

Received:

6 August 2018

Revised:

30 December 2018

Accepted:

5 March 2019

Cite as:

Musaad Al-Mosaind. The effect of age & gender on children's mobility in Riyadh's neighborhoods. Heliyon 5 (2019) e01327. doi: [10.1016/j.heliyon.2019.e01327](https://doi.org/10.1016/j.heliyon.2019.e01327)



The effect of age & gender on children's mobility in Riyadh's neighborhoods

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Abstract

Children's mobility in terms of frequencies, challenges, and solutions have a direct impact on their lifestyle. The study aims to assess the notion of children's mobility within urban neighborhoods in Riyadh, Saudi Arabia. It further examines the effects of school proximity and age/gender of children on their mobility patterns within Riyadh's neighborhoods. A sample questionnaire for school going students are used to assess their mobility patterns. The study showed that age and gender have significant effects on mobility, which seemed to increase among males and older boys in particular. Although automobiles are still the dominant mode for traveling, there are significant differences in walking trips in favor of male students to neighborhood facilities including schools. The study concluded that there is a need for Saudi cities to adopt aggressive policies that promote walking for children and adults within and between nearby neighborhoods.

Keywords: Safety engineering, Geography, Sociology, Environmental science

1. Introduction

Residential neighborhoods' structure and conditions play a major role in children's growth and mental development. Children need to experience an environment that exceeds their homes and backyards. Urban scholars have emphasized the significance of children's mobility within their neighborhoods for enhancing their

cognitive representations of the environment surrounding them (Kytta, 2004; Hillman, 1997; Woolley, 2007). Children are one of the largest consumers of public outdoor environments (Kytta, 2004). Elements of the built environment that exert the greatest influence on children's mobility include safety, green space, access, and integration (McAllister, 2008; Veitch et al., 2017; Lin et al., 2017).

Children's mobility is shrinking at a constant rate across the globe. In the western world, the possibility of children moving around alone has significantly decreased since the early 1970s (Hillman et al., 1990). The emergence of automobiles as the primary mean of traveling in urban areas has significantly influenced nonmotorized trips for both adults and children. The urban landscape has changed in favor of automobile needs; resulting in an increase in travel distances to neighborhood facilities and making walk trips less safe, especially for children (Handy et al., 2008; Camstra, 1997). In-house computer and electronic games have replaced outdoor plays for children in streets and public spaces. This change has resulted in various adverse health and social problems; such as, lack of exercise, obesity, heart diseases, stress, inwardness (Thorleifsdottir, 2008; Churchman, 2003).

Walkable neighborhoods need to have several attributes including the presence of walkable amenities (e.g. grocery stores, parks, schools, playgrounds, etc.), social interactions and spaces, peaceful environment and green space (Brookfield, 2016; Lin et al., 2017; Carver et al., 2012). Denser neighborhoods tend to have better potential for walking compared to lower density neighborhoods. Children need to have specific places to meet and play with friends and peers and to move safely around their residential neighborhoods (Fyhri and Hjorthol, 2009). Unfortunately, today's neighborhoods are designed mainly to tailor for vehicular movements that dominate cities, especially in the developed world, and many developing countries too (Al-Mosaind, 2018).

Children's mobility objectives emphasize the need for children to move freely within and outside their neighborhoods. Freedom to experience outdoors, interact with peers and fulfill their needs and requirements of neighborhoods' facilities and activities are essential components in creating a "child-friendly environment" (UNICEF, 2012).

The notion of children's mobility within neighborhoods has been scrutinized by many urban scholars, especially in the developed world. In many countries; such as England, Germany, Finland, Holland, Canada, Australia, and New Zealand; various studies discussed the issue of children's mobility (Spek and Noyon, 1997; Hillman, 1997; O'Brien et al., 2000; Kytta, 2004; McAllister, 2008; Carver et al., 2012; Carroll et al., 2015; Veitch et al., 2017). Most of these studies have examined the effects of children characteristics; such as age, gender and nationality on their daily mobility patterns and neighborhood interactions. Within gender groups, there are slight differences in participation in neighborhood activities between girls and

boys (Spek and Noyon, 1997; O'Brien et al., 2000; Carver et al., 2012). However, according to Spek and Noyon (1997), the influence of gender is not that significant, compared to other elements such as age and nationality. Age reflects the level of independence for both genders. Older boys have a better chance to participate in neighborhood activities since they enjoy more personal freedom compared to younger ones (Hillman, 1997). Levels of independent mobility have dropped significantly for children aged 7–11 years old in England between 1971 and 1990 (Hillman, 1997). As a result, children tend to travel, either making more walk trips accompanied by adults, or alternatively, by motorized means of travel. In New Zealand and other Pacific nations, Pacific parents consider personal safety as the most critical concern, while Asian and Indian parents consider traffic danger to be the most important one (Lin et al., 2017). The notion of safety and differences in lifestyles and norms could explain such a phenomenon (Kytä, 1997; Veitch et al., 2017).

Unfortunately, Riyadh lacks strict policies that promote children's mobility within their neighborhoods. Existing municipal regulations do not differentiate between the needs and requirements of children and adults in their neighborhoods. Furthermore, most of Riyadh's neighborhoods lack basic facilities for pedestrians, both children and adults alike (Al-Mosaind, 2018; Bahammam, 2002; Al-Skait, 2003). Since the late 1970s, Riyadh has become an auto-dependent city (Al-Mosaind, 2007). Apart from private automobiles, there is a near absence of all other modes of travel in Riyadh, especially walking and public transport modes.

Saudi children deserve better neighborhood arrangements that promote safe and sustainable mobility patterns to their neighborhood facilities especially schools. Current neighborhood planning and design practices and development guidelines do not encourage children to move freely to fulfill their mobility needs. There is a need to assess children's current mobility patterns within their neighborhoods in order to revisit current and future neighborhoods' planning and design practices in Riyadh and Saudi Arabia at large. It also would help to rehabilitate current neighborhoods paving the way for a more livable, efficient and sustainable neighborhood. Unfortunately, there are no credible studies regarding children's mobility in Saudi Arabia and the Arab world at large. All available studies address the notion of children's mobility in the developed world, especially to schools and neighborhood facilities.

This study argues that children characteristics; such as gender and age, affect their mobility patterns within existing neighborhoods in Riyadh. It argues that male children, especially older ones have much better freedom to move around within their neighborhoods compared to their female counterparts. In previous research, neighborhood characteristics, particularly neighborhood's age and residents' income level have shown a noticeable influence on children's mobility to schools and public facilities such as gardens and parks (Al-Mosaind, 2018). Children living in older, less affluent neighborhoods tend to walk to schools and other neighborhood

facilities more than their peers in higher income neighborhoods. In fact. The location of important neighborhood facilities within a walkable distance to children would encourage them to walk and interact with other children. Furthermore, together with other social and cultural factors, children characteristics such as age and gender could be an important element in our understanding of children's mobility patterns.

This research addresses the effect of school location and children's characteristics on their neighborhoods' mobility patterns, specified in the following two questions:

- Does school proximity affect children's mobility to schools in favor of walking vs. motorized trips?
- Do gender and age affect children's mobility to schools and other neighborhood facilities?

This paper is organized into four sections. The first introduces the research problem and aligns it with current local and international literature. Research methodology is briefly explained in the second section. Then, research outcomes are presented in three parts; definition of the effect of gender and age on the patterns of children's mobility in the city of Riyadh's neighborhoods, comparison with international experiences worldwide and discussion of the implications of these results on future city and neighborhood developments in Riyadh and Saudi Arabia. Finally, the paper concludes by stating the primary outcomes of this research and suggests means to enhance children's mobility in cities using environmentally sensitive means of travel especially walking.

2. Methodology

A quantitative research design based on a questionnaire is used to evaluate children's mobility within urban neighborhoods. The data collection process was completed from four neighborhoods in the four geographical sectors of Riyadh, as shown in Fig. 1. The neighborhoods were selected based on their maturity level and are considered, according to which, fully developed (mainly initiating development 30 years ago). This step is to assure the development of all lots, facilities and roads and walkways within these neighborhoods. These are stable, streamlined, and representative of most city neighborhoods. Older developed neighborhoods are facing demographical changes and facilities deterioration, while newly developed ones lack necessary facilities. The study uses a purposive sampling technique to collect the data from students at three educational levels: primary, intermediate and high, to represent three age groups (6–11, 12–14, 15–17 years old, respectively). Exact age was not targeted to ease comparison of travel behavior for similar age groups in various schools' locations.

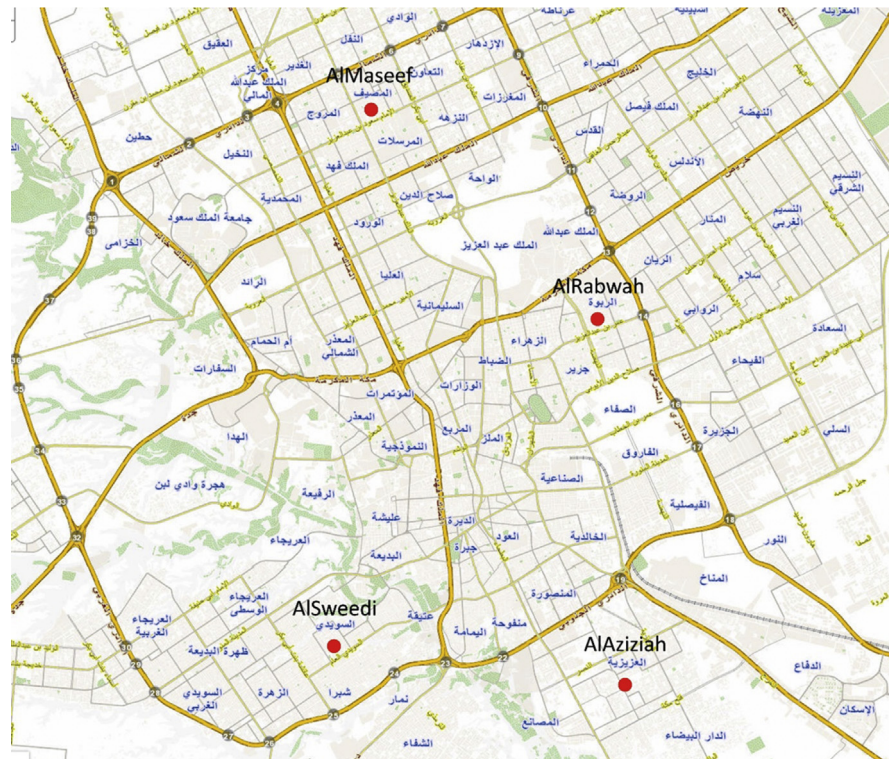


Fig. 1. Study neighborhoods in Riyadh.

The school's system in Saudi Arabia is physically-separated for boys and girls at the three educational levels. Based on national planning criteria for neighborhoods' facilities planning (adopted by the Ministry of Municipal and Rural Affairs), all neighborhoods should have separate public schools for boys and girls (Al-Mosaind, 2018). The study has focused on public schools' children to ensure an equal representation of similar age groups.

The participants were an equal, non-random sample of 30 students per school (boys or girls) at the three educational levels. This process is to ensure an equal representation (for proper comparisons purposes) of both genders and age groups regardless of school sizes. The study has sampled 720 students, divided equally between boys and girls and received 653 responses (90.7% response rate; 92.7% for boys and 88.6% for girls) (Table 1). The difference in response rate is minimal, and there is no need to rectify results to ameliorate the differences. The selection of participants in a typical classroom was left to school principals to ensure the diversity of participants. Teachers were instructed to help students in answering the questionnaire to ensure correctness and completion of answers to all questions including the questions requiring distance range estimation. The questionnaire assesses the extent of mobility patterns among children using different modes of transport such as walking, private buses, public buses, and automobiles. The two-page questionnaire

Table 1. Participants of the study in public schools (Sample size is 30 students per school).

Location	No. of respondents (students) (boys or girls) per school						Total
	Primary		Intermediate		High		
	Girls	Boys	Girls	Boys	Girls	Boys	
AlMaseef	26	30	30	29	30	30	175
AlRabwah	28	30	29	31	31	27	176
AlAziziah	26	30	29	28	22	16	151
AlSweedi	30	30	16	28	22	25	151
Total	110	120	104	116	105	98	653

concentrated on estimating children daily trips to schools and other neighborhood facilities (for further details see the Appendix). It also intended to compare walking trips with auto-related trips, on average, for both genders and the three age groups.

The study also uses data published by Tatweer for School Transportation Company enlisting current enrollment of its public schools' bus system. The Saudi government funds public-school bus system through Tatweer for School Transportation, a public subsidiary company. All female students that live within a distance range of 250–3000 meters from their schools are eligible for school transportation (Tatweer for School Transportation, 2018). Priorities are to students who live further away from their schools and in need of the public bus system. However, the company applies a quota system for all city neighborhoods with an emphasis on needy students.

The study employs three instruments and tools to analyze data; first, a cross-tabulation to describe the size and differences in children trips to schools and neighborhood facilities. Secondly, it uses the t-test to examine whether there are significant differences between the answers of males and females in using different modes of travel (automobile, school bus, private bus, and walking). Finally, the study utilizes the analysis of variance (ANOVA) to test whether there were significant differences between the answers of male and female students in each age category (elementary, intermediate, and high schools). The study context can provide evidence-based knowledge regarding children's mobility in urban neighborhoods.

3. Results

3.1. Differences in children's mobility according to gender

Children tend to make frequent trips to neighborhood facilities. Schools are the most critical facility in any residential neighborhood. All planning criteria worldwide

emphasize school proximity to children, especially for early grades. Other important trip purposes include playing outdoors, going to gardens, visiting relatives and friends, and finally shopping.

The study's questionnaire covers the issue of school proximity to students and the mode of travel used by students. Fig. 2 shows that private automobiles are by far the most dominant mode of travel to schools for both genders. The auto domination can be explained partially by the high percentage of schools located outside children's neighborhoods. Fig. 3 indicates that nearly half of the respondents study in schools located outside their neighborhoods, especially in the case of male students. The slightly higher number of girls' schools, as compared to that of boys, is due to

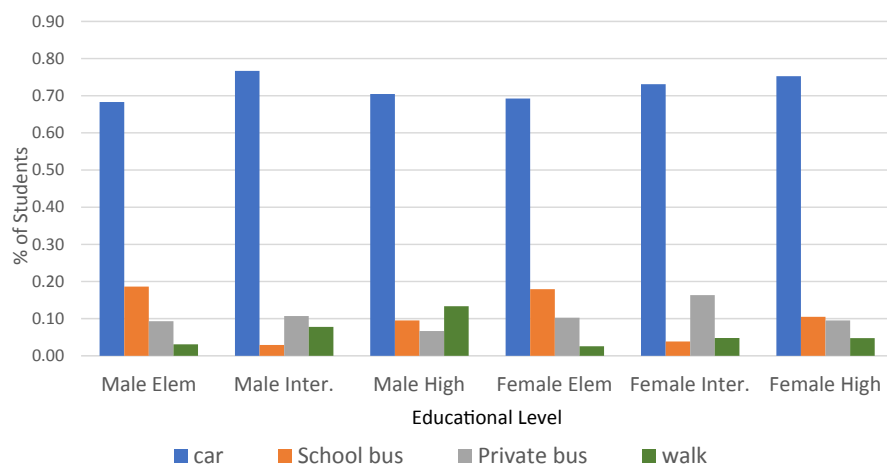


Fig. 2. Travel modes for schools for both male and female students.

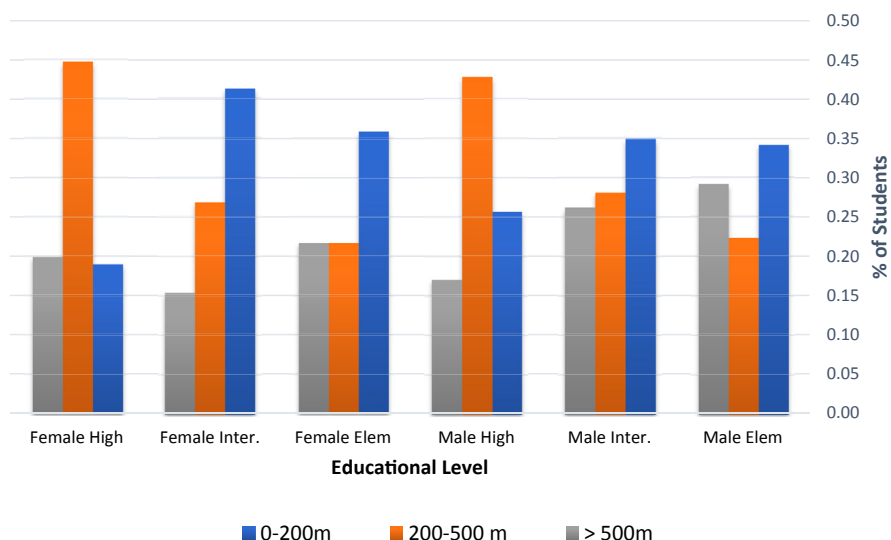


Fig. 3. Percentage of schools located within respondents' neighborhoods and their average distance ranges.

the aggressive policy of the previous Girls' Administration when it was independent of the Ministry of Education.

The results were tested statistically using t-test. It was done to detect whether there is a significant difference between the answers of male versus female students in each of the distance to school ranges (0–200m, 200–500m and >500m). The issue of differences in schools' proximity led to interesting conclusions. Statistical t-test confirmed the notion of school proximity in favor of girls versus boys. It shows that there is a significant difference, at a 1% level, between male and female students for school locations in favor of females. In particular, there are significant differences, at a 1% level, between their answers in schools located less than 200 meters from their homes in favor of females. On the other hand, there are significant differences, at a 1% level, between their answers in schools located more than 500 meters from their homes in favor of male students. Proximity to elementary and intermediate schools is clearly in favor of girls, while boys enjoy slightly better proximity to high schools.

Another striking difference between boys' and girls' mode of travel to schools is concerned with bus use (both public and private). The percentage of girls using buses is nearly double that of boys, due to two factors; the government sole funding of girls' bus transport and the social fear of letting girls walk alone to schools, especially the older ones. According to Tatweer for School Transportation Company, 53509 girl students in Riyadh are transported every day from their homes to schools. It constitutes nearly 10% of the total number of girls' students in Riyadh. [Table 2](#) shows that the percentage of girls, living in the selected neighborhoods for this study, and using public buses, is more than the city's average. This is due to the maturity of these neighborhoods compared to other city neighborhoods. Girls, who do not qualify for government bus subsidy, use private bus companies more often than boys.

The results were tested statistically using t-tests to detect whether there is a significant difference between the answers of male versus female students in each of the school travel modes (Automobile – School bus – Private bus – Walk) and the overall travel mode. [Table 3](#) presents the results of the t-test3s.

Table 2. Number of girls transported to schools by Tatweer for School Transportation Company for the four selected neighborhoods (2017).

Neighborhood	No. of Students	Using Buses	%
AlMaseef	2098	345	16.4
AlRabwah	2787	314	11.3
ISweedi	3016	399	13.2
AlAziziah	12220	2461	20.1
Total	20121	3519	17.5

Table 3. T-test of the different travel modes based on gender.

Variable	T	Df	P-value	Decision
Automobile	-.677	698	.498	No significant Difference
School bus	2.894	660.443	.004	Significant Difference in favor of female at 1%
Private bus	2.894	660.443	.004	Significant Difference in favor of female at 1%
Walk	-4.086	529.418	.000	Significant Difference in favor of male at 1%
Overall Travel mode	1.589	457.319	.113	No significant Difference

Table 3 shows that there is no significant difference between male and female students in using automobiles, while there are significant differences between them in using other travel modes at a 1% level of significance. In Riyadh, automobile usage is undoubtedly high for all children regardless of gender. Further, it is quite clear that girls tend to rely on motorized modes of travel, in contrary to boys who rely more on walking. The study shows that girls use public and private buses to schools more than boys and the differences are statistically significant. Meanwhile, boys rely more on walking to their schools as compared to girls.

The study also explored the notion of children's mobility to other important neighborhood facilities. It measures walk and vehicular trips by children to playgrounds, gardens, sports facilities, shops (commercial facilities) and relatives houses. **Table 4** shows the average daily trips to neighborhood facilities by age and gender for the study sample. Overall both genders make a similar number of trips per day but vary in trip mode. On average, boys make more walking trips on all trips as compared to girls (see **Fig. 4**). Visiting relatives is the most noticeable trip girls make within their neighborhood, due to the high level of social ties between Saudi families.

The second essential walk trips girls make are trips to gardens and playgrounds. Girls tend to be the most important consumers of public gardens (**Spek and**

Table 4. Average daily trips by age & gender to neighborhood facilities.

Age	Walk	Car	Total
Male Elementary	1.06	2.93	3.99
Male Intermediate	0.82	2.97	3.79
Male High	0.95	2.89	3.84
Female Elementary	0.99	3.01	3.99
Female Intermediate	0.62	3.06	3.67
Female High	0.84	3.18	4.02

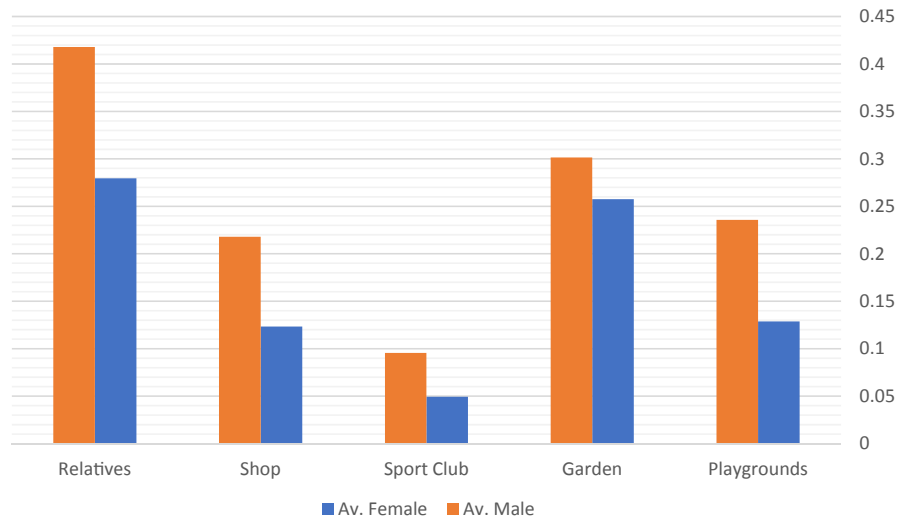


Fig. 4. Average daily walk trips to neighborhood facilities by gender.

Noyon, 1997). The absence of girls' sports clubs inside neighborhoods explains the minimal trips shown in this study. Boys tend to make more frequent trips to visit relatives and go outdoors. Boys are also allowed more often to walk to nearby facilities as compared to girls.

Statistically, there is no significant difference between the answers of male and female students in the daily trip walk to gardens, while there are significant differences between them in the others walk daily trips purposes. Overall, there is a significant difference between the answers of male and female students in the daily walk trip in favor of males.

On the other hand, girls use automobiles more often in all trip purposes within their neighborhoods as compared to boys. Fig. 5 shows the domination of automobile

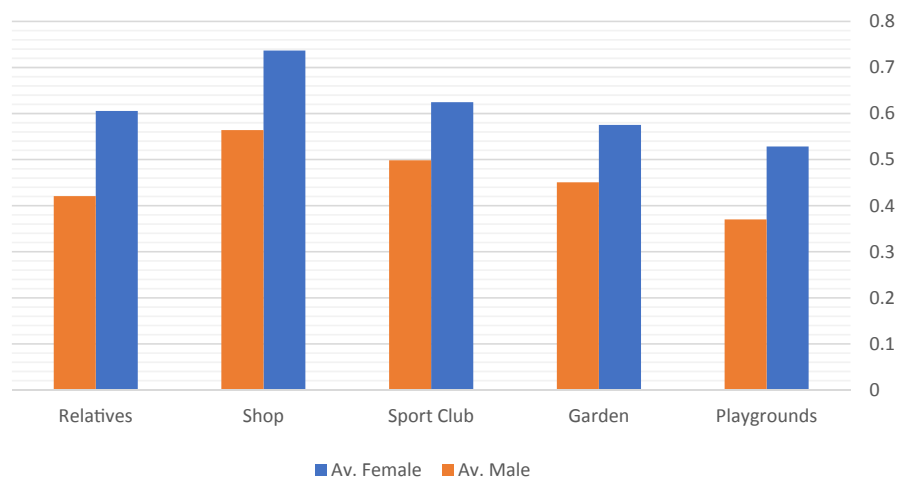


Fig. 5. Average daily automobile trips to neighborhood facilities based on gender.

travel for girls and boys alike. Shopping trips are the most dominant due to the lack of commercial facilities within neighborhoods. Current planning criteria in Riyadh's neighborhoods allow for strip commercial developments along minor and major arterial streets surrounding neighborhoods. Contrary to walk trips to neighborhood facilities, there is a significant difference between the answers of male and female in the daily automobile trip in favor of females.

3.2. Differences in children's mobility according to age

As in the previous discussion, automobile travel to schools is still the dominant mode of travel regardless of age and gender. With regard to other modes of travel, the results show that walking is the dominant mode of travel for boys, especially in high schools' category followed by that of elementary schools (see Fig. 2). For girls, buses are the second highest mode of travel to schools due to the provision of public-school buses to girls. Also, those who are not eligible for public school busing resort to hiring private bus companies to go to schools. The desire for more protection, safety and security could explain that phenomenon.

To check the validity of the study's questionnaires, the study compares the answers of different ages at elementary, intermediate and high schools using the analysis of variance approach (ANOVA). Table 5 shows that age has a significant effect on the school bus travel mode at 1% level of significance; while it does

Table 5. ANOVA test of the travel mode based on the age.

Travel mode		Sum of Squares	Df	Mean Square	F	p-value
Automobile	Between Groups	.461	2	.230	1.172	.310
	Within Groups	137.048	697	.197		
	Total	137.509	699			
School bus	Between Groups	.742	2	.371	4.637	.010
	Within Groups	55.767	697	.080		
	Total	56.509	699			
Private bus	Between Groups	.434	2	.217	2.695	.068
	Within Groups	56.075	697	.080		
	Total	56.509	699			
Walk	Between Groups	.116	2	.058	.798	.451
	Within Groups	50.563	697	.073		
	Total	50.679	699			
Travel mode	Between Groups	.001	2	.000	.295	.745
	Within Groups	.680	697	.001		
	Total	.680	699			

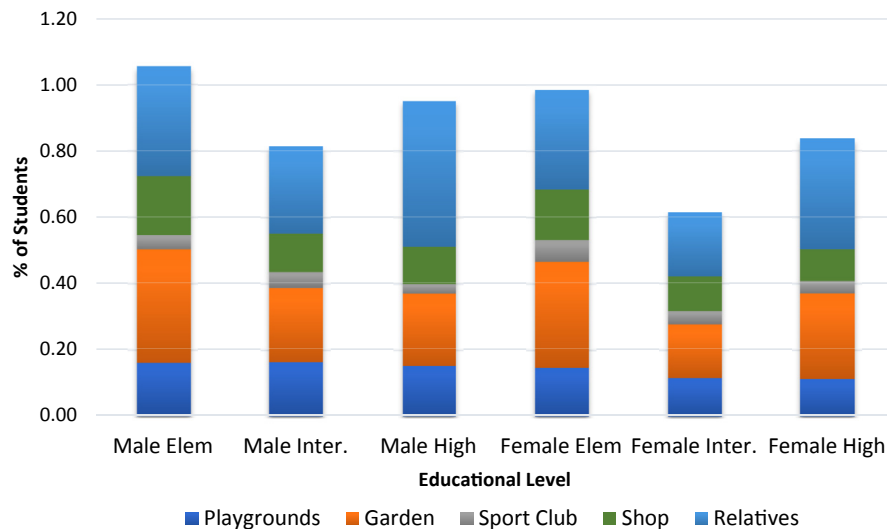


Fig. 6. Average daily walk trips to neighborhood facilities by age groups.

not affect other travel modes. The age factor has no significant effect in overall travel mode. ANOVA test shows that age has a significant effect on the distance to schools located less than 200 meters from homes; while it has no effect on the other distances.

The questionnaires outcomes showed that age has some effect on male children walk trips to other neighborhood facilities (see Fig. 6). First, it is related to visiting relatives living in the same neighborhood for older males, while it, in the second place, reflects the need for young males and females to use neighborhoods' gardens. The second highest daily walk trips are related to visiting gardens for both younger genders. On the other hand, the highest daily automobile trips are to shopping followed by sports clubs as shown in Fig. 7. Similar to gender, there are no apparent

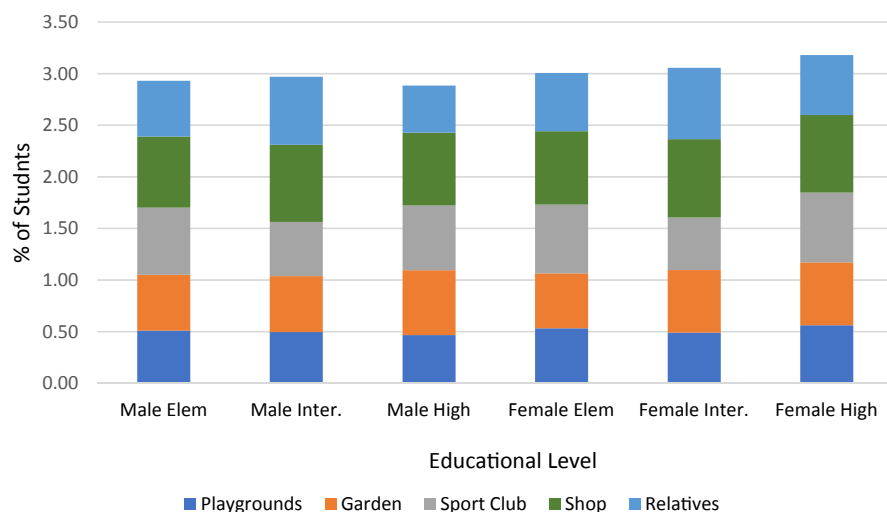


Fig. 7. Average daily automobile trips to neighborhood facilities by age groups.

differences related to age in their daily automobile daily trips to different neighborhood facilities.

The (ANOVA) statistical test confirmed the cross-tabulation results that age influences the daily walk trip of children. It shows that age has a significant effect on the overall daily walk trip. Moreover, age has a significant effect on the sports club daily automobile trip at 1% level of significance, while it has no effect on the other daily automobile trip. In conclusion, older boys tend to walk to neighborhood facilities more than their girls' counterparts, while, the results show, that they exhibit a similar behavior regarding automobile trips.

4. Discussion

There are considerable worldwide differences in children's mobility based on gender and age. Although, boys have a better chance to be allowed to go out alone or with friends, [Kyttä \(1997\)](#) shows the opposite in Western Europe. Girls tend to make more trips than boys to play outdoors. This trend can be explained by the fact that boys make more trips alone than girls, while girls make more trips but in company with other friends ([Kyttä, 1997](#)). Within gender groups, there are slight differences in participation in neighborhood activities between girls and boys. In general, boys play more in public squares and plazas, whereas girls play in neighborhood gardens ([Spek and Noyon, 1997](#), [O'Brien et al., 2000](#); [Carver et al., 2012](#)). Other researchers in Western Europe echo these findings. [Hillman \(1997\)](#) asserts that there are apparent differences in gender-based trips in Britain and to a lesser extent in Germany.

Other factors that explain children's mobility differences in the western world are related to personal characteristics. According to [Spek and Noyon \(1997\)](#), the influence of gender is not apparent as compared to other elements such as age and nationality. Age reflects the level of independence for both genders. Older boys have a better chance to participate in neighborhood activities since they enjoy more personal freedom as compared to younger ones ([Hillman, 1997](#)). They have better chances to go outdoors as compared to girls ([Spek and Noyon, 1997](#); [Kyttä, 1997](#); [O'Brien et al., 2000](#)).

In the Saudi context, the results of this study indicate that gender has a profound impact on children's mobility in Riyadh's neighborhoods. Mainly, it has a significant effect on children's trips to schools and other neighborhood facilities. Male children have more freedom to walk to schools and other nearby facilities; while girls tend to rely more on motorized means of traveling, especially automobiles and school buses.

Furthermore, in Saudi Arabia, socio-cultural factors exert a more significant influence on mobility patterns for children based on gender. Fear from encountering the other gender and the perceived reduced personal safety could explain such gender differences in mobility patterns ([Almahmood et al., 2017](#)). The segregation

of males and females in public spaces observed in Saudi Arabia has a profound impact on girls' mobility in existing neighborhoods. Children travel patterns resemble, to a great extent, their adults' counterparts. In an elaborative study, [Almahmood et al. \(2017\)](#) concluded that Riyadh is gender-specific walkscapes. Females walk more in an indoor environment, such as shopping malls, because they function as urban shelters. On the other hand, streets and public spaces are perceived as men's walkscapes. Male children in Riyadh have a better chance to walk freely in streets and experience outdoors compared to their counterpart girls.

Meanwhile, age has a weaker influence on children's mobility in Riyadh. Only older boys have more freedom to walk to neighborhood facilities, especially schools. Girls of different ages rely heavily on automobiles and school buses (public and private) with few walk trips to schools.

This phenomenon also can be attributed to the fact that most Riyadh's neighborhoods lack basic needs for pedestrians, and especially so for children ([Al-Mosaind, 2018](#)). Unfortunately, children are the most disadvantaged group in using their neighborhood facilities. Issues of personal safety, traffic safety, poor pedestrian pathways, and the lack of street furniture are the main reasons for these fewer walk trips ([Al-Mosaind, 2018](#)). Physical settings may not be the only reason to walk differences between boys and girls. Enjoyment, safety, and suitable walkways are positively associated with walk trips for children to schools ([Veitch et al., 2007](#)). These elements are still lacking in most of Riyadh's neighborhoods ([Al-Mosaind, 2018](#)). Currently, there is no clear policy to enforce the implementation of safe, well-equipped streets' furniture for neighborhood residents. Smaller, fragmented efforts of making friendly neighborhoods were made by developers to enhance their marketability. In Diriyah city, last decade the municipality started to implement certain measures to encourage residents of new homes to abide by newly developed regulations of streets' pavements that are pedestrian-friendly. Residents were supportive of such measures, but unfortunately, this policy faded away after municipality changed management.

Further, design and planning criteria in Riyadh's neighborhoods do not require the presence of commercial centers near homes. Most commercial facilities are designed as commercial strip shops on the peripheries of existing neighborhoods. These types of developments target passing-by costumers who drive their vehicles on main streets. It is uncomfortable and unsafe for children, boys and girls alike, to utilize these shops for their basic needs.

Finally, locations of schools in Riyadh could be the primary cause of these travel patterns of boys and girls at the different age categories. As indicated previously, girls are in a better situation regarding school proximity, especially elementary and intermediate schools. Contrary to others' belief about gender differentiation in favor of males, Saudi Arabia provides much better services to girls in its school

system. The study shows that most schools are close to female students as compared to boys. Also, girls are privileged with free school buses, while boys need to hire private bus companies, walk or ride to schools. The issues of safety, both personal and traffic safety is the second primary reason for these travel patterns characteristics. Studies show that a high percentage of traffic accidents do involve children in Riyadh's neighborhoods (Al-Mosaind, 2018). Finally, most neighborhood streets and walkways are not pedestrian-friendly to encourage students to walk to their schools (Al-Mosaind, 2018; Samimi and Ermagun, 2012).

Unfortunately, Riyadh lacks such a strict policy of promoting the principals of a child-friendly environment. Existing municipal regulations do not differentiate between children's and adults' needs and requirements in their neighborhoods. There is a need to increase the level and intensity of children participating in the design and operation of their neighborhoods. Positive outcomes are observed in countries that provided an official platform for children participating in their cities and neighborhoods (Bartlett et al., 2016).

5. Conclusions

Children's mobility within neighborhoods is one of the essential rights that have been overlooked in the favor of adults, especially automobile users. Children should be able to experience their neighborhoods and its streets and plazas freely without risking their lives. There is a need to balance the provisions of safety and accessibility requirements of neighborhood residents (adults and children) with their mode of travel (motorized and non-motorized means of travel). Enhancing streets visibility and easing walking access to neighborhood facilities, such as schools, gardens, plazas, and shops could allure more girls and younger boys to experience outdoors and reduce their extensive reliance on automobiles. Girls need to overcome the cultural factor of male-separated spaces. They need to share all neighborhood facilities if they are protected from assault and harassment. The new emerging non-segregated projects of walking alleys can be a positive step in encouraging boys and girls of different ages to walk to their neighborhood facilities.

There is an urgent need to enhance the walking environment in existing and future neighborhoods. Saudi cities need to adopt aggressive policies that promote walking for children and adults within and between neighboring communities. Municipalities play a decisive role in achieving a balanced travel pattern within neighborhoods. They need to initiate and implement strict rules and regulations that promote safe neighborhoods, complete streets, enough neighborhood facilities, places for social interactions, and pedestrian priority in neighborhood streets and intersections. Municipalities need to create an enticing environment for children to participate in the well-being of their neighborhoods. There is a strong need to encourage children of both genders and all ages to participate in the decisions and well-being of their

neighborhoods and their physical spaces. This contribution would guarantee the creation of a child-friendly environment that is sensitive and responsive to their needs. Nonetheless, achieving these objectives can be a challenge for every community and institution in today's cities.

Up to date, there has not been any investigative study in other Saudi cities that assess mobility patterns of children to schools and other neighborhood facilities. This study opens a platform for future researchers to examine urban mobility of children concerning their socio-economic and socio-cultural characteristics in today and future cities.

Declarations

Author contribution statement

Musaad Al-Mosaind: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Competing interest statement

The authors declare no conflict of interest.

Additional information

Supplementary content related to this article has been published online at <https://doi.org/10.1016/j.heliyon.2019.e01327>.

Acknowledgements

The author is very thankful to all the associated personnel in any reference that contributed to/for this research.

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