Influence of street design characteristics on walkability: Case studies of two neighborhoods in Erbil

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A R T I C L E   I N F O

A B S T R A C T

Walkability refers to different characteristics of the built environment that creates a space that encourages walking and reduces car dependence. The major purpose of this research is to test the effects of street design characteristics on walkability. This study also aims to address the lack of scientific knowledge regarding factors that affect walkability at street level in residential neighborhoods and how they influence walking behavior. The research problem formulated is "a shortage of scientific knowledge exists about the performed rate of walkability at the street level in residential neighborhoods in Erbil City". Case studies were conducted in two neighborhoods in Erbil City, namely, Gulan 1 neighborhood (as a planned neighborhood by the municipality) and Hiran City 1 (as an investment neighborhood). The hypotheses were drawn on the basis of the research problem. To achieve the research objectives, the authors identified the environmental indicators in the literature review and assessed their impacts on the relationship between walking activity and build environment in two neighborhoods. The research was conducted in two steps. First, detailed indicators were measured at street level to determine street level walkability. Then, walking behavior was evaluated to find its relationship with street walkability. By analyzing the results of these two steps and discovering the relationship among the outcomes, the researchers tested the validity of the drawn hypotheses. Finally, a set of conclusions were established regarding street walkability and walking behavior.

1. INTRODUCTION

Walking, the most fundamental mode of transportation, has a major role in designing communities since the earliest human settlements (Steiner F. and Butler K., 2007). Walking is primarily used for transportation or recreation. Currently, city planning professionals are focusing on the need for creating walkable communities to encourage walking as an alternative mode of transportation for reducing the environmental impacts of other transportation modes. Such individuals have also concentrated on formulating strategies for creating additional walkable communities given its various benefits, such as improving public health, cost saving, equity provision, environmental protection, and livability. Among its defining characteristics, a walkable community is sociable, accessible, livable, attractive, diverse, healthy, safe, environmentally friendly, and of mixed use (Spoon, 2005).

The advantages of walking can be categorized under different subtopics, such as environmental, economic, and social conditions. Moreover, walking brings livability to the streets, thus contributing to the creation of a safer urban environment. From an environmental perspective, walking is a green

mode of transportation as it has low environmental impact, and generates neither noise nor air pollution. As for the health benefits from walkability, walking can improve mental and physical health, including the promotion of cardio-vascular fitness and stress reduction
(Cambra, 2012); (Duncan *et al.*, 2012); (Muhlbach, 2012).
It is noted that the knowledge about the performed rate of walkability at the street level in residential neighborhoods in Erbil City is not quite enough. So, this research tries to assess the walkability rate in different type of streets in residential neighborhoods in the said city.

2.   Literature Review

2.1.   Factors affecting walkability

Walkability is an essential idea for the city planners. However, determining the factors that affect form and behavior is more crucial. Such factors must then be defined to apply the concept into environments. Defining walkability entails many factors, such as accessibility, attractiveness, connectivity, safety (Spoon, 2005) and efficiency (Muhlbach, 2012). Aside from personal factors (including inspiring walks or tendency to take a walk), the condition of the built environment is another determinant which influences walking. Moreover, individuals can decide whether they walk or not, and, thus, walkability studies describes built environment as a factor that influences a large population over a long time (Choi, 2012).

Additional classifications are developed by researchers according to the scale or levels of the built environment factors. These classifications range from the regional planning level through the urban planning and design level and down to the micro-level of urban design and architecture (Choi, 2012). At the macro level design features, planners and designers deal with mixed land use and issues related to the street pattern and site design. At

For the purpose of the present research, two types of residential neighborhoods in Erbil City were selected, Gulan 1 as a municipal subdivided type and Hiran City 1 as an investment project. This research tries to answer two questions, first is "to what extent different types of neighborhoods that have been built in Erbil encourage walking behavior due to their street design characteristics?" And second "how are local residents walking within their residential areas due to the varied street design characteristics?" By using PEDS checklist, and video tracking records walkability at street level has been measured and walking behavior has been evaluated
the micro level, careful attention is required as to the detail and design of sidewalks, crosswalks, building façades, benches, other elements in the human scale (Steiner F. and Butler K., 2007) in addition to sidewalk infrastructure and condition, the presence of trees for shading, safety features, street lighting, aesthetics, and public transportation facilities (Pentella, 2009). Moreover, many determinants affect walkability, which in turn exerts the greatest effect on walking behavior. Spoon summarized the factors influencing walking behavior by differentiating between the personal and subjective and the objective factors determining the variable associated with each factor, (see **Table 1**). Baran and his colleagues assessed walking behavior through face-to-face interviews to assess individual characteristics (e.g., age, gender, income, education, retirement status, and body mass index), contextual characteristics (e.g., perceived safety and social networking), and micro-ecological level variables (e.g., social disorder, physical disorder, and perceptions that one lives in a "busy place") (Baran *et al.*, 2009). Sharifi (2016) classified factors that affect pedestrian behavior into three categories: individual characteristics (age, gender, health, and disabilities), built environment characteristics (type, dimensions, and

attractiveness), and ambient conditions (temperature and visibility). The author used automated video and semi-structured questionnaires to collect walking data (Sharifi, 2016). During their data collection, Frank and his colleagues utilized an accelerometer with a travel survey to measure the physical activities of 532 randomly-selected participants. Sample characteristics assessed include gender, age, and education adjacent to the built environment variables, such as mixed land use, residential density, and connectivity (Frank *et al.*, 2005).

Determinants that influence walking behavior include individual factors (such as age, gender, health, attitude, time, money, family condition, having company, and the feeling of safety), built environment factors (such as distance, safety, attractiveness, and pedestrian infrastructure) and environment conditions (such as weather and visibility). Different methods for assessing walking behavior were also employed.

Table 1 factors affecting walkability

Walking variable		
Personal and subjective factors	• Distance • Traffic safety • Convenience • Cost • Valuation of time • Valuation of exercise	• Physical condition • Family circumstance • Habits • Attitudes and values • Peer group acceptance

Objective factors	• Distance
	• Traffic safety
	• Weather
	• Topography
		• Infrastructure factors:
		  o Pedestrian facilities, traffic condition
		  o Access and linkage of pedestrian facilities to desirable destinations
		  o Existence of competitive transportation alternatives
		  o Street lighting

2.2.   Previous studies

Hrushowy (2006) investigated the influence of pedestrian space network on walking behavior. He utilized a smaller scale than the neighborhood because factors affecting one's perception toward walking involve street-by-street or block-by-block scale rather than the entire neighborhood (Hrushowy, 2006).

Park (2008) explored the street level built environment factors affecting behavior. Four factors from the field survey were studied, including 40 indicators related to curb-to-curb roadways, pedestrian crossings, buffer zones, sidewalks, sidewalks facilities, street scale and enclosures, and nearby buildings and properties (Park, 2008).

Choi (2012) used subjective measurement through observing walking behavior to verify the built environment factors that affect walking behavior at the urban design scale. The data analysis performed was not statistical, but more analytical and based on reasoning (Choi, 2012).

Khalil (2013) explored the urban form that influences children's walking to school. The grid street system with high connectivity seemed more walkable because it decreases distances (Khalil, 2013). Other factors, such as having company and straight connected streets, also makes walking more exciting.

Pentella (2009) conducted a study on the neighborhood and street scales. Two different measurements were used. A GIS was used for measuring residential density, land use mix, street connectivity, public transit density, and crime density at the neighborhood level. Moreover, PED was employed for gauging sidewalk infrastructure and condition, the presence of trees for shading, safety features, street lighting, aesthetics, and public transportation facilities at the street scale. Then, the research correlated the between SES and walkability with respect to the built

environment factors at both scales (Pentella, 2009).

Others analyzed road segments to verify the influence of street network on the choice of the walking mode for transit. The studied variables related directly to mode choice include connectivity correlated with accessibility, density, mixed land use, transit service features, and socio-demographics variables (Ozbil and Peponis, 2012).

Evaluation of the related studies revealed that most research focused on the neighborhood rather than the street level and their influence on walking behavior. The measuring tools applied at the neighborhood level were mostly objective, and they employed software, such as GIS and Space syntax. By contrast, measuring walkability at the street level primarily depended on field surveys, observations, systematic checklists, and interviews. Other methods, such as SPSS and Walk score, were also used.

The current research found that no study exists regarding walkability assessment from diverse neighborhoods which were designed in different periods and by various authorities (such as traditional, municipal, and investment authorities) in Erbil City. Therefore, Erbil City was chosen in this research to assess walkability in different types of neighborhoods at the street level as well as its impact on walking behavior.

2.3.   Research problem

The research problem states that "a shortage of scientific knowledge exists about the performed rate of walkability at the street level in residential neighborhoods in Erbil City."

2.4.   Research objectives

This research aimed to assess the walkability rate in different type of streets in residential neighborhoods in the said city. For the purpose of the present research, two types of residential neighborhoods in Erbil City were selected, including Gulan 1 (as the municipal subdivided type) and Hiran City 1 (as an investment project).

According to the research questions, the hypotheses were formulated as follows. First, walkability rate within the residential neighborhood varies according to the design characteristics at the street level. Second, walking behavior is affected by various design characteristics at the street level.

3.   Methodology

For assessing walkability at the street level, the researcher selected observations on sidewalk availability, sidewalk design and infrastructure, street design and elements, and street lighting. Then, pedestrian environment data scan (PEDS) was used as the measuring tool. This tool involves the direct observation for measuring the detailed design of built environment affecting walkability. The PEDS also uses primary sources for measuring the five groups of streetscape characteristics influencing walkability, namely, environment, pedestrian facility, road attributes, walking/cycling environment, and subjective assessment. The PEDS was developed by Dr. Kelly Clifton and Andrea Livi at the University of Maryland and Dr. Daniel Rodriguez at the University of North Carolina, three notable researchers in the field of urban planning. The evaluation was based on the Likert scale format (poor, fair, good) and scored as (0, 1, 2). Streets were selected according to the connectivity analysis, land use diversity, and location of the street within the neighborhood.

For assessing walking behavior, gender, age category, group formation, and activity type were chosen as variables. Walking behavior can be evaluated by different methods. For the aim of the present research, walking behavior was assessed by conducting a systematic observation and using video tracking records by observing people walking in different times at selected streets to determine how built environment affects walking behavior.

4.   Case study

4.1. Assessment of walkability at street level

In Gulan 1, two streets around the center (shown as G1 and G2 in Fig. (1)) have been selected to assess their walkability at the street level. Moreover, the streets have been divided into segments (GS1, GS2…GS8) (see Fig. (2)). The length of each segment is 154 m. The PEDS check list was filled to assess every segment's walkability.
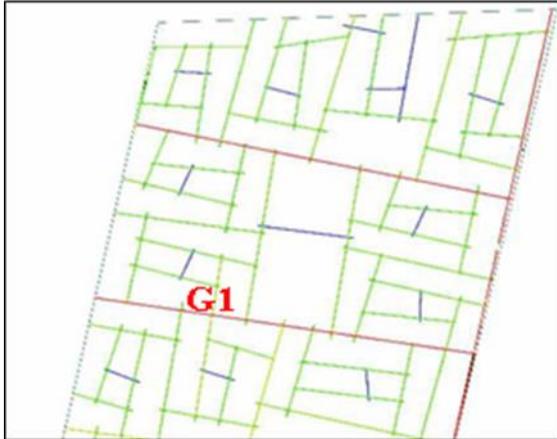

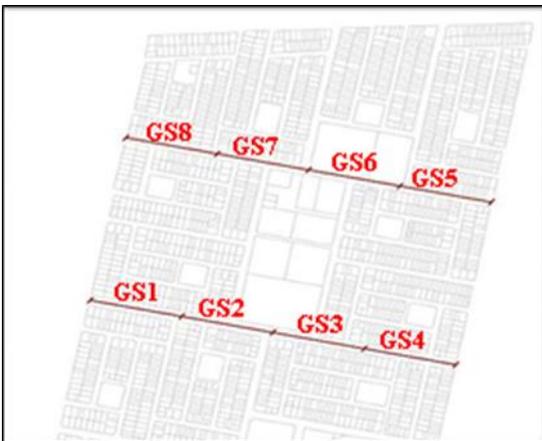Fig. (1) Street selection in the Gulan 1 Neighborhood

Fig. (2) Street segments of Gulan 1

Hiran City 1 is an investment neighborhood. The street which passes through the Hiran City 1 center (see H1 in Fig. (3)) has been selected to assess the walkability of the city at the street level. The street has been divided into segments (HS1, HS2…HS5) as shown in Fig. (4), and the length of each segment is 154 m. The PEDS check list was also be filled to assess each segment's walkability.
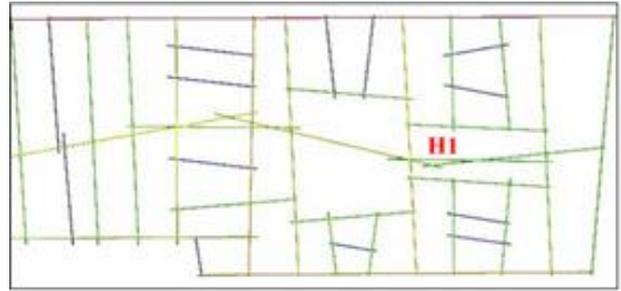

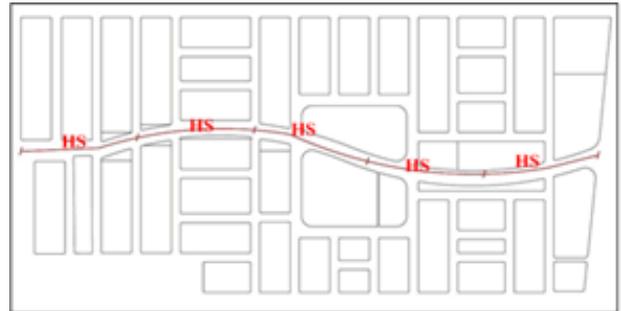Fig. (3) Selected Street in Gulan 1 Neighborhood

Fig. (4) Street segments of Hiran

A PEDS checklist was accomplished for each segment, then the scores for each segment was ascertained. Subsequently, the mean score for each neighborhood was identified by averaging segment scores within the neighborhood.

4.2. Assessment of walking behavior

Various factors affect walking behavior. Individual factors include age, gender, health, attitude, time, income, family condition, having company, and the feeling of safety. Built environment factors involve distance, safety, attractiveness, and pedestrian infrastructure. The final group of factors involves environment conditions, such as weather and visibility. Different methods are also available for assessing walking behavior, including observation, video track recording, questionnaires, and face-to-face interviews.

For the present research, video tracking and observation were employed to assess walking behavior in the selected streets (streets shown in Fig. (1) as G1 and G2 and in Fig. (3) as H1. First, to ascertain the most appropriate time for recording video tracks, the researcher visited locations in the same weather and work day to

take photos and observe situations at 8:00 am, 10:00 am, 12:00 pm, and 4:00 pm in October.

Accordingly, 3:30–4:30 pm was identified as the optimal time period for assessing walking behavior because people were going out for different purposes during that time. At 3:30–4:30 pm, school time ends and pupils go home, people go shopping, children play outside the home, and/or young ones go out to meet friends and talk or sit near shopping areas. Then, cameras were mounted to record the pedestrians' behavior from different points in the G1, G2, and H1 streets. Video tracks were recorded under the same weather condition (normal condition, not too cold and not hot) to obtain an accurate comparison outcome from the walking behavior assessment. For assessing walking behavior, four indicators were assessed, including gender, age, formation of groups, and activity types. The indicators were classified as follows: gender (male and female), age (children up to 15 years old, adult 16–35 years old, middle age 36–55 years old, and from 56 years old and above), formation of groups (single, couple "two persons," and group "more than two persons"), and activity type (shopping, playing, going to school, sitting, passing, and meeting friends). Discussions.

5.   Results
5.1.   Results of PEDS

Detailed findings for the questions of each subsection within each neighborhood were presented in Fig. (5). Results show that Hiran City 1 obtained higher scores in the following subsections: A. Environment, B. Pedestrian facility, and D. Road attributes (see Fig. (6)). Hiran City 1 seems to be more walkable than Gulan 1 with a score of 41.6, whereas the latter obtained a score of 40 (see Fig. (7)).
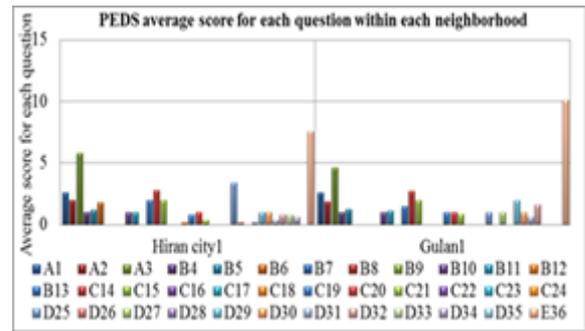

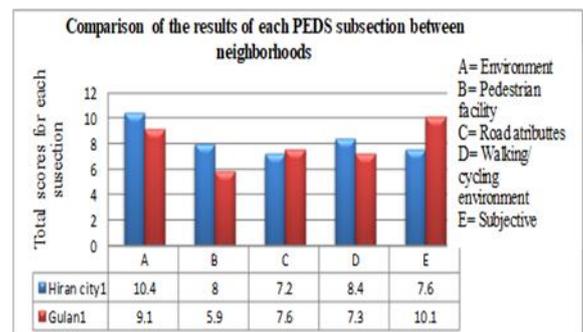Fig. (5) PEDS average scores for each question of subsections within Hiran city1 and Glan1 neighborhoods

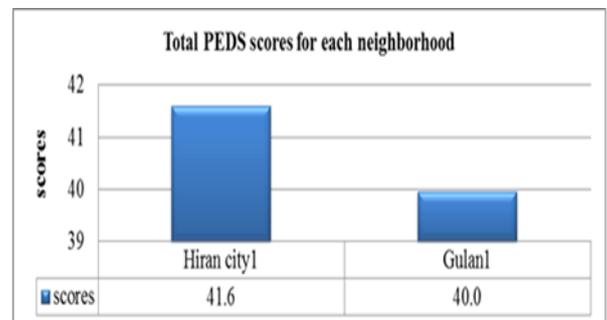Fig. (6) PEDS scores for each subsection within Hiran city1 and Glan1 neighborhoods

Fig. (7) PEDS scores for Hiran city1 and Glan1 neighborhood

5.2.   Results of video track records

In the Gulan 1 neighborhood, walking behavior was assessed by video track records at eight different points representing eight segments of the G1 and G2 streets shown in Fig (8). Video tracks were analyzed to determine the age, gender, group formation, and activity type of pedestrians. Moreover, video track recordings were unified to one-hour duration to determine the rate of mentioned indicators within each point. Then, the minimum, average, and maximum rates were

determined over all the points of both streets as shown in Figs. (9), (10), and (11). Results indicate that pedestrians in the studied points were varied according to the facilities located within the segment. The maximum number of walking people was 891 persons/hr (GS3) and the minimum was 84 persons/hr (GS1). For obtaining the most reliable values, the average value for each indicator and then the rate of each indicator were calculated (see Fig. (9)). The average number of pedestrians was 328 persons/hr. The results are as follows.

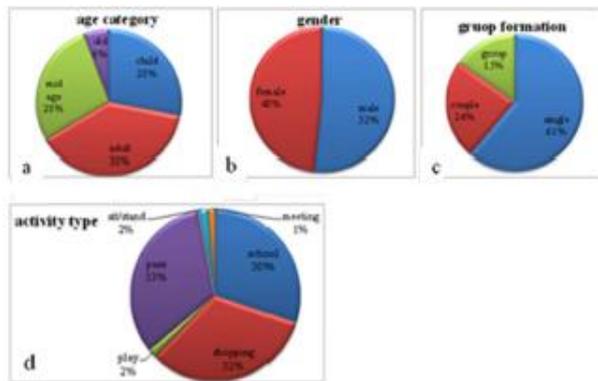Fig. (8) Video tracking points in the Gulan 1 streets

Fig. (9a, b, c, and d) Rate of each indicator for walking behavior assessment in the Gulan 1 Neighborhood.
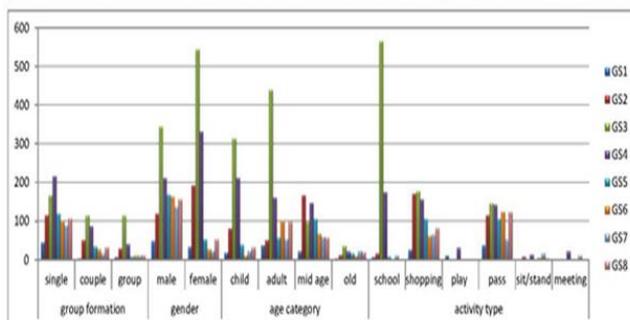

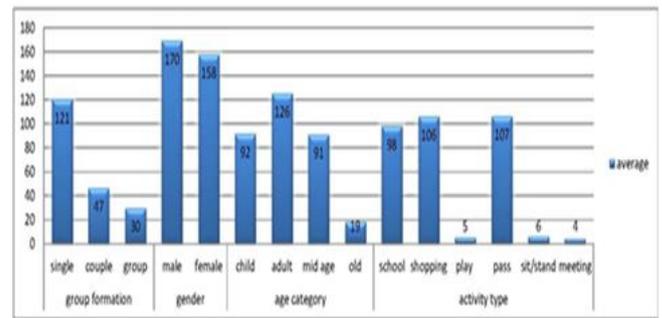Fig. (10) Video tracking results for each point in the Gulan 1 Neighborhood

 Fig. (11) Average results for walking behavior over all points in the Gulan 1 Neighborhood

1.   Age category: the main pedestrians were adults (38%), followed by children and middle-aged persons (both at 28%). Finally, old pedestrians make up 6% of the total (see Fig. (9a)).

2.   Gender: in the streets of Gulan 1, the rate of pedestrians of both genders (male and female) were approximately similar (male: 52%, female: 48%) (See Fig. (9b)).

3.   Group formation: most pedestrians in the studied streets were single persons (61%) (see Fig. (9c)). A total of 24% of pedestrians were couples, and 15% were groups.

4.   Activity type: diverse types of activities were seen in the studied streets given the different uses located within the area of the activity types in Fig. (9d), the most frequent activity during recording time was passing through the studied streets (33%). Then, shopping activity (32%) and school activity (30%) follows. Children who play in the streets and persons who sit or stand in the studied streets represented a minimal rate of pedestrians, as each one of these two activities (play and sit/stand) represented (2%) of the activities. Finally, meeting activity, which indicated people or friends who meet and talk mainly in front of shopping areas denote 1% of the total.

Similarly, in the Hiran City 1 neighborhood, walking behavior was assessed by video track recordings at five different points representing five segments of the studied street (Fig. (12)). The age, gender, group formation, and activity type of pedestrians were determined through analysis of the tracks. The video tracks were

unified to one-hour durations to determine the rate of the above indicators within each point. Then, the minimum, average, and maximum rates were identified over all the points (see Table 3 and Figs. (12), (13), and (14)).
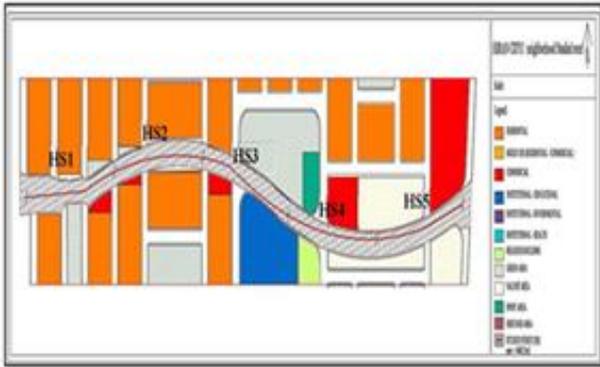

Fig. (12) Video tracking points in the Hiran City 1 Street
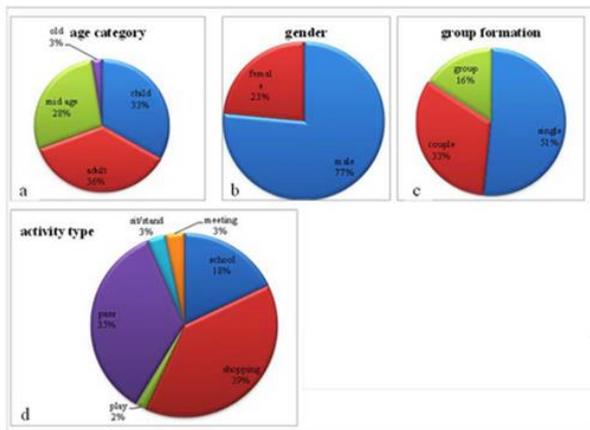

Fig. (13a, b, c, and d) Rate of each indicator for walking behavior assessment in the Hiran City 1 Neighborhood
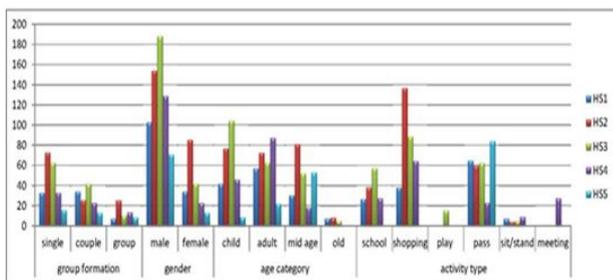

Fig (14) Video tracking result for each point in Hiran city 1 neighborhood

The outcomes revealed that the number of pedestrians in different points varied due to the types of facilities located within the segment. The maximum number of walking people was 164 persons/hr (HS2) and the minimum was 66

persons/hr (HS1). To obtain the most reliable values, the average value for each indicator was obtained, then the rate of each indicator was calculated as shown in Fig. (12). The average number of pedestrians was 107 persons/hr. The results are shown below.

1. Age category: the main pedestrians were adults (36%) and children (33%), including those who go to school or who shop or play in the studied street. Middle-aged persons represent 28% of pedestrians. Finally, old persons constitute 6% of all pedestrians (see Fig. (13a)).

2. Gender: in the Hiran City 1 street, most pedestrians were male (77%). Only 23% of pedestrians were female (see Fig. (13b)).

3. Group formation: most pedestrians were single persons (51%), whereas 33% were couples, and 16% were groups consisting of three persons or more (see Fig. (13c)).

4. Activity type: various activities were observed in the Hiran City 1 street due to the types of facilities located within the studied area. The most frequent activity in the studied street during recording time was shopping activity (39%) (see Fig. (13d)), then passing through the studied street (35%), after which comes school activity, as 18% of the pedestrians were students. "Meeting" and "sit/stand" persons in the studied street were scarce as the rate of each was 3%. Children who play in the streets had the lowest rate (2%) among pedestrians.

5.3. Discussions

Results of the walking behavior assessment in both neighborhoods revealed that significant difference exists between the numbers of pedestrians. The average number of pedestrians in Gulan 1 was 328 persons/hr, whereas Hiran City 1 had 107 persons/hr. The Gulan 1 Neighborhood results indicated that 2620 persons used the studied streets during the video track recording period. The total population size of Gulan 1 is 18722 persons, hence 14% of its residents used the studied streets in one hour. For Hiran City 1, the

neighborhood population size is 5134 persons, and 537 persons used the studied street during the video track recording period. Thus, 10.5% of Hiran City 1 residents used the studied street during an hour. Fig. (15), and (16) show the comparison between the average and percentage of each indicator for both neighborhoods. The main difference is observed in the gender category, because in Gulan 1, the number of males and females recorded in the studied streets were almost equivalent to each other (male: 52%, females: 48%). By contrast, in Hiran City 1, males were three times more than the females (male: 77%, female: 23%) in the studied street.
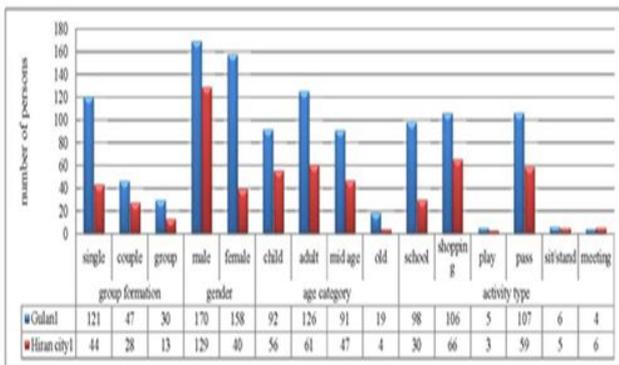

Fig. (15) Comparison between average results for walking behavior in Gulan 1 and Hiran City
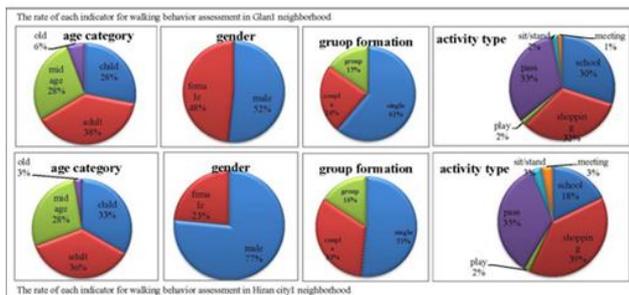

Fig. (16) Comparison between the percentage of each walking behavior indicator in Gulan 1 and Hiran City 1 Neighborhoods

Furthermore, no substantial difference was noted in the age category and group formation between pedestrians of the studied neighborhoods. In Gulan 1, 38% of pedestrians were adults, whereas the figure for Hiran City 1 is 36%. In both neighborhoods, the main pedestrians were single persons (Gulan 1: 61%, Hiran City 1: 51%). For the activity type, a

major variance was observed in school activity, with the proportion of students at Hiran City 1 at 18%, whereas Gulan 1 had a level of 30%. According to these results and the percentage of pedestrians, Gulan 1 outperforms Hiran City 1 in terms of encouraging walking and attracting pedestrians. However, in Gulan 1, the detailed design (street level design) was less than that of Hiran City 1, but its residents were walking more than those of Hiran City 1regardless of safety and car movement. In addition, pedestrians mostly walk on streets instead of walking on sidewalks.

Finally, based on the results of walking behavior assessment, Gulan 1 (as a planned neighborhood) encourages walking more than Hiran City 1 (as an investment neighborhood), because 14% of Gulan 1 residents used the studied streets in comparison to the 10.5% of Hiran City 1 residents. Various activities were performed in the studied streets according to the type of uses located within these streets. This outcome indicated that neighborhood characteristics and/or street characteristics will effect on walking behavior of residents and their decision to walk or not.

6.   Findings

Findings from the practical study demonstrated that all studied indicators affected walking in various ways, and different types of neighborhoods exert diverse influences on walking. The research hypotheses are tested in the rest of this section.

6.1.   Testing the first research hypothesis

The first hypothesis suggests that walkability rate within a residential neighborhood varies according to its physical and design characteristics. To test the validity of this hypothesis at the street level, walkability assessment results were discussed as follows: the walkability rate within the residential neighborhood varies according to the design characteristics at the street level.

In the walkability assessment at the street level, the PEDS checklist was used as a

systematic observation. For assessing street walkability, two main streets were selected in the Gulan 1 neighborhood, whereas one street was chosen in Hiran City 1 (see Fig. (1) and (3)). According to the final results of the walkability assessment at the street level, Hiran City 1 is more walkable than Gulan 1. Given that Hiran City 1 roads and sidewalks were wider than those of Gulan 1, the sidewalk conditions in Hiran City 1 were better than those of Gulan 1. In addition, the parked cars in Hiran City 1 were fewer than those in Gulan 1 because the number of facilities on the studied street of the former were limited and located in points not along the street. Moreover, Hiran City 1 has road-oriented lighting, whereas the streets in Gulan 1 are lit by other lighting sources such as shops, markets, and house lights as no street lighting is present. Thus, first hypothesis is valid.

6.2.   Testing the second research hypothesis

The second research hypothesis is stated as: walking behavior is differently affected by various design characteristics at the street level. To test this hypothesis, walking behavior assessment results and its relationship to design characteristics and the street level results have been discussed as follows.

To determine the relationship between detailed design of the streets and walking behavior, five detailed indicators from (PEDS) checklist were selected. The values of these indicators are varied according to the segments. The selected indicators include land uses within the segment, segment intersections, sidewalk connectivity to other sidewalks or cross walks, degree of enclosure, and articulation in building design. Statistical analysis (using SPSS) was employed to ascertain the relationship between the mentioned indicators and walking behavior as shown in Table 2.

Table 2 Statistical analysis clarifying the correlation between walking behavior and street design characteristics

Spearman's correlation					
Dependent	Independent	Spearman Cor.	P-value	Significant	Note
Behavior	Connectivity of sidewalks	-0.027	0.931	N.S	Negative Relation
Behavior	Segment intersection	-0.386	0.192	N.S	Negative Relation
Behavior	Land use within segment	0.180	0.556	N.S	Positive Relation
Behavior	Degree of enclosure	0.717	0.006	H.S	Positive Relation
Behavior	Articulation in building design	0.529	0.063	N.S	Positive Relation

Note: P-value >0.05 (N.S)not significant , <0.05 (S), <0.01 (H.S) High Significant

According to the Spearman's correlation results in Table 2, a negative relationship exists between sidewalk connectivity and walking behavior. A similar outcome is observed for segment intersections and walking behavior. Hence, despite the increase in sidewalk connections or segment intersections, the number of pedestrians decreased, because connecting sidewalks with its surroundings and the usage of intersections requires crossing aids for pedestrians but no such crossing aids are present in the studied neighborhoods. (Such aids include pedestrian signals, curb extension, pedestrian crossing warning sign, and flashing warning light.) Likewise, increasing the number of intersections decreases the number of pedestrians because increasing intersections (especially cross intersections) encourages traffic flow and fast driving, thus affecting pedestrian safety. Furthermore, a positive relationship is observed between land use types and the proportion of pedestrians, which means that wherever land use type increased (except vacant land), the number of pedestrians will increase. Such outcome is because land use

diversity offers more walking opportunities and provides pedestrians with more activity types. Furthermore, building enclosure is one of the most significant indicators which encourages walking as shown in the statistical analysis. High building enclosures make pedestrians feel safe and comfortable whereas less enclosure, separated buildings, and vacant areas make them feel as if they are missing, and presents an unsafe and uncomfortable walking environment. By contrast, building articulation positively influences walking behavior, as such articulation implies more building openings on the streets, allowing pedestrians to feel safe and comfortable while they walk.

Finally, as mentioned, the current research found that, at street level, a negative relationship exists between intersection numbers, sidewalk connections, and pedestrian numbers. Moreover, land use type, building enclosure, and building articulation as the detailed design at the street level have direct and positive relationship with the number of pedestrians. Therefore, the detailed design of streets differently affects walking quantity.

According to the above discussion, the second research hypothesis is valid.

7.   Conclusions and Recommendations
7.1.   Conclusions
Different scales of walkability studies include the global scale at the city level, the macro scale at the neighborhood level, and the micro scale at the street level and the detailed scale. Built environment factors at each scale differ from other factors in other scales. Detailed design of streets differently affects street walkability and walking behavior. Quantity of land use, degree of enclosure, and articulation of building design positively influence the number of pedestrians, whereas increasing intersections and the discontinuity of sidewalks will reduce the said number. The degree of presence of the detailed factors seems important for creating the major quality of the environment which, in turn, has a

positive impact on the walking experience. Environment qualities, including liveliness, sense of security, and sociability, that are provided by the built environment enables the pedestrians to see, hear, and interact with other people, objects, and activities. Consequently, the built environment encourages walking.

7.2.   Recommendations
Detailed factors (e.g., type of intersections, sidewalk connectivity, building enclosure, building articulation, street lighting, walking obstructions, and crossing aids) must be considered in designing neighborhood streets. Sidewalks in good condition and the provision of crossing aids on most paths from home to destinations may increase the extent of walking. By designing an environment which offers pedestrians with the ability to reduce car dependence, improve air quality, build a sense of community, and increase their physical activity levels, then a similar walkability becomes a viable solution for the dissimilarity of neighborhood walkability in the Erbil City. Moreover, the transportation department in the municipality could be enhanced by establishing a pedestrian system engineering department. This department would be responsible for implementing pathways and sidewalks as well as providing some simple physical elements which will facilitate the improved performance of this system. Likewise, establishing training courses and workshops for developing social awareness regarding the importance of walking is advised. Furthermore, eliminating sidewalk trespassing can be achieved by removing the obstructions to walking on sidewalks.

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