



PEDESTRIAN BEHAVIOR ON EGE UNIVERSITY CAMPUS SIDEWALKS

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Abstract

The idea of sustainable campuses gives particular importance to walking as the primary travel mode. Hence, pedestrian-friendly facilities should be built to achieve this goal. This study investigates the pedestrian walking behavior on the sidewalks on the Ege University campus in Türkiye. The campus is the size of a smaller city with 55,000 students, 3,395 academic staff, and 7,098 administrative personnel. The policy of Ege University is to reduce the number of motorized vehicles on campus. The ‘park and walk’ strategy has been adopted to achieve this goal. Two parking lots have been built at the campus entrance, and those entering the campus are directed to park their vehicles in these parking lots. Therefore, walking is the primary travel mode on campus. In this study walking speed of pedestrians on sidewalks and the factors affecting the walking speed were found. Sidewalks provide safe walking areas for pedestrians; however, as the density increases, pedestrians tend to walk on the street either reserved for bicycles/e-scooters or motorized vehicles. Field observations were made at four sidewalk segments of the campus with video cameras in April 2022. Pedestrians were categorized according to gender, group size, item carrying, earphones, and cellphone usage (talking or texting). A total of 1061 pedestrians were observed. The data were used for computing the average walking speed on sidewalks on the campus. ANOVA was used to determine the factors affecting the walking speed. When all pedestrians were evaluated, the average walking speed on the campus was found to be 1.33 m/s.

Keywords: campus, walking speed, ANOVA

1 Introduction

Planners and designers are interested in the concept of walking to solve many problems such as global warming, health problems, energy consumption, and air pollution. Universities support pedestrian and bicycle mobility for on-campus sustainability [1]. The concept of sustainability, which is related to various issues, has become a concept that countries focus on. This situation has brought the idea of a sustainable campus since the mid-1990s. For this reason, universities have made sustainability a strategic priority in their planning and policies, considering the design of a livable and comfortable environment [2, 3]. Universities should encourage people to shift their travel mode from cars to walking and bicycling. Improving footpaths can encourage people to increase their walking activity. In addition to other effective policies, automobile traffic on campus and parking spaces can be restricted to promote walking [4].

Ege University campus is like a small city with 55,000 students, 3,395 academic staff, and 7,098 administrative personnel. The policy of Ege University is to reduce the number of motorized vehicles on campus. The ‘park and walk’ strategy has been adopted to achieve this goal. Two parking lots have been built at the campus entrance, and those entering the campus are directed to park their vehicles in these parking lots. Therefore, walking is the primary travel mode on campus.

In a study conducted on two different university campuses in the USA, the researchers aimed to observe the type and rate of distractions and the effect of these distractions on crossing safety. Headphones had the highest share (19%) among distracting factors. It was followed by text- messaging (8%) and telephone conversations (5%). There was no significant effect of gender on distraction. However, women were more likely to be engaged in social (talking, texting) distractions compared to men, who were more likely to be involved in individualized (wearing headphones) distractions [5]. In a study conducted in Chengdu, China, observations were made during peak hours on the university campus. Walking speed and pedestrian density were found to be inversely proportional; that is, when pedestrian density is high, walking speed is low. Male students walk faster than female students. The walking speed in a group is lower than the walking speed of a single person. In addition, since men have a longer stride length than women, this affects walking speed, albeit slightly [6].

The study [7] examined the effect of technological and social distractions on pedestrian behavior and crossing time at intersections. It has been determined that messaging on mobile devices is extremely risky for pedestrians, causes an 18% increase in crossing times, and does not exhibit safe crossing behavior. It was observed that pedestrians using headphones cross faster but are less likely to look in both directions before crossing than pedestrians who are not distracted.

Pedestrian behavior using the crosswalk was analyzed by [8]. A total of 1045 pedestrian crossings across 23 midblock crossings were investigated to determine the relationship between distraction types, road cross-section, and other factors with pedestrian walking speeds. The average walking speed was calculated as 1.46 m/s. It has been determined that pedestrians using headphones walk 0.28 m/s faster than others. Another study [9] observed the effect of mobile phone usage while walking at pedestrian crossings. In this study, they investigated the effect of distraction situations (talking on the phone/texting) on pedestrian-vehicle interaction at pedestrian crossings. They stated that walking speed was affected by talking on the phone or texting while walking. Pedestrians who were distracted while walking were observed to walk in a more controlled manner by adjusting the step length or frequency. Pedestrians walking by looking at their phones or texting on the phone have very short strides and slow walking speeds.

In İzmir, Türkiye pedestrian crossing speeds were observed at midblock areas [10]. Pedestrians were categorized according to gender, group size, and item-carrying status. The results showed that men walk faster than women and individual pedestrians walk faster than those who walk in groups.

In this study walking speed of pedestrians on sidewalks and the factors affecting the walking speed were found. Sidewalks provide safe walking areas for pedestrians; however, as the density increases, pedestrians tend to walk on the street either reserved for bicycles/e-scooters or motorized vehicles. Pedestrians were categorized according to gender, group size, item carrying, earphones, and cellphone usage (talking or texting). A total of 1061 pedestrians were observed. The data were used for computing the average walking speed on sidewalks on the campus. ANOVA was used to determine the factors affecting the walking speed.

2 Study area

Four sections with high pedestrian density were determined on the Ege University Campus. Video cameras were installed in these sections to observe pedestrian mobility. Video recordings were made each Friday in April 2022 during afternoon and evening peak hours. A tripod of 9 m height was used to see the pedestrians passing through the section of the determined length on the sidewalk to compute pedestrian speed. Moreover, side-view cameras were used to observe pedestrians' characteristics. Locations, where field studies were made on the campus are shown in Fig. 1.



Figure 1 Observed locations on campus

The main entrance is used by both motorized/non-motorized vehicles and pedestrians. There's a security control for vehicles. A fence along the sidewalk is built to prevent vehicle-pedestrian collisions. Thus, no walking outside the sidewalk was observed. The observed section was 27 m in length. Pandespanian Mansion entrance is used by both motorized/non-motorized vehicles and pedestrians. There's a security control for vehicles. There's no physically built protective measure for pedestrians and bicycle/e-scooter users. The observed section was 27 m in length. The student village entrance is used by motorized/non-motorized vehicles and pedestrians. There's a security control for vehicles. There's no physically built protective measure for pedestrians and bicycle/e-scooter users. The observed section was 30 m in length. The library is in the center of the campus. The road in front of the library directly reaches the metro station; thus, it is excessively used by motorized/non-motorized vehicles and pedestrians. The bike lane is physically separated from the road. The observed section was 27 m in length. The observed sidewalks are shown in Fig. 2.



Figure 2 Observed sidewalks on campus a) Main entrance b) Pandespanian mansion c) Student village entrance d) Library

3 Data analyses

On campus, 1,061 pedestrians were observed at four sidewalk sections. On sidewalks, pedestrians walk in two directions. The bidirectional pedestrian flow generates conflicts between pedestrians. One should yield to the other to continue walking when there is a conflict. It is observed that pedestrians step on the road (or the bikeway) and then get on the sidewalk again. In Table 1, the number of pedestrians who had to step on the road, who walked on the street, and the total number of pedestrians observed at each sidewalk section are presented.

Table 1 Number of pedestrians observed at sidewalk sections

Location	Pedestrians who stepped on the street	Pedestrians who walked on the street	Pedestrians who walked on the sidewalk	Total
Main	-	-	282	282
Pandespanian mansion	-	42	272	314
Student village	-	-	123	123
Library	17	15	310	342

3.1 Descriptive statistics

Pedestrians were categorized according to gender, age, group size, item carrying, earphones, and cellphone usage (talking or texting). In Table 2, the average speed and the 15th percentile walking speed of the pedestrians according to the factors mentioned above are listed. The 15th percentile of pedestrian speed can be used as design speed, by assuming that 85% of pedestrians walk faster than this speed. Fig. 3 shows the crossing speed distribution of the pedestrians.

52.2% were men, and 47.8% were women. Male pedestrians' walking speed is 1.37 m/s, and the 15th percentile speed is 1.17 m/s, while the average speed of female pedestrians is 1.29 m/s and the 15th percentile walking speed is 1.11 m/s. Age was categorized into two groups. The method of estimation related to age is a rough approach. Those who have a notebook/book/drawing equipment or a backpack are considered students and their ages are assumed to be between 18-25. The average speed of the first and second groups is 1.34 m/s and 1.29 m/s, respectively.

The rate of pedestrians walking alone is 52.5%, the rate of pedestrians walking in groups of two is 32.6%, and the rate of pedestrians walking as a group of more than two people is 14.9%. The average speed of pedestrians walking alone is 0.13 m/s higher than pedestrians walking in pairs and 0.23 m/s more than pedestrians walking in groups of more than two people. When the pedestrians were grouped according to their items carrying, most of them walked with backpacks (58.3%). The average and the 15th percentile walking speed of pedestrians walking without carrying any items and backpacks are the same.

When pedestrians are grouped according to their use of earphones, the rate of pedestrians using headphones is 12.6%. The average speed of pedestrians using earphones is 0.12 m/s higher than pedestrians not using earphones. The average speed of pedestrians using earphones was 1.44 m/s. When pedestrians are grouped according to their phone usage, the rate of pedestrians walking while looking at their phones is 11.6%, and the rate of pedestrians walking by talking on the phone is only 5.4%. Pedestrians who do not use a phone have a higher walking speed than other pedestrians.

Table 2 Number of pedestrians observed at sidewalk sections

Factor		Count	Avg. walking speed [m/s]	15 th percentile walking speed [m/s]	Std. Dev.
Gender	Female	507	1.29	1.11	0.18
	Male	554	1.37	1.17	0.19
Age	18-25	935	1.34	1.13	0.19
	26+	126	1.29	1.08	0.21
Group size	Individual	557	1.41	1.23	0.18
	2	346	1.28	1.11	0.16
	3 +	158	1.18	1.07	0.13
Carrying items	No	333	1.34	1.13	0.21
	Backpack	619	1.34	1.13	0.18
	Handbag	109	1.32	1.11	0.21
Earphone	Yes	134	1.44	1.29	0.16
	No	927	1.32	1.11	0.19
Cellphone	No use	881	1.34	1.12	0.19
	Check/text	123	1.33	1.13	0.21
	Talk	57	1.32	1.09	0.19

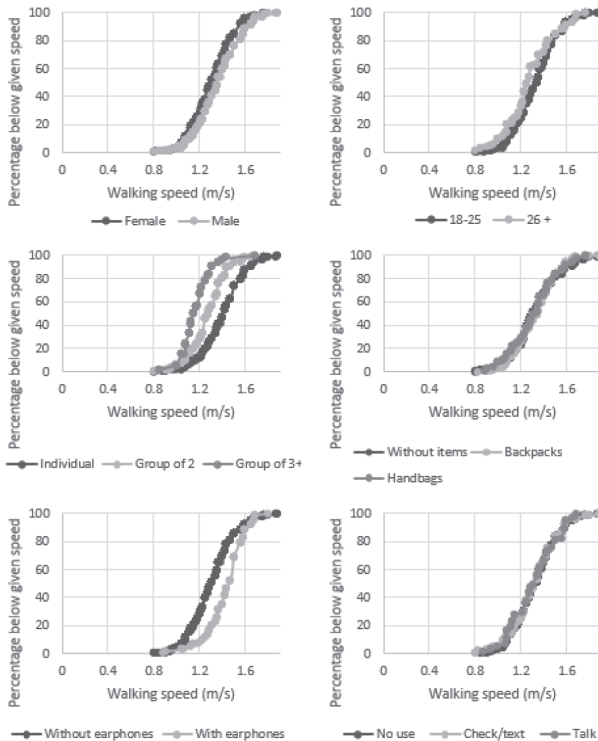


Figure 3 Walking speed distributions

3.2 ANOVA results

Analysis of variance (ANOVA) was performed with walking speed values of 1061 pedestrians observed on four sidewalks on the Ege University campus. The factors affecting the walking speed the most were examined. F values and significance levels were taken into account during the examination. ANOVA analysis results using SPSS v25 are given in Table 3. In Table 3, the factors affecting walking speed are listed starting from the most significant. According to the results, the most significant factor in walking speed is group size. Group size, age, use of headphones, and gender had the same significance level ($p < 0.0001$). However, the F values differ, and the factor with a large F value has a greater effect on walking speed at the same significance level. It was observed that all the factors examined affected the walking speed.

Table 3 ANOVA results

Factor	F	Significance level
Group size	5.421	0.000
Age	2.702	0.000
Earphone	2.694	0.000
Gender	2.029	0.000
Cellphone	1.673	0.002
Items carrying	1.540	0.008

4 Conclusion

This study investigated pedestrian walking speed and influencing factors on sidewalks of Ege University campus in Türkiye. The findings contribute valuable insights for creating a more efficient and pedestrian-friendly campus environment. Various factors influencing pedestrian walking speed, including gender, age, group size, item carrying, earphone usage, and cellphone usage, were analyzed. Field observations were conducted, and statistical analyses were employed to contribute to the understanding of pedestrian dynamics within university campus environments.

The average walking speed on the campus was found to be 1.33 m/s. Notably, gender differences were evident, with men exhibiting higher walking speeds compared to women. The influence of external factors, such as the use of earphones, was also evident in higher walking speeds. Consistent with prior research [6, 10], the study reaffirms that men tend to walk faster than women and individuals outpace group walkers. The significant impact of group size underscores the need for wider sidewalks in high-density areas, particularly near buildings or facilities that attract large crowds. Furthermore, the study highlights the potential safety concerns associated with cellphone usage and earphone use while walking. While the impact on speed was minimal, these distractions can decrease pedestrian awareness and increase the risk of accidents.

The results of this study can be broadly applied to improve pedestrian dynamics across university campuses. By considering the factors identified, such as group size and distractions, the universities can implement targeted improvements. For instance, wider sidewalks near lecture halls or dormitories, areas known for high pedestrian density, can be prioritized. Furthermore, the link between distractions and walking speed highlights the importance of promoting pedestrian safety on campus. By incorporating these findings into campus design and safety initiatives, this study contributes to the development of more efficient, pedestrian-friendly, and ultimately safer university environments.

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