



# Role of social dimensions on active transportation and environmental protection: A survey at the University of Samarra, Iraq

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## ABSTRACT

**Introduction:** This study aimed to understand the sociocultural dimensions that affect people in engaging with active transportation in their daily lives.

**Method:** A paper-based survey was administered to individuals who commute to and from Samarra University in Iraq for work or studying purposes. Approximately 900 people participated in the survey.

**Results:** The majority of females reported that they do not walk or cycle because they feel embarrassed, as walking and cycling are not common within their society. Males also reported that they do not walk or cycle because of their age and social status in the society. An additional analysis was carried out to determine a significant predictor of active transportation (walking or cycling) relative to motorized transportation. Significant variables were gender, distance from home to workplaces (O-D distance), body mass index (BMI), family size, a feeling of social embarrassment when walking or cycling, and the number of bicycles per household. Among many obstacles to transportation that were reported by the participants, only social norms and security concerns were significant in the model.

**Conclusions:** This study identified sociocultural, environmental, and transportation factors that affect the use of active transportation (i.e., walking and cycling) to and from the University of Samara. Increasing awareness within the society about the advantages of active transportation and an improvement in country security will largely help people to engage more in active transportation. This awareness through education should specifically target females whose societal norms and traditions hamper their engagement in active transportation.

## 1. Introduction

The behavior of individuals is largely influenced by social concepts and beliefs that are part of their everyday reality. The concepts and perceptions of individuals are imprinted from the actions and opinions of society. Social actions have a stimulus that defines and shapes behaviors, concepts, and beliefs of individuals (Cole et al., 2014). Changing these concepts and beliefs may affect the individual's daily activities as well as his health (Kaplan et al., 2015). Social environment includes social relationships, the physical and

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cultural surroundings in which people interact (Barnett and Casper, 2001). Thus, social environment as a concept is similar to what is known as the culture of a society that is acquired from a variety of sources (Spencer-Oatey, 2012). Culture is defined as the “beliefs, values, norms, and things people use which guide their social interactions in everyday life” (Götschi et al., 2015).

The transportation field is one of the areas affected by the social environment and its impact on physical activities, and that impact affects the nation's health and environmental aspects (Hernandez and Blazer, 2006). In the Arab world, research related to cultures and social environments faces some challenges owing to lack of resources, censorship, and restrictions (Alijla, 2017; Bamyeh, 2015). Despite these challenges, there are signs of increasing interest in research related to human society and social relationships in universities located in Iraq, Egypt, Lebanon, Syria, and Tunisia. This interest increased recently in oil-rich countries such as Saudi Arabia, the United Arab Emirates, Oman, and Qatar (Faek, 2015). However, pure scientific research linking problems related to transportation, public health, and the social environment is scarce, if not rare.

The motivation for this study was mainly derived from the benefits of active transportation. Walking and cycling represent activities that contribute to public health as well as environmental protection (Stjernborg and Mattisson, 2016). Fast socio-economic development in Arab countries such as Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates resulted in an emerging disease pattern, for example, diabetes and obesity that are mainly attributed to physically inactive lifestyles (Mabry et al., 2010). Cycling and walking improve an individual's health by reducing high blood sugar, blood lipids, and obesity. According to Canada's physical activity guide, a person can improve his health by accumulating 30–60 min of moderate physical activity each day; additionally, it enhances and improves the cardiac function by activating the blood cycle. One study conducted by the American Health Association concluded that the dependency of automobile travel leads to additional costs for road construction, maintenance, and urban expansion. This reduces walkability and results in less physical activity (Bamyeh, 2015).

Encouraging the reduction of widespread use of vehicles will significantly reduce air pollution that is generated from motor vehicles (Nowak and Heisler, 2010). Often, this requires governments to contribute to social change through policies or laws they create and through implementation of incentives and coercion (Rutherford, 1990). Therefore, the culture of society must change seriously and not be dependent on individuals to change their behavior. Despite the apparent change in the vehicle industry and the trend to reduce emissions, the deterioration in air quality will continue if traffic continues to increase (Pedestrian and Bicycle Information Center, 2018). Air pollution emissions from motor vehicles are responsible for several diseases related to respiratory problems. These include irritation of the respiratory system causing inflammation of lungs, reduced lung function, chronic asthma, and pulmonary diseases. Ultimately, it increases hospital admissions and higher consumption of medication, especially for people who are sensitive to diseases (Health Canada, 2002). Statistics from the International Energy Agency (IEA) in 2014 show that CO<sub>2</sub> emissions from transportation represent 20.6% of the total fuel combustion in Iraq (International Energy Agency, 2014). Depending on miles traveled, it is estimated that cycling and walking can displace 1.5–5.0% of vehicle emissions including carbon monoxide, nitrogen oxides, and volatile organic compounds (Pedestrian and Bicycle Information Center, 2018). In addition, walking and cycling can displace as much as 1.6% of CO<sub>2</sub> emissions from motor vehicles (Komanoff et al., 1993). Further, increase in walking and cycling will minimize the huge dependency on fossil fuels such as benzene because cycling and walking do not entail fossil fuel consumption, and that is the main reason for sustainability (Federal Highway Administration, 1993). In developing countries such as Iraq, air pollution emissions generated from motor vehicles increase because most drivers use old vehicles. Additionally, weather conditions play a role in active transportation because of severe heat in summer and severe cold in winter.

This study was conducted, as a field study, in the city of Samarra, one of the most important cities in Iraq and the capital of Islamic culture for the year 2018 (Al Hurra Iraq, 2018). Specifically, the study was conducted at the University of Samarra, which is located in the heart of the city. An appropriate alternative to alleviating transportation problems is to resort to diversity in transportation modes, including active transportation. Iraq is considered one of the first countries to construct roads with paved bricks bonded with bitumen in ancient times within the Mesopotamian civilization dated back to around 4000 BC (Longfellow, 2017; Oates et al., 2007). Presently, Iraq suffers from an infrastructure that is almost rickety and unable to absorb the large population growth and the huge number of vehicles on its roads (Foote et al., 2004). This situation has produced large daily traffic jams resulting in a significant loss of time, which negatively impacts the psyche of road users. Iraqis often rely on vehicles for their daily activities and do not seek alternatives that may be beneficial to them and the community.

The purpose of this paper is to understand different factors that influence a person's choice of walking or cycling to college, such as gender; age; certain lifestyle conditions; and sociocultural, roadway, and environmental conditions.

The paper is organized as follows: the first section introduces the research topic, and the second section covers the background of the issue and reviews past studies. The third section discusses the details of the area studied, and the fourth section illustrates the research methodology, data collection, and the description of the data. The fifth section describes the results and analyses. The study concludes with a summary of the results, the importance of the research, and what can be achieved in the future to develop societal concepts that improve transportation, people's health, and the environment.

## 2. Background

Most Arab countries have different transportation specifications and challenges, but they may share a clear impact on gender inequality through the use of different modes of transportation. For example, until recently, Saudi Arabian women were not allowed to drive vehicles (Al Jazeera News, 2017; Kirk, 2017). The economic side also plays a prominent role in shaping the characteristics and mechanisms of the different modes of transportation used by Arab people. Rich Arab countries such as Qatar, Saudi Arabia, the United Arab Emirates, and Oman use private motorized transportation more often than other Arab countries such as Syria, Yemen, Egypt, Tunisia, and Mauritania, (El-Geneidy et al., 2013). The El-Kadi study (2013) showed the population growth problems faced by

Egypt are accompanied by a huge traffic volume problem. This trend necessitates a significant shift in the use of active transportation to reduce congestion and air pollution, as well as contributing to strengthen the country's economy.

Culture is one of the important factors that influences gender differences in the choice of transportation (Elias et al., 2015). Previous publications clearly demonstrate the impact of traditions on the use of bicycles by women in Arab countries or neighboring Muslim countries (Francesco, 2013). Riding a bicycle for women in Arab countries is undesirable because of reasons related to traditions and community awareness. In some Arab countries, for example, women are allowed to cycle around parks and other recreational areas but not for transportation purposes (Ramdani, 2013). A study that investigated the international prevalence of physical activity among youth and adults found that women in Saudi Arabia have the lowest engagement in physical activity, which includes walking and biking (Sisson and Katzmarzyk, 2008). In Oman, among many barriers to physical activity, there was a social restriction on women and overdependence on motorized transportation (Mabry et al., 2014). Changing the wrong perceptions about walking and cycling that are embedded in the societal norms and traditions will help increase the usage of active transportation in Arab countries, especially for women.

Academic studies on active transportation in Iraq, the focus area of this research, and the impact on physical activities and environmental protection are very scarce compared to studies conducted in other parts of the world, especially in the United States of America (Raad, 2018). Jamal et al.'s study in 2018 deals with the social, cultural, and demographic factors of travelers in Kuwait, which is very close to the situation in Iraq. Kuwait is adjacent to Iraq's southern border and has a pattern and culture similar to Iraq's, but the important difference is their embracing of nationalities of expatriates. The study showed that there is a direct effect of the hot and humid climate on people's choice to walk or cycle while making their daily trips (Jamal et al., 2018).

Several studies have discussed the behavior of travel to and from universities, as well as transportation within the university campuses, which are very similar to transportation practices in many institutions and major workstations. As active transportation is often linked to sustainability, specialists in these institutions, together with their transportation and planning counterparts, aspire to encourage active transportation. Active transportation in university areas can be encouraged by increasing fuel prices, reducing the price of public transportation, and increasing the convergence of university facilities and student dormitories (Ripplinger et al., 2009). According to Jauch et al. (2009), the infrastructure care facilities for cyclists and increased parking fees encourage active transportation practices. The report by Bessey et al. from Western Michigan University (Bessey et al., 2010) illustrated the ways that the university encouraged the use of active transportation and public transportation through the use of free public transportation service and preventing the use of vehicles in the center of the campus. In addition, the survey administered at The University of Sydney (Rissel et al., 2013) showed the important role of education in increasing walking and cycling at the university.

This study contributes to the existing literature on active transportation in the Arab world by studying the influence of cultural, social, and environmental factors on the use of active transportation for people who are commuting to university or college. The study was conducted in Samarra, one of Iraq's urban cities. It focused on people commuting to the University of Samarra, which is located at the center of the city. Some of the research reviewed the benefits and ways of promoting the development of active transportation, especially the research on Arab and non-Arab countries. Previous studies also reviewed the disadvantages of not finding alternative transportation modes for individuals and society in terms of health, environment, and reducing congestion. In addition, some of the challenges faced by active transportation users of both genders have been reviewed. The literature review indicates a need for an in-depth study of social-cultural issues in connection to active transportation in the context of the Arab world. This study aspires to enrich the Arab and international scientific library with updated information of the Middle East in the field of active transportation.

### 3. Case study

Iraq lies in the western part of Asia and is surrounded by several countries (Kuwait, Saudi Arabia, Jordan, Syria, Turkey, and Iran) and has a narrow inlet of 58 km leading to the Persian Gulf, as shown in Fig. 1. Iraq's terrain varies from mountains in the north and northwest, plains in the center and south, and desert at its western part. The total area of Iraq is 437,072 square kilometers (Library Congress, 2006), its population is circa 39.34 million, with 50.6% of the population being male and 49.37% being female. Iraq accommodates several nationalities such as Arabic (with the largest percentage at 75%), Kurdish (17%), Turkmen (3%), and various other nationalities. Religions in Iraq include Islam (95%) and Christianity (5%) (World Population Review, 2017).

As a result of repeated wars in Iraq for several years, along with a prolonged economic embargo of nearly 10 years, the country's economy and infrastructure have been weakened (Bassil, 2012). Changes in the country's policies and the shift from focused management to decentralized administration in Iraq's cities after 2003 led to a major change in the orientation of these cities and changed the focus in these cities on to pressing issues that may affect people's lives (Brinkerhoff and Azfar, 2006). The role of the state in these cities as the regulator and controller of the transportation process (i.e., design, implementation, operation, and services of all types) was reduced because of new policies. One of the most affected fields in Iraq is public transportation. Public transportation became available only between Iraqi cities and the capital of Baghdad, while not being available within other Iraqi cities. Private buses are used in Iraqi cities to transport staff to their workplaces and students to their places of study. This transportation system is based on people with private transportation buses operating on fixed routes, in accordance with fixed launch schedules and fixed fees per trip or per month. There are no published documents that provide fee information for private transportation buses, but it usually ranges from 100 USD to 150 USD per capita per month. Transportation fares on private buses are often lower than taxi fares, with the effect that private buses have reduced transportation costs and traffic congestion.

Economic sanctions and armed conflicts in Iraq have, in the most part, deprived the participation of women in the social, economic, and political affairs of the country. Iraqi women suffer from a lack of educational opportunities and limited access to employment. Unemployment rate for females aged 15 years and above across all governorates in Iraq ranges from 0 to 40%. The



Fig. 1. Field of study in Iraq.

Salah al-Din governorates, consisting of several cities including Samarra, have the lowest female unemployment rate ranging from 0 to 10% (UN Iraq, 2013). In another study, 14% of women actively seek work compared to 73% of men. Iraqi women with higher levels of education face hardship in accessing work, with the unemployment rate increasing to 41% for women with a diploma and 68% for women with a Bachelor's degree (IKN, 2011).

Samarra has the largest pharmaceutical factory in Iraq and the Samarra Dam, which protects the Iraqi capital from floods. Samarra also has many historical sites and was added to UNESCO's World Heritage List in 2007 (BBC News, 2007). Samarra's population was 348,700 people in 2003, which accommodates the largest proportion of the province's population. It is located in the center of the country, 125 km north of Baghdad, and is bordered to the east by the Tigris River, to the north by the city of Tikrit (the center of Saladin province), to the west by the city of Ramadi, and to the east by the city of Baquba, as shown in Fig. 1. Samarra is populated by the Sunni Muslim community and is one of the holiest places for Shiites. The city includes the University of Samarra (founded in 2012), Imam Al-Adham College of Islamic Studies, and some other educational institutes. Hundreds of visitors come to the city every day to visit religious shrines in the old neighborhoods, which are densely populated with old buildings and narrow streets. A new bridge crossing the Tigris River has been built to serve the new sections of the city. The old bridge has been allocated only to serve visitors to religious shrines, with the implementation of several parking garages outside the center to alleviate congestion. The industrial areas are being exploited by the private sector in the southwestern parts of the city, even though a pharmaceutical factory is in the northern part of the city. The eastern parts of the city house residential areas and commercial complexes.

The lack of implementation of new road networks, not in keeping with the population increase, and the survival of existing government buildings have resulted in large daily traffic jams. All the entrances to the University of Samarra suffer from traffic congestion at the beginning and end of each working day. The traffic congestion extends a fair distance from the bottleneck due to the huge volume of traffic approaching the university. Inadequate infrastructure is limited to not only the road networks but also pedestrian and cycle paths, which are often interposed or exploited by vendors and retailers. New initiatives were created by institutions and individuals to encourage walking and cycling to reduce pressure on road networks, increase interest in physical activity, and reduce air pollution. It can be observed that Samarra's roads are not conducive for walkers or cyclists. Roads and



**Fig. 2.** Example of the roads in the city of Samarra, Iraq. This shows the state of the roads, pedestrians (especially females), and the obstacles in their paths.

walkways for pedestrians have deteriorated because of the end of their design life, coupled with a severe shortage of maintenance resources. In addition, there is illegal exploitation of the right of way by shop owners to display their goods, as shown in Fig. 2(c), and the lack of real responsibility for these violations. Shops spread throughout the city after 2003 in an irregular manner, causing distortion of land use.

There is little or no control of land use, which causes daily suffering for members of the community in the city of Samarra. Fig. 3 shows a picture collection of cyclists who suffer due to lack of dedicated paths. Shoulders with no road markings are usually occupied by parked vehicles, and cyclists are, therefore, compelled to use the roads indiscriminately with motorists.

#### 4. Data and methods

##### 4.1. Survey design

To achieve the objectives of this study, a questionnaire was designed to understand the role and impact of sociocultural, environmental, and infrastructural factors on transportation mode choices at the University of Samarra in Iraq. The questionnaire included 23 questions that were divided between personal questions, questions related to the uses of transportation and its obstacles, and the participants' views and perceptions about the role of culture on choices of daily transportation. The questionnaire was written in Arabic and English in parallel with an explanatory introduction and the freedom to accept or refuse to participate. An online questionnaire was not used because of technical problems related to frequent power cuts and the lack of Internet connection for all participants. Despite the expected difficulties of this approach, the survey team was able to survey approximately 900 participants.

Studies indicate that a paper-based questionnaire is the best option, especially when the targeted population is not receptive to rigorous surveys through the Internet (Susan E. DeFranzo, 2012). In addition, it has been noted that direct face-to-face management



**Fig. 3.** Example of the roads in the city of Samarra, Iraq, that shows the state of the roads, cyclists (especially males), and obstacles in their paths.

leads to high response rates (International Survey Associates, 2016). Some of the negative aspects of this study were the length of time required for distributing the questionnaires, retrieving the questionnaires, organizing the questionnaires, and digitizing the data.

#### 4.2. Statistical analysis

The Pearson chi-square test ( $\chi^2$ ) of homogeneity was used to test whether the percent distribution among males and females working or studying at the University of Samarra varies with regard to the transportation mode type, social, and environmental factors. This test is nonparametric with no assumed distribution. It has been used widely, as it does not impose conditions in the data, such as equality of variance or residual homoscedasticity. The null hypothesis the authors wish to reject in this test is that there is no significant relationship between two variables (Pandis, 2016). For this study, we rejected the null hypothesis if the  $p$ -value was less than 0.05. Chi-square statistics can be computed using the equation given below:

$$\chi^2 = \sum_i \sum_j \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \tag{1}$$

where  $O_{ij}$  is the observed frequency and  $E_{ij}$  is the expected frequency across row  $i$  and column  $j$  of the contingency table. The computed  $\chi^2$  is compared with the critical value obtained from chi-square distribution. The specified degrees of freedom (df) for the critical value can be computed as  $(c-1)*(r-1)$ , where  $c$  represents the number of columns and  $r$  represents the number of rows.

The chi-square test is significant, and it does not provide information about the strength of an association between two variables (McHugh, 2012). Therefore, Cramér's  $V$  test was used to test the strength of all significant associations, as identified by the  $\chi^2$  test. The output of Cramér's  $V$  test ranges from 0 to 1 to indicate the strength of association between two variables. This test can be computed using the equation given below:

$$v = \sqrt{\frac{\chi^2/n}{\min(k-1, r-1)}} \tag{2}$$

where  $\chi^2$  is the chi-square statistics,  $k$  is the number of columns, and  $r$  is the number of rows.

The final statistical analysis used a binary logistic model to identify significant factors that influence people's decision on what transportation mode they use for their daily commute to the University of Samarra. The choice of active transportation (walking or cycling), as opposed to motorized transportation (car or bus), was the response of interest. Predictor variables include various sociocultural, environmental, and transportation factors that were gathered using a paper-based questionnaire. The descriptions of these factors are provided in Tables 1 and 2 in the data description section. Binary logistic regression was used because it is a preferred method when the response variable is dichotomous (Davis and Offord, 1997). The logistic regression estimated the probability of a person to choose either mode of the active transportation modes as opposed to motorized transportation, given a set of explanatory or predictor variables. Mathematical formulation of logistic regression can be presented as shown in the equation below:

$$\ln\left(\frac{p}{1-p}\right) = \sum_{i=0}^n \beta_i x_i \tag{3}$$

where  $p$  is the probability of a person walking or cycling and  $x_i$  is the explanatory variable of interest with its corresponding coefficient  $\beta_i$ .

The general model performance was tested using the log-likelihood ratio test and the receiver operating characteristic (ROC) curve analysis. The ROC curve was obtained by plotting the sensitivity against the false-positive rate (1-specificity). Sensitivity

**Table 1**  
Demographics of the participants.

Attribute	Gender	Observed	Frequency (%)
Gender	Male	507	57%
	Female	379	43%
Age	17–29	706	78%
	30–39	124	14%
	40–49	51	6%
	> 50	19	2%
Education level	High school	619	69%
	Bachelor	150	17%
	Diploma	52	6%
	Master's	57	6%
	Ph.D.	21	2%
Family monthly income	\$500-\$1000	369	41%
	< \$500	265	29%
	> \$1000	267	30%

Note: Diploma in Iraq is a degree between Bachelor's and Master's.

**Table 2**

Association of the social environment and transportation factors by gender.

Category/Statistical tests	Attributes	Female	Male
Transportation Modes Pearson Chi2 (3) = 44.6278 Pr = 0.000 Cramér's V = 0.2282	Private buses	14.3%	12.7%
	Drive/Passenger	69.6%	51.7%
	Walk	13.8%	26.8%
	Cycle	0.5%	5.4%
	Other (please specify)	1.9%	3.4%
	Less than 1 km	42.4%	31.0%
Distance from home to school/work Pearson Chi2 (5) = 16.6672 Pr = 0.005 Cramér's V = 0.1372	1–3 km	29.0%	35.7%
	3–5 km	16.1%	15.3%
	5–10 km	5.4%	8.0%
	10–20 km	7.2%	10.1%
	No	12.5%	64.8%
Social embarrassment while walking/cycling Pearson Chi2 (1) = 236.6597 Pr = 0.000 Cramér's V = 0.5237	Yes	87.5%	35.2%
	Age	5.3%	26.2%
Cultural issues associated with social embarrassment Pearson Chi2 (4) = 361.9875 Pr = 0.000 Cramér's V = 0.6580	Gender	64.8%	7.9%
	Social status	4.8%	37.9%
	Type of clothes	4.3%	5.4%
	Social habit	20.8%	22.7%
	Time is not enough	27.4%	38.5%
Transportation, Environmental, and Social obstacles to walking Pearson Chi2 (7) = 102.0918 Pr = 0.000 Cramér's V = 0.3063	Safety concerns	12.9%	8.8%
	Security reasons	7.3%	6.6%
	Roads are in bad condition	6.7%	17.1%
	The sidewalks are in bad condition	3.9%	7.2%
	The destination is too far away	5.6%	5.9%
	Climate	2.6%	3.8%
	Because of society	33.6%	12.0%
	Time is not enough	12.2%	25.0%
	Safety concerns	4.9%	10.5%
	Security reasons	5.1%	7.8%
	Roads are in bad condition	5.4%	23.4%
	The sidewalks are in bad condition	2.9%	7.6%
Transportation, Environmental, and Social obstacles to cycling Pearson Chi2 (7) = 237.2407 Pr = 0.000 Cramér's V = 0.4938	The destination is too far away	3.9%	4.1%
	Climate	1.2%	4.3%
	Because of society	64.3%	17.4%

represents the true positive rates, while specificity represents the true negative rates. The area under the curve was used to explain the percent at which the model can correctly classify the transportation mode of an individual given a set of predictor variables (Fawcett, 2006).

### 4.3. Data description

As mentioned in the research methodology, this study was conducted using a paper questionnaire. One thousand copies were distributed throughout the University of Samarra without the distinction of gender, level of education, or career. The participants were students and workers at the University of Samarra. Results were obtained from 900 participants in total. The sample obtained was approximately 14% of the total number of students and staff members (6300) at the University of Samarra (Department of Student Affairs and Registration, 2018). In addition, the research methodology provided sufficient insights into the details of the questionnaire, which aims to form a clear perception of the impact of social dimensions on transportation mode options in Iraq.

Fig. 4 shows the demographic characteristics of the participants obtained from this survey. The total for each attribute does not equate to the total number of participants because each attribute had some missing information. The participation rate for both genders was 507 (57%) males and 379 (43%) females. The proportion of the female-to-male enrollment for the two academic years at the University of Samarra (shown in Fig. 4) was the same as that for our survey participants. With regard to age, the largest percentage of participants was aged 17–29 years, with 78% of the participants. As for the education level of the participants, 69% of the participants were at the undergraduate level at the university and the remaining 31% had a graduate degree. Income levels, namely, 500 USD, 500 USD–1000 USD, and more than 1000 USD per month, were evenly distributed among participants.

## 5. Results and discussion

### 5.1. Associations of social-cultural dimensions with gender type

The chi-square test of homogeneity was used to test whether the observed distributions of males and females by various modes of transportation, social, and environmental attributes showed statistical difference. Table 1 presents a summary of the results. With regard to transportation mode, the distribution among males and females showed statistically significant difference ( $p = 0.000$ ,

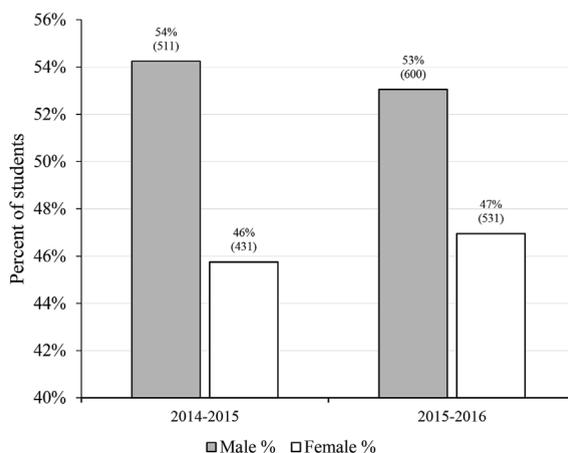


Fig. 4. Student enrollment at the University of Samarra by gender.

Cramér's  $V = 0.23$ ). The percentage of females who were using small cars for their daily commute was 69.6%. This percentage was lower among males who reported to use motorized transportation for their daily commute (51.7%). With regard to nonmotorized transportation, 32.2% of males reported walking and cycling for their daily commute, which was higher than that of females (14.3%). Only 0.5% of females and 5.4% of males reported using bicycles either for commuting or for recreational purposes. This clearly expresses how females feel about cycling in our area of study.

The percent distribution of males and females for the distance of travel from home to the place of study or work was also examined. The distribution of males showed statistical difference when compared with the distribution of females ( $p = 0.005$ , Cramér's  $V = 0.1372$ ). In general, females reported living closer to their work or school location than males. Hypothetically, this was supposed to motivate women to walk or bike to their place of work or study, but this was not the case for females. They reportedly choose motorized transportation (private bus or small car) for their daily commute despite being nearer to their work and school locations.

Male responses also showed statistical difference when compared with female responses when asked whether they were embarrassed to bike or walk as their daily transportation mode ( $p = 0.000$ , Cramér's  $V = 0.5237$ ). For females, the dominant percentage (87.5%) showed a sense of embarrassment when they walked or cycled in their community, whereas only 35% of males reported feeling embarrassed because of societal dimensions. An over-representation of females who feel embarrassed to walk or cycle because of societal dimensions provides insights into why they are likely to choose driving or take a private bus for their daily commute despite being nearer to their work and study places. A gender gap in active transportation has been reported to be prevalent in most Arab countries (Al-Hazzaa, 2018; Sharara et al., 2018; Subhi et al., 2015). In most of these studies, the prevalence of inactivity and sedentary lifestyle has been observed to be higher among females than among males. Creating physical education (PE) programs and health promotion initiatives at the university, and for the public in general, will help to change women's salient beliefs with regard to an active lifestyle (Al-Harbi and Al-Harbi, 2017). The involvement of Arab women in an active lifestyle, which in part encompasses walking and cycling, can be gradually influenced by new ideas that link health with active lifestyles.

Participants were also asked to identify sociocultural issues that trigger the feeling of embarrassment when walking or cycling. Culture is a vital factor that shapes the choice of transportation among Arab women (Elias et al., 2015). Cultural attitudes and beliefs that discourage the use of active transportation among women have been prevalent in Arab countries. Overall, the distribution across sociocultural issues showed statistical difference across gender ( $p = 0.000$ , Cramér's  $V = 0.6580$ ). For females, gender (64.8%) and social habit (20.8%) were the dominant factors, while for males, social status (37.9%), age (26.2%), and social habits (22.7%) were the main factors. Therefore, females were more sensitive to gender and how society looks at them when they walk or cycle, but for males, the decision was mainly influenced by their social status. Most males with high-income jobs are likely to see walking and cycling as an act that will belittle their status in the community. Physical exercise including walking and biking is associated with lower status jobs or occupations (Donnelly et al., 2018; Sharara et al., 2018). Donnelly et al. (2018) reported similar findings where Arab women considered exercising (walking, running, biking, etc.) as a shameful act for older women; it was considered appropriate only for young people. Further, it has been reported that in most of the Arab countries, females are not allowed to walk or exercise alone without being accompanied by a male family member or a husband, which decreases opportunities to exercise such as walking or biking (Benjamin and Donnelly, 2013). Educational awareness about active transportation should be directed toward females who, because of the social norms and traditions, fear walking and bicycling frequently as compared to males.

Other transportation, environmental, and social obstacles to walking and cycling were also investigated. The distribution across gender showed statistical difference as indicated by Pearson chi-square and Cramér's  $V$  tests in Table 2. Time and social environment were the main factors that were pointed out to hinder walking and cycling for both males and females. In addition, males were sensitive to roadway conditions (17%) as an obstacle to walking or cycling, while safety was an additional factor that was of concern to females (12.9%). The decision to cycle for commuting or recreational purpose was mainly obstructed by the social environment for females (64%), while for men, they were likely not to cycle when the roads were in bad condition (23.4%) or when there was not

**Table 3**  
Modal choice logistic regression results.

Variable	Coef.	Odds Ratio	Std. Err.	z	P > z
Gender (Reference: Male)					
Female	-0.740	0.477	0.111	-3.17	0.002
OD distance (Reference: > 5 km)					
< 1 km	2.016	7.511	1.994	7.59	0.000
1-3 km	1.097	2.996	0.803	4.09	0.000
Number of bicycles per family (Reference: 0)					
1-2	0.465	1.592	0.294	2.52	0.012
> 2	0.870	2.387	0.835	2.49	0.013
Body mass index (BMI)	-0.042	0.958	0.015	-2.73	0.006
Family size (Reference: < 6)					
6-10	0.388	1.473	0.294	1.94	0.052
> 10	0.717	2.048	0.658	2.23	0.026
Social embarrassment	-0.400	0.671	0.146	-1.84	0.066
Security concerns	-0.725	0.484	0.142	-2.47	0.014
Society concerns	-0.939	0.391	0.089	-4.13	0.000
Constant	-0.727	0.483	0.231	-1.52	0.128

Log-likelihood ratio test: LR Chi2 (12) = 189.26, Prob > Chi2 = 0.0000, Pseudo R2 = 0.197.

enough time to reach to their destinations (25%). A big part of Iraq's roadway network lacks the necessary pedestrian and cycling facilities that encourage walkable neighborhoods and streets. Specific challenges that have been identified and are typical of most of the roadways in Iraq include uneven and inconsistent sidewalks; low-quality street edges, corners, and finishing; poor sidewalk slope design; insufficient street and landscape furniture; and poor lighting condition (Jamal et al., 2017).

The narrative obtained from this survey demonstrates the significant role played by social traditions and cultures for both genders on the choice of transportation in the University of Samarra, Iraq.

5.2. Modal choice predictors

The logistic regression model was performed to understand the significant predictors of a transportation mode choice reported by a participant. Two major categories of transportation modes were investigated, namely, motorized transportation such as driving or taking a bus, and nonmotorized transportation including walking and cycling. A dummy variable for a response variable was created, with 1 assigned to cycling or walking and 0 for driving or taking a bus.

Table 3 presents the results with coefficient values, odds ratios, and the p-value. The overall model performance was checked using the log-likelihood ratio test, and the predictability of the model was checked using the ROC curve. The log-likelihood ratio test

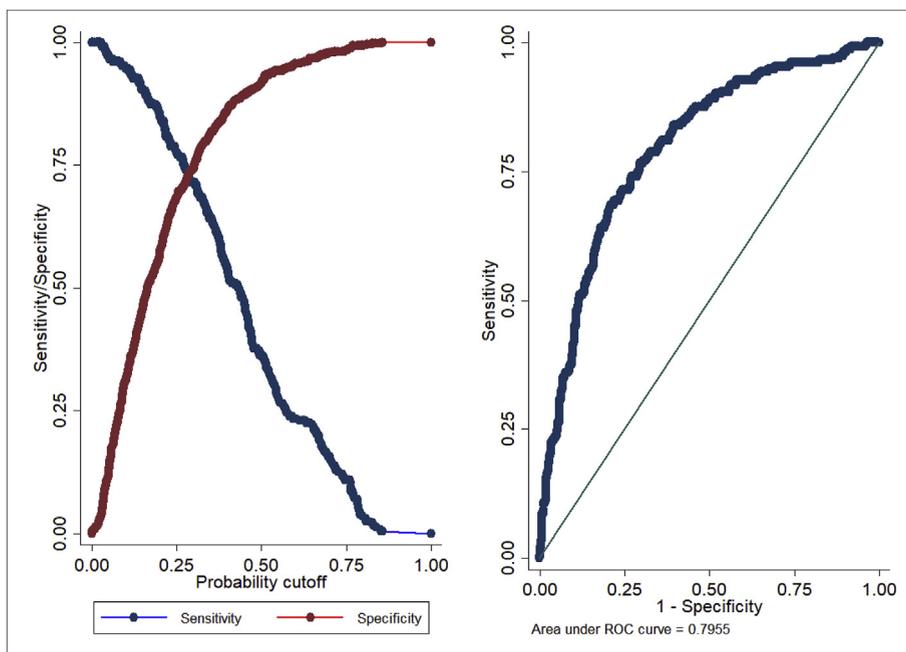


Fig. 5. Estimation of model predictability using ROC curve.

indicated a p-value of 0.000, which is a good indicator of the overall model performance. The area under the ROC curve was 0.7955 (as seen in Fig. 5), indicating that the model can correctly specify a person's mode of transportation given the predictor variables by 80%. Variables that were significant at a 95% confidence level ( $p < 0.05$ ) were retained in the final model, as shown in Table 3.

Predictor variables that were significant in explaining the modal choice were gender, distance from home to school or work (OD distance), body mass index (BMI), family size, social embarrassment, security concerns, and the number of bicycles per family. Variables that increased the odds of cycling and walking relative to driving or taking a bus include smaller distances from home to school and work, a high number of bicycles per household, and relatively large household size. On the contrary, factors that were found to hinder walking or cycling significantly include gender, high BMI, social embarrassment, and security concerns.

The transportation, environmental, and social obstacles to walking or cycling that were tested in the model include time, safety, security, roadway condition, sidewalk condition, climate, and societal norms. For all the transportation and social obstacles to walking and cycling that were investigated in this study, only security concerns and societal norms significantly contributed to the person's choice of transportation mode ( $p < 0.05$ ). Therefore, increasing society's awareness about the advantages of active transportation and improvement of security will encourage people to walk or cycle more often.

## 6. Conclusions

In the Arab world, there are many factors that can influence a person's desire to walk or bike as part of an active lifestyle, such as age, gender, culture, climate, clothing, personal motivation, social support, time, opportunity, and school and government policies (Ali et al., 2010). This study investigated the use of active transportation or what is known as nonmotorized transportation at the University of Samarra, Iraq. The questions were structured to obtain different factors that influence the person's choice of walking or cycling to college such as gender, age, sociocultural and roadway, and environmental conditions.

The gender gap in the use of active transportation was observed for people who were commuting to and from the University of Samarra. Males were more involved in active transportation than females in terms of both walking and cycling. Females preferred to use a private car or buses to go to school or workplaces despite reporting they reside closer to their work or study places than males. Raising awareness and actively changing the attitude of the society and women in the long run requires initiatives that can be maintained consistently in the society. One of the initiatives can be to increase the relevant PE studies and workshops within the university that highlight the health and environmental benefits of active transportation. Education can specifically target women whose sociocultural values impede their engagement in active transportation. Additionally, different media outlets can be used to disseminate educational campaigns and programs to women and society in general, which can help to raise awareness and actively change the attitude of the society in the long run.

Physical roadway network and environmental factors also play a huge role in influencing people's participation in active transportation. The study also looked into the social, cultural, roadway, and environmental factors that hamper engagement in active transportation. The majority of females identified social norms as the main factor. For males, however, safety and poor roadway facility conditions were the main factors that discourage their involvement in active transportation. Long travel time between their places of residence and the university was expressed as a barrier for both males and females. Collaboration among multiple sectors in the city of Samarra, such as transportation, environmental, and urban planning, is needed to ensure a favorable environment is provided for the nonmotorized transportation user. Provision of an enhanced bicycle-friendly environment will promote the use of active transportation not only in the university area but also at the city, regional, and national levels. For example, there has been an ongoing collaborative effort in Samarra organized by security and service departments to remove obstacles such as advertisement boards along pedestrian and cycle paths that were put by retail shop owners to display their goods. Such bold initiatives must be accompanied by enforceable penalties to retailers who are found to abuse the right of way dedicated to nonmotorized users.

It was interesting to notice in our study that among all the obstacles that were reported to hamper the use of active transportation, only social habits and security were significant in predicting a person's mode choice when commuting to and from the university. This provides a clue on where the emphasis should be made in promoting active transportation. People are less likely to walk in situations where their safety and protection are not guaranteed. As the security of the city of Samarra and country in general improves, more people will be likely to engage in active transportation in their daily lives.

The findings of this study are applicable to the University of Samarra or other universities that have similar characteristics. Future research can be extended outside the University of Samarra to discern and compare responses from various community segments in Iraq.

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