City for All Ages: Elderly Residents’ Perceptions of Walkability Attributes in Residential Areas

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Abstract. Residential area is the main area for the elderly to carry out daily activities. The walkability of residential areas directly affects the quality of life of the elderly residents. It is also a symbol of the degree of walkability and the pace of green city construction. To test the influence of urban built environment on walkability in residential areas, this study developed a questionnaire to perceive the elderly residents’ perception of walkability around their neighbourhood, which was based on the Neighbourhood Environment Walkability Scale—Mainland China (NEWS-MC), and modified to reflect the characteristics of residential areas built environment and elderly residents’ behaviour mode. To perceive the final version of Neighbourhood Environment Walkability Scale for elderly residents’ (NEWS-E), We made a pilot study that include 50 samples, and then interview 300 elderly residents from 6 selected residential districts in Harbin, which were different in walkability attributes and economic status. The final version of the NEWS-E included 8 subscales and 4 single items (86 items in total). Test-retest reliability showed moderate to high in total, the NEWS-E could illustrate elderly residents’ perceptions of walkability attributes in residential areas and could be use in other Chinese urban attributes studies related to walking.

1. Introduction

The high speed of cities sprawl and urban regeneration worldwide make public space and acclivities in public space gain increasingly attention than ever. Meanwhile, there is growing interest on research about relationship between built environment attributes and users’ physical activity [1-2]. Studies focus on walking suggest than higher residential density, higher level of land use mix- both diversity and accessibility [3-4], more aesthetic elements are attributes could hence more walking, and associated with neighborhoods more walkable [5-6]. ‘Walkability’ is referred to and generally defined as ‘...the extent to which walking is readily available as a safe, connected, accessible and pleasant mode of transportation’. In the last decade, there was increasing evidence of the influence of neighborhoods built environment characteristics on walkability. Smith and Clifton illustrated that a built environment friendly to pedestrians usually includes characteristics such as high density, convenience to walk to facilities, system coherence, high street connectivity, safety from traffic and crime, comfortable and attractiveness [7]. Researcher in urban planning and transportation also identified key environment attributes on creating walkable neighborhood. Cervero and Duncan found density, trip distance, land use diversity, existing of sidewalk and bike lane could affect people’s choice of walk or bike [8]. The
studies by De bourdeaudhuij demonstrated the effects of space proportion, size of block and traffic congestion on user’s choice of travel mode [9]. To make more research on influence of urban environment’s walkability on physical activities and psychological health or residents, valid measures of walkability are needed. The Neighbourhood Environment Walkability Scale (NEWS) and its abbreviated version (NEWS-A) are developed for use in USA to measure residents’ perceptions of the environment attributes [10]. They value built environment characteristics that are believed to affect residents’ walking choice. Both NEWS and NEWS-A have been found have moderate to high rest-test reliabilities [11], and good criterion the evidence illustrated high-walkable neighbourhoods be found with higher density, land-use mix, street connectivity, more safety and have more aesthetics elements [12]. NEWS and NEWS-A have already been modified and applied in many countries, such as US, Australia, Korea and Hong Kong, and also in Mainland China cities (modified as NEWS-MC). the validity and reliability of the NEWS or NEWS –A have not been examined in mainland China.

However, NEWS has not been applied to different user groups. Compared with other age groups, the elderly residents have obvious differences in travel time, travel mode and destination. At the same time, due to walking speed, physical condition and other factors, the elderly's perception of the built environment of residential areas is also different from other groups. Therefore, it is necessary to establish the environmental perception scale for the elderly residents in residential areas for the elderly friendly and walking friendly design of residential areas.

2. Method

2.1. Measures

Neighbourhood Environment Walkability Scale (NEWS) is an instrument used to obtain residents’ perception of built environment attributes related to walking and bicycling around where they live. The original NEWS includes 98 items and is rarely used, the abbreviated version of it, NEWS-A, which has similar structure to the full version but has fewer items in subscales, is commonly used and have been modified applied in many countries (Brazil, Australia, Poland, Korea, Mexico, Hong Kong and Mainland China). So in this study we used NEWS-MC as the source to develop the NEWS version, which appropriate for Elderly residents (NEWS-E). NEWS-MC has 8 multi-item subscales, a) residential density; b) land- use mix-diversity; c) Land-use mix-access; d) street connectivity; e) infrastructure and safety for walking; f) aesthetics; g) traffic hazards and h) Crime safety, and 5 single-item subscales, including Lack of parking, lack of cul-de-sacs, hilliness, physical barriers and social interaction while walking. All items accept the ones in residential density and land-use mix- diversity subscales are rated on a 4-point Likert scale (1- strongly disagree, 2-disagree, 3-agree, 4- strongly agree). Items in residential density subscale are rated on 5-point Likeert scale, by asking about the frequency of perceive certain type of residences, and weighted ratings are summed to make a residential density perceptions score. Land-use mix-diversity is assessed by time walking from home to various types of destinations, with responses ranging from distance for 1-5mins walking (coded as 5) to distance for more than 30mins walking (coded as 1).

2.2. Participants and procedures

2.2.1. Development and adaptation. The NEWS-MC were developed for all age groups, to develop a version of NEWS which could adapt build environment attributes reflects elderly residents’ need, 6 experts from multi- research fields, urban planning and urban design (2 members), public health (1 member), environment- behavior studies (1 member), physical activity(1 member) and Rehabilitation & Healthcare(1 member) were interviewed with a goal to draft a NEWS-E. All members of the committee reviewed NEWS-A and NEWS-MC, we also provided them NEWS-Brazil, NEWS for Korea and NEWS Hong Kong as reference. Committee members gave their opinions on whether each item should be kept, modified or deleted, or any item should be added after careful thinking about
items relevant to residential areas’ environment characteristics and elderly residents’ behavior mode. In total, 72 items in NEWS-MC were kept, 9 of the were modified, 14 new items were added and 2 items was deleted considering their relevant to the study setting. (Table 1).

Table 1. Adaptations of the NEWS-MC for elderly residents

| Item | Addition items |
|------|----------------|
|      | Distance to community park with exercise facilities |
|      | Distance to community park with chair or rest facilities |
|      | Distance to community park could do square dancing |
|      | Distance to community pharmacy store which could use health insurance card |
|      | Distance to grocery store on street (not attached to shopping mall) |
|      | Distance to grocery store attached to shopping mall |
|      | Distance to community center with facilities for elderly |
|      | Distance to public toilet |
|      | Can easily access the entrance/exit of the building I live in (e.g., there is a lift that I can use) |
|      | There are sitting facilities (e.g., benches) where I can rest in my neighborhood |
|      | I am afraid to cross the road because there are too many passing cars |
|      | There are many covered sidewalks in my neighborhood. The streets of my neighborhood are often slippery. |
|      | It would be difficult to ask for help in my neighborhood because there are not many people around |

| Item | Modifications items |
|------|---------------------|
|      | ‘There are indoor, air-conditioned places (shopping malls) where people can walk’ change to |
|      | ‘There are indoor or half indoor places (shopping malls) where people can walk’ Destination |
|      | ‘fruit/vegetable market’ renamed ‘fresh food market’ |
|      | ‘Destination ‘recreation centre’ changed to ‘recreation and entertainment centre’ |
|      | ‘There is a grass/dirt strip that separates the streets from the sidewalks’ changed to ‘there is a fence that separates the streets from the sidewalks. |
|      | Destination ‘clothing store’ changed to ‘clothing & shoe store’. |
|      | ‘Walkers and bikers on the streets can be easily seen by people in their homes’ changed to ‘walkers and bikers on the streets can be easily seen by other people’. |

| Item | Deleted items |
|------|---------------|
|      | Item ‘Parking is difficult in local shopping areas’ omitted |
|      | Destination ‘your job or school’ |

14 items were added to the questionnaire to provide a better match elderly residents’ travel mode and behavior feature such as ‘Distance to public toilet’ is relevant to older adults (incontinence), ‘The streets of my neighborhood are often slippery. It is a hazard on steep road sections, common in Chinese cities residential areas. ‘There are sitting facilities (e.g., benches) where I can rest in my neighborhood’ is important feature for older adults. 9 Items are modified for adapted residential areas characteristics and elderly residents’ behavior feature. Such as ‘Destination ‘fruit/vegetable market’ renamed ‘ fresh food market’ as markets usually sell vegetables, fruit as well as fresh meat and seafood. Item ‘There is a grass/dirt strip that separates the streets from the sidewalks’ changed to ‘there is a fence that separates the streets from the sidewalks’ because Grass/dirt strips sometimes is uncommon in residential areas in some Chinese cities. Metal fences are used to separate sidewalks from roads. 2 items are removed from the list because they are irrelevant. Item ‘Parking is difficult in local shopping areas’ and ‘distance to your job or school’ are also removed because they are irrelevant to the study setting.
areas’ is deleted because elderly residents usually do not drive nor own a car. Item ‘destination ‘your job or school’ is deleted because not relevant as they are retired. (see Table 1).

2.2.2. Test-retest reliability Potential. Participants were chosen from the six Harbin residential areas mentioned above, the economic status were obtained from national 2015 Census data. Walkability was measured by residential density, intersection density, destination density (service, commercial and facilities), road density (length of street could walk per km2) and type of street block (square grid, radial shape or have many cul-de-sacs). These data were achieved from baidu map (http://map.baidu.com/). Six residential areas, with 70 potential participants were chosen randomly from each neighborhood. The survey was done in November 2018, we went to each neighborhood in both weekday and weekend, morning, noon and evening. When picking the participants, firstly we found elderly resident showed up in that area and asked whether their age is above 55 and whether they lived in this area, if the answer was yes, we further asked whether they would be willing to be reassessed 10 days later after the first survey, and they were told if they finished both survey, they will get 10RMB as reward. After confirm aged over 55, lived in that residential area and agreed to attend both survey, one became our participant. The process in two kind, one was the paper questionnaire, and put name and address and home phone number on the front page, the other was the interviewer and the participants added each other as ‘friend’ on wechat (a social App with high popularity in smart phone holders of all ages, add as friends mean two can message each other, and could also pay and receive money, receive and send documents to each other), then sent them the NEWS-E questionnaire forms, the participants could contacted the interviewer by wechat if they had any questions about the questionnaire. after they sent the first-time forms back, they could get 3RMB. 10 days later we sent them the forms again, and gave who sent forms back 7RMB, the ones who did not sent form back were reminded twice on wechat. The interval between the two surveys ranged from 10-16 days (average 12.4 days). The recruitment rate of the first survey was 83%, 43, 55, 56, 44, 57 and 55 participants responded the second survey, so the total recruitment rate is 7.

3. Results

402 participants attended the first survey, with 172 men and 230 woman, mean age 60.6, 21% participants had a collage degree or above. Among all participants, only 5.2% of them own 1 car or more, and 22% reported they use public transportation ‘very often’, and 64.5% reported they usually walk as travel mode and most of the destinations are in the residential areas they live in. Three hundred participants completed both surveys (132 men and 168 woman), response rate was 74.6%. The sample size per neighborhood was: 43, 55, 56 in high-walkable neighborhoods, 44, 57, 55 in low-walkable neighborhoods.

Through previously built satisfaction systems, we took ICC value below 0.50 as poor, 0.50 to 0.75 as moderate, and above 0.75 as reliability. Test-retest reliability for all subscales and single items of the NEWS-E are shown in Table 2. All subscales and single-items except one- hilly roads- showed moderate to good level of reliability (>0.75), 4 subscales or single items show high level of reliability (>0.90), and all p<0.05.

Table 2 NEWS-E Test-retest reliability and mean subscale scores for Residential areas with different walkability

| Subscale/single item(no. Items) | Test-retest reliability(N=350) | High-walkable (N=183) Mean (SD) | Low-walkable (N=167) Mean (SD) |
|--------------------------------|-------------------------------|---------------------------------|-------------------------------|
| Residential density(6)         | 0.82                          | 3.87(0.31) a**                  | 2.21(0.29)                    |
| Land-use mix – diversityc(30)  | 0.91                          | 4.01(0.38) a**                  | 2.24(0.30)                    |
| Land-use mix – access(7)       | 0.85                          | 3.25(0.31) a*                   | 1.88(0.40)                    |
Table 2 illustrates the results of mean scores on neighborhood walkability subscales between residents from high-walkable and low-walkable neighborhoods. Residents from high-walkable neighborhoods provided ratings indicative of higher residential density, land-use mix-diversity, land-use mix-access, street connectivity, aesthetics infrastructure and safety for walking, traffic hazards, physical barriers, and social interaction while walking. Mean while, residents from low-walkable neighborhoods provided higher ratings of infrastructure and safety for walking of their neighborhoods. Elderly residents’ perception of crime safety, not having many cul-de-sacs, and hilliness did not show difference between low and high walkable neighborhoods.

### Discussion

The result of this study supports the applicability of the NEWS-E to elderly residents in Mainland Chinese residential areas, such as Harbin. The data showed significant difference in elderly residents’ perception on built environment characteristics between high-walkable and low-walkable urban areas. Residential density, land-use mix-diversity, land-use mix-access, street connectivity, aesthetics, traffic hazards, physical barriers, and social interaction while walking illustrated residents could perceive higher level of attributes in these subscales from high-walkable neighborhoods. The walkability of the neighborhoods was objectively measured by residential density, land-use mix, and pedestrian sidewalk connectivity, and the elderly residents’ self-reported result reflected the difference of perceiving these attributes. It is observed that the different direction of ratings on infrastructure and safety for walking, low-walkable neighborhoods were rated higher in most of the items in this subscale, which is different in all aged group study, may be attributed to elderly residents’ preference of more on the open view and wider street which made them have a open view, and the infrastructures elements in low walkable neighborhoods do not have much difference from the high walkable neighborhoods. The insignificant on crime, hilliness and cul-de-sacs subscales were likely because Harbin is a flat city without many hill and the public order is very good here, and the road network in Harbin is basically grid or radiate, the cul-de-sacs is very rare even in residential area, so elderly...
residents can not perceive the relationship between items in these subscales or single items and walking, the result of these 3 subscale is the same as the NEWS-MC study. The mean values comparison between NEWS-E to NEWS-MC and NEWS United States, Australia and Hong Kong indicated that, as hypothesis, residential density was rated much higher than US and Australia but lower than Hong Kong. This can be attributed to the fact that the overall mainland Chinese cities are medium to high density, the urban residential density is higher than US and Australia, but lower than Hong Kong. Land-mix diversity was rated higher in both high-walkable and low-walkable neighborhoods than all the other three studies. It should be notice that the previous studies all used the long version NEWS and we used NEW-A the measure instrument, precluded a direct comparison of the findings.

The limitations of this study include: 1) The participants are the ones who will to attend the survey, not matched on individual respondent demographic. 2) We only do research in for limited residential neighbourhoods, the small number of areas and small sample number of participants may have limited the reliability and variability of some items. 3) We may omit some environment attributes that related to Elderly residents.

Acknowledgments
This work was supported by China Postdoctoral Science Foundation Funded Project (Project No.:2017M612177)

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