Abstract

Purpose – What makes neighbourhood environment more walkable is an important question for urban planning and design research. The purpose of this paper is to explore this question through a case study of urban sidewalks in different contexts of urban neighbourhoods in Rajshahi city of Bangladesh.

Design/methodology/approach – Using participatory observation, Google street view and photography techniques, it examines the quality of the street facilities by demonstrating physical attributes of sidewalks and by analysing how various obstructions on them characterize neighbourhood walkability environment.

Findings – The findings suggest that the unusable sidewalks in Rajshahi city, Bangladesh, are a production of inadequate and inappropriate planning and design that unable to capitalize the functionality of sidewalks as a means of walking. It further argues that the urban planners and designers of streets have paid little attention to the diverse requirements of sidewalks in accordance with spatial and socio-economic categories of urban neighbourhoods.

Originality/value – This study adds insights about the urban sidewalks planning and design in the context of a developing country. It provides an empirical evidence about the constraints and potentials of making a walkable city.

Keywords Physical activity, Walking, Urban planning and design, Neighbourhood walkability, Urban sidewalks

Paper type Research paper

1. Introduction

Neighbourhood environment has increasingly been recognized as an important determinant of sustainable built environment that are related with human health and wellbeing. A well-designed walkable neighbourhood, for instance, may promote physical activity through walking and social connectedness (Ruby et al., 2017; Lee and Talen, 2014; Rana and Xiaolu, 2012). An ideal walkable neighbourhood requires accessible, safe and comfortable pedestrian infrastructure, street network connectivity, safety from traffic and crime and aesthetical beauty of the street environment (Brookfield, 2017; Samarasekara et al., 2011; Alfonso, 2005). Numerous urban planning and human health researchers have claimed that safe, accessible and aesthetic infrastructure of sidewalks encourage the pedestrians to walk, which increase the level of physical activity (Cerin et al., 2006; Landis et al., 2001) that can also result in reducing mental stress and anxiety (Fathi et al., 2020).
Accordingly, it is very important to understand the relationships among built environment, walkability and human health (Humberto et al., 2019; Chiang, 2017; Creatore et al., 2016; Chaix et al., 2013; Leslie et al., 2007). Notably, knowledge on walkable neighbourhood is an essential element of sustainable urban development. For several years, urban planners and human health researchers have been paying significant attention to the important of people focussed street design for making a walkable city (Adkins et al., 2012; Hirsch et al., 2014; Adams et al., 2012; Lo, 2009). For instance, Adkins et al. (2012) note that “quality walking environments are one of several broad factors influencing walking behaviour, along with demographic characteristics, attitudes and the presence of desirable destinations”. Similarly, Hirsch et al. (2014) claim that increases in the number of walking destinations and street connectivity are associated with greater increases in walking for transportation. There is evidence that “physical activity is shaped by neighbourhood-built environment features” (Adams et al., 2012, p.757). But unfortunately, the recommendations in this regard stemming from urban planning and human health researches are hardly adapted to the desires of the people; and in many cases, they are inappropriately implemented (Foltete and Piombini, 2007). For example, several studies report that planning and designs for sidewalks are not executed properly and laws are difficult to enforce (Morshed, 2019; Leather et al., 2011). As a consequence, many cities in the developing countries, such as Bangladesh, do not enjoy the benefits of walking because of poor sidewalks design, insufficient/inappropriate constructions and illegal invasion by the people (Wicramasinghe and Dissanayake, 2017).

There is evidence that sidewalks or footpaths in the big cities of Bangladesh are not walkable for illegal occupation by floating shops, traders and vehicles (Haque, 2020; Islam, 2019; Wadud, 2018). Ratna (2012) explores the hawkers’ struggle for livelihoods and functionality of Dhaka city. As she notes, the hawkers occupy footpaths and creates problems for pedestrians to travel and hinders the flow of vehicular traffic by creating congestion. Almost similarly, Rahman and Hoque (2018) also claim that illegal occupancy of roads and footpaths is one of the major causes of traffic congestion in Dhaka. To solve this problem, Rahman and Rashid (2020) propose a street design that accepts and accommodates the existence of footpath hawkers in the city. Rahaman et al. (2005) also argue that the transportation planners in Bangladesh emphasize on the problems of motorized vehicles, but ignore the importance of footpath management for pedestrians, such as accident (Rahman et al., 2006). However, these studies particularly help to understand the footpaths as a public space, albeit a less attention is paid to explore how and why walkability is important and not equally and sufficiently constructed across neighbourhoods.

Drawing upon the importance of walking and its relationship with built environment, this study explores the barriers and functionality of urban sidewalks with an aim to evaluate neighbourhood walkability. Based on a case study of urban streets in Rajshahi city, it investigates the structural and functional inequalities of physical attributes of sidewalks among three urban neighbourhoods that characterize walkability environment of the city. The road network in the city is basically constructed based on a Master Plan entitled “Rajshahi Metropolitan Development Plan (2015–2024)”, which encompasses an area of 364 square kilometres (The Daily Star, 2015). Rajshahi Development Authority (RDA) is the sole authority to prepare and implement Master Plan for the city. Nonetheless, Rajshahi City Corporation (RCC), a local government institution, has recently constructed several sidewalks with major streets in the city. However, the study argues that the poor walkability environment is a production of inadequate and inappropriate urban planning and design that unable to capitalize the usefulness of urban sidewalks as a means of transport walking, leisure walking and outdoor physical activity. In addition, the urban planners and designers
have paid little attention to the diverse requirements of sidewalks in accordance with spatial, functional and socio-economic differences of urban neighbourhoods.

Based on a review of literature that crosses the field of urban planning and human health, Section 2 presents the concept of walkability and walkable neighbourhood environment. Section 3 describes the method of collecting and computing the data for this study. Section 4 provides a discussion on implications of the findings and suggests the potential measures of making a walkable city. The paper concludes with an assessment of the existing urban planning initiatives and opportunities in Rajshahi city, Bangladesh, with an aim to promote importance of a walkable city.

2. Walkability and walkable neighbourhood environment

Before the automobile era, walkability was inevitable to the city dwellers. With the advance of transport technology, as Southworth (2005, p. 247) claimed, “the walkable city came to an end in the 1920s with the appearance of the automobile, coupled with the emergence of modernism”. The option of walking with the streets was ignored to favour the option of automobile. Nonetheless, recently, the concept of walkability has quickly been included in the lexicon of urban planning and design research with an enormous interest. As Talen and Koschinsky (2013) state, the past decade has witnessed a surge of interest in the walkable neighbourhood. Notably, there is a growing body of walkability studies in relation to urban built environment and human health that can be used to plan and design an inclusive and sustainable neighbourhood environment. The following reviews in this regard structure the discussion under two themes: walking and walkable neighbourhood environment.

2.1 Walking

Walking is among the most common, popular and sustainable mode of transport and physical activity that provides social, environmental, economic and health benefits (Gonzalez-Urango et al., 2020; Farkas et al., 2019; Dai et al., 2015; Saelens and Handy, 2008; Pikora et al., 2003). This is very popular because it requires minimal equipment, no special ability and skill and also incurs a minimum cost (Farkas et al., 2019; Chudyk et al., 2017). Southworth (2005, p.248) claims that “walking is the most accessible and affordable way to get exercise”. Basically, walking has twofold importance: as a mode of transport and as a mode of physical activities including exercise and recreations. For many, this is a valid mode of transport to reach a destination (Smith et al., 2017; Southworth, 2005). In the context of Canada, Farkas et al. (2019) argue that improving neighbourhood walkability may support higher levels of transportation walking and contribute to better health outcomes. Behrens (2005) states that “more than any other mode in South African cities[...], for many young and elderly members of poorer households, it (walking) is the only available mode of travel”.

Walking is also considered as a mode of physical activity for exercise and recreations – a leisure time activity to get mental refreshment from nature, particularly for the older adults and children (Lu et al., 2018; McCormack and Shiell, 2011). Masoumi (2017) explores the associations between walkability environment and childhood’s physical activity and finds that physical inactivity is one of the main drivers of childhood obesity. Similarly, McGrath et al. (2016) in the context of New Zealand captures that designing walkable infrastructure, attractive streets and green space to promote safe pedestrian roaming may increase children’s physical activity. Therefore, walking can be done for transportation, including shopping or going to work; and for leisure-time recreation and physical exercise (Saelens et al., 2003).
Numerous researches also shed light on the impacts of built environment on physical activity of people with different spatial and socioeconomic conditions (Lu et al., 2017; Adkins et al., 2017). For example, Lu et al. (2017) identify the association between objectively measure 3D's (density, diversity and design) and different domains of walking (transport vs leisure). Koohsari et al. (2017) examine the relations between environmental attributes and walking behaviours among the adults with different socioeconomic status in Japan. They found that walking for exercise was related with higher population density, higher street density and shorter distance to the nearest commercial destination in only high socioeconomic status. Sugiyama et al. (2015) report a similar finding while low socioeconomic status areas with disadvantaged perceived environmental attributes in Australia are also associated with recreational walking.

Many other studies in the field of public health and urban planning also give special focuses on the characteristics of urban infrastructure and their relationships with physical activity. For example, Suminski et al. (2008) found evidence of relationships between environmental characteristics of the urban sidewalks/streets and walking. Similarly, Ehrenfeucht and Loukaitou-Sideris (2010, p. 460) note that “sidewalks enable people to move from one place to another—thereby facilitating access among properties—and also allow people to come into contact with others—thereby facilitating access to people”. Saelens et al. (2003) propose an ecological model of neighbourhood environment influence on walking and cycling for transportation, or recreation and exercise. They also ask for more collaboration among a wider range of professions in physical activity research in relation to environment for sustainable urban development.

2.2 Walkability and walkable neighbourhood environment

Walkability has been defined as “the extent to which characteristics of the built environment and land use may or may not be conductive to residents in the area walking for either leisure, exercise or recreation, to access services, or to travel to work” (Leslie et al., 2007). Almost similarly, Southworth (2005, p. 248) defined walkability as “the extent to which the built environment supports and encourages walking by providing for pedestrian comfort and safety, connecting people with varied destinations within a reasonable amount of time and effort and offering visual interest in journeys throughout the network”.

A walkable neighbourhood also denotes a safe and well-serviced neighbourhood which is imbued with qualities and makes walking a positive experience (Speck, 2012). In the same line, Southworth (2005, p. 248) also notes that “a highly walkable environment invites walking by means of a richly connected path network that provides access to the everyday places people want to go. It is safe and comfortable, with streets that are easy to cross for people of varied ages and degrees of mobility”. However, this study focuses on the sidewalk infrastructure and facilities and argues that a better condition of the physical attributes of streets and sidewalks may make a neighbourhood more walkable.

Notably, various studies have used different measures, variables, factors or criteria to assess and audit walkability environment (Clifton et al., 2007; Craig et al., 2002; Srinivasan, 2002; Pikora et al., 2002; Ewing, 1999), but yet to reach an overall agreement on what is appropriate (Talen, 2002) and what should be prioritize (Zavestoski and Agyeman, 2014). For example, transport scholars, urban planners and public health researchers have increasingly recognized the relationships between built environment and socioeconomic and psychological factors that motivates walking behaviour of the people (Battista and Manaugh, 2018; Van Acker et al., 2010). Numerous urban walkability studies emphasize on the physical and environmental attributes of streets and sidewalks to determine the challenges and potential solutions (Brookfield, 2017). For example, Landis et al. (2001)
focuses on the width of sidewalk for determining the level of safety and comfortability during walking. Cerin et al. (2006) state that a well-maintained and obstruction-free sidewalk is crucial for providing a safe walking environment. Bumps and cracks/holes in the sidewalks generally cause significant barriers to walking (Alta Planning and Design for California Department of Transportation, 2005). Sidewalk obstructions can also include out-of-place poles or signs, parked cars, shops/stalls, trees and garbage (Clifton et al., 2007). Streetway and sidewalk construction can also disturb pedestrian flow and create hazards (Donaldson, 1998). Construction zones can pose safety issues for pedestrians by blocking the sidewalk with heavy machinery and materials and creating alternative routes that are less accommodating for pedestrians (RPM Transportation Consultants, 2003).

Scholars also recommend specific solutions for enhancing walkability environment by improving physical and environmental attributes of the streets and sidewalks. For instance, curbs provide a physical separation between motor vehicles and pedestrians to discourage vehicles from parking on the sidewalks and minimize threat to pedestrians (Landis et al., 2001). NSKC (2004) states that properly designed driveway cuts in a street are necessary to avoid obstructions and accidents to pedestrians. Similarly, traffic calming features also add benefit of making street-crossing safer and easier (Stangl, 2011; Ewing, 2001). Several studies add that cleanliness of a street and sidewalks lighting are important factors for assessing walkability (Clifton et al., 2007; Cerin et al., 2006) and to feel comfortable and safe for walking (Kweon et al., 2004). In addition, natural elements such as trees may promote interactions and positive experiences for pedestrians. Because, trees are aesthetically pleasing and can provide a buffer between pedestrian and traffic. To determine urban design quality, Clemente et al. (2005) considers the number of planters on each side of the street as one of the factors for pedestrians. Some emphasizes on the availability of street amenities, such as benches, bicycle parking and street vendors, as a measure for increasing physical activity and pedestrian safety (PEQI, 2008; Clifton et al., 2007; Clemente et al., 2005; Brownson et al., 2003). Walkable Communities Inc. and Local Government Commission Liveable Streets Inc. (2004) recommend public benches every 200 feet along sidewalks, where the sidewalk width is wide enough and business owners are encouraged to place public seating or benches for pedestrian use.

Besides these physical attributes and amenities, various transport planning and policy studies also urge for considering socioeconomic and psychological contexts of neighbourhood environment to assess walkability environment (Battista and Manaugh, 2018; Hirsch et al., 2017; Adkins et al., 2017; Lucas, 2012; Mehta, 2008; Foster and Giles-Corti, 2008). For example, Mehta (2008) points out the importance of social space and its relation with urban design features such as street furniture, landscape elements, articulated facades on the street edge. Battista and Manaugh (2018; p. 54) argue that “walking has featured prominently in social space scholarship since its inception, […], yet it is only recently that social space has been featured in pedestrian planning research”. In addition, Lucas (2012) finds a significant correlation between social exclusion and transport and mobility inequalities with specific reference to the UK and Australia. By reviewing seventeen empirical studies, Adkins et al. (2017) report that the disadvantaged areas are less walkable than the advantaged areas. Similarly, Riggs (2016) demonstrates the racial inequalities in residential walkability in San Francisco Bay Area, USA. As he notes, the blacks are more likely to live in less walkable areas. Studies also underscore the importance of psychological factors to understand the nature of residential choices and travel behaviour (van Acker et al., 2010). After all, residents’ preferences are unavoidable to understand the spatial, socioeconomic and psychological differences among neighbourhoods (Brookfield, 2017).
3. Materials and methods

Google Earth software was used to demarcate the study-loops and to conduct a baseline survey of the sidewalks in Rajshahi city, Bangladesh. Rajshahi is a metropolitan city located in the Western Central region and on the North bank of the River Padma of Bangladesh, near the Bangladesh–India border (Shuaib and Rana, 2020). However, the selected loops for this study are shown in Figure 1. They were selected from three different neighbourhoods, such as commercial areas in the city centre, semi-build up areas and newly developed residential areas. Loop 1 (Commercial Activity-dominant Neighbourhood) is located in the city centre which is characterized by more commercial land uses and less residential settlements. Loop 2 (Traditional Neighbourhood) is located in a growing area of the city where traditional housing areas are mostly visible. This loop also includes a busy transport transit segment to connect the city to the eastern regions including Dhaka, the capital of Bangladesh. Loop 3 (New Residential Neighbourhood) covers a newly developed and prominent residential area of the city (Figure 1). Google street view was completed from June 2018 to August 2018.

Participatory observation was also conducted in the three selected street-loops from June 2018 to January 2019 to supplement and critically cross-check the collected data. Notably, the observation data is still usable to demonstrate the situation because noticeable street development in the city is not reported. However, relevant photographs were also taken during observation to supplement Google view and observational data.

During participatory observation, a modified version of Pedestrian Environmental Quality Index (PEQI, 2008) was adopted to assess the quality of walkable environment by analysing physical attributes of urban sidewalks. The index includes four key aspects of urban sidewalks, which are: street design, vehicle traffic, intersection facilities and perceived safety (Table 1). It was particularly helpful to identify the physical attributes of sidewalks and streets, collect data and make a suitable comparison between them. A checklist was prepared to note down the relevant information such as length and width of sidewalks and streets and calculate thereafter. Only the big roads in the loops were considered for data collection.

Table 1 shows all of the criteria of physical attributes of urban streets and sidewalks were considered during fieldworks for this research. The physical attributes include four domains of indicators: sidewalk facilities, vehicle traffic, intersection facilities and perceived safety.

4. Results

4.1 Sidewalk facilities and walkability environment

Sidewalk facilities have been analysed through the following indicators: presence of sidewalks, width of sidewalks, obstructions on the sidewalks, driveway cuts and curve and seating facilities for pedestrians.

4.1.1 Presence of sidewalks. Sidewalks are available in many streets of Rajshahi city. RCCs, and Roads and Highways Department have recently renovated streets including sidewalks at least one side of them (Figure 2). But there are still many streets in the city need to be renovated with sidewalks facilities. The survey in the selected loops for this study found that about 5.08 kms (61.20%) streets out of total 8.30 kms have sidewalks at least in one side. It was also observed that only 3.30 kms (39.76%) streets have sidewalks in both sides. This indicates that still more than 60% streets of the loops do not have sidewalks in both sides. In addition, 3.22 kms (38.8%) of the streets do not have any sidewalks. Among the loops, loop 1 (commercial area) has more sidewalks than others. About 2.04 kms (92%) of loop 1 have sidewalks in both sides. The worse conditions are present in loop 2 (traditional
Figure 1. Location map of the study area
housing area), where more than half of the streets do not have any sidewalks. Only a small portion of the streets in this loop has sidewalks in one side only. Loop 3 (new residential area) has a better condition than loop 2 in terms of presence of sidewalks. It was found that 45% of the streets in loop 3 have sidewalks in both sides.

4.1.2 Width of sidewalks. Only presence of sidewalks does not sufficiently determine the quality of neighbourhood walkability environment. Width of sidewalks is another criterion to assess the physical quality of sidewalks. It was found that width of all sidewalks is consistent. The average width is 6 feet, but it varies from 3 feet to 14 feet in few places. More than 75% sidewalks of the streets in all loops have a width of less than 8 feet. Despite loop 1 has more sidewalks in length, it has worse condition in terms of width. Approximately 95% 

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<th>Vehicle traffic</th>
<th>Intersection facilities</th>
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<td>Seating facilities</td>
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<td>Curb extensions</td>
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Source: Modified version of Pedestrian Environmental Quality Index (after PEQI, 2008)

Figure 2.
Permanent and temporary obstructions on the sidewalks
of sidewalks in this loop were less than 8 feet in width. Despite loop 2 has a small quantity of sidewalks in length, comparatively a large portion (32%) of this loop are more than 8 feet wide. Almost similar condition was present in loop 3 because only 28% sidewalks were more than 8 feet wide.

4.1.3 Obstructions on the sidewalks. Another important physical attribute of street design is obstructions on the sidewalks. The presence of long and wide sidewalks may not satisfy the requirements for walkability while there are various obstructions on the sidewalks that impede walking and discourage outdoor physical activities. This survey has found two types of obstructions on the sidewalks: permanent and temporary (Figure 2).

Permanent obstructions of walking include trees, electric poles, tubewells and open manholes. On the contrary, temporary obstructions include sidewalk informal shops, garbage-cans, construction materials, parkingLOTS for rent-a-car business, police-box for security and frequent loading and unloading on the sidewalks. As it was observed in the survey, on an average, there are 18 permanent obstructions in one kilometre of the sidewalks. Unfortunately, there were 40 permanent obstructions per kilometres in loop 3. In comparison to this figure, the other loops have a small number of permanent obstructions (approximately 9 obstructions per kilometres), which is below the average. This indicates that the sidewalks in the new residential areas of the city have more permanent obstructions.

This study also found number of temporary obstructions on the sidewalks. These obstructions can be categorized according to the time-duration of their existence on the sidewalks. For example, informal shops on the sidewalks, which is temporary but exist for a long time. Several obstructions are present on the sidewalks for a specific time of a day. For example, parking-LOTS for rent-a-car are available in the day-time, which completely or partially block the sidewalks. In addition, there are several temporary obstructions (loading and unloading on the sidewalks) exist for a small duration, but it completely impedes walkability on the sidewalks. In comparison to loop 2 and loop 3, more temporary obstructions were found in the loop 1. As the loop 1 is located in close proximity to the central business district, people are tended to use the sidewalks for various informal commercial purposes. It was also notable that the commercial segment of the residential area (in loop 3) has also considerable temporary obstructions on the sidewalks. The overall findings indicate that the commercial areas of the city have more temporary obstructions on the sidewalks.

4.1.4 Driveway cuts and curbs on the sidewalks. Driveway cuts are essential segments that help the vehicles to pass through the sidewalks for entering into garage, parking lots and residences. This survey found that there are only 26 driveway cuts (18 in loop 1 and 8 in loop 3) for total 454 households adjacent to the streets in the study areas. This indicates that only 17% and 4.3% households in loop 1 and loop 3 respectively have driveway cuts. In loop 2, there was no driveway cuts. Therefore, approximately 94% households still do not have access through driveway cuts to and from the streets.

Sidewalks are also characterized by existence of curbs. It was observed that almost 85% (7.13 kms) length of sidewalks have curbs that perfectly provide a physical separation between vehicles and pedestrians (Figure 3). But unfortunately, it was also found that curbs in many places are physically damaged and not properly managed. In addition, people are using sidewalks as parking lots avoiding the existence of curbs.

4.1.5 Public seating facilities. Seating facilities during walking is an essential part of street amenities for sustainable walkability environment. Seating facilities such as sidewalk-sheds with benches, cycle stands and vendors may encourage outdoor physical exercises such as leisure walks, particularly for the elderly, disabled and children. But unfortunately,
it was found that there are only three public sheds in 8.30 kms long-sidewalks in the study areas. As can be seen in Figure 4, there are two public sheds with benches in loop 1, and only one in loop 2. Despite loop 3 is located in the residential area and sidewalks are supposed to be more usable, there is no public sheds.

Though the poor facilities of formal public seating facilities on the sidewalks, there are many illegal-informal seating arrangements are present on the sidewalks and even on the streets. As discusses in previous section, many temporary tea-stalls and shops are existing in the study areas that partially or completely occupy the sidewalks providing temporary benches to the customers. Many regular pedestrians also remarked these facilities as useful while there was no formal facility for seating or relaxation during walking. But this informal seating facilities may not be favourable to the female and children pedestrians.

4.2 Vehicle traffic and walkability environment

The vehicle traffic measures also qualify neighbourhood walkability environment. This study investigates number of lanes, number of traffic ways and traffic calming features to measure street quality in terms of walkability. It was assumed that these three features are related with pedestrians’ activities and mobilities, particularly pedestrians’ interests to walk with safety and comfortability. However, it was found that only 1.48 kms streets (17.83%) out of 8.30 kms in the study areas have a width of four-lane. On the contrary, a major portion of the loops (74.45%) has only two-lane width. The rest of the streets (7.71%) are even narrower with a width of less than 8 feet. The downtown or commercial area has comparatively wider streets with four-lane (18% of total) than the traditional and new residential areas (8% of total). In loop 1, approximately 0.72 kms (35%) of the streets have a width equal to four-lane, and the rest of the streets 1.32 kms (65%) were comparatively narrower with two-lane facilities. It was also observed that only 0.64 km (23%) and 0.38 km (11%) of the streets in loop 2 and loop 3, respectively, have a width of four-lane, while rest of the streets are narrower with a width of two-lane or even narrower. Notably, not a single portion of the streets was demarcated according to the standard width (10–12 feet) of lanes.

Number of ways of traffic on the streets is also related with pedestrians’ safety and comfortability which characterize walkability environment. It was found that all of the streets (8.30 kms) of three loops have two-way traffic facilities. There is no one-way traffic system available in the city.

Traffic calming features on the streets are important physical attributes of urban street design and facilities. These features help to control the speed of the vehicles and allow other vehicles and pedestrians to cross the streets that encourage walking and promote pedestrian safety (Clifton et al., 2007). Street traffic calming features include chicanes, speed humps,
street medians, rumble strips and street enforcements. Chicanes and rumble strips are rarely used as a traffic calming measure in Rajshahi city. There was no chicane and rumble strip found in all of the studied loops. It was observed that speed humps and street medians are commonly used to calm the vehicles or to avoid accidents (Figure 5). There are only four speed humps in 8.30 kms long streets and most of them are located in the busiest areas of the loops. Two humps are located in the business areas of the loop 1 while other loops have only one hump each. In addition, the busiest segments of the loops have street-medians. It was found that only 1.41 kms (17%) streets of three loops have street-medians. In loop 1, only 0.65kms (31 %) streets have streets-medians, while loop 2 and loop 3 have 0.43kms (15%) and 0.33kms (10%) respectively.

4.3 Intersection facilities and walkability environment
Intersection traffic calming facilities, including light-signal, ladder crosswalks and zebra marks at crossings, are also significant physical attributes of street quality that affect access and mobility of the pedestrians. It was found that, in total, there are eleven light-signal posts in three intersections of the study loops. Nine light-signal posts were found in two intersections of loop 1. Loop 2 has only two light-signal posts in one intersection. There was no light-signal post in loop 3. Interestingly, not a single light-signal post of the city works properly and pedestrians or vehicles follow the digital signal (Figure 6).

The survey also found presence of sixteen ladder crosswalks in the intersections as well as in between them. It was observed that loop 1 and 2 have 9 and 7 ladder crossings respectively. There is no ladder crossing in loop 3. Interestingly, not a single ladder crossing has posted light-signals with time-indicator facilities. None of them also has the regulatory
system as if pedestrians can switch on the light-signals to control the traffic (Figure 6). In addition, there was no speed camera, roundabout, posted speed-limits and curb extensions for calming the traffic in any of the intersections.

4.4 Perceived safety and security on the sidewalks
Perceived safety is strongly related with the human perceptions in relation to outdoor physical activities such as walking, cycling and social amusements (Clifton et al., 2007). To evaluate perceived safety and security of the pedestrians during walking in Rajshahi city, this study considers several indicators including open littering on the streets, dumping of construction materials, lighting facilities on the sidewalks as safety measure and information signage.

Waste management system in the city does not enforce all the residents and official premises to construct separate waste dumping areas with classified closed-lid bins for waste separations to reduce, reuse and recycle them. People are generally used to dump wastes on the sidewalks/streets, or throw them into the open roadside drains or nearest fallow plots/spaces. RCC provides everyday waste collection facilities from door to door in the study areas. There are paddle-vans travel by the housing streets everyday morning to collect wastes and carry them to the waste dumping areas of the city (Halder et al., 2014). Despite the facts, this survey found that there are fourteen waste dumping areas on the sidewalks/streets in the three loops. It was observed that the traditional housing areas (loop 2) face the worse conditions of waste management while there are eleven open dustbins on the 2.84 kms streets (Figure 7). In the new residential areas (loop 3), there is no open waste dumping grounds but the residential units do not have any facilities to dump their wastes into the classified dustbins to easily separate them.

Another problem to the perceived safety is piling up the construction materials on the sidewalk/streets for a long time. The city authority has proper environmental guidance for the constructors, but unfortunately that is not perfectly followed by them. As can be seen in the Figure 7, people tend to occupy the street sides for the whole period of constructions without any obstacle by the city authority or community organizations.

Street lighting facilities seem to be sufficient in Rajshahi city, though it faces irregularities at night because of frequent load shading of the electricity. People normally stay at home after finishing their daily works. A few residents were observed walking for physical exercise on the sidewalks at the morning and afternoon only. Many of them are not interested to do their exercise at night because of fear of safety and security.

Information signage is another important factor that may encourage walking. The signage is used to guide the pedestrian about direction to a place, information about vehicles and how to behave within a city. Unfortunately, in Rajshahi city, there is no provision of

Figure 6.
Unoperated traffic signals in the city (photo on the left side); Zebra crossing without light-signal post and controlling facilities (photo on the right side)
information signage for the pedestrians and travellers. People normally ask someone stranger or driver about a destination during moving around the city.

However, Table 2 provides a summary of overall condition of sidewalks in Rajshahi city. As the findings suggest, the existing sidewalk facilities are not pedestrian-friendly. More importantly, the sidewalks are poorly designed, constructed and managed. The following section further critically discusses about sidewalk conditions and presents some implications.

5. Discussion

The recent street development in Rajshahi city has been carried out based on the Master Plan (2015–2024), which was approved by the RDA. But, unfortunately, the Master Plan does not provide any detail plan for urban sidewalks development. Recently, RCC has constructed sidewalks with several major streets, even though most of them are hardly usable for walking. Despite a walkable neighbourhood environment plays a pivotal role in facilitating human physical activities as a means of transport walking, leisure walking and outdoor physical exercise; the present practices of urban planning and design in Rajshahi city does not provide sufficient evidence of making walkable neighbourhoods for the pedestrians. This study has tried to explore the physical attributes of street sidewalks of Rajshahi city and found a huge deficiency in sidewalk provision almost equally in all of the three neighbourhoods. More importantly, the sidewalk planning and design largely ignores the functional importance or usefulness of sidewalks. The present street and sidewalk facilities also indicate that the planning authorities emphasize more on the automobile-focussed street development rather than people-focussed design to facilitate transportation as well as walkability considering spatial and socio-economic categories of urban neighbourhoods. In addition, as many other studies (Brookfield, 2017; Saelens et al., 2016; Frank et al., 2010), the findings also confirm the association between walkability and the physical attributes and perceived safety and security of the sidewalks.

Physical attributes of urban sidewalks including street design and vehicle traffic features, intersection facilities and safety measures are important determinants of walking (Zhang et al., 2019; Southworth, 2005; Landis et al., 2001). These attributes are not only prerequisite for a walkable city, but they demand proper planning, designing and maintenance. This study specifically proves that most of the physical attributes of sidewalks are unsatisfactory in the study area. A major segment of the streets of the city is yet to be constructed with the presence of sidewalks with standard width and street facilities

![Figure 7. Wastes on the sidewalks and streets (photo on the left side); Constructors are dumping materials on the sidewalks (photo on the right side)](image-url)
As it was evident, the width of sidewalks is not consistent along the streets. This clearly shows absence of an ideal sidewalk design in the city. In addition, people are bound to walk on the streets with lots of risk and insecurity. Street traffic calming features on the streets and intersections are very poor. Marked traffic lane is rarely visible. Several street-dividers are present, but there is no information signage of U-

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Overall conditions</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sidewalk facilities</td>
<td>• More than 60% streets in the study area do not have sidewalks in both sides</td>
<td>• The sidewalks in the commercial area are narrower and riskier than the sidewalks in the traditional and new housing areas</td>
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<td>• The commercial and new housing areas of the city have more sidewalks than the traditional housing area</td>
<td>• Sidewalk obstructions are needed to be removed to ensure more walkability</td>
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<td></td>
<td>• Width of sidewalks is not equal in all over the study areas. More than 75% sidewalks have a width of less than 8 feet. Sidewalks in the commercial area are narrower</td>
<td>• Sidewalk facilities such as driveway cuts, curbs and seating facilities should be provided according to the requirements of different neighbourhoods</td>
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<td>• Sidewalks in the new residential areas have more permanent obstructions, while the commercial areas have more temporary obstructions</td>
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<td></td>
<td>• Approximately 94% households still do not have access through driveway cuts</td>
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<td></td>
<td>• Seating facilities for the pedestrians are very poor</td>
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<td>Vehicle traffic</td>
<td>• Streets are hardly demarcated according to the standard width (10–12 feet) of lanes</td>
<td>• Vehicle traffic facilities in the city is poorly planned and designed, which are not conducive for comfortable walking</td>
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<td>• Streets do not have one-way traffic system</td>
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<td>• Street calming features are poorly designed and rarely followed by the travellers</td>
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<td>Intersection facilities</td>
<td>• Intersection facilities, such as light-signal and zebra marks at crossings are not pedestrian-friendly</td>
<td>• Streets need active intersection facilities, such as light-signal, zebra crossing with digital time signal for the pedestrians, particularly for the elderly and school going children</td>
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<td>• There are unused and inoperable light-signal posts</td>
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<tr>
<td>Perceived safety and security</td>
<td>• There are waste dumps on the sidewalks/streets. Traditional housing areas have more waste mismanagement</td>
<td>• Waste and construction materials management is related with walkability environment</td>
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<td>• Construction materials occupy the sidewalks</td>
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<td></td>
<td>• Pedestrians are reluctant to go out for walking at night because of poor street lighting facilities</td>
<td>• Street lighting facilities and information signage on the sidewalks are essential for making the city more walkable</td>
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<tr>
<td></td>
<td>• There is no information signage for the pedestrians and travellers</td>
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</table>

**Table 2.** Summary of sidewalks and walkability environment in Rajshahi city

(dos Santos et al., 2019). As it was evident, the width of sidewalks is not consistent along the streets. This clearly shows absence of an ideal sidewalk design in the city. In addition, people are bound to walk on the streets with lots of risk and insecurity. Street traffic calming features on the streets and intersections are very poor. Marked traffic lane is rarely visible. Several street-dividers are present, but there is no information signage of U-
turn, speed limit and indication of parking area with time. People do not travel by following the traffic signals. A limited number of traffic signal-posts are placed on the streets, but not active and hardly followed by the people. This indicates that traffic rules and regulations are not digitally or technologically controlled and properly managed. The busiest intersections are manually operated by traffic police. However, there are several ladder crosswalks in the city. Once again, they are not properly constructed/maintained with signal facilities, light and time indicators and street-bumps to calm down the vehicles. Likewise, there are no roundabout and curb extension feature on the streets to control traffic speed which is also very important for a pedestrian-friendly street design.

Notably the existing sidewalks are not free from different permanent and temporary impediments that essentially discourage walking. Driveway cuts and curbs are not suitably and sufficiently constructed to facilitate the pedestrians as well as motorists. Comfortability measures such as public seating facilities during walking is astonishingly absent in the sidewalks. Green amenities like trees are found on the sidewalks as impediments, rather than an element of aesthetic beauty and measure of comfortability.

The perceived safety features of a sidewalk shape people’s perceptions of safety and security and, therefore, influence willingness of walking (Kweon et al., 2004). In the same line of previous findings (Clifton et al., 2007; Cerin et al., 2006), this study also informs that street cleanliness, proper safety measures and presence of information signage are useful factors that may evaluate and enhance walkability environment. Unfortunately, the results in this regard indicate an unsatisfactory state of perceived safety features are existing in Rajshahi city. As it was found, there are no rules and regulations in place to manage dumping of waster and construction materials on the sidewalks/streets. Similarly, not a single street in the city has information signage, which is also an important factor of walking (dos Santos et al., 2019).

Therefore, the sidewalks of Rajshahi city are yet to be effectively and appropriately planned, designed and constructed to facilitate pedestrians’ walkability considering their needs and spatial variabilities of urban neighbourhoods (Speck, 2018, 2012; Lotfi and Koohsari, 2011; Southworth, 2005). However, the following areas require more attention for making Rajshahi a walkable city.

The first and foremost aspect of urban planning for Rajshahi city is to understand the usefulness of sidewalks. There are plenty of evidence that walking-friendly infrastructure encourage pedestrian movement, which limit the excessive use of automobile (Foltete and Piombini, 2007); reduce traffic congestion, carbon emissions and noises; and contributes to health improvements (Alawadi et al., 2021; Lopez and Wong, 2019). This will also require involvement of communities in the planning process for giving a scope of saying their priorities as well as for awareness building.

Therefore, secondly, Rajshahi city needs more street and sidewalk infrastructure, while a large part of the streets does not have sidewalks and necessary facilities. For example, the width of the sidewalks should be need-based. A human-mobility mapping of the city might be helpful in this regard. This indicates that the wider sidewalks should be constructed in the crowdy places, such as commercial and highly populated areas (loop 1). Residential areas (loop 2 and loop 3) must have sidewalks in both sides of the street. Most importantly, the unwalkable and illegally occupied sidewalks in all over the city need to be restored and renovated. Moreover, removal of all sidewalk obstructions is mandatory to ensure walkability environment. Sidewalk facilities such as driveway cuts, curbs, greeneries and seating facilities should be provided according to the requirements of neighbourhoods.

Thirdly, safety and comfortability measures for the pedestrians are inevitable for making a city walkable. As it was found in Rajshahi city, vehicle traffic facilities are also
poorly planned and designed, which are not conducive for comfortable walking. For example, street calming features are poorly designed and rarely followed by the travellers. In addition, intersection facilities, such as light-signal and zebra marks at crossings are not pedestrian-friendly, particularly for the elderly and school going children. Therefore, the city needs a complete renovation of streets and sidewalks to ensure safety and comfortability (Alawadi et al., 2021; Mehta, 2008).

Fourthly, sidewalks planning and design should emphasize on the spatial, socioeconomic and demographic contexts of the city. Urban planning should accept the reality that there is inequality in providing infrastructural facilities. As it was evident in Rajshahi city, the traditional housing area (loop 2) is neglected in comparison to commercial (loop 1) and new housing areas (loop 3).

Finally, this study calls for an integrated and adaptive approach in urban planning for Rajshahi city during street designing by focussing more on new construction and usability of existing sidewalks rather than emphasizing only on vehicle transportation. As the city is undergoing a major infrastructural development now, it is high time to formulate apposite planning and policies for making walkable neighbourhoods by engaging all relevant stakeholders (Baldwin and Stafford, 2019; Elhamy, 2012) and by reducing lacking in cooperation between relevant planning authorities (Ahmed and Swapan, 2009; Lima, 2003).

6. Conclusion
This study contributes to the empirical findings by exploring the physical attributes of urban sidewalks and suggests important insights for future planning and design of urban streets considering the importance of walkability environment. It has emphasized the condition of urban sidewalks development in micro-scale, which might be comparable to other cities in the developing countries. Theoretically, it endeavours to examine the urban planning and design scenarios that still lacks in proper sidewalks planning and development. The empirical evidence in this study informs that the importance of urban sidewalks is largely ignored by the urban planning authorities of Rajshahi city, Bangladesh. Both the RDA and RCC are yet to provide satisfactory and appropriate sidewalk facilities for the pedestrians. However, the results presented in this paper can be an important baseline information for proper planning of sidewalks. Accepting the importance of sidewalks for human health and wellbeing, this study recommends for an effective mapping, planning and promoting walkable neighbourhoods to make a liveable and sustainable city. All of the stakeholders related to urban development and planning must recognize the importance of sidewalks and a walkable neighbourhood. Most importantly, a people-focussed design of urban streets is imperative for making a walkable city. However, it is acknowledged that this study did a preliminary investigation of the status of urban sidewalks only in three selected neighbourhoods of a city. It is also felt that only words cannot visualize the exact situations of sidewalks on the ground, unless more visual techniques and photographs are used. However, further research is needed to explore the reasons of deficiency of urban sidewalks and discrepancy in the implementation of development planning. Why sidewalks with the streets are ignored during planning might be a good question to explore the institutional drawbacks in making a walking city. In addition, the difference between walkable and non-walkable neighbourhoods in the context of physical activity might be investigated by analysing perceptions of relevant stakeholders through a more scientific research design in future.
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