Daily Walking Behavior and Neighborhood Environment: A Case Study in Tokyo Metropolitan Area

Hao Hou
Graduate School of Life and Environment Sciences, University of Tsukuba
Email: <houhao880828@gmail.com>

(1) Motivation: The main purpose of this study is to detect the characteristics of daily walking behavior (DWB) in Tokyo Metropolitan Area (TMA) and its potential relationships with personal attributes as well as neighborhood environment. In order to achieve the main purpose, the spatial patterns of DWB in TMA and the effects of personal attributes on DWB were detected. Further, the walkability of neighborhood was measured for finding the potential relationships between it and people's DWB.

(2) Data: For the evaluation of DWB, the People Flow Data (PFD) of Tokyo in 2008 made by CSIS (Center for Spatial Information Science), the University of Tokyo was employed. For the evaluation of neighborhood environment, we used the location data of residential buildings from Zenrin© TOWN II digital map, the road network data from OpenStreetMap project, the land use information and spatial distribution of public transportation facilities from National Land Numerical Information constructed by the Japanese government.

(3) Methodology: PFD provided the personal and spatial information of people's movement. Transportation mode (TCODE) helped to extract only the walking behavior. The spatial information of the walking activities was recorded by longitude (LON) and latitude (LAT). PURPOSE was for extracting only the DWB. After the extraction, the records were summarized based on personal ID (PID) to get the total daily walking time of each person. Five criteria (residential density, street connectivity, land use diversity, bus stop density and railway station accessibility) were selected to evaluate the neighborhood environments. Equal weights were given to each criterion to calculate the walkability. All the values were normalized to force the values to fall into 0 and 1. As a result, the final values of walkability (Walk Score) ranged from 0 to 5.

(4) Results and discussion: The results of people's DWB (see fig.1) were summarized by the standard 1 km^2 mesh with the average walking time of all the residents in each grid. The results showed that rural residents' daily walking time were less than people who live in the urban core and suburban areas. People living in the urban areas close to the city center had the highest average utilitarian walking time per day. The result of evaluating neighborhood environment (see fig.2) showed that residents in urban areas with a good accessibility to the city center had the highest potential for daily utilitarian walking behavior, followed by the residents in the urban core and rural areas. By comparing figure 1 and figure 2, it can be detected that residents in the rural areas have low walkability in the neighborhood and low utilitarian walking time. On the other hand, residents in the urban areas, especially areas close to the city center, enjoyed high walkability and had more utilitarian walking time per day. This consistence proved that residential density, street connectivity, land use diversity, bus stop density, railway station accessibility are necessary factors for evaluating neighborhood environment in TMA. The evaluation of neighborhood environment reflected the reality and the results can be utilized by both urban planners and transportation network designers for building a more walkable city. Future studies are encouraged on deeper statistical analysis of the relationships between neighborhood environment and utilitarian walking time to increase the credibility of the findings.

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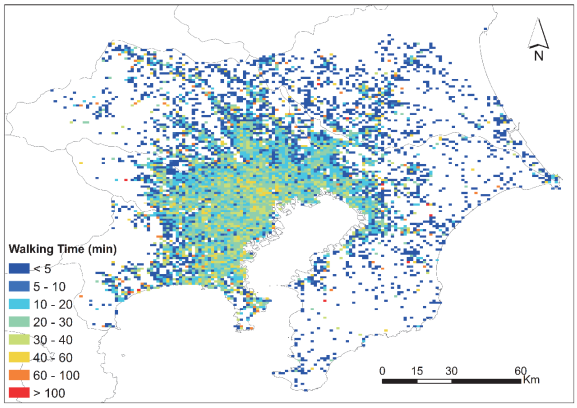

Fig 1: Walking time of residents in TMA (1 km^2 mesh)

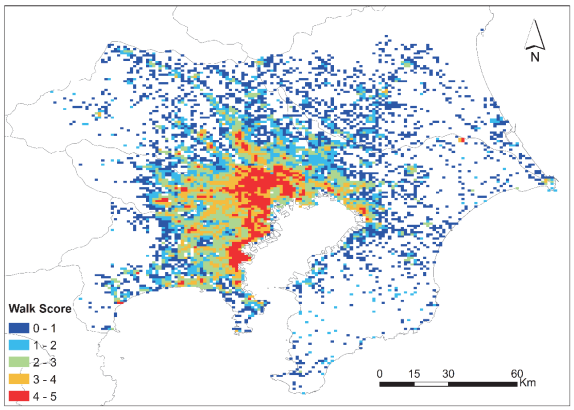

Fig 2: Walk Score (Walkability) map of TMA (1 km^2 mesh)