arabia unveiled its "Saudi Arabia 2030 Vision[8], a comprehensive strategy to promote women empowerment and inclusive urban settings. Saudi Arabia was the only country to bar women from driving until September 2017. However, a royal proclamation allowed women to drive in June 2018. Of almost 15 million people, 45% are women [9]. Thus, this demographic transition impacts women's daily lives, societal contributions, and the nation's well-being, economics, and Sustainability. This development also supports Vision 2030 goals. However, Saudi women's gender-responsive daily transportation encounters are poorly understood. Women have unequal mobility chances in the country. However, empirical study on their everyday mobility experiences is scarce [10].

This research seeks to examine and emphasise the significance of gender-responsive public transportation in Saudi Arabian cities, specifically Riyadh, Jeddah, and Dammam, where public transportation services (SAPTCO public buses & Taxi) are available. The focus is on addressing the specific needs of women. This suggests that it is important to emphasise the distinct cultural and social circumstances and requirements of women to adopt the notion of gender mobility and decrease disparities in mobility. This study analyses the influence of social and cultural norms in specific areas on the requirements for gender-based mobility. This study also analyses the current mobility indicators and dimensions in the Kingdom of Saudi Arabia (KSA). It proposes a comprehensive general toolkit for effectively resolving gender-related mobility challenges in the Kingdom of Saudi Arabia (KSA), drawing inspiration from the "Four A's" concept introduced by the World Bank. The Four A's concept evaluates public Transport's influence on individuals' well-being and social inclusivity.

II. Methodology

The present study employs an inductive analytical approach that is divided into four distinct phases. Firstly, it conducts a thorough examination of the existing body of literature on gender and urban mobility worldwide, with a particular emphasis on Saudi Arabia. This thematic analysis aims to identify the causes of gender mobility disparities on a global scale, with a specific focus on Saudi Arabia. Additionally, it seeks to extract the framework known as "The Four A's Framework," which was published by the World Bank in 2020, as an approach to addressing gender mobility issues. Furthermore, this paper investigates a variety of urban mobility indicators formulated by different international organisations and countries, with a particular emphasis on Saudi Arabia. These indicators are subsequently compared using a thematic analysis to determine the most frequently used indicators, utilising the Four A's Framework of the World Bank. This framework categorises the indicators into four areas, hence facilitating the study. Subsequently, the commonly used indicators will be employed to analyse the reasons causing gender-based mobility to ascertain the most appropriate indicator for each distinct urban mobility reason related to gender. Finally, utilising the Four A's framework of the World Bank, a gender mobility Toolkit is created for women in Saudi Arabia, taking into account the findings from the analyses mentioned above. This general toolkit includes specific modifications such as reframing, rephrasing, adding, and reducing certain indicators. The developed toolkit facilitates an understanding of the factors of gender differences in urban mobility and provides an in-depth examination of each area, with a focus on the main indicators and sub-indicators.

The analysis underscores the significance of integrating indicators about privacy, security, availability, and diversity of public transportation into the toolkit to address women's distinct requirements, safety considerations, and cultural contexts in developing public transportation systems. Additionally, this study aims to shed light on disparities in mobility patterns based on gender while also offering key concepts to effectively tackle difficulties related to gender-based mobility, privacy, and security. The primary objective of these initiatives is to advance gender equality in the context of urban transportation in Saudi Arabia.

This study is divided into four sections. The first section highlights the importance of urban mobility and its relationship with gender in Saudi Arabia. The second section provides an overview of different indicators of urban mobility. In the third section, the study examines the disparities in mobility experienced by individuals of different genders. The last section delves into the proposed gender mobility general toolkit, specifically designed to address the unique needs and challenges of gender mobility in Saudi Arabia.

III. Literature Review

A. Urban Mobility and Gender in KSA

Urban transportation systems should prioritise road user needs and promote sustainable and environmentally friendly travel [11]. Society needs sustainable urban transportation networks to improve accessibility for everybody, including women [12]. People can easily access economic and social advantages via sustainable mobility, especially public transportation [13].

The 2030 U.N. Sustainable Development Goals

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(SDGs) aim to make transportation networks for the poor safe, accessible, profitable, and sustainable [14]. Scholarly discourse ignores women's public safety and gender's transportation choices and behaviours [15], [16]. Despite walking and taking public transit, women's mobility difficulties are disregarded [17], [18]. Many planning processes ignore women's neighbourhood development concerns and ideas. Instead, they prioritise street flow and asphalt paving solutions. Due to household responsibilities, women spend more time and are closer to their homes. Hence, this method fails to address road safety. Women perceive streets differently than males and devote more time to neighbourhood streets[19]. Additionally, many male decision-makers have little impact[20].

Gender and transportation research explores how planning practices perpetuate gender inequities [21], [22] and how gender determines mobility patterns [15], [23]. Gender affects travel patterns, modes, and restrictions. Travel patterns usually involve several short trips for residential, social, and occupational reasons [24], [25], [26]. However, several Middle Eastern countries, such as Saudi Arabia, have neglected urban mobility, relying heavily on private cars for daily transportation[27]. Public transit is scarce in most Saudi cities, limiting urban mobility[10]. Also, a major barrier to the use of public transit in KSA is the social status of its users, specifically foreign workers from countries such as India and other comparable nations. Many Saudi nationals view riding the SAPTCO bus as "disgraceful" because it is seen as a service for low-income individuals who are marginalised and inferior in society, as noted by [28]. Therefore, society considers it improper for women to use these types of public transportation simultaneously with men[10]. Female passengers increased their use of ride-hailing services like Careem and Uber in 2014[29]. The expected 2022 launch of a Riyadh metro system and the 2018 regulation modification allowing women to drive are projected to enhance public transportation use[29]. Before women's driving privileges, Saudi women's travel options were informal car-sharing with family, official car-sharing, private vehicle chauffeurs, contractual drivers, or taxis[30], [31]. In traditional Saudi households, women mainly used informal vehicle-sharing agreements as passengers, with male family members driving[30]. In many Saudi homes, private drivers are common[9], [31]. After updated driving regulations were implemented in 2018, women's access to and use of privately owned vehicles increased[9].

Due to legal and cultural factors, Saudi Arabia restricts women's travel and employment outside the home [32]. Women are primarily limited to domestic and caregiving activities, resulting in shorter but more frequent journeys [33]. This culture emphasises that improving women's urban mobility requires improving transportation infrastructure and services and addressing social, economic, political, and physical hurdles. These hurdles include class, gender, poverty, physical disability, and affordability [34].

The hot weather in Saudi Arabia strongly discourages users from relying on public transportation. Effective temperature regulation, particularly in extreme weather conditions such as those seen in Saudi Arabia, is of utmost importance for the female population. Regrettably, the SAPTCO bus stations lack any provisions for temperature regulation[27]. The bus stops lacked waiting rooms or shades. Waiting for the bus in hot weather, even for just five minutes, can be challenging, especially for children, women, and seniors. The bus stops should be structured in a manner that offers comfortable seating arrangements together with adequate shade to shield riders from hot weather conditions[27].

Mobility must be socially considered instead of focusing solely on transportation infrastructure to encourage freedom and independence [35]. The social components of mobility are crucial, especially for women with unique travel needs [36], [37]. Gender-responsive public transportation, including consideration of women's needs and preferences, can promote mobility and encourage active daily life [18], [38], [39]. Thus, vertical equity must be considered when considering women's travel needs in local physical environments and social and cultural norms [40], [41].

B. Reasons for Gender Mobility Differences Worldwide and in Saudi Arabia

Extensive studies have consistently demonstrated that women exhibit distinct

travel patterns compared to men[20]. Several characteristics have been identified as potential influences on gender disparities in travel behaviour. These factors include age, household size, education level, possession of a driving license, ownership of a car, income level, workplace location, and accessibility to transportation options [42], [43], [44], [45]. Additional elements, such as culture and institutions, significantly shape travel behaviour and views. Examining mobility patterns in connection to culture and home structure provides valuable insights into transportation patterns and is a viable approach for researching gender disparities [46]. This finding was supported by a study presented by Wei-Shiuen Ng and Ashley Acker at the International Transport Forum held in Paris, France. According to the authors, there is a possibility of variations in travel behaviour between developed and developing cities[47]. As an example, in the modal choices Internationally, men use cars more frequently than women [48], [49], [50], [51], [52], [53], [54]. In Saudi Arabia, a study indicated that 70.4% of women use private automobiles, 22.5% use taxis, 3.0% walk, and 2.2% use public buses. Women tend to travel less often and are more inclined to do it during non-peak hours globally due to social and cultural norms[53], [57], [60], [61], [62], [63]. In Saudi Arabia, women frequently remain at home from 10 a.m. to 5 p.m., which may result in missing out on food shopping and picking up their children. They typically rely on male family members to drive[31], [64]. Regarding security, Harassment is the main barrier that prevents women from using public transport, leading to changes in their travel habits and conduct as indicated by [69], [73], [74], [75], [76], [77], [78], [79]. In Saudi Arabia, privacy is a significant norm rooted in history, religion, and culture, which greatly affects movement and travel[31], [32], [80], [81], [82]. Female passengers do not have adequate privacy at SAPTCO bus stations, as there are no separate waiting rooms or seating for them [27]. Regarding infrastructure issues, Considering the user-friendliness of waiting areas is crucial for maintaining women's safety[73]. In Saudi Arabia, waiting rooms are crucial for using public transit due to the hot temperature, which can make it difficult for children, women, and elderly individuals to deal with the heat [27]. To explore more, a comparative analysis is undertaken in Table (3) to examine the factors contributing to gender mobility disparities globally and within Saudi Arabia. The findings underscore the significant impact of contextual factors, cultural dynamics, and societal norms on individuals' choices and behaviours related to gender mobility.

An in-depth comprehension of the complexities behind gender disparities in mobility on a worldwide scale, as well as within specific contexts like Saudi Arabia, reveals the complex relationship between cultural, social, economic, and infrastructural elements that influence travel patterns. Differences in age, education, cultural norms, and accessibility are among the factors that contribute to the observed inequalities in how men and women navigate their environments. Efforts to improve transportation in cities, influenced by frameworks such as the Sustainable Development Goals, provide chances to prioritise accessibility, safety, efficiency, and sustainability in transportation infrastructure. This, in turn, promotes gender equality and empowers women. Nevertheless, the inadequate amount of study and indicators in Arab nations, specifically in Saudi Arabia, creates a substantial void in comprehending and tackling gender mobility concerns in these settings. Incorporating gender-sensitive indicators into urban mobility assessments can help bridge the gap and promote more inclusive and equitable transportation systems. This approach addresses the specific problems experienced by women and fosters greater gender equality in transportation.

C. Urban Mobility Indicators

Various organisations and nations have devised a framework comprising dimensions and indicators aligned with the Sustainable Development Goals (SDGs) to allocate resources towards enhancing walking and public transportation infrastructure that is accessible, safe, efficient, affordable, and sustainable. One such goal is SDG 11, which focuses on attaining sustainable Transport for all. Measurements and indicators are utilised to assess, analyse, and depict urban mobility in diverse places. Indicators offer a comprehensive understanding of the condition of sustainable mobility inside a city, facilitating the design of optimal solutions and monitoring advancements [88]. In addition, the proposed measures would enable municipalities to engage in comparative

analysis with other cities of comparable scale, facilitating knowledge exchange and mutual learning [89]. Unfortunately, the majority of the indicators included in this study are published in Western societies. This is mainly because there is insufficient research on gender mobility in Arab countries, especially within Saudi Arabian society. The purpose of this study is to emphasise the significance of addressing gender mobility in Arab countries, specifically Saudi Arabia, to achieve more gender equality and strengthen women's empowerment. This section delineates frequently employed indicators seen in diverse reports and articles (see Table I).

1. Mainstream gender in road transport, W.B., 2010[86]

This report offers valuable support to professionals in transport and gender and is funded by the Gender Action Plan (GAP) Trust Fund of the World Bank. Integrating gender perspectives into road transport projects is of great importance, as it serves as a strategy to promote economic development and environmental sustainability and address gender disparities. The study emphasises the convergence of gender and transportation policies and programmes, presenting practical approaches to address gender-related issues in road transport projects. The primary focus of the GAP programme is to enhance women's economic empowerment in World Bank Group client countries. This purpose aligns with the broader goal of fostering gender equality and empowering women, as stated in Millennium Development Goal 3 (MDG3), which ended in 2015 after the release of the SDGs. The document includes a fundamental table that outlines sample data and critical indicators for establishing benchmarks and evaluating the progress of initiatives focused on incorporating gender perspectives into road transport projects. The focus of this study is mainly directed at 20 indicators relevant to the pedestrian environment and public transit infrastructure.

1. Gender toolkit, ADB 2013[90]

The toolkit was established by the Gender and Development branch of the Asian Development Bank (ADB) to offer support to ADB officials, consultants, and government partners engaged in activities related to the transport sector. The main goal of this effort is to support the integration of gender-responsive project planning practices in the transport industry. The toolkit guides professionals in the transportation and gender field regarding integrating gender equality considerations into project design, implementation, and policy engagement. The toolkit comprises many subsectors that align with the investments made by the Asian Development Bank (ADB) in the transport sector. The subsectors encompassed within this category consist of rural roads, national highways, railways, urban transportation systems, bridges, waterborne transportation, and ports. While the suitability of various elements in the toolkit may differ, users can choose the relevant subcategories corresponding to their project's specific context. This study primarily concerns the identification of 14 indicators related to urban transport, with a particular focus on improvements in transport services and the integration of design elements responsive to gender considerations.

2. Urban Agenda, 2019[89]

This report aims to allocate resources towards improving pedestrian and public transit infrastructure, specifically emphasising accessibility, security, efficiency, affordability, and sustainability. This objective aligns with Sustainable Development Goal 11.2, which seeks to advance the accessibility of sustainable transportation choices for all individuals. The significance of transport networks that offer door-to-door accessibility is recognised by the urban agenda of the European Union (E.U.), the International Association of Public Transport (UITP), and Walk21. To accomplish this objective, a set of indicators and case studies has been developed to strengthen the walkability of urban areas and improve the accessibility of public transit (URBAN AGENDA FOR THE EU, 2019). The metrics described above are classified into four separate domains of 14 primary indicators. These metrics assess the accessibility, safety, efficiency, and affordability of pedestrian infrastructure and public transportation networks in urban areas. Implementing a hierarchical methodology in these metrics enables the acquisition and distribution of data by governmental entities, augmenting the capacity to make well-informed choices and foster progress.

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3. Smart city options: *Gender Equality and Mobility, Mind the Gap* [53]:

The publication entitled "Smart Choices for Cities" was authored by the cooperation known as CIVITAS WIKI. The primary objective of the book entitled "Gender Equality and Mobility: Mind the Gap" is to facilitate the widespread dissemination of knowledge related to the concept of sustainable urban Transport. In Europe, there is an increasing emphasis from both national and local governments on bolstering their efforts to address gender disparities in the realm of mobility and transportation. The MOBILIS project, implemented during the CIVITAS II phase as part of the broader CIVITAS programme, has established specific protocols designed to conduct a gender sensitivity audit. The project's primary aim was to enhance understanding and recognition of gender-related components inherent in policy initiatives implemented by metropolitan areas. Additionally, the study sought to assess the impacts of these measures and formulate policy recommendations for urban mobility planning. This paper primarily focuses on two key aspects, specifically the development of accessibility, safety, and comfort across various transportation modes and improving transportation service supply.

4. Saudi Arabia's "Vision 2030" program[8]:

Saudi Arabia has implemented the "Vision 2030" initiative to enhance domestic mobility. The programme, initiated in 2016, encompasses diverse social and cultural goals to generate a profound and lasting influence on the country. The Vision 2030 plan incorporates a range of initiatives and endeavours that are expressly designed to improve Transport and mobility. These projects involve implementing metro and bus networks to alleviate traffic congestion and provide transport alternatives inside urban regions such as Riyadh and Jeddah. These programmes contribute to the goal of creating sustainable and livable urban environments across Saudi Arabia. While there is no dedicated programme solely centred on mobility, the Vision 2030 initiative aims to address the crucial objective of modernising Saudi Arabia comprehensively, encompassing the matter of mobility.

Four A's framework: The concept of the Four A's was initially introduced by the World Bank in 2005 [91] and subsequently revised in 2018 [92] and 2020 [60] to facilitate scholarly investigations on the subject of mobility among women in Latin America. The Four A's technique is employed to assess the impact of public transit on well-being and social inclusion. The concept encompasses availability, affordability, acceptability, and accessibility.

Following a comprehensive examination of global urban mobility indicators, a comparative assessment was undertaken utilizing the four A's framework established by the World Bank (see Table II). This analysis aimed to identify shared indicators and determine the most commonly used across various international urban indicators. Concerning Table II, the researchers propose an extensive toolkit of urban mobility indicators that incorporates all the measures employed in these global urban mobility assessments.

TABLE I: INTERNATIONAL URBAN MOBILITY INDICATORS
source: Authors

Name of indicator	Year of issuing	Institute of issuing	Location	Number of indicators	Main aspect
Mainstream gender in road transport	2010	World Bank	World Bank group client countries	20	The integration of gender perspectives into road transport projects
Gender toolkit	2013	Gender and development branch of the Asian development bank (ADB)	Asian countries	14	Support the integration of gender-responsive project planning practices in the transport industry
Urban agenda	2019	European union (E.U.), International association of public transport (UITP) & walk21	European countries	Four domains /14 primary indicators	Allocate resources towards improving pedestrian and public transit infrastructure, specifically emphasizing accessibility, security, efficiency, affordability, and sustainability

Smart city options: gender equality and mobility, mind the gap	2020	CIVITAS WIKI	Europe	4	To address gender disparities in mobility and transportation, with a focus on developing accessibility, safety, and comfort across various transportation modes, as well as improving transportation service supply.
Saudi Arabia's "vision 2030" program	2016	Saudi Arabia Government	Saudi Arabia	Not mentioned	Enhancing domestic mobility as part of the vision 2030 initiative

Table I I: URBAN MOBILITY INDICATORS FROM INTERNATIONAL ORGANIZATIONS, source: Authors

The Four A's of the World Bank for Gender Mobility,2020 [59]		Mainstream Gender in Road Transport, W.B.,2010[85]	Gender tool kit, ADB 2013[89]	Urban Mobility Indicators by Urban Agenda of E.U.,2019[88]	Smart choices for cities Gender equality and mobility: mind the gap! E.U.,2020[52]	Saudi Arabia 2030 vision [8]	Conclusion of common Urban Mobility Indicators
Availability	Connectivity of Public Transport	Number of improved terminals	Not Mentioned	Motorised transport alternative	Not Mentioned	Not Mentioned	Integration of Public Transport & Intermodal Terminals
		Number of Changes in women's transport mode use		Mode share walking and Public Transport			
	Coverage of Urban Public Transport	Adequate service routes		Not Mentioned			Coverage of Public Transport
		Intermediate Modes of Transport					Informal Transport
	Low Availability Issues	Changes in the frequency of transport services			Availability of P.T. during non-rush hours	Development of Public Transport	Availability of Public Transport
		Number of improved sidewalks	Kilometres of sealed and separate pedestrian	Provision of Walking space	The existence of pathways in cities	Not Mentioned	Availability of Sidewalks
Affordability	Travel Cost	Not Mentioned	Income spent on P.T./ Average cost of trips	Average income paid on Transport	Not Mentioned	Not Mentioned	Affordability
			Flexible multiple-trip tickets	Not Mentioned	Affordable, flexible fares for multi-trips		
		Set affordable fares	Not Mentioned	Number of subscription tickets	Discounted fares		
Acceptability	Quality of Urban Transport	The proportion of roads in good shape is maintained regularly and used by women.	Not Mentioned	Not Mentioned	Enhance the quality of walking & cycling paths.	Not Mentioned	Public Transport Quality
	User Comfort	Number of rest facilities	Number of waiting areas at stations and stops		Seating areas		User Comfort
		Number of women who are satisfied with new transport services provided.	The percentage of women content with new transportation services	Walking & P.T. overall Satisfaction	Not Mentioned		Satisfaction
	Security	Increased perception of Security using P.T.	Number of harassments on P.T. reported by women and girls	Perception of Safety for women.	Increase the level of Security.		Security
		Not Mentioned	Not Mentioned	Level of human activity	Not Mentioned		
		Number of lights	Number of street lighting	Availability of lighting	adequate lighting		
	Reliability	Not Mentioned	Not Mentioned	Reliability of Services	Not Mentioned		Reliability
		Pedestrian Facilities	Number of female toilets	Pedestrian Amenities			Amenities & Furniture
		Not Mentioned	Not Mentioned	Satisfaction With maps, Timetables, and Journey information	Better provision of transport information		
Accessability		Not Mentioned	Not Mentioned	Accessibility of Stations and stops to people with Reduced physical mobility.	Provide stations with lifts.	Not Mentioned	Accessibility for Impaired Groups
	Access to Transport Services	Number of improved bus stops, signals,		Population Residing <500 Meters from a P.T. Stop	Improve accessibility in vehicles, stations and stops.		Access to Public Transport
		Average travel time to formal and informal places of work and by Mode of Transport	Travel time saved (hours per day) by women	Total time spent walking or riding P.T. on daily trips	Not Mentioned		
		Number of trips made by women by mode of Transport	Number of trips made by women by way of Transport	Total number of daily trips by Walking and P.T.			
	Access to Opportunities	Changes in women's travel patterns	Not Mentioned	Several jobs and urban services are accessible within 60 minutes by P.T.		Reduce congestion to increase accessibility of jobs and services	Access to Jobs and Services
		Number of improved pedestrian crossings, safety islands	Number of pedestrian crossings	Provision of Safe crossings	Safe pedestrian crossings,	Not Mentioned	Accessibility of Pedestrians

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IV. STUDY RESULTS

A. Analyzing Urban Mobility Indicators for Gender Considerations

After reviewing global urban mobility indicators used by various organizations and countries, as outlined in Table II, this study seeks to evaluate the factors that impact gender-specific urban mobility thoroughly. The aim is to determine the most suitable indicator for each reason. The analysis presented in Table III is the foundation for developing a gendered urban mobility general toolkit. This general toolkit aims to enhance one's understanding of the unique mobility needs, safety concerns, comfort preferences, and overall views of women in their daily experiences.

A. Proposed Gender Urban Mobility General Toolkit in Saudi Arabia

The authors analysed and examined the factors contributing to gender disparities in mobility and subsequently correlated these factors with relevant indices of urban mobility, as presented in Table III. The authors have put up a general toolkit based on international urban mobility metrics, as shown in Table II, according to the analysis conducted. This general toolkit aims to tackle gender-specific requirements, perspectives, safety considerations, and cultural contexts within public transportation systems, seeking to advance gender equality in everyday mobility within the Saudi Arabian environment. The general Toolkit presented in this study draws from the Four A's framework of the World Bank while incorporating specific alterations such as reframing, rephrasing, adding, and lowering particular indicators. These adjustments have been made to better align the framework with the unique mobility requirements of different genders, as illustrated in Figure 1. The general toolkit proposes the following recommendations to mitigate the challenges faced by women in Saudi Arabia concerning their mobility.

Availability: The toolkit improves availability by dividing it into pedestrian and public transportation availability. Pedestrian Availability: The toolkit suggests including an indicator that measures the proportion of women-specific sidewalks and pedestrian zones in the urban environment. Pavements are essential for active transportation and women's mobility, especially in Saudi Arabia, where walking is rare. Sidewalks will improve pedestrian infrastructure, improving women's mobility. Public Transit Availability: The toolkit emphasises public transport availability, coverage, and integration. Additionally, it advises adding a new indicator measuring public transit diversity and range. The first indicator assesses public transportation availability using multiple sub-indicators, including stations, routes, frequency, service hours, and coverage. The proposed sub-indicators attempt to improve women's transportation access through various strategies. These strategies include increasing public transit routes and frequency, flexible service hours, and neighborhood-wide coverage. These measures would help women travel safer and more efficiently, allowing them to exploit hitherto unattainable opportunities. The second indicator assesses how well the Saudi Arabian public transport network accommodates gender mobility patterns, given the limited availability of such services. This availability will allow women to travel regardless of distance, lowering their car use. The third indicator measures public transportation system integration. This review helps women organise their complex routes, reducing their use of private vehicles and increasing public transportation. Public transportation inclusion is crucial, especially in Saudi Arabia, where women are officially barred from public transit. This indicator will improve public transportation diversity by introducing gender-specific services like "pink buses" and "pink metro." Such programs should increase female public transit use and empower women.

TABLE III: GENDER MOBILITY DIFFERENCES INTERNATIONALLY AND IN KSA, source: Authors

Gender differences in mobility	International reasons	Saudi Arabia reasons	Suggested indicators to solve those problems
Modal Choices and Preferences	The frequency of car usage is lower among women than men[48], [49], [50], [51], [52], [53], [54].	Saudi Arabian research [9] found that 70.4% of women drive private cars, 22.5 % taxis, 3.0% walk, and 2.2 % public buses.	**Availability of female-only Public Transport** **Availability of Sidewalks** **Coverage of Public Transport**
	In developed and developing nations, it is observed that women have a greater tendency to walk compared to men[48], [49], [50], [55], [56].	Even though walking is not a prevalent mode of travel in Saudi Arabia, it is still more favoured than using the public bus[27].	**Accessibility of Pedestrians** **Availability of Sidewalks**
Socio-cultural Norms and Constraints	Women tend to commute shorter distances to their workplaces and prefer establishing their enterprises closer to their residences than men. Consequently, this pattern results in a more limited scope of geographic mobility for women. [48], [49], [52], [53], [56], [57], [58].	Legal and socio-cultural norms in certain societies limit women to domestic roles, leading them to make short, frequent trips[33].	**Accessibility of Public Transport** **Access to Jobs and Services** **Availability of Public Transport** **Coverage of Public Transport**
	Moreover, numerous research has consistently demonstrated that women have a greater propensity to utilize public transit as opposed to private automobiles[48], [50], [51], [52], [54], [55], [59].	Socio-cultural factors lead to public transport being predominantly used by non-Saudi labour, making it socially unacceptable for women to use[10].	**Diversity of transportation modes** **Availability of female-only Public Transport** **Coverage of Public Transport** **Integration of Public Transport** **Privacy in transportation modes**
	Women travel less frequently and are more likely to do so during off-peak times[53], [57], [60], [61], [62], [63].	Women often stay home between 10 a.m. and 5 p.m., missing grocery shopping and kid pickups. They usually wait for male family members to drive[31], [64].	**Privacy in transportation modes** **Availability of female-only Public Transport**
	Women typically use less formal, less effective, and less expensive forms of transportation[51], [57], [58], [60], [65].	Women in Saudi Arabia have limited mobility options[10], with their choices for transit being notably restricted.	**Diversity of transportation modes** **Availability of female-only Public Transport** **Privacy**
Safety and Security Concerns	According to a survey, 61%–73% of women were more worried about Security in public transit [66]. Another study [67] found that over 60% of BRT[1] users had experienced sexual harassment. 91% of Indian women reported feeling insecure [68].	Public transportation security is essential to Saudi women. According to a study, women on SAPTCO public buses were 34.8% anxious and 34.3% concerned. Eighty per cent of women are worried about taxi safety[27].	**Security** **Privacy** **Availability of female-only Public Transport**
	Women's mobility may be restricted by their fear of travelling alone, at night, or in an unsafe environment. As a result, they may avoid or use public transit less frequently [69], [70], [71], [72].	The primary concerns for women feeling unsafe were travelling alone with unfamiliar male drivers and taxi privacy issues [27].	**Security** **Privacy** **Availability of female-only Public Transport**
	Gender-responsive public transportation use depends on individual security at bus stops [23]. At these stations, security personnel, sufficient lighting, visibility, and safety precautions are necessary to protect women[27].	The SAPTCO public bus stops and the broader infrastructure do not offer security features[27]	**Security**
	Harassment constitutes the predominant obstacle impeding women's use of public transportation, hence necessitating modifications to their travel patterns and behaviour [69], [73], [74], [75], [76], [77], [78], [79].	In Saudi Arabia, privacy is a historical, religious, and cultural norm that severely impacts mobility and travel [31], [32], [80], [81], [82]. Women lack privacy at SAPTCO bus stops, including separate waiting areas and seating[27].	**User comfort** **Privacy**

1 Bus Rapid Transit

Infrastructure Issues	Women face a disproportionate number of mobility barriers and experience a more significant impact from time restrictions in their everyday travels[57], [60], [61].	The SAPTCO public bus operates between 3:00 p.m. and 10:00 p.m. with no morning services, which, combined with distant bus stops, challenges women's use[27].	**Availability of Public Transport** **Access to Public Transport**
	The consideration of waiting area user-friendliness holds significant importance in ensuring women's safety [73].	SAPTCO bus stops lacked necessary amenities like waiting rooms or shade, making it challenging to stay in the heat, especially for kids, women, and older people [27].	**User comfort** **Access to Public Transport**
	Accessibility elements are critical for women. These include barrier-free routes to transit stops, spatial access, and transit vehicle designs that accommodate their needs (e.g., low-floor cars, wheelchairs, pram storage, etc.)[83], [84].	The infrastructure of SAPTCO is not gender-responsive. High-floor buses, absence of storage for baby strollers/wheelchairs, and missing connecting footpaths to bus stops all pose barriers[27].	**Accessibility for Impaired Groups**
Economic Considerations	Due to the higher cost of transportation for multi-stop routes, women have indicated in multiple surveys that they spend a large percentage of their income on it[40], [60], [85], [86], [87].	Women often do not cover the cost of car purchases, but they typically handle charges related to personal drivers, operation, and maintenance[10].	**Affordability of Travel cost**

Public Transport Affordability: The toolkit examines affordability through two indicators: affordable fares and multi-trip pricing. The indicators will regulate transportation fees to make them more reasonable and ensure equal access for women and people with disabilities. Affordable multi-trip rates may encourage women to use public transportation, saving them money on car expenses.

Accessibility: the proposed toolkit restructured accessibility indicators into two groups. One category evaluates pedestrian accessibility, while the other evaluates public transit accessibility.

1. The suggested toolkit's Pedestrian Accessibility category redefines core indicators for assessing gendered accessibility perceptions. Crosswalks, pedestrian crossings, and sidewalk inclines are essential markers. These qualities are fundamental in all street designs, although they are missing in some underdeveloped nations, causing gender inaccessibility. These sub-indicators should make walking safer and more appealing for women by improving highways and pedestrian areas. This approach is expected to reduce pedestrian-vehicle accidents, enhance pedestrian safety, and boost the likelihood of pedestrians using certain streets. The programme also emphasises two sidewalk gender inclusiveness measures. These measurements consider the number of daily walking excursions and the duration of each gender's walks. These two studies highlight the need to record the time and frequency of walking trips by different genders in different communities to assess walkability. This statistic will help analyse district walkability from a gender viewpoint and examine the factors that affect it.

2. The proposed toolkit divides public transportation access into five indicators: accessibility for impaired groups, gender-based access to work and services, accessibility of stops, total number of trips by gender, and total duration. The first indicator is critical for measuring public transportation accessibility for underrepresented populations, including women and people with impairments. Women like accessibility characteristics like barrier-free routes to transit stops, spatial accessibility, and user-responsive transit vehicle design. This metric helps measure gender-based public transportation accessibility. If this issue is resolved, all genders will use public transit more. The second indicator measures gender-inclusive employment and service access within a 45-60 minute travel time. Accessibility geographical analysis can identify locations with poor transportation infrastructure, indicating areas that need development to match gender-specific mobility patterns. The third indicator was changed for gender-specific needs. Bus and light rail stations should be every 400 and 800 meters, respectively, to determine neighbourhood stop frequency. This intervention should improve transportation infrastructure, increase regional transit options, and reduce pedestrian distances. These enhancements should boost women's mobility and access to opportunities outside their immediate area. Both prior indicators have been rewritten to be more gender-specific.

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The first indicator measures how long different genders commute by public transit. The daily public transportation time allocation for each gender will be determined using these data. This indicator will also help identify concerns like poor intermodal connectivity or slow or inaccessible transit options that extend the route. The second indicator is the total number of daily public transportation trips by gender. This indicator will help assess gender use in each locality as a public transportation accessibility indicator. These indicators can help women access public transit by identifying and solving transportation issues.

Acceptability: The toolkit reduces some metrics and adds others to improve gender mobility indicators in Saudi Arabia. One of the new indicators addresses privacy, a critical issue for Saudi women using public transportation. This signal promotes privacy by providing women-only sections in public transit, waiting areas, and stations. Segregated public transportation networks are expected to increase women's use and empower them in cities. Another consideration is gender comfort on public transit. It has three sub-indicators: seating, shelter, and temperature regulation. The toolkit includes these sub-indicators. Seating and shelter availability at every public transportation station will be assessed using the first two indicators. Due to Saudi Arabia's climate, a temperature control indicator is justified. This strategy will help regulate public transportation and stop seating temperatures. The most crucial factor in daily life is gender security. This indicator has three sub-indicators: adequate lighting, natural surveillance, and active monitoring. The suggested method uses a gender-based score system to assess bus stop and sidewalk lighting accessibility in different neighbourhoods. The toolkit proposes rethinking the natural surveillance indicator from a gender perspective. This project aims to provide a scoring system to assess natural monitoring in urban thoroughfares, public transportation hubs, and pedestrian walkways. Active surveillance highlights the importance of this indicator and identifies locations where surveillance infrastructure may need development to meet gender-specific needs. This work requires checking every local route, public transportation station, and sidewalk for active surveillance.

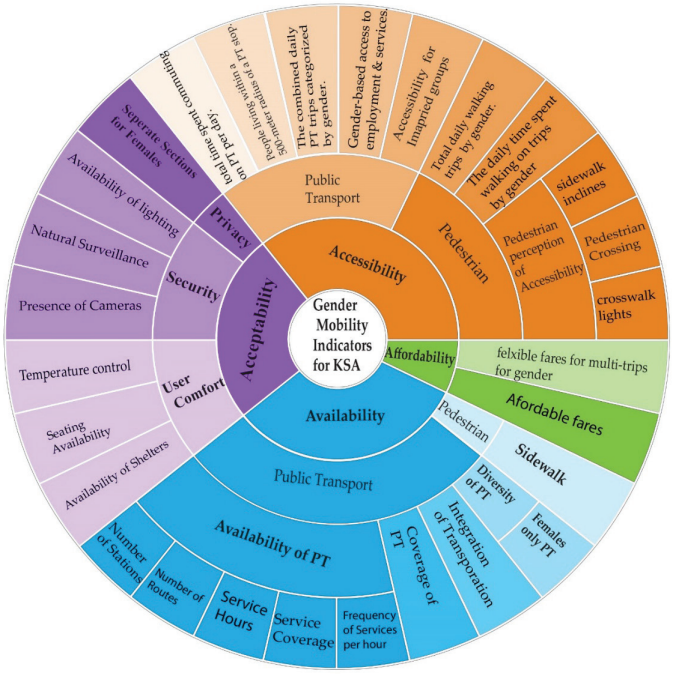

Fig. 1. Proposed gender mobility general toolkit for KSA, source: Authors

V. DISCUSSION

The study emphasizes the importance of adopting a gendered perspective when examining urban mobility, with a specific focus on acknowledging and addressing the distinct mobility needs of women. Through an analysis of worldwide urban mobility indicators and their application to the socio-cultural milieu of Saudi Arabia, this study elucidates the multifaceted nature of mobility, encompassing not just transportation but also its intricate connections with gender roles, societal norms, and safety considerations.

The conventional approach to urban mobility indicators has typically lacked gender considerations. However, this study emphasizes the importance of acknowledging the distinct requirements, perspectives, and limitations experienced by women. The gendered perspective encompasses the pursuit of equity and the imperative to provide the safe, comfortable, and efficient mobility of half the population inside urban environments.

The need to tailor global indicators to local contexts is apparent, as the World Bank's Four A's foundational framework becomes inadequate in its one-size-fits-all approach. A customised strategy is required due to the

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distinct cultural and societal environment of Saudi Arabia, particularly concerning the roles and mobility of women. The use of markers, such as privacy, which may have varying degrees of relevance in different circumstances, emphasizes this assertion.

The toolkit offered emphasizes the necessity of including pedestrian and public transportation infrastructure. Providing sidewalks and pedestrian zones is crucial in promoting active transportation modes while implementing complete public transportation systems facilitates travel over greater distances. The adoption of this dual approach is critical to enabling the advancement of sustainable urban mobility.

Moreover, incorporating comfort-related metrics, such as temperature control, exemplifies the comprehensive perspective on mobility that emphasizes the significance of the entire travel experience, encompassing both the process and the endpoint.

Fundamentally, the research focuses not just on physical motion but also on the concept of empowerment. By acknowledging and addressing the distinct obstacles to mobility experienced by women, the researchers create opportunities for greater involvement in public spheres, economic endeavours, and social interactions. Tools like the suggested "pink buses" and "pink metro" symbolise the ongoing transition towards a more inclusive urban setting.

Although the study used a detailed methodology, it is essential to acknowledge that potential objections may emerge. Although culturally significant, the implementation of segregated transportation modes may be perceived by specific individuals as reinforcing gender disparities rather than fostering their integration. The delicate nature of striking a balance between cultural sensitivity and promoting gender equality necessitates additional research.

With the ongoing expansion of urban areas, there will be a heightened need for mobility solutions that are efficient, safe, and inclusive. The toolkit given in the study provides a framework that other countries and localities may utilize to tailor and implement according to their unique circumstances. Furthermore, the research underscores the significance of ongoing feedback and adaptability. As societal norms undergo transformation and urban dynamics experience shifts, it becomes necessary to reassess the indicators and methods in place periodically.

VI. CONCLUSION

This study critically analyses gender and urban mobility in Saudi Arabia, introducing an innovative general toolkit specifically designed for gender-specific urban mobility. This study emphasizes the importance of including a gender-focused strategy in urban transport planning, based on the World Bank's Four A's framework. Additionally, the researchers have tailored these worldwide insights to suit the specific cultural, socioeconomic, and infrastructural context of Saudi Arabia. The local application of this general toolkit is expected to significantly improve women's daily mobility by tackling persistent obstacles like privacy, security, and accessibility. The projected reforms aim to empower women by offering them safer, more comfortable, and fair access to urban mobility solutions.

The research at hand adds to the global discussion on gender equality in urban transport by highlighting the significance of adapting international frameworks to specific contexts. This study provides useful insights for places facing similar cultural and infrastructure constraints by focusing on the specific difficulties and solutions in the Saudi context. The toolkit provides a framework for incorporating gender considerations into urban planning and transport policies globally, highlighting the importance of customizing methods to local conditions to successfully tackle gender inequalities in mobility.

As cities develop, the demand for transit options that are inclusive, safe, and efficient grows more crucial. This study establishes the foundation for the next research and policy development to promote cooperation among urban planners, policymakers, and communities to enhance the inclusivity of urban settings. By acknowledging and tackling the distinct mobility obstacles experienced by women, one can progress towards a fairer and thriving urban future for everyone.

More studies are needed to apply and evaluate the gender-specific urban mobility toolkit in Saudi Arabia and in different geographical areas and cultural circumstances to customize and deploy the toolkit effectively.

Governments, urban planners, and transportation agencies in Saudi Arabia must work together to implement the toolkit. Engaging stakeholders helps integrate the toolkit's ideas into urban planning and transportation strategies. Researcher and policymaker collaboration is needed to monitor the effects of these changes and make necessary adjustments.

This research shows the need for gender-specific considerations in urban mobility design, especially in culturally diverse and dynamic Saudi Arabia. The study emphasizes the need for a personalized methodology because universal measures may not account for the myriad of cultural, social, and safety considerations that affect gender-based mobility. Including privacy, security, comfort, and accessibility, the toolkit improves urban transportation for women.

Female-inclusive urban mobility empowers women, improves economic possibilities, and fosters social cohesion. This study lays the groundwork for collaborations between scholars, policymakers, and urban designers to create universally accessible urban environments. A more inclusive and prosperous urban future can be achieved by acknowledging and addressing women's unique challenges.

References

[1] F.-J. Van Audenhove, O. Korniichuk, L. Dauby, and J. Pourbaix, "The Future of Urban Mobility 2.0: Imperatives to Shape Extended Mobility Ecosystems of Tomorrow," Jan. 2014.

[2] World Bank Group, "Population, female (% of total population) | Data." [Online]. Available: https://data.worldbank.org/indicator/SP.POP.TOTL.FE.ZS?end=2018&start=2018&view=bar

[3] UNSD and DESA, "SDG Indicators — SDG Indicators," United Nations Statistics Division, Department of Economic and Social Affairs. Accessed: Sep. 06, 2020. [Online]. Available: https://unstats.un.org/sdgs/indicators/indicators-list/

[4] R. Crompton, *Women and work in modern Britain*. New York: Oxford University Press, 2002.

[5] J. Hoff, *Law, gender and injustice : legal history of U.S. women*, New ed. New York: New York U.P., 1994.

[6] M. B. Katz, M. J. Stern, and J. J. Fader, "Women and the Paradox of Economic Inequality in the Twentieth-Century," *J Soc Hist*, vol. 39, no. 1, pp. 65–88, Sep. 2005, doi: 10.1353/jsh.2005.0107.

[7] A. Cornwall, "Whose voices? Whose choices? Reflections on gender and participatory development," *World Dev*, vol. 31, no. 8, pp. 1325–1342, Aug. 2003, doi: 10.1016/S0305-750X(03)00086-X.

[8] Saudi Arabia—Vision 2030, "The Progress & Achievements of Saudi Arabia—Vision 2030," https://www.vision2030.gov.sa/.

[9] N. Al-Qarawi and M. Kamargianni, "She Drives KSA: Phase 1 Survey Report," *Imam Abdulrahman Bin Faisal University: Dammam, Saudi Arabia.* , Sep. 2018, Accessed: Oct. 19, 2023. [Online]. Available: https://www.iau.edu.sa/sites/default/files/resources/she_drives_report_survey_results_0.pdf

[10] N. Alshabibi, "A Priminalry Determination of Factors Effecting Female Travel Demand, Pattern, and Behavior in the Kingdom of Saudi Arabia," *International Journal of Psychosocial Rehabilitation*, vol. 23, no. 1, pp. 11–20, Mar. 2019, doi: 10.37200/IJPR/V23I1/PR190208.

[11] UNESCAP, "Transport and communications bulletin for Asia and the Pacific. No. 76 : gender and transport | ESCAP." Accessed: Oct. 22, 2023. [Online]. Available: https://www.unescap.org/publications/transport-and-communications-bulletin-asia-and-pacific-no-76-gender-and-transport

[12] B. C. Richardson, "Sustainable transport: analysis frameworks," *J Transp Geogr*, vol. 13, no. 1, pp. 29–39, Mar. 2005, doi: 10.1016/J.JTRANGEO.2004.11.005.

[13] M. Ogryzek, D. Adamska-Kmieć, and A. Klimach, "Sustainable Transport: An Efficient Transportation Network—Case Study," *Sustainability*, vol. 12, no. 19, Oct. 2020, doi:

10.3390/SU12198274.

[14] U. SDGs, "@UN_Enable Full report: bit.ly/UN-report-disability-sdgs Realizing the Sustainable Development Goals by, for and with Persons with Disabilities Making cities and communities inclusive and sustainable for persons with disabilities (Goal 11) Disability-incl," 2015. Accessed: Oct. 31, 2020. [Online]. Available: https://www.un.org/development/desa/disabilities/wp-content/uploads/sites/15/2020/02/Cities-Brief-Disabilities.pdf

[15] S. Hanson, "Gender and mobility: New approaches for informing sustainability," *Gender, Place and Culture*, vol. 17, no. 1, pp. 5–23, Feb. 2010, doi: 10.1080/09663690903498225.

[16] A. Loukaitou-Sideris, "A gendered view of mobility and transport: Next steps and future directions," *Town Planning Review*, vol. 87, no. 5, pp. 547–565, Sep. 2016, doi: 10.3828/tpr.2016.38.

[17] C. Greed, "Are we still not there yet? Moving further along the gender highway," in *Integrating Gender into Transport Planning: From One to Many Tracks*, Palgrave Macmillan, 2019, pp. 25–42. doi: 10.1007/978-3-030-05042-9_2.

[18] T. P. Uteng and J. Turner, "Addressing the linkages between gender and transport in low- and middle-income countries," *Sustainability (Switzerland)*, vol. 11, no. 17, 2019, doi: 10.3390/su11174555.

[19] M.-P. Kwan, "Gender, the Home-Work Link, and Space-Time Patterns of Nonemployment Activities," *Econ Geogr*, vol. 75, no. 4, p. 370, Oct. 1999, doi: 10.2307/144477.

[20] D. Peters, "Gender and Sustainable Urban Mobility," *Global report on Human Settlements 2013*, p. 63, 2013, [Online]. Available: http://www.unhabitat.org/grhs/2013

[21] C. H. Greed, *Women and planning: creating gendered realities*. 1994. doi: 10.1016/s0264-8377(96)90012-5.

[22] M. Roberts, "Introduction: Concepts, themes and issues in a gendered approach to planning," in *Fair Shared Cities: The Impact of Gender Planning in Europe*, Taylor and Francis, 2016, pp. 1–18. doi: 10.4324/9781315581835-6.

[23] R. Law, "Beyond 'women and transport': Towards new geographies of gender and daily mobility," *Prog Hum Geogr*, vol. 23, no. 4, pp. 567–588, 1999, doi: 10.1191/030913299666161864.

[24] E. Blumenberg, "En-gendering effective planning: Spatial mismatch, low-income women, and transportation policy," *Journal of the American Planning Association*, vol. 70, no. 3, pp. 269–281, 2004, doi: 10.1080/01944360408976378.

[25] C. Miralles-Guasch, M. M. Melo, and O. Marquet, "A gender analysis of everyday mobility in urban and rural territories: from challenges to sustainability," *Gender, Place and Culture*, vol. 23, no. 3, pp. 398–417, Mar. 2016, doi: 10.1080/0966369X.2015.1013448.

[26] J. Turner and M. Grieco, "Gender and Time Poverty: The Neglected Social Policy Implications of Gendered Time, Transport and Travel," *Time Soc*, vol. 9, no. 1, pp. 129–136, Mar. 2000, doi: 10.1177/0961463X00009001007.

[27] M. A. Al-Rashid, K. M. Nahiduzzaman, S. Ahmed, T. Campisi, and N. Akgün, "Gender-Responsive Public Transportation in the Dammam Metropolitan Region, Saudi Arabia," *Sustainability*, vol. 12, no. 21, pp. 1–17, 2020, Accessed: Oct. 19, 2023. [Online]. Available: https://ideas.repec.org/a/gam/jsusta/v12y2020i21p9068-d438246.html

[28] L. Steg, "Car use: lust and must. Instrumental, symbolic and affective motives for car use," *Transp Res Part A Policy Pract*, vol. 39, no. 2–3, pp. 147–162, Feb. 2005, doi: 10.1016/J.TRA.2004.07.001.

[29] W. Saleh and A. Malibari, "Saudi women and vision 2030: Bridging the gap?," *Behavioral Sciences*, vol. 11, no. 10, p. 132, Oct. 2021, doi: 10.3390/BS11100132.

[30] M. F. Errigo and G. Tesoriere, "Urban Travel Behavior Determinants in Saudi Arabia," *TeMA: Journal of Land Use, Mobility and Environment*, vol. 0, no. 0, pp. 31–46, Jun. 2018, doi: 10.6092/1970-9870/5449.

[31] H. P. Peterson and Z. Al Kassim, "A Case Study On Perceptions Of Public Transportation In The Eastern Province Of Saudi Arabia," *Transport Problems*, vol. 15, no. 2, pp. 5–15, 2020, doi: 10.21307/TP-2020-015.

[32] M. H. Clarke, "Making transport work for women and men : challenges and opportunities in the Middle East and North Africa (MENA) region - lessons from case studies." Accessed: Oct. 22, 2023. [Online]. Available: https://documents.worldbank.

org/en/publication/documents-reports/documentdetail/220381468278678436/making-transport-work-for-women-and-men-challenges-and-opportunities-in-the-middle-east-and-north-africa-mena-region-lessons-from-case-studies

[33] X. Lu and E. I. Pas, "Socio-demographics, activity participation and travel behavior," *Transp Res Part A Policy Pract*, vol. 33, no. 1, pp. 1–18, Jan. 1999, doi: 10.1016/S0965-8564(98)00020-2.

[34] UN-HABITAT, "Mobility as Access: Equitable Urban Mobility," *United Nations Headquarters: New York, NY, USA*, 2014.

[35] K. Doughty and L. Murray, "Discourses of Mobility: Institutions, Everyday Lives and Embodiment," *Mobilities*, vol. 11, no. 2, pp. 303–322, Sep. 2014, doi: 10.1080/17450101.2014.941257.

[36] S. Iqbal, A. Woodcock, and J. Osmond, "'The effects of gender transport poverty in Karachi,'" *J Transp Geogr*, vol. 84, Apr. 2020, doi: 10.1016/j.jtrangeo.2020.102677.

[37] J. Cubells, O. Marquet, and C. Miralles-Guasch, "Gender and Age Differences in Metropolitan Car Use. Recent Gender Gap Trends in Private Transport," *Sustainability 2020, Vol. 12, Page 7286*, vol. 12, no. 18, p. 7286, Sep. 2020, doi: 10.3390/SU12187286.

[38] A. K. Das, "Gender-Responsive Public Transport," pp. 1–12, 2020, doi: 10.1007/978-3-319-71061-7_106-1.

[39] M. Maciejewska, O. Marquet, and C. Miralles-Guasch, "Changes in gendered mobility patterns in the context of the Great Recession (2007–2012)," *J Transp Geogr*, vol. 79, p. 102478, Jul. 2019, doi: 10.1016/J.JTRANGEO.2019.102478.

[40] T. Uteng, "Gender and Mobility in the Developing World," *undefined*, 2012.

[41] UN-HABITAT, "The State of Arab Cities 2012 , Challenges of Urban Transition | UN-Habitat." Accessed: Oct. 22, 2023. [Online]. Available: https://unhabitat.org/the-state-of-arab-cities-2012-challenges-of-urban-transition

[42] S. Hanson and I. Johnston, "GENDER DIFFERENCES IN WORK-TRIP LENGTH: EXPLANATIONS AND IMPLICATIONS," *http://dx.doi.org/10.2747/0272-3638.6.3.193*, vol. 6, no. 3, pp. 193–219, 1985, doi: 10.2747/0272-3638.6.3.193.

[43] M.-P. ; Kwan and A. Kotsev, "Gender differences in commute time and accessibility in Sofia, Bulgaria: a study using 3D geovisualisation on JSTOR." Accessed: Oct. 22, 2023. [Online]. Available: https://www.jstor.org/stable/43868630

[44] M. G. Boarnet and S. Sarmiento, "Can Land-use Policy Really Affect Travel Behaviour? A Study of the Link between Non-work Travel and Land-use Characteristics," *http://dx.doi.org/10.1080/0042098984538*, vol. 35, no. 7, pp. 1155–1169, Jun. 1998, doi: 10.1080/0042098984538.

[45] H. Best and M. Lanzendorf, "Division of labour and gender differences in metropolitan car use: An empirical study in Cologne, Germany," *J Transp Geogr*, vol. 13, no. 2, pp. 109–121, Jun. 2005, doi: 10.1016/J.JTRANGEO.2004.04.007.

[46] A. Bernard, A.-M. Seguin, Y. Bussiere, and A. Polacchini, "Household Structure and Mobility Patterns of Women in O-D Surveys: Methods and Results Based on the Case Studies of Montreal and Paris," *PsycEXTRA Dataset*, Jan. 2011, Accessed: Oct. 22, 2023. [Online]. Available: https://www.academia.edu/45540409/Household_Structure_and_Mobility_Patterns_of_Women_in_O_D_Surveys_Methods_and_Results_Based_on_the_Case_Studies_of_Montreal_and_Paris

[47] W.-S. Ng and A. Acker, "Understanding Urban Travel Behaviour by Gender for Efficient and Equitable Transport Policies," *International Transport Forum Discussion Papers*, Feb. 2018, doi: 10.1787/EAF64F94-EN.

[48] S. Srinivasan, "A Spatial Exploration of the Accessibility of Low-Income Women: Chengdu, China and Chennai, India," *Gendered Mobilities*, pp. 157–172, Dec. 2008, doi: 10.4324/9781315584201-17/GENDER-SOCIAL-USAGE-MOBILE-TECHNOLOGIES-INFORMATION-SOCIETY-POLICIES-EVERYDAY-PRACTICES-TOMMI-INKINEN.

[49] N. Tanzarn, "Gendered Mobilities in Developing Countries: The Case of (Urban) Ugand." Accessed: Jan. 10, 2023. [Online]. Available: https://www.taylorfrancis.com/chapters/edit/10.4324/9781315584201-13/gendered-mobilities-developing-countries-case-urban-uganda-nite-tanzarn

[50] M. Polk, "Are women potentially more accommodating than men to a sustainable transportation system in Sweden?," *Transp Res D Transp Environ*, vol. 8, no. 2, pp. 75–95, Mar.

2003, doi: 10.1016/S1361-9209(02)00034-2.

[51] Chantal DUCHÈNE, "Gender and Transport Chantal DUCHÈNE," 2011. Accessed: Nov. 18, 2020. [Online]. Available: www.internationaltransportforum.org

[52] S. Rosenbloom, "Understanding Women's and Men's Travel Patterns: The Research Challenge," *undefined*, 2006.

[53] CIVITAS, "Smart choices for cities," 2014.

[54] C. Vance and R. Iovanna, "Gender and the Automobile," *Transportation Research Record: Journal of the Transportation Research Board*, vol. 2013, no. 1, pp. 54–61, Jan. 2007, doi: 10.3141/2013-08.

[55] R. Goel, O. Oyebode, L. Foley, L. Tatah, C. Millett, and J. Woodcock, "Gender differences in active travel in major cities across the world," *Transportation (Amst)*, pp. 1–17, Jan. 2022, doi: 10.1007/S11116-021-10259-4/FIGURES/3.

[56] A. Anand and G. Tiwari, "A gendered perspective of the shelter-transport-livelihood link: The case of poor women in Delhi," *Transp Rev*, vol. 26, no. 1, pp. 63–80, Jan. 2006, doi: 10.1080/01441640500175615.

[57] M. C. Lecompte and B. S. Juan Pablo, "Transport systems and their impact con gender equity," *Transportation Research Procedia*, vol. 25, pp. 4245–4257, Jan. 2017, doi: 10.1016/J.TRPRO.2017.05.230.

[58] O. Blumen and A. Kellerman, "GENDER DIFFERENCES IN COMMUTING DISTANCE, RESIDENCE, AND EMPLOYMENT LOCATION: METROPOLITAN HAIFA 1972 AND 1983∗," *http://dx.doi.org/10.1111/j.0033-0124.1990.00054.x*, vol. 42, no. 1, pp. 54–71, 1990, doi: 10.1111/J.0033-0124.1990.00054.X.

[59] UN Habitat, "WOMEN'S SAFETY AUDITS What Works and Where?," 2008.

[60] K. Dominguez, A. L. Machado, B. Bianchi Alves, V. Raffo, S. Guerrero, and I. Portabales, *Why Does She Move?* World Bank, 2020. doi: 10.1596/33466.

[61] T. L. Brennan, "AN ANALYSIS OF TRIP BEHAVIOUR PATTERNS OF WOMEN IN DEVELOPING COUNTRIES: A CASE STUDY OF PUEBLA, MEXICO (ABSTRACT ONLY)," Jul. 1996.

[62] J. Hine and F. Mitchell, "The role of transport in social exclusion in urban Scotland: research finding," 2001.

[63] J. Hine and F. Mitchell, "Transport disadvantage and social exclusion : exclusionary mechanisms in transport in urban Scotland," 2003, Accessed: Dec. 18, 2022. [Online]. Available: https://books.google.com/books/about/Transport_Disadvantage_and_Social_Exclus.html?id=qmWwEOdwsmgC

[64] M. Nihal, "Saudi Women Driving: Women express concern over 'no hailing taxi' law." Accessed: Oct. 24, 2023. [Online]. Available: https://saudiwomendriving.blogspot.com/2013/10/women-express-concern-over-no-hailing.html

[65] A. Bhide, "Engendering the Mumbai Suburban Railway Network Study for Mumbai Rail Vikas Corporation – URK." Accessed: Feb. 07, 2023. [Online]. Available: https://urk.tiss.edu/research/engendering-the-mumbai-suburban-railway-network-study-for-mumbai-rail-vikas-corporation/

[66] H. Allen, G. Cárdenas, L. P. Pereyra, and L. Sagaris, "Ella se mueve segura. A study on women's personal safety in public transport in three Latin American cities," Mar. 2019, Accessed: Oct. 19, 2023. [Online]. Available: https://scioteca.caf.com/handle/123456789/1407

[67] M. Orozco-Fontalvo, J. Soto, A. Arévalo, and O. Oviedo-Trespalacios, "Women's perceived risk of sexual harassment in a Bus Rapid Transit (BRT) system: The case of Barranquilla, Colombia," *J Transp Health*, vol. 14, p. 100598, Sep. 2019, doi: 10.1016/J.JTH.2019.100598.

[68] S. Shah and A. Raman, "Calaméo - OLA Mobility Institute - What Do Women And Girls Want From Urban Mobility Systems?" Accessed: Oct. 19, 2023. [Online]. Available: https://www.calameo.com/books/007099207a3350f080431

[69] C. Dameria and A. H. Fuad, "Enhancing female pedestrians' safety perceptions through the permeability of building frontages (case study: blok M area)," *IOP Conf Ser Earth Environ Sci*, vol. 673, no. 1, p. 012040, Feb. 2021, doi: 10.1088/1755-1315/673/1/012040.

[70] N. Gardner, J. Cui, and E. Coiacetto, "Harassment on public transport and its impacts on women's travel behaviour," *https://doi.org/10.1080/07293682.2017.1299189*, vol. 54, no. 1, pp. 8–15, Jan. 2017, doi: 10.1080/07293682.2017.1299189.

[71] A. Lubitow, M. J. Abelson, and E. Carpenter, "Transforming mobility justice: Gendered harassment and violence on transit," *J Transp Geogr*, vol. 82, p. 102601, Jan. 2020, doi: 10.1016/J.JTRANGEO.2019.102601.

[72] K. J. Clifton and A. D. Livi, "Gender Differences in Walking Behavior, Attitudes About Walking, and Perceptions of the Environment in Three Maryland Communities." Accessed: Jan. 17, 2023. [Online]. Available: https://trid.trb.org/view/773070

[73] A. Loukaitou-Sideris and C. Fink, "Addressing Women's Fear of Victimization in Transportation Settings," *Urban Affairs Review*, vol. 44, no. 4, pp. 554–587, Mar. 2009, doi: 10.1177/1078087408322874.

[74] M. J. Smith, "Addressing the Security Needs of Women Passengers on Public Transport," *Security Journal 2008 21:1*, vol. 21, no. 1, pp. 117–133, Jan. 2008, doi: 10.1057/PALGRAVE.SJ.8350071.

[75] TTC, METRAC, and MTPF, "MOVING FORWARD: MAKING TRANSIT SAFER FOR WOMEN: A JOINT STUDY OF SECURITY ON THE RAPID TRANSIT SYSTEM RELATIVE TO SEXUAL ASSAULTS..," p. 81, 1989.

[76] A. Gekoski, J. M. Gray, J. R. Adler, and M. A. H. Horvath, "The prevalence and nature of sexual harassment and assault against women and girls on public transport: an international review," *Journal of Criminological Research, Policy and Practice*, vol. 3, no. 1. Emerald Group Publishing Ltd., pp. 3–16, 2017. doi: 10.1108/JCRPP-08-2016-0016.

[77] S. Harsment, "Statistics – The Prevalence of Street Harassment," Stop street Harassment. org. Accessed: Oct. 31, 2020. [Online]. Available: http://www.stopstreetharassment.org/resources/statistics/statistics-academic-studies/

[78] E. El Feki, S., Heilman, B. and Barker, G., *Understanding Masculinities: Results from the INTERNATIONAL MEN AND GENDER EQUALITY SURVEY (IMAGES)-MIDDLE EAST AND NORTH AFRICA*. 2017. Accessed: Sep. 04, 2020. [Online]. Available: www.promundoglobal.org

[79] B. El Deeb, "Study on Ways and Methods to Eliminate Sexual Harassment in Egypt Objectives of the Study nd a s tion k n a a Th preci Ap The Geographical Scope Distribution of the samples surveyed Geographical Scope of the Study," pp. 1–16, 2013, [Online]. Available: http://www.dgvn.de/fileadmin/user_upload/DOKUMENTE/English_Documents/Sexual-Harassment-Study-Egypt-Final-EN.pdf

[80] A. Canale, T. Campisi, G. Tesoriere, L. Sanfilippo, and A. Brignone, "The Evaluation of Home-School Itineraries to Improve Accessibility of a University Campus Trough Sustainable Transport Modes," *Communication Systems and Applications*, vol. 12250 LNCS, pp. 754–769, 2020, doi: 10.1007/978-3-030-58802-1_54.

[81] K. J. Assi, M. Shafiullah, K. M. Nahiduzzaman, and U. Mansoor, "Travel-To-School Mode Choice Modelling Employing Artificial Intelligence Techniques: A Comparative Study," *Sustainability*, vol. 11, no. 16, Aug. 2019, doi: 10.3390/SU11164484.

[82] K. J. Assi, K. M. Nahiduzzaman, N. T. Ratrout, and A. S. Aldosary, "Mode choice behavior of high school goers: Evaluating logistic regression and MLP neural networks," *Case Stud Transp Policy*, vol. 6, no. 2, pp. 225–230, Jun. 2018, doi: 10.1016/J.CSTP.2018.04.006.

[83] T. P. Uteng and T. Cresswell, "Gendered Mobilities," *Gendered Mobilities*, pp. 1–270, Jan. 2016, doi: 10.4324/9781315584201.

[84] C. Greed, "Overcoming the Factors Inhibiting the Mainstreaming of Gender into Spatial Planning Policy in the United Kingdom," *http://dx.doi.org/10.1080/00420980500060269*, vol. 42, no. 4, pp. 719–749, Apr. 2005, doi: 10.1080/00420980500060269.

[85] S. Aloul, R. Naffa, and M. Mansour, "Gender in Public Transportation – TInnGo Observatory." Accessed: Dec. 11, 2022. [Online]. Available: https://transportgenderobservatory.eu/resource/gender-in-public-transportation/

[86] World Bank, "Mainstreaming Gender in Road Transport : Operational Guidance for World Bank Staff." Washington, DC, 2010. Accessed: May 16, 2023. [Online]. Available: http://hdl.handle.net/10986/17455

[87] K. Scott and J. Babinard, "What Do Existing Household Surveys Tell Us About Gender and Transportation in Developing Countries," *undefined*, 2011.

[88] WBCSD, "Sustainable Mobility Indicators - SMP2.0." Accessed: Aug. 30, 2022. [Online]. Available: https://www.wbcsd.org/Programs/Cities-and-Mobility/Sustainable-Cities/City-Business-Collaboration/SiMPlify/Resources/

Volume 10, Issue 1, June 2024 - ISSN 2356-8569
http://dx.doi.org/10.21622/RESD.2024.10.1.782

Sustainable-Mobility-Indicators-SMP2.0

[89] URBAN AGENDA FOR THE EU, "URBAN MOBILITY INDICATORS,FOR WALKING AND PUBLIC TRANSPORT," 2019, Accessed: Aug. 30, 2022. [Online]. Available: https://ec.europa.eu/futurium/en/system/files/ged/convenient-access-to-public-transport.pdf

[90] ADB, "Gender toolkit : transport : maximizing the benefits of improved mobility for all.," p. 86, 2013.

[91] A. de Avila Gomide, S. K. Leite, and J. M. Rebelo, "Public Transport and Urban Poverty: A Synthetic Index of Adequate Service." Accessed: Feb. 04, 2021. [Online]. Available: https://trid.trb.org/view/810724

[92] D. Pulido, G. Darido, R. Munoz-Raskin, and J. Moody, "The Urban Rail Development Handbook," *The Urban Rail Development Handbook*, Sep. 2018, doi: 10.1596/978-1-4648-1272-9.