Towards a Walkable City: Evaluating the Design and the Physical Conditions of Urban Sidewalks in Nablus City Using GIS*

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***Abstract*— Walking is a primary means of transportation in developing countries, but poor pedestrian infrastructure poses a barrier to achieving urban sustainability. This research aims to assess the condition of sidewalks in Nablus through a field study of 1,418 randomly selected street segments analyzed using Geographic Information Systems (GIS). The analysis addressed four main aspects of sidewalks: (1) sidewalk availability; (2) sidewalk width; (3) sidewalk surface quality; and (4) obstacles that limit their use. The results showed that 46% of the segments lack sidewalks at all, and that the vast majority of existing sidewalks are no more than 2 meters wide. It also revealed that 80% of surfaces are of average quality, and that 34% of the segments suffer from both permanent and temporary obstructions. These results reveal fundamental gaps that limit pedestrian safety and accessibility. The study recommends combining high-cost physical interventions to widen and improve sidewalks with low-cost legal and regulatory measures to remove obstacles and control violations, thus contributing to enhancing walkability and achieving more sustainable cities.**

I. Introduction

Walking is a primary means of transportation in cities, especially in developing countries where a large portion of the population relies on it daily due to the limited availability and high cost of alternative transportation [1]. The literature has shown that walking is a pivotal element in promoting public health and sustainable mobility [2]. However, this high dependence is often not matched by a suitable urban environment. Many cities in developing countries suffer from weak pedestrian infrastructure, particularly absent or poor-quality sidewalks, which negatively impacts the safety and comfort of their users [3, 4, 1].

Conversely, other studies indicate that providing a suitable walking environment through connected and safe sidewalks, proximity to services, and diverse land uses directly contributes to increasing walking rates and achieving broader health, social, and economic benefits [5]. This view is supported by the results of studies conducted in developing cities such as Tehran, which showed that improving sidewalk design and integrating elements of the built environment can enhance the adoption of walking as a primary urban choice [6]. Official health reports have also emphasized that providing pedestrian-friendly infrastructure, such as safe walkways and facades, not only encourages physical activity but also contributes to improving quality of life and reducing environmental pollution resulting from reliance on vehicles [7]. Together, this evidence highlights that improving the walking environment is a key input for developing public health policies and sustainable urban planning in developing countries.

Sidewalks are one of the most essential elements in any walkability assessment, as they constitute the infrastructure that enables individuals to move safely and comfortably away from vehicle traffic. The literature indicates that most walkability indices include the condition, width, and quality of sidewalks as a key criterion in their assessment [8]. The quality of sidewalks, in terms of width, network integrity, and continuity, is directly related to pedestrians' ability to use urban space, as confirmed by studies that have addressed the development of walking indicators in urban environments [9].

Applied research in various cities, like Jalandhar City in India, has shown that poor or absent sidewalks are among the most significant obstacles to promoting walking as a sustainable mode of transportation [10]. Furthermore, national plans to promote physical activity have highlighted that sidewalks are not merely supportive infrastructure, but rather a prerequisite for increasing walking rates at the community level and promoting public health [11]. In developing urban contexts, field studies have shown that sidewalks are the most influential component in the equation of comfort and safety for pedestrians, as their absence or poor quality reduces urban sustainability and increases reliance on polluting and expensive modes of transportation [12].

Based on the above research, this study aims to contribute to the literature on developing countries in general, and Palestine in particular, by highlighting the importance of sidewalks in enhancing walkability, analyzing their condition as a fundamental step toward understanding the urban challenges facing pedestrians, and offering scientific solutions that can support sustainable urban planning.

II. Methodology

Based on previous studies on walkability and the importance of pedestrian-supportive infrastructure, a suitable methodology was designed to collect field data and analyze the condition of sidewalks in Nablus City. This methodology aims to provide an accurate scientific database on: (1) the availability of sidewalks, (2) their physical characteristics, (3) their functional condition, and (4) the barriers that limit their use. This will contribute to assessing their suitability for pedestrians and providing actionable scientific recommendations.

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A. Sample Design and Preparation

A random sample of 1,418 street segments was selected from the Nablus Road network as shown in Figure 1 below. A "segment" was defined as the portion of the street between two consecutive intersections. This definition allows for an objective measurement of the even distribution of sidewalk characteristics across the road network.

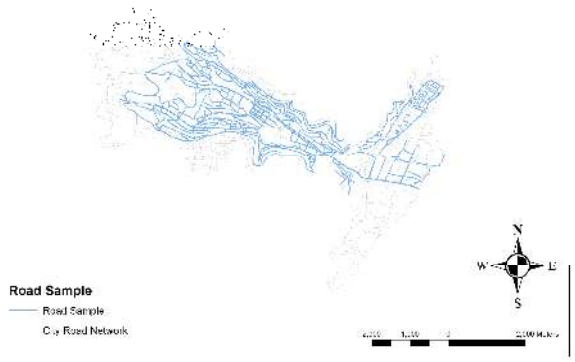

Figure 1. Sample road segments

All road segments were entered into a Geographic Information Systems (GIS) program, with each segment assigned a unique identification number. This facilitated the linking of field data to spatial maps and subsequently enabled the geographic analysis of the results, revealing spatial patterns of obstacles and sidewalk quality.

B. Field Data Collection

A special field data collection tool was designed to collect data by walking along the selected sample road segments and directly observing the sidewalk characteristics. This tool relied on field observation and systematic documentation to ensure comprehensiveness and accuracy of the data. The collected data included the following variables:

- Sidewalk Availability and Coverage Percentage: The availability of sidewalks on each road segment was recorded. In addition, the degree of coverage for each segment was quantitatively documented (full, partial, or no coverage), allowing for an understanding of continuity gaps in the sidewalk network.
- Sidewalk Width: Sidewalk width was measured using simple measuring tools (a standard meter) and classified into three categories: less than 1 meter, from 1 to 2 meters, and greater than 2 meters. This indicator reflects the sidewalk's capacity to accommodate different numbers of pedestrians or special groups, such as people with disabilities.
- Pavement Surface Condition: The quality of the surface material was assessed based on direct observations and pre-determined criteria:
  - Very Good: A flat, uniform surface free of defects and potholes.
  - Moderate: The presence of potholes, cracks, or depressions that make walking less comfortable but do not prevent use.
  - Poor: A large number of potholes, depressions, and swellings that make walking difficult and limit pedestrian safety.
- Sidewalk Obstacles: Two types of pedestrian obstructions have been documented:
  - Permanent Obstacles: These include fixed elements that require structural investment for removal or redesign, such as utility poles and trees planted within the sidewalk path.
  - Temporary Obstacles: These include practices and behaviors that can be addressed administratively or legally, such as vehicles parking on sidewalks, placing garbage containers, displaying merchandise by vendors, and construction work that obstructs walkways.

TABLE I. SUMMARY OF FIELD VARIABLES, THEIR MEASUREMENT MECHANISM, AND THEIR IMPORTANCE IN ASSESSING WALKABILITY.

Variable	Measurement method	Research importance
Sidewalks availability	Direct measurement: (Ful Coverage /Partial Coverage/None)	Reflects the level of basic pedestrian accessibility and reveals infrastructure gaps.
Coverage	Descriptive classification (complete/partial/non-existent)	Demonstrates the continuity of the sidewalk network and is linked to safety and ease of movement.
Sidewalk width	Field measurement in meters and classification (less than 1 m, 1-2 m, more than 2 m)	Determines the capacity of the sidewalk to accommodate pedestrians and special groups such as people with disabilities.
Pavement surface condition	Qualitative Rating: Very Good / Average / Poor	An indicator of comfort, safety while walking and the need for maintenance.
Permanent obstacles	The presence of electricity poles/trees within the sidewalks	Reveals structural constraints that require long-term engineering interventions.
Temporary obstacles	Monitoring parking of vehicles/garbage containers/merchandise/construction works	Behavioral or administrative obstacles that can be addressed through legislation and oversight.

This comprehensive field framework enabled the collection of comprehensive quantitative and qualitative data, which contributed to building an accurate picture of the reality of sidewalks in Nablus and their suitability for pedestrian needs.

III. RESULTS AND DISCUSSION

Analyzing the status of sidewalks in Nablus City constitutes an essential entry point for understanding the dimensions of walkability in developing urban environments. The analysis is divided into four main interconnected themes: (1) sidewalk availability, (2) sidewalk width, (3) surface quality, and (4) obstacles affecting their function. Addressing these aspects of sidewalks helps highlight the structural and organizational imbalances that limit the efficiency of pedestrian infrastructure. It also provides a scientific basis for guiding urban planning toward enhancing equity in access and ensuring sustainable mobility. The results are presented sequentially, starting with the availability of sidewalks as the foundation of any walking experience, then progressing to examining their width and surface quality, and finally identifying obstacles that pose direct challenges to their safe and effective use.

A. Analysis of sidewalk availability in the research sample

The results indicate that more than half of the sections (54%) contain sidewalks to varying degrees, but only one-fifth of the sections display complete continuity, as the diagram in Figure 2 and 3 shows. In contrast, nearly half of the street network lacks sidewalks at all, reflecting a significant structural gap.

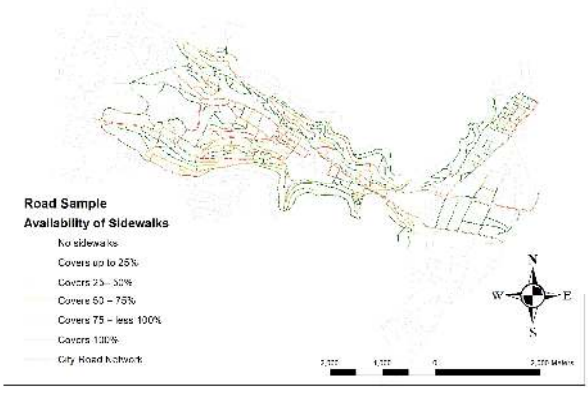

Figure 2. Spatial distribution of sidewalk coverage

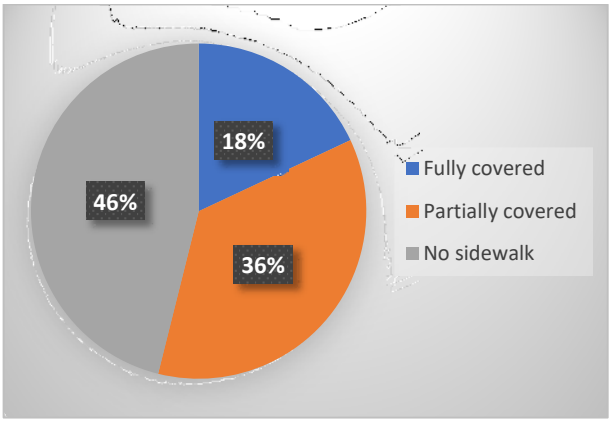

Figure 3. Percentages of sidewalk coverage

The absence of sidewalks in nearly half of the sections poses a direct threat to pedestrian safety. It also reflects shortcomings in urban planning that have not prioritized walking as a primary means of transportation. Partial coverage also reveals the problem of "discontinuity", as pedestrians are forced to step into the street, increasing risk levels and weakening the appeal of walking. The 18% coverage rate is very low compared to international standards for sustainable urban cities and indicates an urgent need for targeted policies to bridge gaps in the network.

B. Analysis of Sidewalk Width

It is clear that the vast majority (96%) of sidewalks do not exceed 2 meters in width, while approximately one-third do not exceed 1 meter, a level that does not allow two people to pass easily across each other.

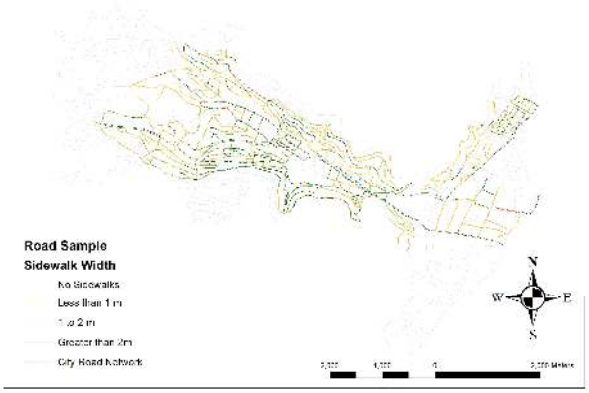

Figure 4. Spaial distribution of sidewalk width variation

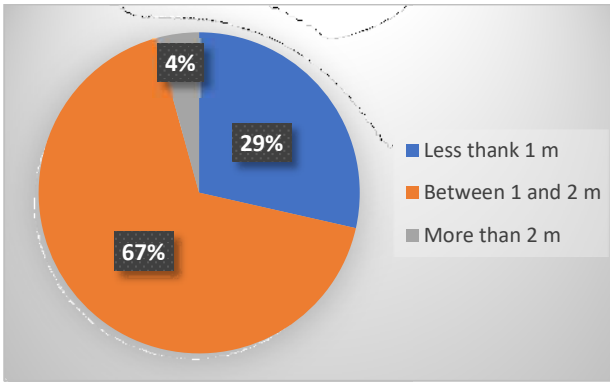

Figure 5. Sidewalk width results

The limited width reduces the capacity of sidewalks and hinders comfortable use by pedestrians, especially those with disabilities or those using strollers. Sidewalks less than 1-meter-wide result in one-way movement, forcing pedestrians to engage in competitive behavior that may lead to collisions. It may also lead them to step onto the road, exposing them to the risk of accidents with vehicles. Even sidewalks with widths between 1 and 2 meters, which constitute the vast majority of available sidewalks, may be insufficient in commercial areas or in front of schools and markets where demand is high. The small percentage (4%) that exceed 2 meters is considered insufficient to achieve acceptable service levels at the city level.

C. Pavement surface condition analysis

The majority of the sidewalks fall into the moderate category with 80% of surveyed sample, which means that they are usable but susceptible to rapid deterioration. The percentage of very poor-quality sidewalks (13%) poses a real risk to pedestrian safety.

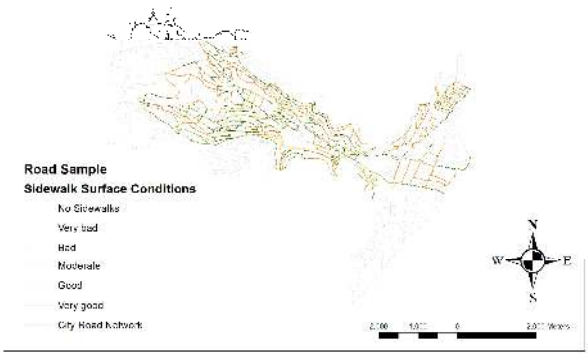

Figure 6. Spatial distribution of sidewalk surface conditions

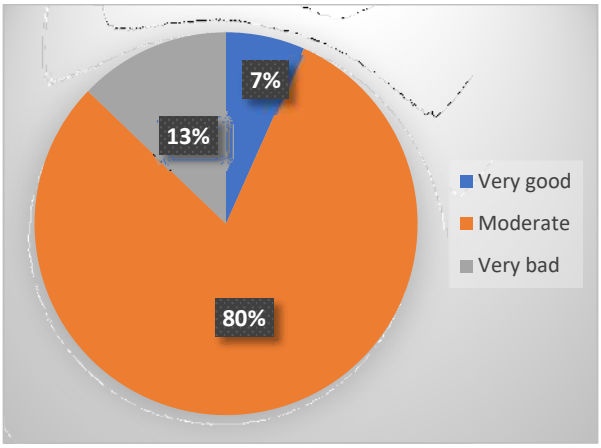

Figure 7. Sidewalk surface conditions

Surface condition directly impacts comfort and safety. Average-quality sidewalks often have cracks or minor subsidence, and over time and with lack of maintenance, they can deteriorate into very poor condition, doubling subsequent rehabilitation costs. The 13% of sections in deteriorated condition means that there are sections that represent critical "danger points," especially for vulnerable pedestrians such as people with disabilities, the elderly, children, and mothers with children. The very low percentage of good surfaces (7%) reflects the absence of regular preventative maintenance programs, as sidewalks are often treated after they have completely deteriorated.

D. Analysis of Sidewalk Obstacles

The results show that approximately four-fifths (79%) of the sections suffer from varying degrees of obstruction, and that only one-fifth of the network are obstruction-free.

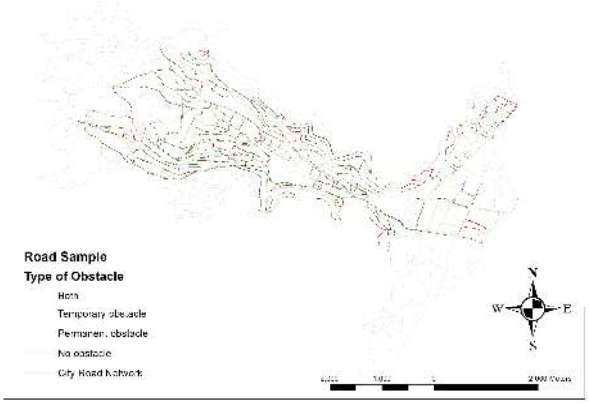

Figure 8. Spatial distribution of obstacle types

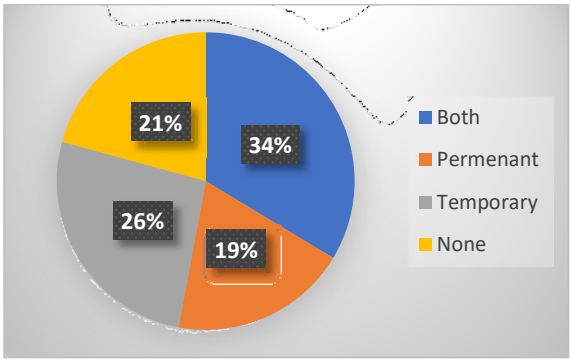

Figure 9. Obstacles categories

Permanent obstructions, such as poles and trees planted within sidewalks, reflect a lack of institutional coordination during street design and implementation. Temporary obstructions, such as parked vehicles, goods, and containers, reflect weak oversight and law enforcement. The presence of a mix of permanent and temporary obstructions in approximately one-third of the sections represents the most serious situation, as the sidewalk loses its functionality entirely. The results confirm that the usability of a sidewalk depends not only on its presence or width, but also on being obstacle-free to facilitate pedestrian movement and encourage more walking.

IV. Conclusion and Recommendations

The four analyses reveal that the walking environment in Nablus suffers from interconnected structural and functional deficiencies. In terms of coverage, nearly half of the sections lack sidewalks, while full coverage does not exceed 18%. In terms of width, 96% of sidewalks are less than 2 meters, restricting comfortable movement and impairing service. Regarding surface condition, 80% of sidewalks are in moderate condition and vulnerable to deterioration, while 13% are in very poor condition and pose danger points. Finally, approximately 79% of the sections suffer from obstructions, whether permanent or temporary, that limit their function. Together, these results reflect an urban environment that is unsupportive of walking and point to two main gaps: a continuity gap linked to the absence or interruption of sidewalks, and a functional gap linked to the poor quality and obstruction of sidewalks. its lack of obstructions that restrict pedestrian movement.

Based on the findings, the following recommendations can be formulated for the municipality, decision-makers, and the community:

1. At the planning level:

o Integrate sidewalk standards (full coverage, adequate width, and surface quality) into all new road projects.

o Develop a comprehensive urban walkability plan, prioritizing options based on population density and proximity to schools, markets, and health facilities.

2. At the engineering and technical level:

o Raise sidewalks less than 1 meter wide to the minimum acceptable level (1.8 meters on residential streets and 2.5 meters on commercial streets).

o Implement a periodic preventative maintenance program to ensure that average-quality sidewalks remain in good condition, while addressing critical areas with deteriorating surfaces.

3. At the administrative and legal level:

o Implement effective monitoring and preventive fines for temporary violations such as parking, displaying merchandise, and storing containers.

o Establish a coordination system between the municipality and service providers (electricity, telecommunications, and water) to avoid placing poles or equipment in pedestrian paths.

4. *At the community level:*

o Citizen awareness campaigns to promote a culture of respecting sidewalks as a public space designated for pedestrians.

o Engaging civil society and the private sector in maintaining model pedestrian crossings to enhance public confidence and encourage positive behavior.

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