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IDENTIFYING BARRIERS TO WALKABILITY WITHIN THE HERITAGE CITY OF MYSORE, KARNATAKA, INDIA

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Abstract

Historically, streets have served a range of functions, primarily those associated with shopping and social interactions. However, in the 20th century, the street design became centred on traffic movement. It enhanced the space for automobiles, while public lives were marginalized to sidewalks, not to forget the problems faced by the street hawkers, quintessential to the Street scene in India. The historic core of Mysore, a metropolitan city in the Southern state of Karnataka in India, has had various attempts to enhance its mobility but has not had much success. The paper summarises a pilot study carried out on Asoka Road in the city of Mysore to investigate its walkability. A descriptive quantitative technique was adopted, in which a random sample of respondents who happened to walk down Asoka Street were given questionnaires and surveys to complete to collect data. The results revealed that the level of comfort of the street amounted to 51.8% and that the pedestrian path was quite uncomfortable.

Keywords: Walkability, Streets, Historic Core, Pedestrians

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INTRODUCTION

A high level of pedestrian activity is often associated with more sustainable urban form (Gehl, 2013),(Speck, 2013), robust local economies (Glaeser, 2012), better public health outcomes (Asah Nasrudin et al., 2018), (Rundle et al., 2007) and stronger social networks (Rogers et al., 2011). Pedestrian areas have been minimised to allow for better road opening (Mohd Isa et al., 2019). Growing evidence indicates that land use patterns in many countries do not facilitate the healthy development of human beings as well as that of the economy (Wang & Yang, 2019). Environmental elements, such as the weather and season, are mentioned by scholars as having an impact on travel behaviour and non-motorized forms of transportation (Aboelata & Sodoudi, 2020).

Objectives

1. To analyse the pedestrian mobility pattern in a select street in the Planning District-1 (PD-1) in the city of Mysore. To calculate the Comfort Level of walking at the roadside in a selected street.

Walkability in Mysore: a brief background

Mysore, the second-most populous city in Karnataka, has a population of 0.983 million as per the 2011 Indian census and a projection of 1.65 million for 2021- (Census of India 2011 - Karnataka - Series 30, 2014) and is expected to grow rapidly. Mysore's physical and social infrastructure is under great pressure due to the city's expanding population and rising car ownership from 0.2 million in 2001 to 0.4 million in 2011 (Directorate of Urban Land Transport, n.d.).

LITERATURE REVIEW

How streets become walkable

Planning, transportation, the environment, and even the professions of health and wellness have all given attention to the issue of walkability. Traditionally, a person who is on foot is considered a pedestrian; but, more lately, people who use wheelchairs or additional devices have been included in this definition. The term "walkability" describes the actual physical setting in which people walk. It characterised the area made up of streets, buildings, and streetscape. When an area is conducive to walking, it is considered a pedestrian environment. According to (Speck, 2013), there are four key factors of the general Theory of Walkability'. More crucially, the book describes what makes a street “pedestrian friendly” and further detail what makes a city appealing to pedestrians. Walkability is broadly impacted by Accessibility, Pedestrian Surface Conditions and Cleanliness of the pathway. Walkability is essential to urban design since it benefits liveability, sustainability, and health on three different levels. Reducing transportation-based consumption and individualistic goals, such as the desire to own and operate a private vehicle, can be reconciled conceptually and practically

by embracing walkability as an urban solution. The following are important elements that help make pathways more walkable:

a) Sidewalks: Having continuous, well-kept walkways on both sides of the road promotes pedestrian traffic.
b) Crosswalks: At junctions, well defined crosswalks improve accessibility and pedestrian safety.
c) Encouragement of mixed-use zoning within walking distance, cutting down on the need for lengthy automobile excursions.
d) Benches, Shelters, and Lighting: Adding features like benches, shelters, and enough lighting improves pedestrian comfort and safety.
e) Trash Containers: Having trash cans helps keep the area tidy and conducive to walking.
f) Pedestrian Bulbs: Increasing sidewalk length at crosswalks can improve pedestrian safety and visibility.
g) Integration of Public Transportation facilitates a smooth transition between walking and public transportation.

METHODOLOGY

Study area: Mysore Local Planning District 1 (PD-1)

Mysore's City centre covers an area of 300.15ha (Figure 1). Four satellite picture tiles are needed for obtaining the Site Plan using ArcGIS 10.2.2 environment. The four tiles have the row and path (76°38',12°19'), (76°39', 12°19'), (76°39', 12°18') and (76°38', 12°18') were Geo-referenced respectively.

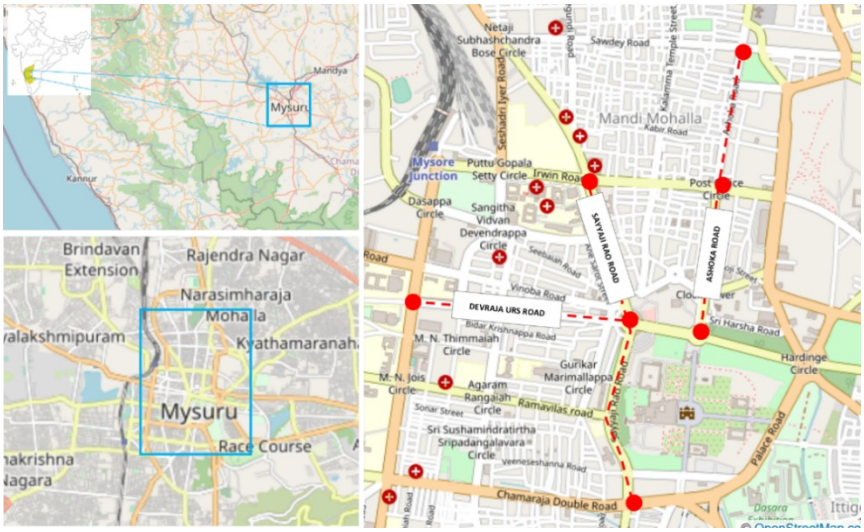

Figure 1: Location of Mysore in the Indian State of Karnataka
Source: Open Street Maps

MATERIALS & METHODS

The study developed a set of standards to evaluate the feasibility of turning former commercial routes into pedestrian areas, as indicated in **Table 6**. Then, this was implemented on a selected historic centre street. In addition to the five main criteria (street characteristics, traffic, commercial structure, environmental challenges, and community engagement), there are about 19 sub-criteria. Each component in this approach is assigned a grade based on how likely it is to influence the conversion of a commercial street into a pedestrian one.

- The items in the first category are those that require six points.
- Each element in the second category is worth four points.
- The items that require two points for each are represented by the third one.

In the case of Commercial Street, if the total evaluation result is greater than 76 points, the decision is to make the street a pedestrian-oriented street by utilising the toolkit and adding the weights. The street's potential does not meet the requirements to be designated as a pedestrian-only commercial street if the total score exceeds 76 points. (**Figure 2**).

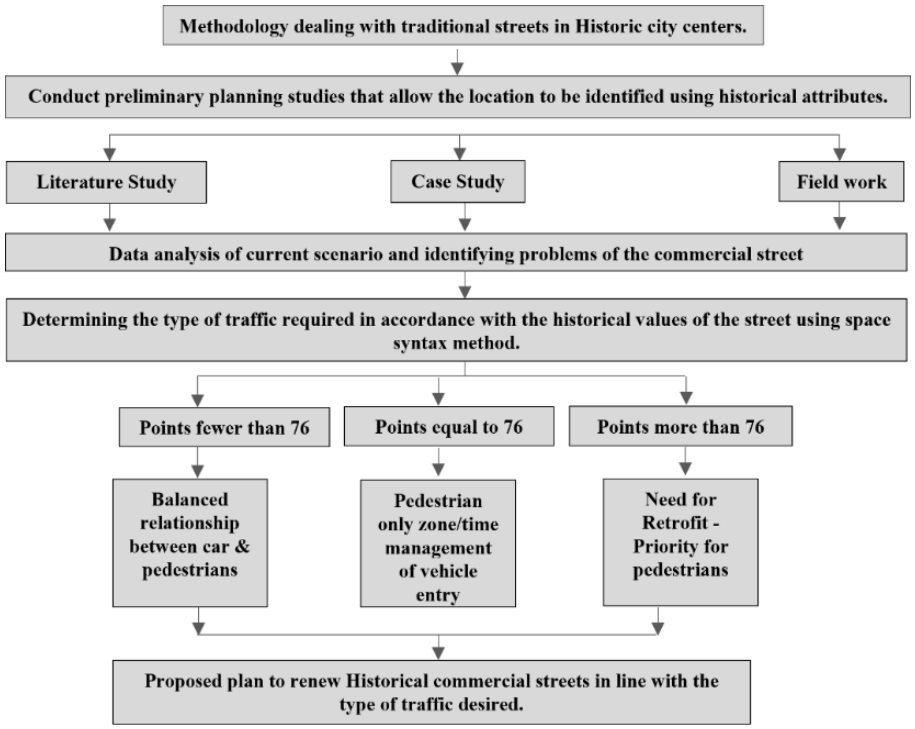

Figure 2: Showing the flowchart of the Methodology
Source: compiled by author

Sampling and Sampling Procedures

Using Fisher's method, a judgmental sampling technique was used to determine the sample size of 96 pedestrians (age group limited to 15–59 years old) who were randomly questioned on Ashoka Street.

$$n = \frac{Z^2 P(1-P)}{I^2}$$

Where: n = Sample size [where population > 10,000]
Z = Normal deviation at the desired confidence interval. In this case, it will be taken at 95%
Z = Normal deviation at the desired confidence interval. In this case, it will be taken at 95%, Z value at 95% is 1.96.
P = Proportion of the population with the desired characteristic.
Q = Proportion of the population without the desired characteristic.
I = Degree of precision; will be taken to be 10%. Since the proportion of the population with the characteristic is not known, then 50% will be used i.e.

$$n = \frac{196^2 0.5(1-0.5)}{0.1^2} = 96$$

Class Intervals and Sidewalk Comfort Level Criteria

Many factors affect how pleasant walkers find the pedestrian path, including the degree of circulation and accessibility, the quality of the surface, the degree of cleanliness, the level of beauty, and the quantity of obstacles. To analyse the data obtained from respondents, the following steps were taken:

a) Determine the respondent's score by multiplying the number of items, the number of respondents, and the maximum and minimum scores that result from multiplying the lowest and highest scores.
b) The calculation of the respondent's score and the percentage of pedestrian comfort level was then arrived at.
c) Class Intervals and Sidewalk Comfort Level Criteria were then arrived at as follows:

Table 1: Sidewalk Comfort Level Criteria

Score Intervals	Percentage Interval	Comfort Level Criteria
7200≤ X<6048	84% ≤ X < 100%	Very comfortable
6048≤ X<4896	68% ≤ X < 84%	Comfortable
4896≤ X <3744	52% ≤ X < 68%	Quite Comfortable
3744≤ X <2592	36% ≤ X < 52%	Uncomfortable
2592 ≤ X <1440	20% ≤ X < 36%	Very Uncomfortable

Source: Author's calculations

The instruments employed in this investigation are a modification of the comfort factor that researchers (Hidayat et al., 2020) developed and modified.

Table 2: Main Themes of Survey Questions Towards Pedestrian Survey

Criteria		Response	Description and Role
	Respondents' personal information	Open	Demographic characteristics
Accessibility (A)	A1_ Pedestrian paths can be accessed by all pedestrians, including those with special needs.	Likert Scale	To determine the respondents understanding of the physical attributes of the street.
	A2_ The pedestrian paths surface is in good condition		
	A3_ The pedestrian paths are wide enough for walking		
	A4_ The pedestrian path is interrupted with modal conflicts.		
	A5_ There is a sufficient difference in the surface height of the pedestrian path and the traffic lane.		
Pedestrian Conditions (PC)	P1_ The walkway paving surfaces are broken	Likert Scale	To understand respondents awareness of activities along the street
	P2_Flowerpots / trash block the pedestrian path		
	P3_Parking of vehicles block the pedestrian paths		
	P4_Pedestrian paths are not well connected to Sub-way Facility		
	P5_The Central Business District needs re-development.		
Cleanliness (C)	C1_The surface of the pedestrian path is not slippery.	Likert Scale	To understand respondents' attitude on how cleanliness may affect walkability.
	C2_ The slope of the pedestrian path is quite gentle.		
	C3_ Pedestrian path is clean from trash		
	C4_The surface of the pedestrian path is overgrown with shrubs.		
	C5_Odorless environment		

Source: author

25 street vendors between December to February 2021 were subjected to convenience sampling between the hours of 8:00 to 9:00 a.m. and 6:00 to 7:00 p.m.

Table 3: Main Themes of Survey Questions Towards Street Vendor Survey

Criteria		Response	Description and Role
Hawking Experience	Would you prefer a designated space for hawking?	Likert Scale	To understand hawkers' attitude towards pedestrianisation
	What is your opinion of pedestrianisation?		

Source: Author

Statistical Analysis

The authors used Statistical Package for Social Scientists (SPSS) series 24 and Microsoft Excel tools to analyse data. The A numerical coding of the qualitative

responses was done for analysis and storage. Data analysis involved simple descriptive statistics such as frequency counts and percentages to summarize the data and inferential statistics such as Correlation and Regression Analysis.

RESULTS AND DISCUSSION

Validity Test

There are fifteen questions in the questionnaire, each of which represents three factors. The question item is deemed legitimate if the value of rcount > rtable, and vice versa. Given that n = 96 has a 5% significance level, the value of rtable is known to be 0.205.

Table 4: Test of the Validity of Accessibility Instrument (A), Pedestrian Condition (PC) and Cleanliness (C) instruments.

		A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	C1	C2	C3	C4	C5
A1	Pearson Correlation	1	.457**	.485**	.420**	.382**	.921**	.464**	.498**	.408**	.484**	.537**	.260*	.270**	.478**	.538**
A2	Pearson Correlation	.457**	1	.684**	.573**	.383**	.533**	.994**	.693**	.498**	.840**	.542**	.628**	.398**	.712**	.652**
A3	Pearson Correlation	.485**	.684**	1	.610**	.419**	.562**	.673**	.993**	.532**	.728**	.667**	.546**	.471**	.693**	.711**
A4	Pearson Correlation	.420**	.573**	.610**	1	.464**	.488**	.575**	.619**	.920**	.637**	.643**	.635**	.539**	.785**	.558**
A5	Pearson Correlation	.382**	.383**	.419**	.464**	1	.465**	.392**	.433**	.417**	.433**	.536**	.507**	.601**	.538**	.461**

Source: Author

Table 4 shows that the Pearson Correlation value for each question item in Accessibility (A), Pedestrian Condition (PC) and Cleanliness (C) variable instruments is greater than rtable=0.205. The overall significance value is less than 0.05. Hence, the question indicator of all accessibility variables has a valid construct.

Performance assessment-Reliability Test

A reliability test was conducted to measure the measuring instruments' consistency level. The results of the variable instrument reliability testing are presented in **Table 5**.

Table 5: Instrumental Reliability Test for Variables

Variable	No of items	Cronbach Alpha	Reliable Limit	Information	KMO test	Significant level	Percentage of Variance Explained
Accessibility (A)	5	0.825	0.6	Acceptable level of Reliability	0.829	0.000	59.4%
Pedestrian Conditions (PC)	5	0.883	0.6	Acceptable level of Reliability	0.845	0.000	68.7%
Cleanliness (C)	5	0.886	0.6	Acceptable Internal Consistency	0.846	0.000	68.8%

Source: author

The reliability test using Cronbach's Alpha for all variables is well above the acceptable level of 0.6. The results of KMO test for all variables are well beyond 0.5 and are deemed acceptable. All results from Bartlett's Test of Sphericity are significant, indicating the data's suitability for factor analysis.

FINDINGS AND ANALYSIS

Pilot study-Ashoka Road

The current streetscape is a thin section of 2183 m that ranges in width from 12 to 15 m (Figure 12). Buildings are arranged closely without any side setbacks. The proposed Toolkit in **Table 6** for guiding the decision-making process was applied to Ashoka Street as a pilot project. Summing the weights, the assessment of the street is more than 76 points; hence the decision is to turn the street into a pedestrian-oriented street.

Table 6: The Proposed Toolkit for Guiding the Decision-Making Process for Ashoka Road (indicated by ✓)

Criteria	Sub-Criteria	Number of points per item		
		6	4	2
Street Characteristics	Location	✓Historic Centre	City Centre	Beyond City Limits
	Width	≤10 m	✓Between 10 m and 15 m	≥15m
	Street Length	≤1.5 km	✓Between 1.5km & 3km	≥3 km
Traffic	Street scale	✓Friendly	Human	Unfriendly
	Accessibility	High	Average	✓Low
	Functional Continuity	Good	Acceptable	✓Low
	Vehicle Intensity	✓High	Average	Low
	Pedestrian Intensity	✓High	Average	Low
	Parking	✓Within 800m	≥800m	≥1500m

Criteria	Sub-Criteria	Number of points per item		
	Access	✓Hard	Average	Easy
	Car-pedestrian relationship	✓Conflicted	Balanced	No conflict
	Car absorption in parallel streets	✓Low	Average	High
Commercial structure	Type of shop	✓Suitable for pedestrian streets	Some pedestrian needs	Fewer than 4 activities
	Diversity of activities	✓High (≥10)	Between 4 and 10	< 4 activities
Environmental factors	Street orientation	Favourable Wind	✓Average	Bad
	Street shading	✓ Not available	Can be solved	Can be solved
	Ventilation	✓Bad	Average	Good
Community participation	Hawker's opinion on pedestrianisation Pedestrian Satisfaction	An approval rate of 60-100% ✓36% ≤ X < 52%	An approval rate of 50-59% 52% ≤ X < 68%	Less than a 50% approval rate 68% ≤ X < 84%
Total points of street		**90 points**		

Source: compiled by author

Analysis of Pedestrian Comfort Level on Asoka Road

The overall comfort level of the pedestrian path is obtained as follows (Hidayat et al., 2020):

Percentage of pedestrian comfort level =

$$\frac{Total\ Score\ of\ Respondents\ \times 100\%}{Total\ Maximum\ score}$$

$$= 51.8\%$$

Overall, 51.8% respondents agree that the pedestrian path on Ashoka Street is uncomfortable, as can be seen in the **Table 1**.

RESULTS AND DISCUSSION

Table 7 Presents a summary of the social demographic of the study respondents. Most of the respondents were female, with 49% and 47% male. Most of those interviewed were between the age of 15 and 24 years.

Table 7: Social Demographics

Gender	Frequency	Percentage
Female	47	49.0
Male	45	46.9
Prefer not to say	4	4.2
Total	**96**	**100.0**

Age Group	Frequency	Percentage
>55	7	7.3
15 - 24	48	50.0
25 - 34	28	29.2
35 - 44	9	9.4
45-54	4	4.2
Total	**96**	**100.0**

Education	Frequency	Percentage
Pre-University College	13	13.5
Primary	4	4.2
Secondary	2	2.1
University	77	80.2
Total	**96**	**100.0**

Source: compiled by author

Accessibility

38.5% respondents felt that Pedestrian paths couldn't be accessed by all pedestrians (A1) while 39.6% disagreed that paths were in good condition (A2).

Table 8: Frequency Counts for A1and A2

A1	Frequency	Percent
1	13	13.5
2	37	38.5
3	36	37.5
4	6	6.3
5	4	4.2
Total	**96**	**100.0**

A2	Frequency	Percent
1	9	9.4
2	38	39.6
3	34	35.4
4	12	12.5
5	3	3.1
Total	**96**	**100.0**

Source: Compiled by Author

Cleanliness

43.8% of respondents said that there was rubbish on the pedestrian pathways. (C3) while 40.6% respondents disagreed with the path being overgrown with shrubs (C4). Accessibility has been negatively impacted as demonstrated in **Figure 5**(a).

Table 9: Frequency Counts for C4 and C3

C4	Frequency	Percent
1	6	6.3
2	39	40.6
3	38	39.6
4	9	9.4
5	4	4.2
Total	**96**	**100.0**

C3	Frequency	Percent
1	6	6.3
2	42	43.8
3	36	37.5
4	9	9.4
5	3	3.1
Total	**96**	**100.0**

Source: Compiled by Author

Regression Analysis

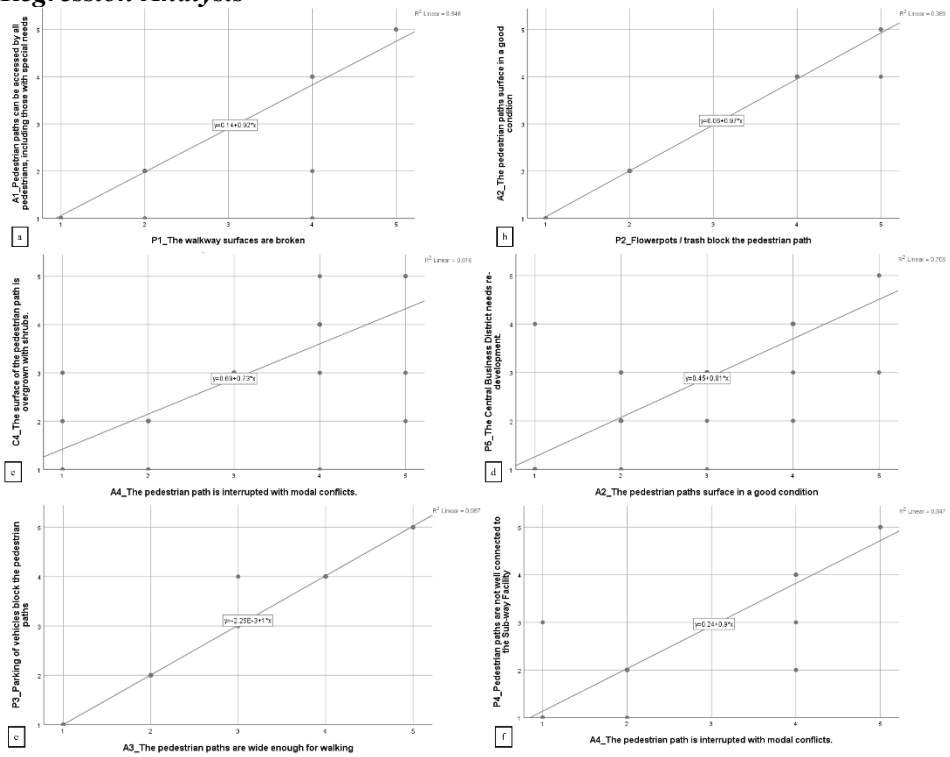

Figure 5: A High Correlation Exists Between (a)P1-A1, (b)P2-A2, (c) C4-A4, (d) P5-A2, (e) P3-A3 and (f)P4-A4.
Source: compiled by author

The regression analysis in **Figure 5** yields a relatively high R-squared of 0.6 and above, indicating that the independent variable (Accessibility) and dependent variables (Pedestrian Conditions and Cleanliness) confirm their strong influence on each other. This means that:

a) The Accessibility of Ashoka Street correlates positively to the paving surfaces of the pathways (R^2 =0.848) given by the equation y=0.14+0.92*x.
b) The Pedestrian path surface condition was highly influenced by the placement of obstructions/trash cans (R^2 =0.989) given by the equation y=0.06+0.97*x.
c) The Pedestrian path surface overgrown with shrubs positively correlates positively to modal conflicts (R^2 =0.616) given by the equation y=0.69+0.73*x.
d) The Pedestrian path surfaces correlates positively to the development of the Central Business District (R^2 =0.705) given by the equation y=0.45+0.81*x.

e) The pedestrian surface walkway width was influenced by the on-street parking (R^2 =0.987) having a negative correlation given by y=-2.5E-3+1*x.
f) The lack of Subway connectivity has a positive correlation to the modal conflict on the pathway (R^2 =0.847), given by the equation y=0.24+0.9*x.

CONCLUSIONS

Based on a study of 96 respondents' data, Ashoka Street had a 51.8% total level of discomfort. This is corroborated by the absence of numerous metrics, including the degree of accessibility and circulation, the surface's state, the degree of cleanliness, and the degree of obstructions to pedestrian paths. The study concludes that restoring the pavement's functionality is essential to raising people's comfort levels.

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