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# Social norms and perceptions of Saudis on active transportation

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The culture of active transportation (walking or cycling) in the Kingdom of Saudi Arabia (KSA) is less prevalent than in other societies. This study aims to understand the perceptions of people in the KSA about the role of cultural dimensions on active transportation. The study was conducted in Jeddah, prominent urban city in Saudi Arabia. The city suffers from rapid growth in vehicle users compared to active transportation. An online survey was employed with around 800 individuals participating from King Abdulaziz University. The results were analysed based on participants' sex. Few participants reported walking as the mode of transportation from home to work/school and no participants reported using a bicycle as daily commute. Females identify societal tradition and norms as the main factors that impede their engagement in active transportation. Males, who were embarrassed to walk/cycle, defined clothing and social status as the main barriers. Most males and females identify climate (high temperature throughout the year) as one of the main obstacles to walk/bike. Significant social, environmental, and infrastructural predictors of participants' modal choice were the distance from home to school/workplace, age, social values, family size, citizenship, and road safety.

## KEYWORDS

social norms, environment, physical activities, active transportation, transportation mode

## 1 Introduction

Social concepts and beliefs affect the behaviour of individuals in their everyday activities. Society's activities and opinions impact people's thoughts and perceptions, where determine and form the behaviour of human beings (Cole et al., 2014). Modifying these perceptions and concepts may shape a person's everyday activities and as a result his wellbeing (Kaplan, Spittel, 2015). The social environment can be defined as social relationships between what people interact with and the cultural and physical surroundings (Barnett, 2001). Therefore, culture, which is defined as the beliefs, values, norms, and things people use which guide their social interactions in everyday life (Götschi et al., 2016), of a society or social environment is attained from several sources (Spencer-oatey, 2012). Social norms are shared standards of acceptable behaviour by groups (Lapinski and Rimal, 2005), or cultural phenomena that prescribe and proscribe behaviour in specific circumstances (Hechter and Opp, 2001).

Social environment affects many areas and specially the transportation field, it impacts the physical activities and thus nation's health and environmental features (Hernandez and Blazer, 2006). Despite the commendable decision by the Saudi Arabian government to grant Saudi women the right to drive, the adoption of active transportation still presents challenges, given that women now exhibit increased confidence in venturing outdoors. The culture of active transportation, walking or cycling, in the KSA is less widespread

compared to other societies. There are various reasons for this, such as the absence of infrastructure and sidewalks, the high temperatures with a lack of cover, and the type of clothing worn. Despite what some might consider exaggerated behaviours, Arab societies, in particular, Saudi society, favour these behaviours and respect them as part of their heritage and culture. Therefore, this study aims to study the impact of Saudi society on the use of active transportation.

Saudi Arabia and other affluent Arab Gulf countries are endeavouring to remain up to date with fast-paced transportation advancements and harness their advantages for economic growth (Dahim, 2021). Developed countries are characterized by having advanced transportation systems and sustainable urban development through efficient, convenient, safe, and environmentally friendly road networks (Pojani and Stead, 2015). Therefore, it is important for the KSA to take measures that will help improve the quality of life of Saudi citizens. In recent years, Saudi cities have witnessed significant traffic congestion due to the massive population growth and the lack of diversity in transportation systems (Aboukorin and Al-shihri, 2015). These developments cause delays in transportation, with long queues of stationary cars, that negatively affect the attitude and performance of drivers. The congestion also increases emissions from the cars' engines, which cause air pollution. The interest in encouraging active transportation will reflect positively on the Kingdom's environment by mitigating emissions from motorized transportation (United Nations, 2013). It is worth mentioning that active transportation is non-motorized transportation, which can be ideally connected to public transportation systems, such as buses, railways, and ferries (APHA, 2010). According to U.S. Energy Information Administration in 2021, Saudi Arabia was the largest consumer of oil in the Middle East in the fields of transportation fuels and power generation (EIA, 2021). There has been a significant slowdown in the development of public transportation in the Kingdom because of government subsidies for fuel prices and people's dependence on private cars. All of this has had negative impacts on air quality, leading to increased healthcare costs and environmental regulatory expenses. The kingdom is also ranked eighth in the world in terms of the amount of carbon dioxide emissions (Alkhathlan and Javid, 2015). All these observations influence the country's Gross Domestic Product (GDP). For example, they contribute to increased traffic congestion, higher infrastructure costs, and environmental impacts. However, in Saudi Arabia the (GDP) *per capita*, purchasing power parity in 2020, was 44,328.18 US dollars compared with the global average of 19,446.24\$ (Bank, 2021).

It is evident that Saudi Arabia is actively pursuing advancements in transportation to boost economic growth (Dahim, 2021). The country recognises the importance of modernizing transportation infrastructure, aligning with the sustainable urban development seen in developed countries (Pojani and Stead, 2015). As Saudi cities grapple with significant traffic congestion due to population growth and limited transportation diversity (Aboukorin and Al-shihri, 2015), there's a pressing need to prioritize pedestrian safety. The heavy vehicular traffic not only leads to emissions and air pollution but also poses risks to pedestrians (Al-Zahrani and Jadaan, 1995; Mansuri et al., 2015). This underscores the necessity of reevaluating pedestrian road designs and promoting active transportation as

effective solutions to alleviate congestion and improve overall urban mobility. The National Transportation Strategy (MOT, 2011) emphasizes this approach by stating, "The road will help to reduce the high percentage of victims among pedestrians".

Saudi society is witnessing an increase in non-communicable diseases associated with an inactive lifestyle (Al-Hazzaa and AlMarzooqi, 2018). F DeNicola (2015) noted the need to research the causes of non-communicable diseases among Saudis and the importance of developing appropriate strategies for them and stated: "healthcare systems in the KSA should begin preparing for secondary prevention strategies and implementing grass-root-level policies for addressing NCDs among the aging group of young Saudis already threatened with chronic weight-related conditions as their risk for additional or worsening diseases increases." (DeNicola et al., 2015).

Studies have demonstrated the need for a better understanding of a community's culture by those responsible for planning modern transportation systems (Hasan et al., 2022). This understanding of a community's culture is expected to increase the capacity for a successful road network (Jamal et al., 2018). Streets that are compatible with the needs of people in our modern times are those that bring diversity and attraction to people, for walking, cycling, and reducing dependence on cars (Kuzmyak and Dill, 2012).

## 1.1 Background

The promotion of physical activity in many countries in the world has become associated with the advancement of active transportation. However, active transportation can only thrive through the creation of three essential elements: implementation, legislation, and encouragement (Forsyth et al., 2008; Lubitow et al., 2016; Li and Joh, 2017). Where the element of implementation provides the infrastructure that serves its users, the element of legislation provides protection and preservation of rights of users, and finally, the element of encouragement helps to motivate people to walk and bike. Nonetheless, it is useful first to understand the requirements of the community before starting any project related to social behaviour and to identify the obstacles that may oppose it. The participation of an informed society in the decision-making of any project often leads to better decisions and results for all (Bennett et al., 2017). The implementation of facilities for walking or cycling without the need to use them will become failed projects and waste of public money (Pepper, 2015).

Montoya-Robledo et al. (2020) examined how gender stereotypes intersected with cycling patterns among caregivers in Bogotá, focusing on four districts. They explored women's caregiving roles, men's adherence to toxic masculinity, and women's vulnerability in public spaces, aiming to provide policy recommendations for gender-sensitive mobility planning. Yuan et al. (2023) investigated how gender and other factors influenced active transport decisions in cities. They found that women from lower socioeconomic backgrounds often walked out of necessity, while those with higher status preferred cycling. Recommendations included community programs, safe environments, media campaigns, mixed land usage, and gender equality advocacy. Goel et al. (2022) studied gender differences in active travel

across 19 major global cities, revealing that females favoured walking and public transport, while males were more inclined to cycle, especially in cities with high cycling rates. The study highlighted the importance of implementing gender-sensitive policies to address disparities in active travel.

Chaix's study explored the relationship between transportation and physical activity, investigating its role in meeting official recommendations. The findings revealed that walking, biking, and public transportation trips make substantial contributions to physical activity levels. This emphasizes the potential benefits of boosting participation in active and public transportation to align with established physical activity guidelines (Chaix et al., 2014). Dehghanmongabadi highlighted the pressing necessity of overhauling transportation systems to tackle sustainability issues and bolster social, economic, and environmental wellbeing. Conducting a narrative review of available literature, the study focuses on advocating for active transportation to provide insights for urban policymakers, transportation planners, and public health officials. By elucidating critical determinants, the research aims to steer initiatives promoting active transportation for daily mobility (Dehghanmongabadi and Hoşkara 2020). Finger analysed adults' adherence to recommended aerobic physical activity levels through walking and cycling for transportation. The study unveiled correlations between factors such as higher population density, older age, lower income, and better health with increased walking and cycling for transportation purposes. These findings suggest that promoting walking and cycling can enhance overall physical activity levels and offer valuable insights for shaping public health strategies (Finger et al., 2019). Harumain investigated the role of sociodemographic factors in active transportation, crucial for sustainable urban transport. Statistical analyses revealed that education level and occupational status significantly influenced the distance between home and public transportation stations. These findings hold implications for various sectors, including urban planning, transportation, health, and education, and can aid decision-making to promote active transportation (Harumain et al., 2022). Rahman explored how the built environment impacts active transportation. Despite favourable conditions, factors such as the prevalence of low-cost motorized vehicles impose limitations on active travel. The study demonstrated that compactness and sidewalk conditions influence walking, while roadway infrastructure and travel distance affect both walking and bicycling (Rahman et al., 2023). Salvo outlined that the field of physical activity and public health primarily follows a choice-based model, stemming from high-income countries. However, in many low- and middle-income countries (LMICs), physical activity is often dictated by economic necessity rather than free choice. To address this discrepancy, Salvo proposed a 'necessity-versus choice-based physical activity models' framework to guide research and promotion efforts in LMICs (Salvo et al., 2023).

Albawardi's study revealed that an unacceptable level of consistent physical activity in the kingdom, particularly among women (Albawardi et al., 2017). According to the World Health Organization (WHO) in its 2010 statistics, Saudi women are the least active in the world, with 74.9% of the Saudi women being inactive (World Health Organization, 2010). Al-Dosari, in his study, indicated that there is a significant impact that religion, heritage, and the community's culture on the behaviour of a Saudi family and the Saudi individual during their daily activities (Mohammed and Dossry, 2012).

Research studies on any subject are often discussed according to the researchers' interest. Therefore, it has been observed that most of the research that addresses physical activity in Saudi society focuses on the health aspects. For instance, the study by Al-Shahri in 1996, which showed that one of the causes for the negative effects on health is the lack of exercise (Al-shahri, 1996). In addition, the study by Majeed in 2015 discussed the causes of obesity among Saudi women, which is due to malnutrition and the lack of physical activity (Majeed, 2015). Studies that examine behaviours and their impact on physical activity were mentioned in the 2015 study by Alsubaie, the study assessed the reasons for the decline in physical activity among younger male adolescents, but it did not address the physical activities associated with transportation (Alsubaie and Omer, 2015). The study presented by Al-Zalabani argued that there is a need for programs that contribute to the alleviation of inactivity and promote stimulation of physical activity in different regions and sectors of society in Saudi Arabia (Al-Zalabani et al., 2015). The research done by Samara was the closest to the proposed study we conducted. However, Samara's study also did not address the issue of transportation and focused specifically on the health aspects of women. The study dealt extensively with the impact of societal culture despite the researchers' statement that participants did not disclose the influence of religion or family as barriers that may prevent them from physical activity (Samara et al., 2015). The study of Sharara reviewed research and articles interested in physical activity in Arab societies and discusses the need for methods and techniques of analytical analysis for a more profound examination of the contexts of those studies (Sharara et al., 2018). The study pointed out in its conclusion that there are certain aspects of the cultural context in the Arab region that appear to discourage physical activities. Consequently, the urgent need to investigate the attitudes of people in Saudi Arabia regarding their transportation choices, particularly active transportation, is evident. This research aims to gain insight into the perception of active transportation among Saudis. Unique and pioneering, this study seeks to elucidate the overarching patterns in people's transportation preferences, their implications, and the underlying reasons guiding their decisions.

## 1.2 Case study

The KSA is one of the wealthiest countries and the largest oil exporters, ranking second in the world's oil reserves and it has the sixth-largest gas reserves in the world (Hendrix, 2017). The administrative land of Saudi Arabia is split into 13 administrative areas, each of which contains several provinces (Hendrix, 2017). This study was conducted in the province of Jeddah, which lies within the region of Makkah (Mission et al., 2013) in the western part of the KSA on the Red Sea coast (see Figure 1). The city of Jeddah is the economic and tourist capital of Saudi Arabia and the first regarding urban development with many high-rise buildings and towers (ARCADIS, 2015). The city of Jeddah faces transportation challenges due to its connection to seaports and the lack of suitable major external road networks and with the city's internal road networks, especially tracks, used to transport goods (MOT, 2011). In recent years, the city has experienced a dramatic increase in traffic congestion, a reduction in traffic safety, and a significant increase in car emissions (Khawagi, 2017). Jeddah seeks to offer several strategic solutions to increase the efficiency of transportation in all its forms, such as the development of a rail

system, a metro system, an international airport, public transportation networks, and active transportation networks (Riyadh Chamber of Commerce, 2005).

## 2 Methodology

### 2.1 Questionnaire design and descriptive analysis

The study included 22 questions (Supplementary Appendix S1) starting with an introduction explaining the purpose of the research and gave the participants the freedom to choose to answer the questions or not. The questionnaire was divided into three main parts. The first part has personal questions such as (sex, age, income level, and academic achievements) similar approach was used by (Alhomaidat et al., 2023). The second part has concerns about transportation’s usefulness and impediments this part was inspired from (Hasan et al., 2022). The final part has questions on the participants’ perspectives and thoughts on the influence of Saudi culture in everyday transportation decisions, this approach was also used by (Hasan et al., 2022). The survey also included clarification of the time needed to complete the answers and referenced the fundamental approvals for the study from the authorities having jurisdiction. This study used the university emails to disseminate the survey to the largest number of staff and students in the selected university. Universities serve as

microcosms of broader society, encompassing individuals from various backgrounds, cultures, and socioeconomic statuses. They play a pivotal role in shaping societal norms, values, and behaviours. Therefore, the survey was distributed through internet, social media platforms, and email over a 4-week period in 2019. Only one request was sent, and no incentives were provided. With the goal of achieving a 95% confidence level and a 5% margin of error, considering a total population of 77,095 (University, 2019) and a sample proportion of 0.5 as suggested by (Alhomaidat et al., 2021), the minimum required sample size for the survey was calculated to be around 383 (approximately 400) participants. However, the survey received around 800 responses.

The Microsoft Forms program, one of the most important applications of the Office 365 Microsoft Pack, was used to publish the questionnaire. This program, like many survey programs, allows monitoring of results during the questionnaire distribution period. Microsoft Forms provides the ability to participate in the survey through different browsers and on all devices (such as computers and smart phones). The program also provides the results of the survey via an Excel file that provides charts.

The benefits of online surveys are known to many people (cheaper, more flexible, faster, more versatile, responsive to respondents, and more suitable for larger sample sizes) (Polaris Marketing Research, 2012; Albdour et al., 2022). Nonetheless, at the same time, they also have some challenges for the examiner. One of the most significant challenges is that the examiner is not able to

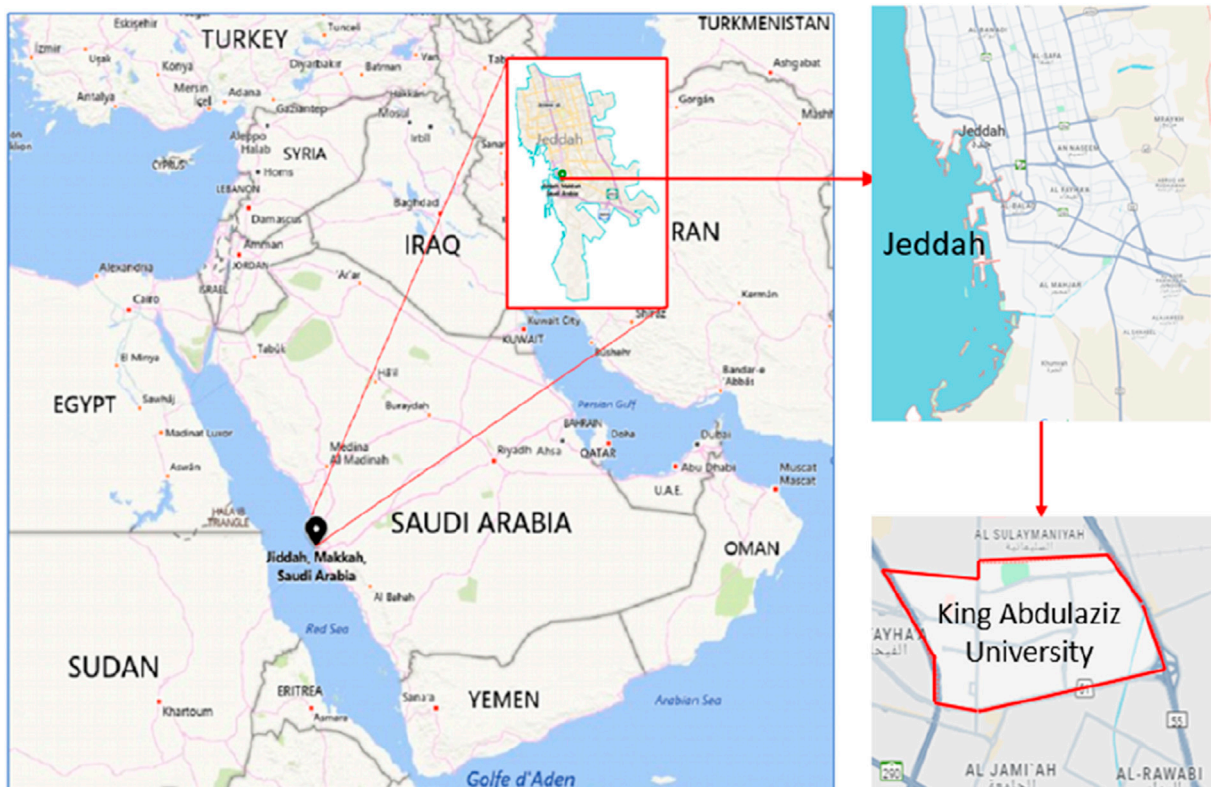


FIGURE 1 The field of study in Jeddah city, located within the area of Makkah.

comprehend the concerns and questions about the questionnaire except by continually checking the results of the questionnaire periodically. There is also no tool for the examiner that allows them to be able to directly request an answer from a specific participant, which may be available to the examiner on a paper survey. It is also not advisable to increase the number of questions in the Internet survey because it may cause participants to leave the entire questionnaire without completing it.

## 2.2 Statistical analysis

To examine whether the percentage distribution among male or female differs with regard to perceptions and obstacles that may prevent them from using active transportation, the nonparametric Pearson chi-square test ( $X^2$ ) of homogeneity was carried out. ( $X^2$ ) is appropriate for establishing if two grouping criteria in contingency tables are independent of each other (Washington et al., 2010). Furthermore, it enables the usage of each cell in the contingency table with its corresponding attribute cross-classification. The chi-square test ( $X^2$ ) equation for two-way contingency table is depicted in Eq. 1. Whereas the null hypothesis is the two sexes are statistically independent, the alternative hypothesis is the two sex groups are not statistically independent.

$$X^2 = \sum_{i=1}^r \sum_{j=1}^c \frac{(O_{ij}E_{ij})^2}{E_{ij}} \quad (1)$$

Where the observed and expected frequencies are  $O_{ij}$  and  $E_{ij}$ , respectively, and the degrees of freedom is  $df = (r - 1)(c - 1)$ . Where  $(i, j)$  denotes the expected count, the number of rows and columns represented by  $(R, C)$ , respectively.

The logistic regression model was also utilized for identifying key parameters influencing resident's decision on what mode of transportation residents' preference. The choice of active mode of transportation as opposed to other types of modes of transportation, was the response of interest. The logistic regression equation is shown in Eq. 2. Explanatory variables comprise such as nationality, household size, social value, distance from home to destination, and road safety concerns variables gathered from the online survey. Tables 1, 2 describes these variables for males and females.

$$\ln\left(\frac{p}{1-p}\right) = \sum_{i=0}^n \beta_i x_i \quad (2)$$

Where the  $\beta_i$  is the parameters corresponding to the explanatory variables  $x_i$ , and  $P$  is the probability of person use active mode of transportation.

Assumptions form a crucial basis for understanding the intricate interplay of social, cultural, and environmental factors that influence transportation behaviours and preferences, especially concerning active transportation modes. These assumptions inform the interpretation of research findings and the framing of discussions around interventions and policy implications aimed at fostering sustainable transportation practices. Cultural factors, such as societal norms and religious beliefs, are assumed to exert a significant influence on individuals' choices regarding active

transportation, potentially leading to gender disparities in attitudes and behaviours, especially in contexts like Saudi Arabia where cultural and religious considerations are prominent. It is further assumed that women may experience a higher level of embarrassment due to societal expectations and gender roles, impacting their use of active transportation modes. Moreover, assumptions about the practical challenges posed by traditional clothing and the overall community perception and acceptance of active transportation initiatives are integral to shaping strategies for promoting sustainable transportation and addressing cultural and societal barriers. These assumptions collectively contribute to a more holistic approach to understanding and addressing transportation preferences and behaviours within diverse cultural and social landscapes.

## 3 Results and discussion

Results were obtained from approximately 800 participants, including 656 Saudi participants and 144 non-Saudi participants. Figure 2 presents a summary of the demographic characteristics of the study participants. To ensure a 95% confidence level and a 5% margin of error, the survey aimed to achieve a minimum sample size of around 383 (approximately 400) participants, considering a total population of 77,095 (University, 2019) and a sample proportion of 0.5. However, the survey received approximately 800 responses, exceeding the minimum requirement. The figure depicts a participation rate of 35% for females and 65% for males. The female-to-male ratio for the 2019 academic year at the specified location (Al-jazirah, 2019) closely corresponds to that of our survey participants. The primary age groups were (15–24), (25–34), and (35–44), constituting 90% of the participants. Low-income earners constituted the smallest income group (1%), while middle-income earners were the most prevalent (70%). High-income earners (More than 20,000 SAR per month) represented (30%) among the various income groups. It is noteworthy that both the age groups and income distribution are consistent with the published statistics of the (General Authority for Statistics, 2016).

Table 1 shows the participants' responses to the questionnaire and Chi-square test of homogeneity for each answer. The table was distributed according to the participants' sex (males and females), reflecting the gender imbalance within both the country as a whole and the university's population (World Bank, 2022; Kau, 2017). The Chi-square test was used to examine if there was a significant difference in the participants' responses by sex. When discussing the transportation mode options, both sexes stated they do not use bicycles, which is one of the most important means of active transportation. Also, both sexes stated they do not walk for their daily commute, and they prefer to use private cars. The same is true for the use of private buses, which is rare for both sexes but more common for females ( $\chi^2 = 7.018, p = 0.030$ ).

Females were living a bit further (>20 km) from their workplaces or school compared to males. However, overall, there was no significant difference in distribution among males and females concerning distance from home to school or workplaces ( $\chi^2 = 4.437, p = 0.109$ ).

As for the participants' answers to their social embarrassment about the use of active transportation, this was more evident in

TABLE 1 Statistical characteristics of participants for both sex.

Attribute		Female (280) (%)	Male (520) (%)	$\chi^2$	p
Which mode do you use when you go to work or school?	Drive/passenger	89	92	7.018*	0.030
	Private/public buses	8	2		
	Walk	4	6		
What is the approximate distance between your home and workplace or school?	(<10 Km)	51	56	4.437	0.109
	(10 Km-20 Km)	30	34		
	(>20 Km)	18	11		
Do you suffer from any disease that requires walking or bicycling instead of cars according to the advice of the specialist doctor?	Diabetes	3	4	0.806	0.848
	High blood lipid	5	4		
	None	77	75		
	Obesity	15	16		
Do you suffer from social embarrassment when you are walking or riding a bicycle?	Yes	43	15	38.096*	0.000
	No	57	85		
If your answer is yes that you are embarrassed, what are your reasons?	Age	8	22	0.005	0.947
	Sex	31	3	99.843*	0.000
	Social status	13	25	2.032	0.154
	Clothing	18	22	10.203*	0.001
	Social habit	30	29	28.513*	0.000
What are the obstacles that prevent you from walking?	Time is not enough	13	16	2.814	0.093
	Safety concerns	10	11	0.844	0.358
	Security reasons	5	4	1.137	0.286
	Roads are in a bad condition	10	11	1.524	0.217
	The sidewalks are in a bad condition	9	14	6.869	0.009
	The destination is too far away	16	17	0.546	0.460
	Due to the impact of climate	20	23	4.897*	0.027
	Society norms and traditions	16	5	42.236*	0.000
What are the obstacles that prevent you from riding bicycles?	Time is not enough	5	10	12.237*	0.000
	Safety concerns	13	15	4.767*	0.029
	Security reasons	7	5	0.049	0.826
	Roads are in a bad condition	11	18	20.673*	0.000
	The sidewalks are in a bad condition	9	14	11.739*	0.001
	The destination is too far away	9	12	4.704*	0.030
	Due to the impact of climate	12	18	18.217*	0.000
	Society norms and traditions	34	7	137.194*	0.000

\* Significant at 95% confidence level.

females (43 percent) than in males (15 percent). Males were embarrassed to walk or bike due to their social status (25 percent,  $\chi^2 = 2.032$ ,  $p = 0.154$ ), their clothes type (22 percent,  $\chi^2 = 10.203$ ,  $p = 0.01$ ), and their age. The impact of clothing on men in Saudi Arabia may be attributed to the type of clothing they wear, called “Thob”, and headwear that is not conducive for active transportation. Females were more sensitive

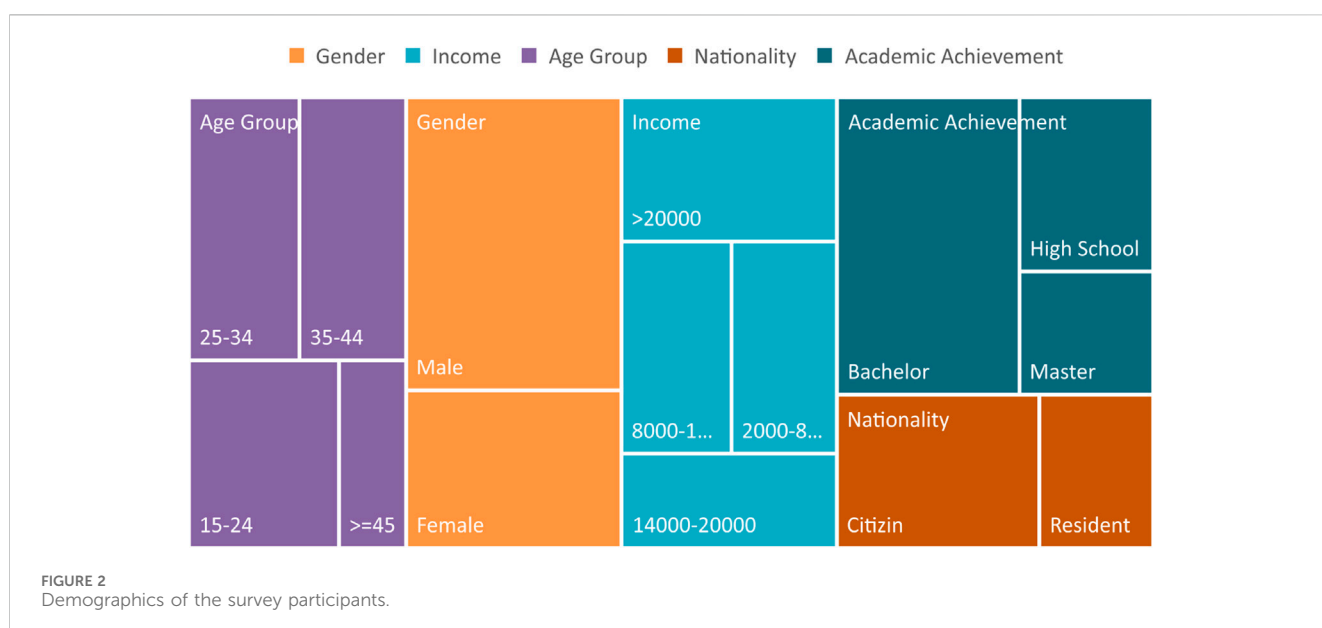
to sex issues (31 percent,  $\chi^2 = 99.843$   $p = 0.000$ ) and people consider it as bad social habits that prevents them from using active transportation (30 percent,  $\chi^2 = 28.513$ ,  $p = 0.000$ ).

Participants were also asked to identify various social and environmental factors that impede their involvement in active transportation. The majority of males and females identify climate as one of the main obstacles to walking. However, females (16 percent) were

TABLE 2 The Logistic model.

Variables	Females				Males			
	Coef	OR	z	P > z	Coef	OR	z	P > z
OD distance	-0.05	0.95	-0.91	0.36	-0.82*	0.07	-2.74	0.01
Age	-0.08**	0.92	-1.86	0.06	-0.97	0.04	-0.74	0.46
Resident	1.56*	4.76	2.05	0.04	-2.96**	0.63	1.72	0.09
Family size	0.29	1.34	1.58	0.12	-1.18	0.10	1.59	0.11
Social values	-3.10*	0.05	-2.66	0.01	-0.78	0.89	-0.29	0.77
Road safety	0.58	1.79	0.77	0.44	-0.22*	0.70	-2.16	0.03
Constant	-1.16	0.31	-0.69	0.49	0.18	1.61	-1.08	0.28

\* Significant at 95% confidence level.  
 \*\* Significant at 90% confidence level.



more sensitive to social norms and traditions than males (5 percent). For the case of bicycles, the participants’ responses were statistically different among males and females. Males identified infrastructure and environmental factors such as safety, roadway condition, and sidewalk condition as the main obstacles to bicycling. However, females’ involvement in bicycling as the mode of transportation was hindered mostly by society norms and tradition (34 percent,  $\chi^2 = 137.194$ ,  $p = 0.000$ ). Additionally, there was no significant gender difference in reported disease prevalence, with both genders similarly affected by health conditions influencing transportation choices.

### 3.1 Modal choice predictors

Logistic regression was used to determine significant predictors of participants’ mode of transportation. In the modelling process, walking was removed since few participants reported walking. However, the use of a bus can also be considered an active form of transportation, partly since a person has to walk or bike to access the bus stops/stations.

Logistic regression identified significant predictors of taking a bus as opposed to the use of a private car as a primary mode of transportation from home to work/school. The results of the logistic analysis (coefficient values, odds ratios, and the  $p$ -value) are presented in Table 2. Furthermore, Figure 3 displays a graphic summary of the marginal effects results. Two logistic regression models were estimated for each sex type. Variables that were significant at 90 percent confidence level in either of the two models were retained.

Variables that were found to be significant in predicting participants’ mode of transportation for both males and females were participant nationality. Residents, who are not Saudi citizens, were more likely to take a bus compared to Saudi citizens ( $OR_{females} = 4.76$ ,  $OR_{males} = 0.63$ ). These results agreed with past literature that found the community’s culture has an impact on the behaviour of a Saudi family and the Saudi individual during their daily activities (Mohammed and Dossry, 2012). Predictor variables that were only significant to males were distance from home to work/school and road safety concerns. Males who were living far from their working place/school were less likely to opt for walking or taking a bus for their daily

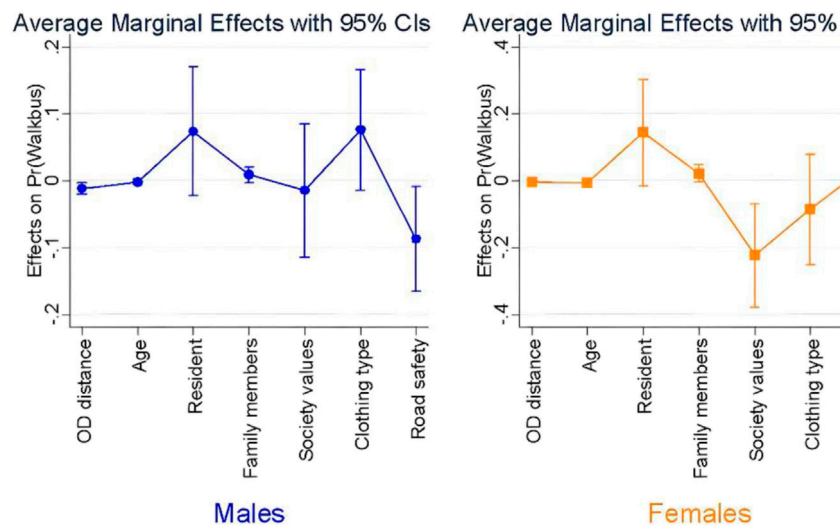


FIGURE 3 Marginal effect of the predictor variables.

commute ( $OR_{males} = 0.07$ ). Distance from home to school or work was also found a significant variable in the previous study conducted in Iraq (Hasan et al., 2022). Similarly, males who expressed their concerns on road safety issues were expected to use private cars ( $OR_{males} = 0.70$ ).

Age and social values were significant predictors of females' modes of transportation. Females who reported to be affected by social norms and traditions were less likely to take a bus ( $OR_{female} = 0.05$ ). Also, as females age, they are more inclined to use private cars than take a bus ( $OR_{females} = 0.92$ ). These findings were consistent with the previous study (Albawardi et al., 2017) who found that the level of stable physical activity in women in Saudi society is low. The gender gap in transportation modes is prevalent in most Arab countries. Females are more influenced by social norms and traditions, which makes them less likely to use active transportation options.

## 4 Conclusion

Large cities in the KSA have witnessed rapid development and significant growth in work activities in recent years, as well as a massive increase in the number of residents and citizens. The city of Jeddah was chosen for the case study in this research because it is the economic and tourist capital of the Kingdom and the most active and developed in all fields relevant to this study. An increase in traffic congestion is reflected by increased activity in the city. Traffic congestion causes many bottleneck traffic situations and increases queuing on roads. Despite all of this, people are still reluctant to search for other ways that may relieve them of the burden of congestion and its consequences. However, it is illogical to start any transportation-related project that is costly and laborious before understanding the culture and perceptions of the community the project will affect. Therefore, this study attempts to understand people's opinions of active transportation in the KSA and assist specialists in the field of transportation and urban planning. Participant's answers about their perceptions, the concerns they face, and the daily challenges in their journeys provide solutions for specialists to improve the performance of the transportation system.

As previously stated, a survey sample of 800 participants was conducted at the King Abdulaziz University, Jeddah, KSA. The study showed a significant variation in the use of modes of transportation between females and males as indicated by Chi-square test. The lack of use of bicycles by all participants during their trips is remarkable. Social embarrassment was more prevalent among females (43%) than males (15%), which is the result of the culture and traditions of society. This study noted that the type of clothing has a more significant effect on males (22%) than for females (18%). Besides, the majority of males and females identify climate as one of the main obstacles to walking. High temperatures in the KSA for most of a year may be likely to discourage people from walking and biking.

Significant predictors of active transportation modes, as opposed to a private car, were the distance from origin to destination, age, participant's nationality (resident or citizen), family size, social values, and road safety concerns. Predictor variables that were only significant for males were distance from origin to destination and road safety concerns, while age and social values were significant mode choice predictors for females. The Kingdom has actively participated in several regional and international consultations and discussions to achieve the goals of sustainable development. Those goals were adopted at the UN Summit, which was held in September 2015 within the framework of the UN Sustainable Development Plan (Political, 2018).

Saudi Arabia considers the sustainable development plan as a priority. Many legislations and directives have been issued in agreement with the Kingdom's Vision 2030. The Kingdom's Vision 2030 is based on three main standards: a prosperous community, booming economy, and an ambitious nation. Jeddah is the second largest Saudi city after the capital, Riyadh, in terms of interest in urban development projects and in various aspects that serve people's lives, including the development of infrastructure, green areas, and sports areas (Davids, 2014; Mark Lee and Al-Mansour, 2020).

Based on the study outcomes, it is necessary to focus on improving and issuing new legislation that contributes to the



infrastructure provisions for users of active transport and in the various regions around KSA. As well as emphasizing the need to increase the green area and provide corridors equipped with means that may change the climate condition of the active transport users' route and protect them from harsh weather. Moreover, raising the societal awareness in reducing the dependency on vehicles as the only means of transportation and diversifying the dress code, even for certain periods of the day, to enhance transportation strategies and improve the overall health, and reduce diseases for people in general.

It may be useful to carry out a similar study in several years to observe the changes in the community and culture that will have taken place. Only recently, females have been allowed to drive a car in the KSA. This is not only a change in the transportation system but also a difference in the Saudi culture and its traditions. The Kingdom has begun plans to diversify transportation conditions, especially railway and metro lines. All these changes might provide an exciting twist in the choice of transportation that will be worth investigating.

In future studies related to this topic, assessing the infrastructure status for pedestrians, cyclists, and aligning it with global standards is crucial for identifying existing gaps and areas for improvement in transportation systems, ultimately enhancing sustainability and accessibility. Moreover, future research should delve into long-term trends such as technological advancements, policy changes, and economic shifts to anticipate challenges and opportunities proactively. This forward-looking perspective will deepen the understanding and guide measures for sustainable transport initiatives. Exploring alternative hypotheses or competing theories can offer a more comprehensive understanding of factors influencing studied outcomes. Additionally, conducting impact assessments of harsh atmospheres, particularly in regions like Saudi Arabia, will help grasp challenges faced by active transport users due to environmental factors. Integrating these aspects into research endeavours will enrich the understanding and significantly contribute to fostering sustainable and user-friendly transportation environments. Moreover, the study's sample from King Abdulaziz University in Jeddah may not fully represent the entire city or the Kingdom, which could introduce biases regarding age, education level, and socioeconomic status. Exploring other transportation modes, such as public transit or shared mobility, could provide additional insights. Moreover, reliance on self-reported data may lead to recall bias and social desirability bias, potentially affecting the accuracy of responses. It is also essential to investigate other relevant factors, such as urban design and infrastructure accessibility. While the findings are aligned with sustainable development goals and Vision 2030, there is a need

for a more comprehensive exploration of broader socio-political and economic factors shaping transportation policies and practices in Saudi Arabia.

## Data availability statement

The original contributions presented in the study are included in the article/[Supplementary Material](#), further inquiries can be directed to the corresponding author.

## Author contributions

RH: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Validation, Writing–original draft. FA: Conceptualization, Data curation, Methodology, Validation, Writing–review and editing. MA: Methodology, Visualization, Writing–review and editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fbuil.2024.1369704/full#supplementary-material>

## References

- Aboukorin, A. A., and Al-shihri, F. S. (2015). Rapid urbanization and sustainability in Saudi Arabia: the case of dammam metropolitan area. *J. Sustain. Dev.* 8, 52. doi:10.5539/jsd.v8n9p52
- Albawardi, N. M., Jradi, H., Almalki, A. A., and Al-Hazzaa, H. M. (2017). Level of sedentary behavior and its associated factors among Saudi women working in office-based jobs in Saudi Arabia. *Int. J. Environ. Res. Public Health* 14, 659. doi:10.3390/ijerph14060659
- Albdour, M. S., Shalby, M., Salah, A. A., and Alhomaiddat, F. (2022). Evaluating and enhancing the energy efficiency of representative residential buildings by applying national and international standards using BIM. *Energies* 15 (20), 7763. doi:10.3390/en15207763
- Al-Hazzaa, H. M., and AlMarzooqi, M. A. (2018). Descriptive analysis of physical activity initiatives for health promotion in Saudi Arabia. *Front. Public Heal.* 6, 329–410. doi:10.3389/fpubh.2018.00329

- Alhomaïdat, F., and Eljufout, T. (2021). Perception of cycling risks and needs associated with skill level, gender, and age. *Archives Transp.* 59 (3), 113–127. doi:10.5604/01.3001.0015.2390
- Alhomaïdat, F., Hasan, R. A., Eljufout, T., and Abbas, A. H. (2023). User's perceptions of electric, hybrid, and fuel-powered vehicles in Iraq and Jordan. *Case Stud. Transp. Policy* 12, 101004. doi:10.1016/j.cstp.2023.101004
- Al-jazirah (2019). *Acceptance indicators in public universities exceed 87% of the number of male and female students*. Available at: <https://www.al-jazirah.com/2019/20190623/In33.htm> (Accessed December 10, 2021).
- Alkhatlan, K., and Javid, M. (2015). Carbon emissions and oil consumption in Saudi Arabia. *Renew. Sustain. Energy Rev.* 48, 105–111. doi:10.1016/j.rser.2015.03.072
- Al-shahri, M. Z. (1996). *Health and lifestyle: a Saudi profile*, 13–21.
- Alsubaie, A., and Omer, E. (2015). Physical activity behavior predictors, reasons and barriers among male adolescents in Riyadh, Saudi Arabia: evidence for obesogenic environment. *Int. J. Health Sci. (Qassim)*. 9, 395–402. doi:10.12816/0031229
- Al-Zahrani, A. H., and Jadaan, K. S. (1995). Current traffic safety issues in Saudi Arabia. *J. King Saud. Univ. - Eng. Sci.* 7, 151–161. doi:10.1016/S1018-3639(18)30623-8
- Al-Zalabani, A. H., Al-Hamdan, N. A., and Saeed, A. A. (2015). The prevalence of physical activity and its socioeconomic correlates in Kingdom of Saudi Arabia: a cross-sectional population-based national survey. *Taibah Univ. Med. Sci.* 10, 208–215. doi:10.1016/j.jtumed.2014.11.001
- APHA (2010). *Active Transportation Benefitting health, safety and equity*.
- ARCADIS (2015). *Global city focus Jeddah*.
- Bank, T. W. (2021). *Saudi Arabia: GDP per capita*. PPP [WWW Document]. Glob. Econ.
- Barnett, C. (2001). A definition of “social environment”. *Am. J. Public Health*.
- Bennett, N. J., Roth, R., Klain, S. C., Chan, K., Christie, P., Clark, D. A., et al. (2017). Conservation social science: understanding and integrating human dimensions to improve conservation. *Biol. Conserv.* 205, 93–108. doi:10.1016/j.biocon.2016.10.006
- Bruckner, A., Rowlands, G., Riegl, B., Purkis, S., Williams, A., and Renaud, P. (2011). *Atlas of Saudi Arabian Red Sea marine habitats*.
- Chaix, B., Kestens, Y., Duncan, S., Merrien, C., Thierry, B., Pannier, B., et al. (2014). Active transportation and public transportation use to achieve physical activity recommendations? A combined GPS, accelerometer, and Mobility Survey Study. *IJBNPA* 11 (1), 124. doi:10.1186/s12966-014-0124-x
- Cole, G. E., Holtgrave, D. R., Rios, N. M., Mitchell, D. T., and Lindström, K. (2014). *Internal and external factors that encourage or discourage health-relevant behaviors*.
- Dahim, M. (2021). Enhancing the development of sustainable modes of transportation in developing countries: challenges and opportunities. *Civ. Eng. J.* 7 (12), 2030–2042. doi:10.28991/cej-2021-03091776
- Davids, M. (2014). *Quality of life program today*, 1–236.
- Dehghanmogabadi, A., and Hoşkara, Ş. (2020). Determinative variables toward promoting use of active modes of transportation: enhancing level of sustainable mobility in communities. *SAGE Open* 10 (3), 215824402096111. doi:10.1177/2158244020961118
- DeNicola, E., Aburizaiza, O. S., Siddique, A., Khwaja, H., and Carpenter, D. O. (2015). Obesity and public health in the kingdom of Saudi Arabia. *Rev. Environ. Health* 30, 191–205. doi:10.1515/reveh-2015-0008
- Finger, J. D., Varnaccia, G., Gabrys, L., Hoebel, J., Kroll, L. E., Krug, S., et al. (2019). Area-level and individual correlates of active transportation among adults in Germany: a population-based multilevel study. *Sci. Rep.* 9 (1), 16361. doi:10.1038/s41598-019-52888-x
- Forsyth, A., Hearst, M., Oakes, J. M., and Schmitz, K. H. (2008). Design and destinations: factors influencing walking and total physical activity. *Urban Stud.* 45, 1973–1996. doi:10.1177/0042098008093386
- Gale, T. (2007). *Saudi Arabia facts, information, pictures | Encyclopedia.com articles about Saudi Arabia*. [WWW Document]. Encyclopedia.com.
- General Authority for Statistics (2022). *Demography survey*. Available at: [https://www.stats.gov.sa/sites/default/files/en-demographic-research-2016\\_4.pdf](https://www.stats.gov.sa/sites/default/files/en-demographic-research-2016_4.pdf).
- General Electric (2015). *Saudi digital water opportunities*.
- Goel, R., Oyebo, O., Foley, L., Tatah, L., Millett, C., and Woodcock, J. (2022). Gender differences in active travel in major cities across the world. *Transportation* 50 (2), 733–749. doi:10.1007/s11116-021-10259-4
- Götschi, T., Garrard, J., and Giles-Corti, B. (2016). Cycling as a part of daily life: a review of health perspectives. *Transp. Rev.* 36, 45–71. doi:10.1080/01441647.2015.1057877
- Harumain, Y. A., Koting, S., Rosni, N. A., and Ibrahim, N. (2022). The influence of sociodemographic background on active transportation: a case study of bangsar and Shah Alam, Malaysia. *Front. Built Environ.* 8. doi:10.3389/fbuil.2022.925956
- Hasan, R. A., Abbas, A. H., Kwayu, K. M., and Oh, J. S. (2019). Role of social dimensions on active transportation and environmental protection: a survey at the University of Samarra, Iraq. *J. Transp. & Health* 14, 100564. doi:10.1016/j.jth.2019.05.003
- Hasan, R. A., Irshaid, H., Alhomaïdat, F., Lee, S., and Oh, J.-S. (2022). Transportation mode detection by using smartphones and smartwatches with machine learning. *KSCE J. Civ. Eng.* 26 (8), 3578–3589. doi:10.1007/s12205-022-1281-0
- Hechter, M., and Opp, K.-D. (2001). *Social norms* (Russell Sage Foundation). American Psychological Association. (n.d.). *Apa PsycNet*. American Psychological Association <https://psycnet.apa.org/record/2001-00827-000>.
- Hendrix, C. S. (2017) *WORKING PAPER WP 17-2 kicking a crude habit: diversifying away from oil and gas in the 21st century*.
- Hernandez, L. M., and Blazer, D. G. (2006). “The impact of social and cultural environment on health,” in *Genes, behavior, and the social environment: moving beyond the nature/nurture debate*.
- IP-Guide (2017). *Intellectual property protection system in Saudi Arabia - IP guide - IP coster*. [WWW Document]. IP coster.
- Jamal, E., Columbia, B., Scott, D., Columbia, B., Idris, A., and Lovegrove, G. (2018). Investigating social, cultural and demographic factors of commuters' mode choices in Kuwait City & surrounding urban areas: towards Developing a More Sustainable. *Transp. Syst.* doi:10.2478/udi-2019-0017
- Kaplan, R., and Spittel, M. D. D. (2015). *Population health: behavioral and social science insights/understanding the relationship between education and health* (AHRQ Publication). <https://www.ahrq.gov/sites/default/files/publications/files/population-health.pdf>.
- Kau (2017). *Open data. King Abdulaziz university*. Available at: <https://www.kau.edu.sa/Pages-od.aspx>.
- Khawagi, W. Y. (2017). *The problem of traffic congestion in Saudi Arabia*, 8, 1632–1638. <https://www.ijser.org/researchpaper/The-problem-of-traffic-congestion-in-Saudi-Arabia.pdf>.
- Kuzmyak, J. R., and Dill, J. (2012). Walking and bicycling in the United States, the WHO, what, where and why. *Tr. News* 280, 4–15.
- Lapinski, M. K., and Rimal, R. N. (2005). An explication of social norms. *Commun. theory* 15 (2), 127–147. doi:10.1093/ct/15.2.127
- Li, W., and Joh, K. (2017). Exploring the synergistic economic benefit of enhancing neighbourhood bikeability and public transit accessibility based on real estate sale transactions. *Urban Stud.* 54, 3480–3499. doi:10.1177/0042098016680147
- Lubitow, A., Zinschlag, B., and Rochester, N. (2016). Plans for pavement or for people? The politics of bike lanes on the ‘Paseo Boricua’ in Chicago, Illinois. *Urban Stud.* 53, 2637–2653. doi:10.1177/0042098015592823
- Majeed, F. (2015). Association of BMI with diet and physical activity of female medical students at the University of Dammam, Kingdom of Saudi Arabia. *J. Taibah Univ. Med. Sci.* 10, 188–196. doi:10.1016/j.jtumed.2014.11.004
- Mansuri, F. A., Al-Zalabani, A. H., Zalat, M. M., and Qabshawi, R. I. (2015). Road safety and road traffic accidents in Saudi Arabia: a systematic review of existing evidence. *Saudi Med. J.* 36, 418–424. doi:10.15537/smj.2015.4.10003
- Mark Lee, S., and Al-Mansour, A. I. (2020). Development of a new traffic safety education material for the future drivers in the Kingdom of Saudi Arabia. *J. King Saud. Univ. - Eng. Sci.* 32, 19–26. doi:10.1016/j.jksues.2018.11.003
- Mission, T. E., Jeddah, H., and Asia, C. (2013). *Historic Jeddah, the gate to Makkah (kingdom of Saudi Arabia) No 1361*.
- Mohammed, T., and Dossry, A. (2012). *Consumer culture in Saudi Arabia: A qualitative study among*. <https://ore.exeter.ac.uk/repository/bitstream/handle/10036/4205/AlDossryT.pdf?sequence=1>.
- Montoya-Robledo, V., Montes Calero, L., Bernal Carvajal, V., Galarza Molina, D. C., Pipicano, W., Peña, A. J., et al. (2020). Gender stereotypes affecting active mobility of care in Bogotá. *Transp. Res. Part D Transp. Environ.* 86, 102470. doi:10.1016/j.trd.2020.102470
- MOT (2011). *National transportation Strategy*.
- Owen, L., Ochsenwald, W. L., and Holm, D. A. (2017). *Arabian Desert | facts, location, plants, animals, & map | britannica. Com. Doc. Encycl. Br.*
- Pepper, E. (2015). Never eliminate public advice: nepa success stories. *Be a force for the future*.
- Pojani, D., and Stead, D. (2015). Sustainable urban transport in the developing world: beyond megacities. *Sustainability* 7, 7784–7805. doi:10.3390/su7067784
- Polaris Marketing Research (2012). *White paper series six key advantages of online surveys (and three potential problems)*.
- Political, H. L. (2018). *Towards sustainable development, the Kingdom of Saudi Arabia, the first national voluntary review 1439 AH - 2018 ad*.
- Rahman, Md. M., Upaul, S., Thill, J.-C., and Rahman, M. (2023). Active transportation and the built environment of a mid-size Global South City. *SCS* 89, 104329. doi:10.1016/j.scs.2022.104329

- Riyadh Chamber of Commerce (2005). *Saudi Arabia – regional and global transport hub: a public - private partnership opportunity*.
- Salvo, D., Jáuregui, A., Adlakha, D., Sarmiento, O. L., and Reis, R. S. (2023). When moving is the only option: the role of necessity versus choice for understanding and promoting physical activity in low- and middle-income countries. *Annu. Rev. Public Health* 44 (1), 151–169. doi:10.1146/annurev-publhealth-071321-042211
- Samara, A., Nistrup, A., Al-Rammah, T. Y., and Aro, A. R. (2015). Lack of facilities rather than sociocultural factors as the primary barrier to physical activity among female Saudi university students. *Int. J. Womens. Health* 7, 279–286. doi:10.2147/IJWH.S80680
- Sharara, E., Akik, C., Ghattas, H., and Makhoulf Obermeyer, C. (2018). Physical inactivity, gender and culture in Arab countries: a systematic assessment of the literature. *BMC Public Health* 18, 639–719. doi:10.1186/s12889-018-5472-z
- SK films Inc (2009). *Journey to mecca: in the footsteps of ibn battuta*.
- Spencer-oatey, H. (2012). What is Culture? A compilation of quotation. *Glob. Open House*.
- United Nations (2013). *World economic and social survey 2013*. New York: Department for Economic and Social Affairs.
- University, K. A. (2019). King Abdulaziz univeristy history [WWW document]. Available at: <https://www.kau.edu.sa/Pages-Our-History.aspx> (Accessed September 30, 2021).
- U.S. Energy Information Administration (2021). *EIA-independent statistics and analysis. International - U.S. Energy Information Administration (EIA)*. <https://www.eia.gov/international/analysis/country/SAU>.
- WHO (World Health Organization) (2010). Global status report on noncommunicable diseases. *World Health*.
- World Bank Open Data (2022). Population, female (% of total population) - Saudi Arabia. *World Bank. Open Data*. Available at: <https://data.worldbank.org/indicator/SP.POP.TOTL.FE.ZS?locations=SA>.
- World Population Review (2018). *Saudi Arabia population 2018 (demographics, maps, graphs)*. World Popul. Rev.
- Yuan, Y., Masud, M., Chan, H., Chan, W., and Brubacher, J. R. (2023b). Intersectionality and urban mobility: a systematic review on gender differences in active transport uptake. *J. Transp.* 29, 101572. doi:10.1016/j.jth.2023.101572