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Research Article

Impact of the Pedestrian System on Environment and Individual Safety in MUET, Pakistan

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Abstract

Background and Objectives: The universities are the important innovative and fundamental for sustainable development, as universities play an important role for providing learning and healthy living environment for their students and employees. Mobility is one of the major issues that must to overcome. In the very last century, day by day automobile use is increasing, which is a major cause of urban pollution, environment degradation. This study highlighted the issue of existing roadway system and the need for proposed pedestrian path and other facilities by placing emphasis on the active green transportation. Walking and bicycling are a cheap mode of transport which is not only promoting health effects on people but reduce the negative impacts on environment and also save the time. **Materials and Methods:** This study was conducted to investigate the pedestrian facilities at Mehran University of Engineering and Technology (MUET), Jamshoro, Pakistan and to develop the model of a suitable pedestrian facility network for the study area. In this study, data were collected by using questionnaire survey method (Average Index Model), content analysis, detailed land use study, traffic count survey and pedestrian count survey. **Results:** Results found that MUET does not have positive walking experience. Outcome of the research may help the university administration to provide friendly walkability environment at MUET campus. **Conclusion:** It is clearly found that condition of foot-path bus-bays points road markings were absent through content analysis survey. These reasons forced employees and students not to walk to make pedestrian friendly campus.

Key words: Walkability, pedestrian-friendly, campus planning, model, sustainability, convenience

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Pedestrian accessibility plays a fundamental role in sustainable urban transport policies, along with quality public transport, rational pricing of motor vehicle use and land use-transport integration¹. University campus can be defined as the main educational core for national and international students, scholars spend much time in the campus environment the comfortable and easy accessibility and connectivity for the user is one of the major challenges to overcome². Built environment supports and encourages walking by providing for pedestrian comfort and safety. It must have paths that connect people to varied destinations within a reasonable amount of time and effort³. People commonly called universities, are small cities with their own communities, they have their own infrastructure facilities, e.g. water supply, electricity and road system etc.⁴. Managing transport demand and supply in a general manner is a far better approach in recognizing sustainable urban transport systems that provide efficient and equitable access for public and goods¹. Day by day campus population is increasing and there has been an enhancement in the use of automobile, almost every campus faces the serious trouble with such increasing traffic volume, heavy energy consumption, high cost vehicles and their maintenance, air pollution and the unfavorable effects on greenhouse gases on environment, on the health of campus students and employees⁵. Mobility is one of the necessities of life, to mobilize from one place to another which can be comprehend with so many different modes such as private cars buses and non-motorized vehicles walking and cycling⁶. The excessive use of automobiles for every short distance create more pollutants like carbon dioxide which increase global warming, air pollution and noise pollution which disturb campus environment⁷. In addition of global damages, this is also projected that half million people per year die impulsively in Asia because of greenhouse gases, transport and environment degradation. This is very important to address these problems with the start from institutions⁸. Objective of this study was to investigate the pedestrian facilities at MUET Jamshoro and to develop the model of a suitable pedestrian network for the study area.

MATERIALS AND METHODS

This study was carried out at Mehran University of Engineering and Technology, Jamshoro, Sindh, Pakistan from 2, January, 2018 to 31, December, 2018 as shown in (Fig. 1)

University campus was divided into 3 zones to conduct the survey as shown in (Fig. 1). To carry out this research study, a multi layered methodology was used which includes questionnaire and content analysis related to pedestrian friendly campus. This research took place 6 months duration for collection and analysis of data.

Data collection and analysis: The questionnaire was designed to obtain the opinion of staff and students regarding the largest barrier in walking in university campus. The respondents were requested to rank four-point Likert scale for investigating the largest barrier during walking. The average index equation was used for the measure of 1-4 rank. The data were analyzed according to three zones of MUET campus. The content analysis is the feedback by authors on different keyword the total eight aspects. Factors were collected from literature such as mode choice, safety, sidewalks, aesthetic views, behavior etc. All the data were collected by real life site observation and discussions and the data were analyzed according to 0 and 1, 0 means not available and 1 means available. This study falls under the category of medium place scale, because it involves campus study.

RESULTS

In this study, average respondent's preference given to personal safety is largest barrier in walking in the university as presented in Table 1.

Table 1 highlights the phenomenon of point distribution according to different categories from fairly high to low, i.e., 4 points to fairly high and 1 point for low, respectively. Total 170 questionnaire were filled from the study area and points were computed accordingly, e.g., 52 respondents chose "Fairly high" for the parameter "Personal safety," which was allotted with 4 points. The rest of the categories for the same parameter, the score was 60 (High), 35 (Moderate) and 23 (Low) and the points were allocated as 3, 2 and 1, respectively. The final score was determined as 2.82 that rated the parameter "Personal safety" at higher priority.

Table 2 clarifies the largest barriers in walking as rated by the local population of the study area.

As shown in Table 2, the parameters, i.e., "Lack of Sidewalks" and "Lack of shelter" were given maximum score comparatively. "Weather conditions" and "Personal safety" were also rated second and third with the scores 2.9 and 2.8.

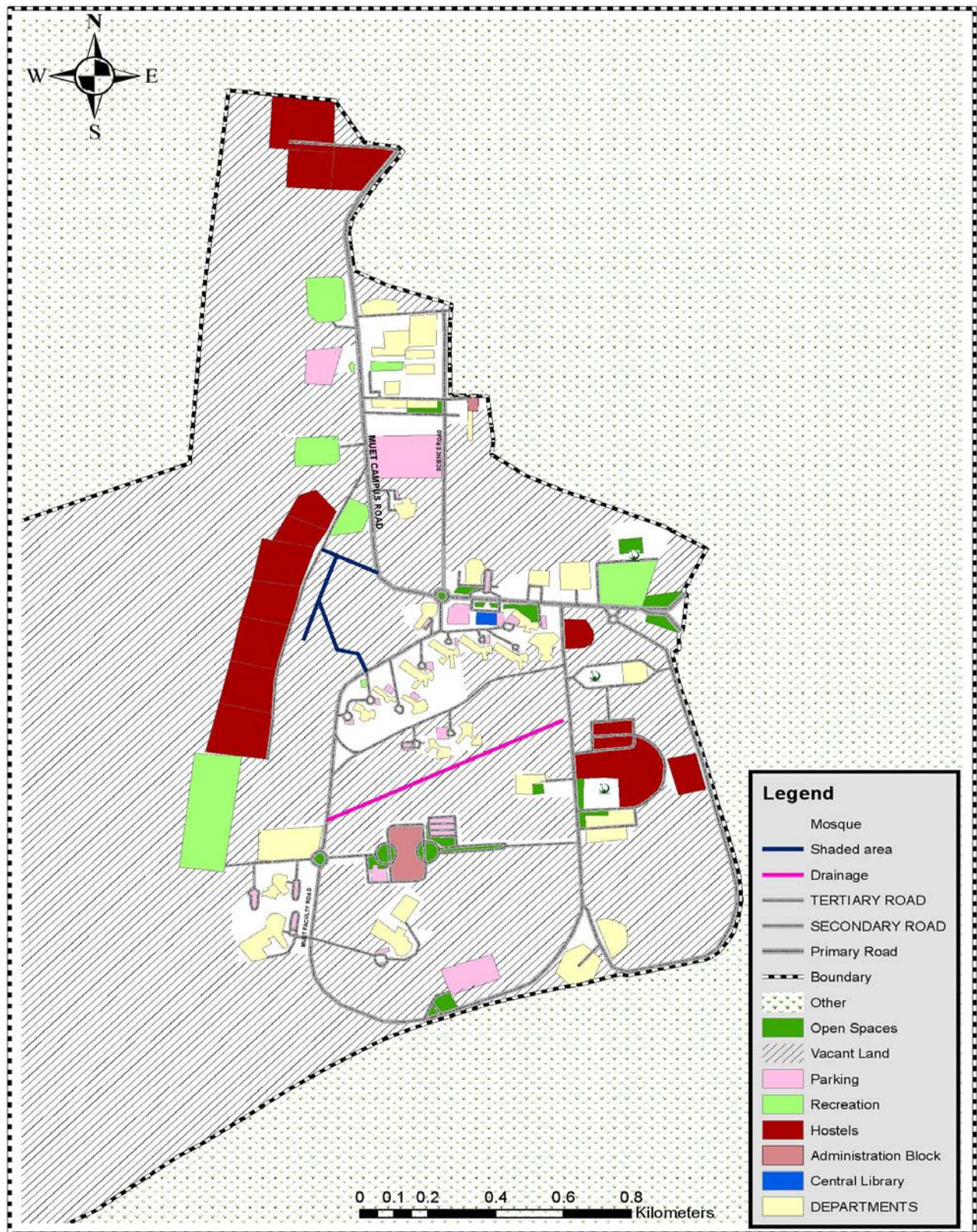


Fig. 1: Land use Map of MUET campus

Source: Prepared by Author

Table 1: Questionnaire results

As the number of questionnaire were 170 , n=170, So largest barrier in walking for first zone importance we have:

52 Fairly high	= 4 Points = 208
60 High	= 3 Points = 180
35 Moderate	= 2 Points = 70
23 Low	= 1 Points = 23
170	481

Since, 170 respondents answered the questionnaire, we have $481/170 = 2.82$

Average respondent's preference was given to personal safety, which is the largest barrier in walking at university

Table 2: Largest barrier in walking

Parameters	Fairly High	High	Moderate	Low	Average	Score
Personal safety	52	60	35	23	481/170	2.8
Health reason	45	55	50	20	465/170	2.7
Distance to destination	38	62	49	21	457/170	2.6
Lack of sidewalks	54	50	35	31	467/170	3.0
Time consuming	50	49	48	23	466/170	2.7
Weather condition	47	67	38	18	483/170	2.9
Lack of shelter	61	52	39	17	495/170	3.0

Table 3: Mode choice

Mode choice	Zone-1				Zone-2				Zone-3			
Cars 1	1	1	1	1	1	0	0	1	1	1	1	1
Buses1	1	1	1	1	1	1	0	1	0	1	0	
Pedestrian	1	1	1	1	1	0	1	0	0	0	1	0
Bikes 0	0	0	1	1	1	0	0	1	1	0	1	
Rickshaw	0	0	1	1	0	0	0	0	1	1	1	0
Others	0	1	0	0	0	0	0	0	0	0	0	0

Table 4: Sidewalk condition

Sidewalks	Zone-1				Zone-2				Zone-3			
No side walks	1	0	0	1	1	0	0	0	1	0	0	0
Not continuous	0	0	0	0	0	0	0	0	0	0	0	0
Location is not suitable	0	0	0	0	0	0	0	0	0	0	0	0
Vehicles are closer	1	0	0	1ss	0	0	0	0	0	0	0	0

Table 5: Street crossing

Street crossing	Zone-1				Zone-2				Zone-3			
Road is wide to cross safely	0	0	0	0	1	0	0	0	1	1	1	0
signals/audible signals	0	0	0	0	0	0	0	0	0	0	0	0
Marked pedestrian crosswalk	0	0	0	0	0	0	0	0	0	0	0	0

The content analysis was also performed, which can be seen in Table 3-10. The overall rating of the variables can be apprehended in content analysis that further illustrated the condition of sidewalks, usages of vehicles, safety measures for the pedestrians and road condition. The mode choice of the study area can be seen in Table 3.

As seen in Table 3, zone-1 was found busiest with cars, buses and pedestrians as compared to zones-2 and 3. More bikes and rickshaw usage was recorded in zone-3.

The information about the condition of sidewalks can be seen in Table 4.

As shown in Table 4, the content analysis of sidewalks of all three zones observed that the overall condition is not suitable for pedestrian walk. Zone-1 was found facilitated with some walk ways, but they were also not found continuous according to length of the road and they were also much closer to vehicles. The data related to street crossing can be seen in Table 5.

As depicted in Table 5, the street crossing conditions of all three zones determined that the overall rating was not found suitable with friendly environment, because of lack of safety measures, like proper signal system and traffic signs, etc for students and employees. The information about the behavior of students and drivers can be seen in Table 6.

Table 6: Student and driver behavior

Student and driver behavior	Zone-1				Zone-2				Zone-3			
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Students not look forward towards traffic	1	0	0	1	1	1	1	0	0	0	1	1
Students walk on the center	1	1	0	1	1	0	1	1	0	1	1	1
Drivers do not give way to pedestrians	0	0	0	0	1	1	1	0	0	0	0	0
Drivers do not obey the traffic rules	1	1	0	0	1	1	0	0	1	1	1	1

Table 7: Safety

Safety	Zone-1				Zone-2				Zone-3			
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Bulk of traffic	1	1	1	1	1	1	1	0	0	0	0	1
Behavior of drivers	0	0	0	1	0	0	0	1	1	0	0	1
Streets lighting	1	1	1	1	1	1	1	1	1	1	1	1

Table 8: Street furniture

Street furniture	Zone-1				Zone-2				Zone-3			
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Benches	0	0	0	0	1	1	0	0	0	0	0	0
Shades/Canopy	0	0	0	0	0	0	0	0	0	0	0	0
Landscaping	0	0	1	0	0	1	1	1	0	0	0	0
Enough trees towards existing routes	0	0	1	1	0	0	0	0	1	1	0	0
Separate lanes	0	0	0	0	0	0	0	0	0	0	0	0
Sitting arrangement	0	0	0	0	0	0	0	0	0	0	0	0

Table 9: Connectivity

Connectivity	Zone-1				Zone-2				Zone-3			
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Paths 0	0	0	0	0	0	0	0	0	0	0	0	0
Alternative routes	1	1	1	0	1	1	0	1	0	0	0	0

Table 10: Aesthetic condition

Aesthetic	Zone-1				Zone-2				Zone-3			
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Trees along road	0	1	1	1	0	0	0	0	1	1	0	0
Art designs	0	0	0	0	0	0	0	0	0	0	0	0
Attractive landmarks	0	0	0	0	0	0	0	0	0	0	0	0

Students do not pay attention to the traffic, while walking on the busy streets of the study area. They were found busy in discussions and using cell phones during their walk on the streets (Table 6). Most of students walk on the center of the road, specially female student groups were found walking in parallel and covering almost half of the carriage way. Drivers were also found with careless driving, hence, there are certain chances of calamities in busy hours. On the other hand, the safety parameters can be seen in Table 7.

As presented in Table 7, there was no any safety inside university campus to walk safely. Based on survey, immense traffic was noted during busy timings and drivers were not obeying the traffic rules of the university. One thing must be appreciated that the over all street light system of the university was suitable to provide enough light during late hours. The street furniture information is given in Table 8.

There was no any proper street furniture, infrastructure facilities available in all three zones of study area, as shown in Table 8. Meanwhile, the connectivity system is highlighted in Table 9.

According to Table 9, results showed that the overall walking paths were not available in all three zones, but there was a lot of provision to implement enhanced walkability along the existing road network. This may reduce conflict among the pedestrian and motor vehicles. The aesthetics information can depicted in Table 10.

As described in Table10, it was observed that trees and plants significantly existed in zone-1, but zone-2 and zone-3, greenery scenario was not so good. All zones needed more attention to add art and attractive landmarks and more greenery.

DISCUSSION

The different parameters were considered by keeping in view the road safety of the pedestrians, like availability of walkways, personal safety, shelter and over all situation of the traffic on the roads of the university. The walking environment was found miserable for the pedestrians. There were neither proper sidewalks nor roadways markings and safety measures. The parameters that were selected in this study for safe pedestrian movement were also highlighted in many related studies. Some of them are discussed hereafter.

Kelly *et al.*⁹ mentioned that there were number of pedestrian attributes considered while measuring the importance of walkability. This research studied the different factors and used the 5 scale point from very bad to very good. The factors included pedestrian quality, connectivity, safety and clean pavements. The average score was greater than 3, most of the selected attributes, such as Pavement cleanliness score 2, street lighting score 1, safety score 0, road crossing 3.

Murwadi and Dewancker¹⁰ and Ferrer *et al.*¹¹ used a qualitative methodology to identify and compare factors of the built environment and walking. The barriers found for short trip in the study are the fear of crime, lighting in night, safe side walks for walking and visibility of marking. The conditions of paths ways and the dissatisfaction level are concern with durability of path, material, aesthetic and continuity of path. It is found that overall satisfaction has a correlation with 5 dominant factors, which are durability of path material factor (0.62), absence of obstruction (0.60), continuity of path without significant elevation differences (0.69), aesthetics (0.59) and availability of shelter (0.53). This study also used content analysis for the qualitative data through author perspective. The results showed zones-1 and 3 having the bulk of private vehicles and overall condition of sidewalks, streetlights were not suitable for the walk. No safety measure and street crossing marks were available. It was also observed that drivers and students were found unaware about traffic rules and regulations. All zones needed more art and attractive landmarks and zone-2 needed more green spaces.

Afsar *et al.*¹² worked on the consequences of physical factors that indicated, respectively 32% of walking in the campus of this study. However, Bijan's study used similar walkable environmental criteria as used in this research. It was observed from the literature and this research also found that university campuses have lack of walking infrastructure. Walking is instantly in direct relationship with physical infrastructure, like walk ways and connectivity of different locations in the university.

The different campus studies used pedestrian level of service (PLOS) system for knowing the pedestrian services in

university campus¹³ and multi layered methodology to improve the mobility in order to find the ways for more sustainability in the education campuses¹⁴. However, in this study, content analysis was executed to clarify the problems related to pedestrian movement. To avoid calamities, this study suggests the prompt construction of side walks along the roads of the university. Later on, proper shelter and furniture facilities must be provided for the comfort of the pedestrians.

CONCLUSION AND RECOMMENDATIONS

This study has measured entirely different physical factors that directly have distress walking in MUET. The primary analysis was assumed. One is to rank the most important barrier contained by the employees and students and also the second analysis was studied the behavior and physical investigation that user need to encourage. Total findings of the investigation that individual wish to walk less due to lack of shelters, lack of safety, lack of sidewalks. This can be analyzed the physical infrastructure having an instant relationship to the walking. Through content analysis survey it clearly displays the real condition of foot-path bus-bays points road markings were absent. These reasons forced employees and students not to walk. Quite a lot of students mentioned concern about safety.

This study recommends the formulation of transport policy for MUET Campus. The policy that must will take care the rights of the pedestrians and will ensure the free movement of pedestrians and vehicles throughout the campus. Also, proper parking facilities should be provided separately for the locals and visitors. Spaces must be allocated for the students car parking at different locations of the university. Bus divers must be given time to time education about the driving rules and rights of the pedestrians.

SIGNIFICANCE STATEMENT

This study is a significant endeavor in promoting walkable friendly environment in the university campus for students and employees. This research has focused on health and safety aspect by understanding the need of future sustainability of university campus.

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