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Measuring and Evaluating Urban Walkability through Walkability Indexes: A Case of Murree

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Abstract

Walking is an integral part of our daily life and it has become an important component of sustainable transport system in the present era. Without proper methods to measure walkability, proper analysis could not be carried out and amongst the availabale methods, Walkability Indexes are the most appreciated; that include Global Walkability Index and Asia-Index. Extending the existing research on walkability indexes, the present study aims to develop a modified walkability index named "Local Walkability Index" for measuring walkability alongwith Global Walkability Index and Asia-Index in Murree, Pakistan. Furthermore, comparison of three indexes has also been carried out which refelects that Local Walkability Index is providing more realistic walkability ratings.

Keywords: Keywords. Urban Walkability, Global Walkability Index, ASIA Index, Measuring Walkability Index

1. Introduction

The cities of the world have expanded with the modernization and development in transportation. Cities were small when people used to walk or use animals to move around. With the invention of motor cars the size of cities have started to expand (Melosi, 2004; Muller, 1995). After the inclusion of mass transit and freeways, the cities have started to develop along major roads to form suburbs, thus further increasing the size of the cities (Giuliano, 1995). With the expansion of cities different problems started to arise. In present day, the dependence on automobiles is increasing and has become the main mode of transportation in many cities. It has resulted in the growth of cities in form of sprawling growth pattern and low-density developments (Azmi & Karim, 2012b) which is causing transportation problems like congestion, delays, parking, overpricing etc.

The conventional approach of transportation planning is mainly based on the provision of additional road infrastructure. This traditional way of road construction and expansion is creating annually increasing traffic, making it an unsustainable strategy (Litman, 2003). It has also proved to be inefficient because high level of congestion

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persists in the city centers and major roads (Tsakalidis et al., 2014). Reviewing this conventional approach, transportation planners have began to shift their focus from the private cars to sustainable transport systems, among which walkability is prominent (Tsakalidis et al., 2014). In addition, Planners and traffic engineers have realized that funds for the development and maintenance of highways and roads are not enough to cope with the growing traffic and congestion (Arnott et al., 1991). Because of these changes in town planning and transport policies, walkability has recently become one of the main concerns for urban planners (ÖZGEN, 2012). Walking is also a good way to promote the sustainability in a city because walkable cities are considered as more livable and environmentally sustainable (Osmond, 2005). In many countries walking is attracting public interest to make laws and policies for it. UK pedestrian policy promotes walking as a way to support the sustainable transport in the form of laws and plans (Middleton, 2010). It was also found that level of walking does not influence the walkability but it is dependent on the walkability of neighborhoods (Lotfi & Koohsari, 2011).

Walkability can be generally defined as the measure of suitability of an area for walking. To make a city walkable, it should be ensured that there are enough facilities for the pedestrians to walk easily. Consideration of creating a walkable place is also important so that it can create a comfortable place to live (Shamsuddin et al., 2012). It should also be ensured that all the basic facilities like school, grocery store, park etc. are available at a walking distance. A review of literature has concluded various parameters which can make a neighborhood walkable. These parameters could be classified in seven groups:land use safety, traffic,crime rate, ease in walking and cycling, accessibility, environmental aesthetics, others like social relations in neighborhoods (Cubukcu, 2013). It is also suggested that a broad mix of land-use with walkable destinations further increases walkability (Chen, 2012; Smith et al., 2008).

To measure walkability, researchers have devised many ways. The easiest and cheapest way is the usage of any web-based tool; most common among these is known as “Walk Score” ("WalkScore©," 2014). Duncan (2013) has endorsed Walk Score as a good way to measure walkability across geography of that area. In their paper, Carr et al., (2010) have considered Walk Score as a fine tool for calculating nearby facilities. In a further research Walk Score was found as a handy and economical option to understand the level of access to nearby facilities (Carr et al., 2011). It is also been evaluated on the basis of GIS indicators; which showed positive results (Duncan et al., 2011).

Another way to measure walkability is to calculate the walkability Indexes. Global Walkability Index (GWI) made by Krambeck (2006) for the World Bank is the pioneer work in the field. To assess the Global Walkability Index, set of components, indicators and variables are set with a methodology to calculate data and evaluate it. After the World Bank, Asian Development Bank has developed the methodology to calculate it by altering the previous method to match the conditions of the Asian cities (Fabian et al., 2010). This was further used by Luadsakul and Ratanvaraha (2013) to calculate the walkability index by applying weightings to different LOS according to the local conditions of Nakhon Ratchasima Province. Good points of both these indexes were combined to make a new index which is used for the case study of Murree. This index is named as “Local Walkability Index” because it is made after the pilot study for the city

of Pakistan. All these indexes were compared with each other to find the best method for measuring walkability.

2. Case Study Area

The selected case study area is the hub of Murree city which is the most famous tourist town of Pakistan. Murree is a hill station and about 2 million tourists come to Murree on annual basis. The case study area is the most congested area of Murree and is the focus of all the tourists. All the hotels and recreational points of Murree are also present here. The hub and center of case study is the GPO Chowk, which extends to an approximate distance of 2 km towards Kashmir Point and 2 km towards Pindi Point. All the adjoining main roads are part of the case study area. The overall length of the case study from Pindi Point to Kashmir Point is approx 3.43 km and area is approx 4 km^2.

3. Methodology

3.1 Walk Score

It is difficult to assess and quantify Walkability because many factors are affecting it. These include; built environment, traffic condition and delays, land use patterns, social behaviors and human perception (Litman, 2003). Considering the aforementioned factors, the application of walkability index is one of the different methods of evaluation that has been widely used in many countries (Luadsakul & Ratanvaraha, 2013). Many ways have been used and proposed by researchers to calculate it, including web-based tools and Walkability Indexes. There are a variety of web-basedtools that can evaluate neighborhood walkability, in the21st century, none has arguably received as much attentionas Walk Scores ("WalkScore©," 2014). Other then web based tools the most commonly used methods are “Global Walkability Index” developed by Krambeck (2006) for World Bank and ASIA Index developed by The Asian Development Bank according the conditions of Asian cities (Fabian et al., 2010). These methods are difficult to adopt because collecting footpath condition data and level of other pedestrian facilities requires huge financing and considerable amount of time (Frackelton et al., 2013).

Although there is a need for Walk Score validationwork in rural and international contexts, existing validationwork strongly suggests that Walk Score is good atmeasuring various neighborhood walkability features across geographies and its use will increase in the future (Duncan, 2013). In another research, Walk Score has been restricted for only estimating the accessibility to nearby facilities, which limits Walk Score, as a low cost and easy-to-use method, for assessing density of neighborhoods and access to nearby land-uses only (Carr et al., 2010). Walk Score has the ability to provide specific distances tolocal amenities that may influence decision of transport mode e.g., walk or drive (Carr et al., 2011). A study has confirmed that Walk Score has been regarded as a valid measure of estimating neighborhood walkability at different geographical locations and at different scales (Duncan et al., 2011). These all studies specify that Walk Score can reliably measure walkability to different amenities such as park and shops (Carr et al., 2011) and different community design features mainly street connectivity (Carr et al., 2010) but another study limits Walk Score to only a 1600m buffer distance (Duncan et al., 2011). The Walk Score calculated for Murree city is from Mall road which is the center of the city. Thus it can be said that the Mall Road of

Murree has a Walk Score of 53 out of 100 ("WalkScore©," 2014). The area covered on foot by the default time of Walk Score of 20 minutes showed that from Mall Road almost all the central city is within walking range and both Kashmir Point and Pindi Point can be accessed on foot. For the Walkability indexes, the best and most common method used to measure the walkability is Global Walkability Index (Krambeck, 2006). It is used and mentioned in the researches all over the world (Azmi & Karim, 2012a; Hung et al., 2010; Neog). It was further altered by the Asian Development Bank to suit the conditions of Asian cities (Fabian et al., 2010) which is further adjusted in the context of Pakistan to use in this research.

3.2 Global Walkability Index (GWI)

In the original GWI there were two different kinds of surveys, public agency survey and field survey. The public agency survey is simple in which all is required to ask the questions from the public agency related to required data. For this purpose few questions were used by Krambeck that were numerically ranked by assigning points to each response, summing them up and normalizing across results with a z-score by a pre-described plan to include in the rating. To match the methodology with other walkability indexes this survey was not used in the calculation of Global Walkability Index of Murree.

The other survey used in the pioneer study was the field survey. For this purpose city was divided into blocks of 1 km by 1 km or 500m by 500m, depending on the size of the city. Among these, few blocks were selected for the survey and each was surveyed separately by using separate sheets for each block. In this survey, every major road in the block and important streets should be surveyed in the form of stretches. Results can be laid down on a piece of survey form that can be analyzed later. The survey form includes the nine characteristics that were also used in ASIA Index Local Walkability Index.

In the work of Krambeck, these characteristics are called as Level-of-Service (LOS). For each LOS, values were observed from 1 to 5 depending on the condition of that area, after following the guidelines available with the research. These LOS can be observed in the table 1of walkability indexes below. Other than these LOS, lengths of surveyed stretches and pedestrian counts of 10 minutes were also observed. These LOS were then normalized by using the formula $\sum(x*length*10*count)/\#/10$. "#" is the number of stretches observed, length is the length of surveyed stretch in km and count is the pedestrian count of 10 minutes. A final average for all LOS is then collected to calculate the final walkability Index (Krambeck, 2006).

The second known method is the ASIA Index made by CAI-Asia and Asian Development Bank. The methodology used in the ASIA Index is based on the one laid in the GWI. The overall methodology used in ASIA Index is the slightly modified form of the GWI to accommodate complete route assessment. In ASIA Index, field surveys were carried out in each selected city and in 4 different areas, including; residential, educational, and commercial areas and around public transport terminals. Instead of using the pedestrian volume for calculation of index, it is used as the main constraint while selecting the survey areas. In the study, complete route assessments were carried out by following the logical pedestrian routes.

3.3 ASIA Index

In ASIA Index, Field surveyors rated the road stretches in range 1 and 5 for every LOS, for each area type. Although ASIA Index claims that, the averages for each LOS were calculated into a rating system from 0 (lowest score) to 100 (highest score), originally the values are from 10 to 100. It is because with minimum value as 1 and not zero, the minimum value that can be achieved after calculations is 10. The walkability ratings for different area types were calculated by finding the average of the individual parameters' average. The final walkability index was then calculated by talking average of the walkability ratings of all area types of the city.

The method used by CAI-Asia for calculation of ASIA Index is different as compared to GWI because it does not use the number of people walking and the length of the stretch in the calculation of the rating. The reason for not using these parameters is explained by Fabian et al. (2010) that this study does not include number of people walking and length of stretch in its calculation for index rating so that inherent bias can be eliminated. Usage of a certain stretch must not be used as a parameter in calculation of the rating of an area because it affects areas having better facilities but low usage. This is also applicable on length of surveyed stretch. In the pilot study lengths of stretches and pedestrian counts were conducted but not used in the calculation of the walkability rating.

3.4 Local Walkability Index

Taking into account the pros and cons of Global Walkability Index and ASIA Index, an amended methodology is developed to make an improved index named as “Local Walkability Index”. This index can be used for other researches and other cities and will give better walkability rating of a city. The methodology for the selection of the case study area can base on the city and its local characteristics. For this purpose either GWI or ASIA Index methodology can be used to select the sample for doing the survey in case study area. In case of Murree, whole central city is selected as case study area for which the other indexes were also calculated. This shows that the field survey methodology and noted ratings are same for all three indexes but calculations differ.

Local Walkability Index is the continuation of GWI and ASIA-Index, thus similar methodology was used in it. Field Surveys are the major part of the study and were conducted by filing out the field survey form. Just like others, in this method observation surveys were carried out to fill the required survey form. The observation ratings were noted about the LOS / Parameters in range 1 and 10. Although values in GWI and pioneer ASIA Index study were between 1 and 5, the improved methodology for further researches recommended by ASIA Index was to change the range to 1 and 10. 1 is the minimum value, showing bad condition of that parameter and 10 shows the best condition of that parameter. The data regarding each characteristic was noted in the questionnaire which was then analyzed to calculate Local Walkability Index.

To simplify the research and calculating the required data, case study area was divided into different stretches. For each stretch, surveyor walks the entire section of the road and at the end note down the rating of observed facilities for different parameters. Other than ratings of different parameters length of surveyed stretch and pedestrian count of

10 minutes were also required. The lengths were calculated with the help of GIS while pedestrian counts were conducted in the field. Pedestrian counts were observed on weekends for Murree because reconnaissance survey of Murree and interview of officials revealed that being a tourist city, peak traffic in Murree is on the weekends.

The GWI and ASIA Index have some drawbacks, for example, GWI is dependent on length of stretch and pedestrian count. Higher the length or pedestrian count, higher will be the rating. On the other hand ASIA Index completely removes the factor of pedestrian count and length of the surveyed stretch. If two stretches have length of 1 km and 0.1 km, both will be considered equal. In the same way, similar case is for pedestrian count. To find a solution for issues like these, the Local Walkability Index gives the importance to each road stretch according to its percentage in the overall lengths of road stretches. Because of this method, if the length is 1 km for one stretch and 0.1 km for other stretch the overall impact on the walkability rating for 1 km stretch will be 10 times higher as compared to 0.1 km stretch. The same goes for the pedestrian count where percentages of pedestrians will affect the walkability ratings. According to this method, if any road stretch has 0 pedestrians, its ratings effect on the overall rating will be zero. The reason behind using this method is to give more weightage to stretches that are used more or are long. In this way every meter of length has equal value. In the same way, as the planning is for people, every person gets equal share in the rating making high pedestrian count stretch more important than low pedestrian count.

To calculate this index separate values are calculated according to percentage of pedestrians and lengths. The methodology is same as of GWI and ASIA Index in which the calculation is carried out for individual parameter then the final average is calculated. For each parameter, If the values are up to 5, the values can be analyzed by using the formula "[(∑x*l)*20]/Total Length". In which x is the rating of that particular stretch for the selected parameter, l is the length of that stretch in kilometers and total length is the sum of all the lengths of all stretches. In the same way the rating for pedestrians can be taken by using the formula "[(∑x*p)*20]/Total Pedestrian", where p is the pedestrian count of that road stretch and total pedestrians are the sum of all pedestrians counted on all stretches for a period of 10 minutes. In the same way, the rating can be calculated if the values are between 1 and 10. For this purpose, following formulas can be used; "{(∑x*l)*10}/Total Length" and "{(∑x*p)*10}/Total Pedestrian". The final average of both pedestrian and length's values can be calculated to find the final Local Walkability Index.

4. Results & Discussions

The original Global Walkability Index, ASIA Index and Local Walkability Index calculated for Murree city can be observed in the following table. The original GWI contains the values of each section from 1 to 5 but to compare it with other 2 indexes, the GWI was also calculated with values up to 10. In GWI and ASIA Index, 9 parameters were used but for Murree city, it was observed that slope level is a major factor which needs to be added. Murree is a hill town and slope level affects the walkability, this parameter was added. As all three indexes are calculated by taking the average of all parameters' ratings, this or any other parameter can be easily added. Therefore, first ratings without slope were calculated than the ratings were calculated by including slope as a parameter.

Table 1: GWI, ASIA and Local Walkability Indexes

Index	Global Walkability Index		ASIA Index		Local Walkability Index	
	Values 1 to 5	Values 1 to 10	Values 1 to 5	Values 1 to 10	Values 1-5	Values 1-10
1. Walking Path Modal Conflict	78.73	74.93	64.29	59.76	67.98	63.33
2. Availability Of Walking Paths	68.37	65.38	53.33	49.76	58.62	54.98
3. Availability Of Crossings	40.52	30.10	26.67	17.14	35.11	25.76
4. Grade Crossing Safety	97.81	93.77	89.05	82.62	88.08	82.93
5. Motorist Behavior	80.57	74.39	70.00	65.71	69.61	64.69
6. Amenities	76.45	68.14	49.52	44.05	59.50	53.27
7. Disability Infrastructure	42.44	33.24	26.19	16.43	33.69	24.44
8. Obstructions	78.65	73.96	66.19	62.14	69.03	64.69
9. Security from Crimes	107.85	104.67	90.48	85.48	92.81	88.75
Walkability Score	74.60	68.73	59.52	53.68	63.82	58.09
10. Slope	79.95	74.49	59.05	54.76	65.41	61.15
Walkability Score with Slope	75.13	69.31	59.48	53.79	63.98	58.40

From the table 1, it can be observed that the overall rating of original GWI for Murree is 74.60. The values of 1 to 10 are slightly lower because the original values observed from field were from 1 to 10 and the values of 1 to 5 are derived from it. After rounding off the values, the values have fallen because both 1 and 2 means 1 in “values up to 5” and for “values up to 10”, when dividing by 2, 1 get the value of 0.5 and 2 get the value of 1. The same case is for rest of the values, that is why the rating of values up to 10 is less as compared to values up to 5. Furthermore it can be observed from the GWI in the table 1 that security from crimes is very good while availability of crossings and disability infrastructure are the worst. The grade crossing safety is also very good which is close to 100 but the overall values does not properly show what values are good, which range is normal and below what value the condition is poor. It only shows which characteristic need more attention.

The overall walkability ratings of ASIA Index,calculated with values from 1 to 5 and the recommended format for future researches of 1 to 10, without dividing the area into residential, commercial etc. can be observed in the above table 1. To further highlight the differences between walking environments of different cities, this extension was recommended (Fabian et al., 2010). Unlike GWI, values in ASIA Index are between 10 and 100 so one can easily assess the situation for each parameter. Just like GWI, from the above table 1 it can be assessed that the grade crossing safety and Security from crimes are almost at best level and there is very little room of improvement. However the availability of crossings and disability infrastructure are at the worst possible situation and many improvements are needed. Furthermore, amenities and availability of walking paths should also be improved.

The Local Walkability Index for values up to 5 and for values up to 10 can be seen in the above table 1. The walkability rating of Local Walkability Index is 63.82 for values up to 5 and 58.09 for values that are up to 10. As the values can only come between 0 and 100, the condition of the city can be easily assessed without the need for any other

city's index ratings. Unlike ASIA Index, this index can give values of less than 10 because if there are no pedestrians the value will become zero. The recommended division of areas in ASIA Index are residential, commercial, educational and around public transport terminals. However to suit the local conditions of Murree, the areas are separated into recreational, commercial, residential and others. Out of 42 road stretches, 20 were recreational, 6 were commercial and 11 were residential. Only 5 remained which were combined to form one group of others. These stretches include highway areas and areas that are present near public transport terminal. The calculated values for each land-use and their un-weighted averages can be seen in the following table 2.

Table 2: ASIA Index & Local Walkability Index with Categories for Values up to 10

Values: 1 to 10	ASIA Index					Local Walkability Index				
	Recreational	Commercial	Residential	Others	Average	Recreational	Commercial	Residential	Others	Average
1. Walking Path Modal Conflict	54.5	70	62.73	62	62.31	56.49	76.98	63.75	64.6	65.46
2. Availability Of Walking Paths	50.5	60	45.45	44	49.99	52.03	68.58	48.43	42.45	52.87
3. Availability Of Crossings	13.5	38.33	15.45	10	19.32	11.52	57.88	20.14	10	24.88
4. Grade Crossing Safety	81	81.67	85.45	84	83.03	78.9	87.21	88.63	83.04	84.44
5. Motorist Behavior	61.5	71.67	72.73	60	66.47	61.69	68.84	71.38	65.06	66.74
6. Amenities	57.5	36.67	23.64	44	40.45	60.58	53.89	23.32	50.16	46.99
7. Disability Infrastructure	15.5	20	15.45	18	17.24	22.17	32.96	15.57	14.91	21.4
8. Obstructions	67.5	51.67	50.91	78	62.02	66.16	59.33	51.83	78.76	64.02
9. Security from Crime	87.5	96.67	77.27	82	85.86	89.39	97.44	76.64	87.84	87.83
Walkability Score	54.33	58.52	49.9	53.5	54.08	55.44	67.01	51.08	55.2	57.18
10. Slope	54.50	60.00	50.91	58.0	55.85	62.15	61.49	52.59	59.3	58.88
Walkability Score (with Slope)	54.35	58.67	50.00	54.0	54.25	56.11	66.46	51.23	55.6	57.35

From the ratings of ASIA Index, it can be observed that for individual parameters, security from crimes is better in commercial areas as compared to other land uses. In a similar way amenities have highest rating in recreational areas and residential areas have the least rating of present amenities. Overall the walkability rating is almost same in all areas with commercial areas having slightly better walkability and residential areas having least walking friendly environment. The ASIA Index calculations including slope level showed that the walkability rating is highest in commercial areas which is 58.67. It is lowest in residential areas which is 50.00 and recreational areas and other land uses have similar ratings of 54.35 and 54.00 respectively. After calculating the average of these four values the average rating is 54.25. It is slightly less than the overall rating because it does not cater the number of pedestrians and lengths of stretches on different land uses. Just like ASIA Index, the Local Walkability Index can also be calculated for individual land uses which can be observed in the above table 2. The overall calculations showed that even though the slope is added as a parameter, the value has minutely changed. The overall rating has improved to 57.35 from 57.18 in the same way, the ratings of all landuses have also increased slightly except for commercial areas whose rating has declined. The analysis of slope level shows that the slope is only at satisfactory level with a rating of 58.88. This can be improved by making stairs and making the paths a little plain.

5. Comparison of three Indexes

It can be clearly observed from table 1 that the Global Walkability Index (GWI) has the highest rating of 74.60. The Local Walkability Index has the second highest value of 63.82 and ASIA Index has the lowest rating value of 59.52. The positive point about ASIA Index and Local Walkability Index is that these values are between 0 and 100, so the analysis is easy. On the other hand GWI can have as high value as possible. If the lengths and pedestrian counts increase, this value increases. This can be observed in the context of Security from Crimes, where GWI rating is 107.85. The GWI has highest ratings for each parameter but for the other two indexes, different index has high value for different parameter. For example; Local Walkability Index has high value for Availability of Walking Paths while grade crossing safety shows a high index rating for ASIA Index. As the overall value of Local Walkability Index is slightly high as compared to ASIA Index, it can be concluded that there are more facilities on longer stretches or the stretches that have more pedestrians and the facilities are less on short stretches and the road stretches that have low traffic count. As all three indexes take the overall average, in the end the parameter of slope can be added to each Index. Other than increasing the parameter, the walkability ratings of GWI and ASIA index can also be calculated for values up to 10 which were already explained. The calculated walkability indexes with parameter of slope and values up to 10 can also be seen in the table 1. With addition of slope the difference in the ratings of ASIA and Local Walkability Index has increased some more with approx 5 points which was 4 in the calculations without slope. This shows that increasing or decreasing a parameter can affect the ratings. Just like previous calculations, the level of slope is also highest in GWI along with rest of the parameters.

The analysis of the above indexes shows that the overall condition of walkability is only at a satisfactory level and there is a lot of room for improvement in the overall walkability of city. Among the parameters, availability of crossings and disability infrastructure are at the worst level. Even though availability of crossings has low rating value, grade crossing safety shows that it is not an issue in Murree. The major issues in Murree are the non-availability of sidewalks and conflict of pedestrians and vehicles. Of all the parameters, grade crossing safety and security from crimes are the only two parameters which are very good and only a little improvement is possible. From all the above analysis and calculations, a summary is made which is presented in the table 3 below;

Table 3: Comprison of GWI, ASIA and Local Indexes

Characteristics	GWI	ASIA Index	Local Index
Increasing any new parameter	✔	✔	✔
Individual Analysis	✘	✔	✔
Calculations for values upto 10	✔	✔	✔
Dependency on pedestrian count	✔	✘	✔
Inclusion of stretches with zero pedestrian count	✘	✔	✔
Dependency on length	✔	✘	✔
Moderate time taking	✔	✔	✔
Surveyor Biasness	✔	✔	✔
Rating Value Range	infinite	Up to 100	Up to 100

6. Conclusion

This study mainly focused on the measurement of walkability of a city in the form of walkability indexes. Two existing walkability indexes; Global Walkability Index and ASIA Index, were analyzed in detail and after combining the good points of both indexes and development of an improved methodology Local Walkability Index is developed. The methodology was then applied on the Murree city which is the most prominent tourist city of Pakistan.

The study concluded that the easiest and least costly methods to measure the walkability rating of an area are web based tools, among which WalkScore is the most prominent. WalkScore is dependent on the accessibility of land-uses rather than the facilities available for pedestrians. The calculated WalkScore of Murree city from Mall Road, which is the city center, is 53 out of 100. The other walkability indexes calculated after proper surveys, dependent on the facilities for pedestrians, showed a slightly better condition. The original GWI for Murree is 74.60, ASIA Index is 59.52 and the new index named Local Walkability Index is 63.82. The ASIA Index and Local Walkability Index are out of 100 while GWI can go much higher than 100.

Similar methodology is used for all three indexes which show that all indexes can be calculated from the same field data. It also illustrates that if the individual ratings of all stretches are present for any old research, which were collected for either GWI or ASIA Index, the Local Walkability Index can also be calculated for it. The research also shows that Local Walkability Index is the best index among the three, because it is the extension of other researches and has positive points of both indexes. Walkability Indexes are a good way to analyze the area specifying the parameters which are good and parameters which need improvement. It is also possible to add new parameters in walkability indexes according to need, for example “Slope level” was added in the context of Murree. Overall the index value of more than 80 out of 100 should be considered as good rating. Using the data of individual stretches, it is easy to find the required improvement in specific road stretch which can increase the index value.

The methodology for the development of walkability indexes require considerable amount of time and money and the only limitation is the biasness of the surveyor. For the improvement in the ratings, it is recommended that for future researches values are observed from 0 to 10 rather than 1 to 10. This will calculate the rating from 0 to 100 instead of 10 to 100. Furthermore weightages may be applied to different parameters for the future studies.

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