# The Association of Building Use with Walking Activity of Residents

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## 1. Introduction

The decline in the amount daily walking activity (DWA) due to the pandemic is a concern since high level of walking activity (WA) is associated with a reduced risk of the development of cardiovascular diseases [1]. Therefore, in the field of urban planning and public health, particular attention was paid to urban structure which stimulates WA of residents. Building use (BU), the commercial land use of a building, is associated with residents' WA in this context [2] while a specific BU strongly associated WA is unknown. In addition, a purpose of WA which is affected by BU has not been discussed enough.

This study shows an association of residents' accessibility to different BU with their WA, where accessibility stands for the number of specific commerce within residential distance. Furthermore, strength of the association with different purpose of WA, namely, DWA and leisure walking activity (LWA) is discussed.

## 2. Methods

This study used data from the questionnaire regarding WA conducted around Kusatsu River Park [3]. The questionnaire was carried out in October 2017, aiming to study the influence of the opening of KRP to WA of residents living within approximately 800 m from the park. 2 pieces of the questionnaire were distributed to each of 1,100 randomly selected households. The respondents were asked the frequency (days/week) and time (minutes/day) of their DWA and LWA in their neighborhood in a past several week. Shopping and dining out were provided as an example of a purpose of DWA, while promenade or running were provided as an example of LWA. The respondents also reported their personal attributes.

A total of 538 households, 765 residents answered the questionnaire, then the respondents whose answers were inappropriate or inadequate (n=140) were excluded from the sample. The final sample size for the analysis was 625 respondents.

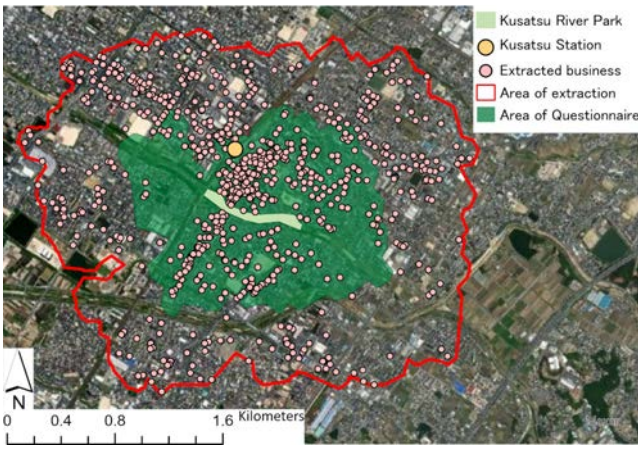


**Fig. 1.** *Extracted buildings in the study area*

Data for BU in the study area was obtained using Zenrin Building Point Data (ZBPD), a record of the information about all the buildings in Japan. The data consists of the location of the buildings and the number of business in each commercial category. In this study, the categories in ZBPD were further classified into 8 BU groups. **Fig.1** shows the extracted buildings.

Each resident's accessibility to a specific BU was assessed by number of the BU in their 600 m network distance reach. The reach was calculated on ArcGIS Pro 2.7.4. The dummy variables for building use exposure (BUE) were created for each BU group, and set as 1 for those who have more BU than the median of the respondents.

Logistic regression models were used to estimate the association of residents' accessibility to different BU with their WA. The model estimates the odds ratio for belonging to high DWA group (more than 120 minutes/week) or high LWA group (at least once a week) as a dependent variable. The model consisted of all the

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personal attributes terms as predictor variables of basis. Additionally, the BUE terms were included to the model one by one. The regression analyses were performed using R 4.1.2.

## 3. Results and discussions

The logistic regression results are shown in **Table 1**. For DWA, all the BUE terms became were positively associated. This is due to the concentration of high DWA group near the station where the center of the commerce is located. While, there was a difference in the strength of the association. Among the BU groups, the medical BU had the strongest association with DWA of residents as AIC was the smallest of all the BUE terms, followed by restaurants and store. For LWA such a significant association could not be observed.

This study provided another evidence for the association of accessibility to BU and DWA of residents. The result was consistent with the former case study in Japan [4], while the study only revealed association with commercial facilities such as convenience store or supermarkets, and the association with medical facility was not reported. Unlike the commercial facilities, the medical facilities are unlikely the destinations for DWA. Therefore, this study suggests a new perspective to the former studies by stating that the accessibility to medical facilities being a proxy to a feature inducing DWA of residents.

While this study used density-based accessibility for the assessment, the distance-based accessibility should also be taken into consideration especially for destinations of WA. The study using distance-based accessibility will establish the effect of a specific feature to a local community and imply whether the facilities are direct-cause to WA or a proxy. Yet, it is hard to define influential features. Further study on tackling this problem is suggested.

## 4. Conclusion

The study used the data of questionnaire regarding residents' WA and ZBPD to reveal the association of the accessibility to BU with residents' WA of different purpose. While the association with DWA was established It was also implied that medical BU being a proxy to a feature inducing residents' DWA.

This study contributed by adding a new perspective the existing study of influential features to DWA. Further study on the association of distance-based accessibility with WA is suggested.

**Table 1.** *Logistic regression results*

| | Odds ratio for belonging to high DWA group (95% CI) <AIC> |
|---|---|
| Restaurant | 1.16*** (1.08, 1.25) < 834.65 > |
| Shop | 1.14*** (1.05, 1.23) < 838.41 > |
| Service | 1.15*** (1.06, 1.24) < 837.14 > |
| Store | 1.16*** (1.07, 1.25) < 835.54 > |
| Financial | 1.13*** (1.05, 1.22) < 839.94 > |
| Medical | 1.18*** (1.09, 1.27) < 831.22 > |
| Educational | 1.14*** (1.06, 1.23) < 837.79 > |
| Public | 1.12*** (1.04, 1.20) < 840.84 > |

| | Odds ratio for belonging to high LWA group (95% CI) <AIC> |
|---|---|
| Restaurant | 1.03 (0.95, 1.12) < 877.27 > |
| Shop | 1.03 (0.95, 1.11) < 877.46 > |
| Service | 1.03 (0.95, 1.11) < 877.41 > |
| Store | 1.04 (0.96, 1.12) < 876.97 > |
| Financial | 1.06 (0.98, 1.15) < 875.94 > |
| Medical | 1.05 (0.97, 1.13) < 876.51 > |
| Educational | 1.04 (0.96, 1.12) < 876.94 > |
| Public | 0.97 (0.90, 1.05) < 877.33 > |

*p<0.1; **p<0.05; ***p<0.01

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## References

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