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## **Walkable area within which destinations matter: Differences between Australian and Japanese cities**

### **Abstract**

Adults' walking for transport is important for health benefits and can be associated with availability of destinations such as shops and services within 10–15 minute walk distance from home. However, relevant evidence is mostly from Western countries. This study examined associations of destinations with walking for transport in Australian and Japanese cities. Data were collected from Adelaide, Australia (n=2508) and four Japanese cities (n=1285). Logistic regressions examined associations of self-reported walking for transport with the number of destination types within walk-distance categories. Walking was significantly associated with the number of destination types within a 10 minute walk from home for Australia and with the number of destination types within a 6–20 minute walk for Japan. Further research is needed on why walking by residents of Japanese cities can be influenced by more-distant local destinations than in Australia, in order to inform physical activity-related environmental and policy initiatives.

### **Keywords**

environment, international comparison, neighbourhood, proximity, walking

## 1 INTRODUCTION

2 Identifying the built-environment attributes of urban areas that may influence adults' walking is  
3 important to inform the development of environmental innovations and policy strategies for  
4 increasing physical activity and reducing risk of major chronic diseases.<sup>1</sup> The availability of  
5 local destinations is associated with walking for transport, but it is unknown how close  
6 destinations should be in order to facilitate walking.<sup>2,3</sup> Studies using perceived-environment  
7 measures (based on study participants' self-reports) typically consider an area within 10–15  
8 minute walk from home as being walkable and ask about attributes within that distance.<sup>4</sup> It has  
9 been shown that the perceived availability of, or proximity to, local destinations within such a  
10 distance category can be associated with walking for transport in Australia<sup>5</sup> and the USA.<sup>6,7</sup>  
11 However, it is unknown whether this criterion is applicable to other countries, particularly in  
12 Asia. More studies in the context of Asian countries – where the risk of major chronic diseases  
13 is increasing – are needed to inform local environmental and policy initiatives to increase  
14 population-wide participation in physical activity.

15  
16 To identify potential variations in the area within which adult residents are likely to walk, we  
17 examined the associations of available local destinations (the number of utilitarian destination  
18 types) with walking for transport, across different perceived walk-distance categories in  
19 Australian and Japanese cities.

20

## 21 METHODS

### 22 Samples

23 *Australia:* Data were collected in Adelaide (population: 1.1 million), the capital of South  
24 Australia, during 2003–2004. Detailed methods have been described elsewhere.<sup>5</sup> Briefly, study  
25 participants were drawn from 154 urban Census Collection Districts (CCDs). These CCDs were

26 selected from the top and bottom quartiles in “walkability,” a composite measure consisting of  
27 dwelling density, land use mix, intersection density and net retail area ratio,<sup>8</sup> in order to  
28 maximise environmental variability. Within the identified CCDs, residential addresses were  
29 randomly sampled, and residents of private dwellings aged between 20 and 65 were invited to  
30 participate. Eligible participants who agreed to take part were mailed a survey. The total  
31 number of responses was 2650. The return rate for those who completed the survey as a  
32 proportion of those who responded to our initial request was 74.2%. The overall response rate  
33 as a proportion of all households initially identified in the sampling frame was 11.5%. The  
34 study was approved by the Behavioural and Social Sciences Ethics Committee of the University  
35 of Queensland.

36  
37 *Japan:* Data were collected from four cities (Tsukuba, Shizuoka, Kagoshima and Koganei)  
38 between February 2007 and January 2008. In each city, using the registry of residential  
39 addresses, 1000 adults (20–69 years) were randomly selected from all residential areas  
40 (smallest administrative units) regardless of their population, stratified by gender and age  
41 category. These cities were chosen to include a wide range of environmental attributes. Among  
42 them, three are regional cities (Tsukuba, Shizuoka and Kagoshima) and one is a municipality in  
43 the Tokyo metropolitan area (Koganei). Tsukuba (population: 215,000) is a university town  
44 located 50 km northeast of Tokyo. Shizuoka (population: 726,000) and Kagoshima (population:  
45 606,000) are a regional centre located in central and western Japan. These regional cities have a  
46 relatively dense inner-urban area, surrounded by suburban residential, industrial and  
47 agricultural areas. Koganei (population: 115,000) consists mainly of commercial and residential  
48 areas. Of the chosen residents, 1508 returned the survey (response rate = 37.7%). The study  
49 received prior approval from the Tokyo Medical University Ethics Committee.

50

51 **Measures**

52 The outcome variable was self-reported walking for transport, which was dichotomised into no  
53 or any walking. In Australia, the frequency of walking for transport in the last seven days and  
54 the average duration of walking for those days were asked, using the long version of the  
55 International Physical Activity Questionnaire.<sup>9</sup> In the Japanese study, participants reported daily  
56 minutes of walking for commuting (to work and to school) and errands in a typical week. The  
57 validity of this walking measure (including walking for recreation) against pedometer was  
58 found reasonable.<sup>10</sup> Participants were advised to consider walking that lasted more than 10  
59 minutes in Australia and 5 minutes in Japan. Walking duration was not used in this study  
60 because it may depend more on distant destinations, and underestimate the importance of  
61 nearby destinations.

62  
63 The exposure variable was the number of destination types within different perceived  
64 walk-distance categories (measured in minutes). This was assessed in both countries using a  
65 part of the Neighborhood Environment Walkability Scale, a validated instrument to measure  
66 environmental attributes relevant to physical activity.<sup>11</sup> Participants were asked how long it  
67 would take to walk to the nearest business or service for each of the 11 types: local shop,  
68 supermarket, greengrocer, dry cleaning, post office, video shop, pharmacy, bookshop, library,  
69 café/restaurant and gym/fitness club. They were included in both studies as commonly available  
70 neighbourhood destinations. The response categories were within 5, 6–10, 11–20, 21–30 and  
71 30+ minute walk from home. The number of destination types that existed within 5, 6–10,  
72 11–20 and 21–30 minute walk was identified for each participant.

73  
74 Participants also reported the following socio-demographic characteristics: age, gender,  
75 education, work status, having a child in household and car ownership.

76

## 77 **Analyses**

78 Logistic regressions examined associations of walking for transport with the number of  
79 destination types within 5, 6–10, 11–20 and 21–30 minute walk, adjusting for the  
80 socio-demographic variables, separately for Australia and Japan. Models included the four  
81 destination variables simultaneously. The model for Adelaide corrected for CCD-level  
82 clustering, and that for Japan adjusted for cities. Analysis was conducted using STATA10.

83

## 84 **RESULTS**

85 The final samples excluded those who left the majority of destination items blank, those who  
86 did not answer the walking questions, and those older than 65 years. The final Australian  
87 sample was 2508 adults (mean age: 44.3), consisting of 64% women, 46% with tertiary  
88 education, 62% with job, and 31% with one or more children in the household. The final  
89 Japanese sample was 1285 adults (mean age: 45.6), consisting of 55% women, 60% with  
90 tertiary education, 79% with job, and 29% with one or more children. In both samples, about  
91 10% had no car, 40% had one car, and 50% had two or more cars.

92

93 Table 1 shows the prevalence of walking for transport and the number of destination types in  
94 each perceived walk-distance category by localities. In Adelaide, 77% of participants reported  
95 walking for transport, and the median duration of walking was 120 minute/week in low  
96 walkable areas and 140 minute/week in high walkable areas (among walkers). In Japan, 59% of  
97 participants reported walking for transport, and the median duration of walking was 70  
98 minute/week for Tsukuba, 70 minute/week for Shizuoka, 120 minute/week for Kagoshima and  
99 150 minute/week for Koganei (among walkers).

100

101 Table 2 shows the odds of walking for transport for each additional destination type in each  
102 walk-distance category. The number of destination types within 5 and 6–10 minute walk (but  
103 not within 11–20 and 21–30 minute walk) was significantly associated with walking for  
104 transport in Adelaide. In Japan, the number of destination types within 6–10 and 11–20 minute  
105 walk (but not within 5, 21–30 minute walk) was significantly associated with walking for  
106 transport.

107

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INSERT TABLES 1 & 2 ABOUT HERE

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112

## **DISCUSSION**

113 Studies examining perceived environmental attributes relevant to physical activity typically  
114 assess the environment in an area within 10–15 minute walk from home.<sup>4</sup> Our findings for  
115 Australia and Japan are broadly consistent with this definition: Local destinations within 10  
116 minute walk in Australia and 6–20 minute walk in Japan were associated with walking for  
117 transport, suggesting that this may be the area where people would walk to shops and services.

118 Building on previous studies that show associations of distance to destinations with  
119 walking,<sup>12,13</sup> this study provides information about how close destinations may need to be, in  
120 order to facilitate residents' walking. Future studies are needed on the actual distances that  
121 adults will and will not walk in order to access local destinations – that is, 'threshold' (as  
122 opposed to 'associational') evidence. Such findings can inform the development of policy and  
123 environmental initiatives that should increase adults' physical activity.<sup>3,14</sup>

124

125 The difference observed between Japan and Australia is notable. The findings suggest that

126 walking by residents of Japanese cities may be influenced by more-distant local destinations.  
127 This may be interpreted as showing that residents in Japanese cities would walk further to get to  
128 destinations. A potential explanation for the difference is different travel behaviours between  
129 these countries. The cities examined in Japan have several train lines used for commuting  
130 (except for Tsukuba, which has only one line). Walking to a nearby train station is a typical  
131 transport activity among Japanese adults, and walking for more than 10 minutes to get to a train  
132 station may not be uncommon for them. Since shops and services often cluster around a train  
133 station, destinations within a 20 minute walk may be considered as walkable by the Japanese  
134 sample. In contrast, Adelaide residents may rely less on trains for commuting or shopping: their  
135 utilitarian trips may consist mainly of walking or driving to a nearby shopping area. This  
136 explanation is consistent with a study reporting a large difference in the use of public transport  
137 between Asian and Australian cities.<sup>15</sup> Differences in parking space availability may be also  
138 responsible for the observed results. However, the duration of walking appeared to be shorter in  
139 regional cities in Japan than it was in Adelaide. Further research with more precise walking and  
140 distance measures is warranted.

141  
142 A study conducted in Perth, Western Australia, which used objectively-measured distance,  
143 reported slightly different results from those for the Australian sample in this study.<sup>16</sup> In the  
144 Perth study, participants' walking for transport was associated with a number of utilitarian  
145 destination types within 400 m and 1500 m from home, which may be equivalent to 5 minute  
146 and 20 minute walk distance. Further research is warranted to examine how best to assess  
147 walkable distances to local destinations.

148  
149 It may be presumed that adults in Japan, where density is high and public transport is well  
150 developed, are highly active for transport. However, we found that the Japanese sample had a

151 lower proportion of transport walkers and fewer destination types, particularly in the 5 minute  
152 walk category, compared to the Australian sample. These results may be due to the majority of  
153 the Japanese data being collected from regional cities, whereas the Australian data were  
154 collected only in a state capital. As shown in Table 1, residents in regional cities engaged in  
155 lower levels of walking for transport than those in Tokyo or in Adelaide. The duration of  
156 walking (median minutes among walkers) was also shorter in regional cities in Japan. Physical  
157 inactivity may be a public health issue to be addressed in regional areas in Japan. Further  
158 research examining the prevalence and determinants of active transport in urban and regional  
159 areas can help develop effective health promotion strategies specific to these areas.

160  
161 The number of destination types within 5 minute walk was not associated with walking for  
162 transport in the Japanese study. This suggests that residents in Japan may walk for transport  
163 whether or not there are destinations within the immediate vicinity of their home. It is possible  
164 to argue that the distribution of destinations may be relevant in this regard. Destinations in  
165 Japan may be more clustered (e.g., around a train station), which may induce walking even if  
166 they are not very close, in comparison to those in Adelaide. Research has not examined how  
167 clustering of destinations can influence walking. Future studies need to examine this aspect of  
168 neighbourhood environments.

169  
170 A study limitation is the differences in data collection methods (selection of study sites,  
171 recruitment methods) between the Australian and Japanese studies. In particular, different  
172 methods used to assess walking may have resulted in slight variations in the way walkers were  
173 identified in Australia and Japan. Different demographic characteristics of the samples (e.g.,  
174 more women in the Australian sample, more workers in the Japanese sample) may have  
175 introduced confounding. However, key measures employed for the studies were comparable,

176 which allowed us to examine if the relationships between built environment attributes  
177 (destinations) and walking varied between these two countries. In both countries, the findings  
178 were obtained from particular cities, thus may not be generalisable to other localities with  
179 different population size or density. The use of perceived walk-distance to destinations is  
180 appropriate, as specifying the area under consideration in this way is needed for studies using  
181 perceived environment measures. Research has also shown poor agreement between perceived  
182 and objectively-measured distance to destinations, and potential independent roles for these  
183 measures on walking.<sup>17</sup> In addition, identifying perceived environmental attributes and how  
184 they are different from objective assessments are important, as mismatch between them is  
185 associated with physical activity behaviours.<sup>18</sup>

186  
187 Research on physical activity and the environment have been conducted predominantly in  
188 Western countries. The present study identified potential differences between Australia and  
189 Japan in how far residents would walk to utilitarian destinations. This study suggests that  
190 findings from studies in Western countries may not be directly applicable to Japan, which is one  
191 of the most-Westernised countries in Asia. People's lifestyle has been changing rapidly  
192 (becoming more sedentary) in Asian countries, and it has major implications for public health.  
193 <sup>19,20</sup> Environmental interventions to address physical inactivity should be considered and  
194 implemented in the context of Asia. However, the urban areas of developing countries in Asia  
195 may be substantially different from Western countries, in terms of how environmental attributes  
196 may influence residents' physical activity. Our findings highlight the importance of  
197 locally-obtained data to inform the development of local environmental and policy initiatives  
198 for physical activity promotion.

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## TABLES

Table 1. Prevalence of walking for transport and mean numbers of destination types (SD) within perceived walk-distance categories for Adelaide and Japanese cities

	Adelaide			Japanese cities				
	LW <sup>1</sup>	HW <sup>2</sup>	Total	Tsukuba	Shizuoka	Kagoshima	Koganei	Total
N	1293	1215	2508	337	326	285	337	1285
Walking for transport, % yes	73%	82%	77%	53%	50%	50%	80%	59%
# of destination types within...								
5 minute walk	1.9 (2.9)	4.0 (3.3)	2.9 (3.3)	1.2 (1.9)	2.4 (2.6)	2.0 (2.4)	2.5 (2.5)	2.0 (2.4)
6–10 minute walk	2.5 (3.1)	2.9 (2.4)	2.7 (2.8)	1.6 (1.9)	2.6 (2.1)	2.2 (2.2)	3.5 (2.3)	2.5 (2.2)
11–20 minute walk	3.0 (3.3)	2.3 (2.3)	2.7 (2.9)	1.7 (1.8)	2.2 (1.9)	2.1 (2.2)	3.2 (2.4)	2.3 (2.2)
21–30 minute walk	1.7 (2.6)	1.0 (1.5)	1.3 (2.2)	1.6 (1.8)	1.2 (1.3)	1.1 (1.5)	1.0 (1.2)	1.2 (1.5)
Total (within 30 minute walk)	9.1 (2.7)	10.1 (1.5)	9.6 (2.3)	6.0 (3.3)	8.4 (2.9)	7.4 (3.1)	10.2 (1.2)	8.0 (3.1)

1 low walkable areas, 2 high walkable areas

Table 2. Odds ratios (95% CI) of walking for transport by each additional destination type within perceived walk-distance categories for Adelaide and Japanese cities

Number of destination types within ...	Adelaide (n=2508)	Japanese cities (n=1285)
5 minute walk	1.11 (1.06, 1.16)***	1.03 (0.97, 1.10)
6–10 minute walk	1.09 (1.03, 1.14)**	1.08 (1.02, 1.15)*
11–20 minute walk	1.01 (0.97, 1.05)	1.08 (1.01, 1.15)*
21–30 minute walk	1.03 (0.97, 1.09)	1.03 (0.94, 1.12)

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Models included all four destination variables simultaneously, adjusting for age, gender, education, work status, having a child or not, car ownership, and cities (Japan only), and correcting for CCD-level clustering (Adelaide only).