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Key Messages

1. Reliable and valid interviewer-administered questionnaires were developed to investigate associations of perceived neighbourhood attributes of Hong Kong older adults with their walking for transportation and recreation.

2. Access to and availability of different types of services and destinations, provision of facilities for resting/sitting in the neighbourhood, and easy access to/from residential buildings may help maintain an active lifestyle by facilitating walking for transport in the neighbourhood.

3. Access to services, indoor places for walking, environmental aesthetics, low traffic, and absence of physical barriers may promote recreational walking.

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Effects of built environment on walking among Hong Kong older adults

Introduction

The number of senior residents (aged 65+ years) in Hong Kong is projected to reach 2.3 million in 2013, corresponding to 27% of the total population.[1] Regular engagement in physical activity contributes to healthy ageing. Walking is recommended for seniors because it is versatile, affordable and relatively safe. The accrual of 30 minutes of walking on most days of the week is deemed to have significant health benefits.[2]

The neighbourhood environment plays a decisive role in facilitating residents' walking.[3,4] Knowledge of built environmental characteristics conducive to an active lifestyle can inform policies on public health, land use, and transportation. Neighbourhood safety, aesthetics, access to facilities, and street connectivity (number of intersections) are positively related to walking in seniors.[4] In western countries, the impact of the neighbourhood environment on the physical activity levels of seniors has been studied. It is unknown whether the associations can be generalised to an Asian urban context, which is markedly different in culture and built form. Hence, this study aimed to develop and validate instruments for investigating the associations between the built environment and walking in senior residents of Hong Kong and other similar Chinese cities, and to provide effects of perceived attributes of the neighbourhood on walking for different purposes.

Methods

This study was conducted from October 2006 to July 2008. It consisted of two stages: (1) translation/development and validation of self-report instruments of the perceived neighbourhood environment, and (2) assessment of walking within and outside the neighbourhood. The original measures for adaptation to a Chinese-speaking senior population were the abbreviated Neighbourhood Environment Walkability Scale (NEWS-A)[3] and the walking section of the Neighbourhood Physical Activity Questionnaire (NWQ).[5]

A multi-disciplinary panel of experts adapted the original NEWS-A to reflect the built environment of Hong Kong and needs of seniors. The adapted NEWS-A and NWQ were translated into Chinese, back-translated into English, and pilot tested on a sample of Hong Kong seniors aged 65+ years who were able to walk without assistance, had no cognitive impairment, and resided in a priori selected locations. They were recruited from Elderly Health Centres (EHC) in Wan Chai, Nam Shan, Tseung Kwan O, and Yuen Long.

These EHCs were selected based on walkability and socio-economic status (SES) of their catchment areas (districts). Based on information from the Census and Statistics Department and the Centamap (www.centamap.com), median household income and percentage of owner-occupiers were used as measures of SES, whereas household density, intersection density, and commercial and service destinations density were used as measures of walkability. Eight street blocks were randomly selected in each area (total 32 street blocks). The median household income ranged from HK$12 200 to 25 000 and the percentage of owner-occupiers ranged from 42% to 62%. Approximately 15 EHC members

were recruited from each street block.

The Chinese-versions of the NEWS-A and NWQ (hereafter named NEWS-ACS, and NWQ-CS, respectively), and the long version of the International Physical Activity Questionnaire (IPAQ)[3,5] were interviewer-administered to consenting participants (recruitment rate, 78%). Socio-demographic information was also collected. Participants were asked to wear an accelerometer (motion sensor) for a week, keep a diary of walks, and be reassessed 2 weeks after the first assessment. Of 96 consenting participants recruited (three per street block), 94 provided valid accelerometry/diary data. The built environment (400 m radius circles around 32 street blocks corresponding to ~13-minute walking distance for Hong Kong older adults) was collected via environmental audits.

The original NEWS-A was a 54-item questionnaire assessing perceived environmental characteristics related to walking.[3] The NEWS-ACS included 22 additional items describing features of the environment relevant to the study setting and target population. The NWQ-CS consisted of the same items of the original NWQ, which assessed usual walking within and outside the neighbourhood (defined as a 10-15 minute walk from home).[5] Participants reported the frequency, duration, destinations of walking for recreation and transport within and outside the neighbourhood. Physical activity was assessed using the long version of the IPAQ,[3,5] which consisted of five domains: work, transportation, housework and house maintenance and caring for family, leisure-time, and sitting. Respondents reported the number of days per week and the time per day they usually spent doing these activities.

A weekly diary of walks was used to record within and outside neighbourhood walking. Accelerometers (motion sensors), worn for a week during waking hours, were used to measure ambulatory activities. The numbers of minutes of non-sedentary activity, within the timeframe of each walking trip/period recorded in the diary, were computed for each participant and summed for each of the four categories of walking for transport and recreation within and outside the neighbourhood. A validated audit tool (modified for Hong Kong so as to provide data comparable to those collected via the NEWS-ACS) was used to collect multiple-rater objective environmental data on the participants' neighbourhood environment (every street within a selected 400 m buffer zone).

Results

There were 50 subjects in the pilot study and 484 (283 women and 201 men; 67% aged 65-74, 31% aged 75-84, and 3% aged 85+) in the validation study.

Factor analysis indicated that the NEWS-ACS consisted of 13 multi- and 4 single-item inter-correlated constructs: residential density, heterogeneity of land use, access to services, physical barriers to walking, street connectivity, human and motorised traffic, infrastructure for walking, indoor places for walking, aesthetics, social disorder/litter, traffic speed, presence of people, crime, fence separating traffic from sidewalks, bridge/overpass connecting to services, easy access of residential entrance, and sitting facilities. Most items showed moderate-to-excellent levels of test-retest reliability (intraclass correlation [ICC], >0.40).

Regression models were used to examine the associations of perceived neighbourhood attributes (measured by the NEWS-ACS) with matching attributes from objective environmental audits. Most correlations were significantly positive and ranged from small ($0.11 > r > 0.24$) to large ($r > 0.37$). This suggested that perceived neighbourhood attributes could be proxies of objective environmental characteristics.

Regression models were used to examine the extent to which perceived neighbourhood attributes (measured by the NEWS-ACS) were related to walking for different purposes (measured by the NWQ-CS), adjusting for demographic characteristics and total weekly minutes of physical activity other than walking (measured by the IPAQ) [Table]. Absolute values of >0.37 represent strong associations, whereas values of 0.10 to 0.24 represent moderate associations. Weekly minutes of walking for transport was positively associated with perceived heterogeneity of land use, access to services, human and motorised traffic, crime, easy access to residential entrance, and sitting facilities in the neighbourhood. Walking for recreation was positively associated with access to services, street connectivity, indoor places for walking, and bridge/overpass connecting to services. Physical barriers to walking was negatively associated with human and motorised traffic. These

Table. Associations of perceived neighbourhood attributes with self-reported weekly minutes of walking within the neighbourhood

Attribute	Walking for transport (r)	Walking for recreation (r)
Residential density	0.07	-0.06
Heterogeneity of land use	0.15[‡]	0.01
Access to services	0.11*	0.10*
Physical barriers to walking	0.06	-0.09*
Street connectivity	0.06	0.09*
Human and motorised traffic	0.12[†]	-0.09*
Infrastructure for walking	0.06	0.01
Indoor places for walking	0.07	0.12[†]
Aesthetics	0.01	0.10*
Social disorder/litter	0.06	0.01
Traffic speed	-0.05	-0.07
Presence of people	0.03	-0.06
Crime	0.11*	0.01
Fence separating traffic from footpath	0.01	0.03
Bridge/overpass connecting to services	-0.03	0.09*
Easy access of residential entrance	0.11*	0.08
Sitting facilities	0.20[‡]	0.03

* P<0.05
[†] P<0.01
[‡] P<0.001

findings indicated that some environmental characteristics influenced the walking behaviour of Hong Kong seniors.

Moderate-to-excellent test-retest reliability was noted for all NWQ-CS items, except for weekly minutes of walking for transport outside the neighbourhood. The same variable had the weakest association with walking measured via an accelerometer/diaries (ICC=0.35, P<0.001) owing to the participants' tendency to underreport this type of walking in the NWQ-CS. No other significant differences were noted between mean weekly minutes of walking collected using the NWQ-CS and accelerometry/diary data. The associations between NWQ-CS and accelerometry/diary measures of other types of walking ranged from 0.52 to 0.77. Overall, the associations were higher than those observed for other self-reported measures of physical activity, and this supported the validity of the NWQ-CS.

Discussion

Accelerometry/diary data recorded walking in the last 7 days, whereas the NWQ-CS measured habitual walking. This might have yielded lower levels of concurrent validity than when the NWQ-CS had captured walking in the last 7 days. Studies using the NWQ-CS as a measure of context-specific walking for different purposes need to interpret estimates of transport-related walking outside the neighbourhood with caution.

Validity of the NEWS-ACS was based on associations between perceived environmental characteristics and walking behaviour. Access to and availability of services,[3,4] access to residential entrance, and the presence of sitting facilities in the neighbourhood were potential determinants of walking for transport in Hong Kong seniors. Several other perceived environmental attributes tended to be related to walking for transport in the expected direction. Perceived crime, and human and motorised traffic were positively associated with walking for transport. This may be due to the fact that residents may be more aware of crime in their local areas, and destination-dense, busy areas tend to attract more crime and have higher levels of traffic.[3] Environmental aesthetics (presence of greenery and attractive sights), access to services, street connectivity, indoor places for walking, and bridge/overpass connecting

to services were potential determinants of recreational walking.[3,4] In contrast, human/motorised traffic and physical barriers to walking were possible deterrents of recreational walking.[3] Although most correlates of walking in older adults were similar to those observed elsewhere and in younger cohorts,[3,4] neighbourhood attributes that were peculiar to Hong Kong (access to residential entrance—lifts in high-rise buildings) and seniors (facilities for sitting and resting) were identified. Thus, an environment supportive of walking may help Hong Kong older adults maintain an active lifestyle.

Acknowledgements

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