Association between a new healthcare access index and life expectancy in the Kanto region of Japan

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COI Disclosure

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The authors have no conflicts of interest to disclose regarding this presentation.

Introduction (1)

- **Accessibility to medical institutions is crucial for primary care.**

Gulliford M, Lancet Public Health. 2017.

- **Previous studies estimate that accessibility to medical institutions might affect life expectancy.**

Cutler DM, N Engl J Med. 2006.
Bunker JP, Milbank Q. 1994.

- **In these studies, only specific medical institutions (e.g., clinics, hospitals) were included (Fig 1). Spatial accessibility to multiple-scale medical institutions has not been simultaneously evaluated.**

McGrail, Int J Health Geogr. 2012
Fujiwara, J Stroke Cerebrovasc Dis. 2018

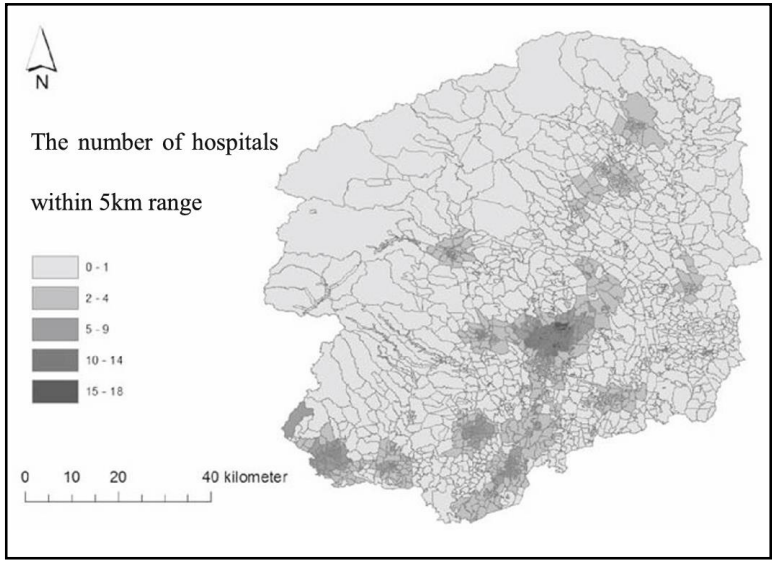

Fig. 1 Geographical distribution of number of hospitals within 5 km range.

Nakamura T, BMC Health Serv Res. 2017

Introduction (2)

- **The shift from hospital-based to community-based care has been proceeded in Japan, due to factors, such as declining and super-aging populations.**

Kotani K, Biosci Trends. 2023.

- **A method is needed to simultaneously assess accessibility to medical institutions of different sizes, such as clinics, hospitals, and tertiary hospitals.**

Purpose

1. **This study aimed to develop an accessibility scale to simultaneously assess accessibility to medical institutions of different sizes, such as clinics, hospital, and tertiary hospitals (Japan-Spatial Accessibility Scale for Medical Institutions; J-AMI).**
2. **To assess the association between the accessibility scale and life expectancy.**

Methods (1): Subject area and life expectancy

【Design】

This study is a descriptive study using a geographical information system with publicly available data from 2020.

【Subject area】

The study included 32,017 administrative census mesh blocks (“Cho-cho-aza”), 30,323 clinics, and 2,014 hospitals across seven provinces in the Kanto region, including Tokyo (Fig 2). The population of this area is approximately 43 million.

【Life expectancy】

Life expectancy by municipality was obtained from the Life Expectancy Table by Municipality 2020, published by the Ministry of Health, Labour, and Welfare.

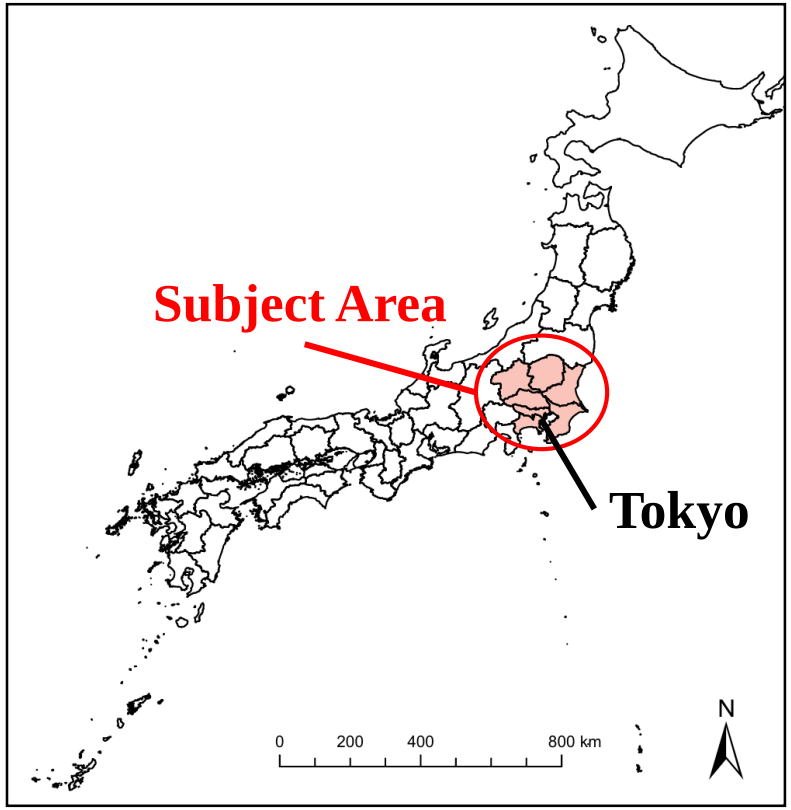

Fig. 2 Subject area in this study.

Methods (2): Developing the J-AMI

[1] The J-AMI comprises three elements:

1. **Road distance from each mesh block to the nearest clinic**
2. **Road distance from each mesh block to the nearest hospital**
3. **Road distance from each mesh block to the nearest tertiary hospital**

[2] Calculating the distance from each block to each medical institution

The center of gravity of each mesh block was taken as the representative point. The road distance from each mesh center of gravity to the nearest medical institution was calculated by provinces.

Methods (3): Developing the J-AMI

[3] Scoring methods

1. Clinics: scored by <u>every 1 km</u>

(1 pt ≤ 1 km, 1 km < 2 pts ≤ 2 km, …, 6 km < 7 pts ≤ 7 km, 7 km < 8 pts)

2. Hospitals: scored by <u>every 2 km</u>

(1 pt ≤ 2 km, 2 km < 2 pts ≤ 4 km, …, 12 km < 7 pts ≤ 14 km, 14 km < 8 pts)

3. Tertiary hospitals: scored by <u>every 4 km</u>

(1 pt ≤ 4 km, 4 km < 2 pts ≤ 8 km, …, 24 km < 7 pts ≤ 28 km, 28 km < 8 pts)

The scores (each score; 1−8 points) for clinics, hospitals, and tertiary hospitals were aggregated for each mesh and the total was treated as the J-AMI score for the mesh (score; 3−24 points).

Methods (4)

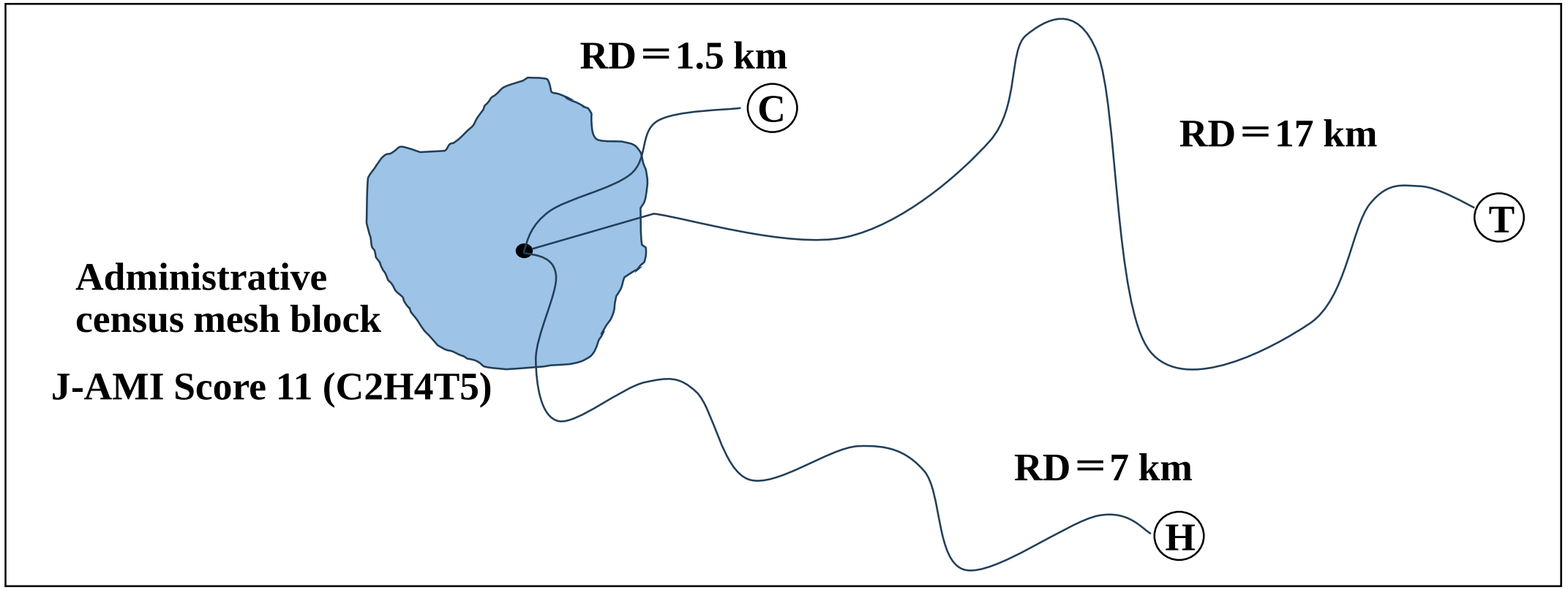

Figure 3. Example: Calculating J-AMI scores

Ⓒ Since the RD 1.5 km to the nearest clinic is greater than 1 km and less than 2 km, the score is **2** points.

Ⓗ Since the RD 7 km to the nearest hospital is greater than 6 km and less than 8 km, the score is **4** points.

Ⓣ Since the RD 17 km to the nearest tertiary hospital is greater than 16 km and less than 20 km, the score is **5** points.

RD; road distance, C; clinic, H; secondary hospital, T; tertiary hospital

Methods (5)
Calculating the population-weighted municipal J-AMI score (PWM-J-AMI score)

J-AMI scores weighted by the population of each administrative census mesh block were calculated by each municipality, which became the population-weighted municipal J-AMI score (PWM-J-AMI). The formula for calculating the PWM-J-AMI is shown in Equation (1):

$$PWM\text{-}J\text{-}AMI\ Score\ i = \frac{\sum_j Pj \times J\text{-}AMI\ Score\ j}{\sum_j Pj} \quad (1)$$

Where *PWM-J-AMI Score i* is the PWN-J-AMI Score of municipality *i*, *Pj* represents the population of block *j*, and J-AMI Score j represents the J-AMI Score of block *j*.

Methods (6): Statistical analysis

- **The correlation between the PWM-J-AMI and life expectancy per municipality was examined, using Spearman's rank-order correlation. SPSS version 27 (IBM, Armonk, NY, USA) was used for statistical analyses.**

- **Geographical information was analyzed using ArcGIS Pro 3.0 (ESRI, Redlands, CA, USA).**

Results (1)

Table 1. General characteristics and J-AMI scores of administrative census mesh blocks (n = 32,017)

	Median (IQR)
Population of administrative census mesh block (person)	811 (289–1850)
Area of administrative census mesh block (km^2)	0.22 (0.12–0.77)
J-AMI score (point)	5 (4–8)

J-AMI; Japan-Spatial Accessibility Scale for Medical Institutions, IQR; interquartile ranges.

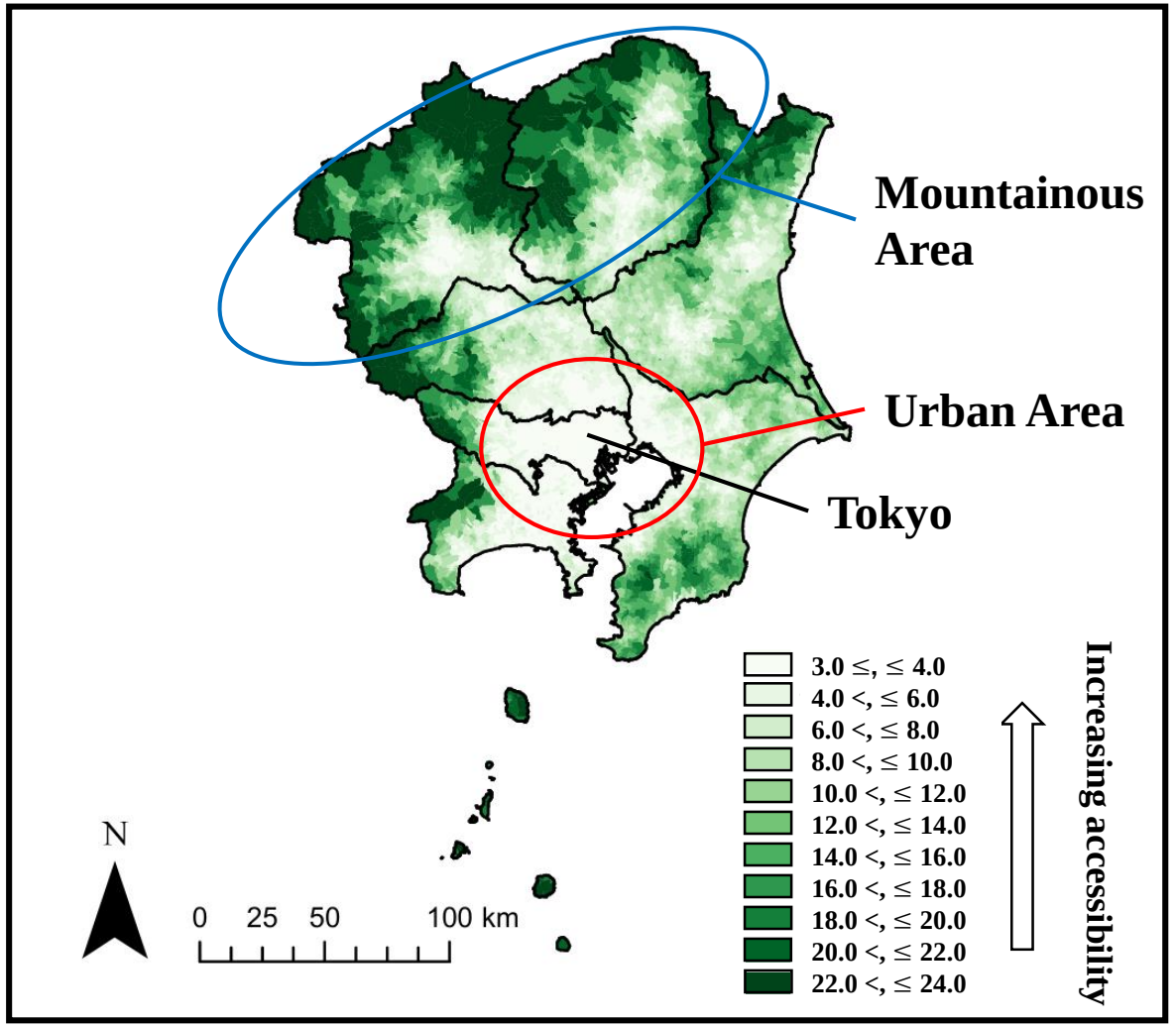

Figure 4. Regional distribution of J-AMI scores by administrative census mesh blocks in the Kanto region.

Results (2)

Table 2. General characteristics and PWN-J-AMI scores for each municipality (n = 335)

	Median (IQR)
Population of municipality (person)	74,283 (24,201–169,179)
Area of municipality (km^2)	46 (22–109)
Male mean life expectancy (years)	81.3 (81.0–81.9)
Female mean life expectancy (years)	87.3 (87.1–87.8)
PWM-J-AMI score (point)	5.9 (4.1–9.3)

PWN-J-AMI; population-weighted municipal J-AMI score, IQR; interquartile ranges.

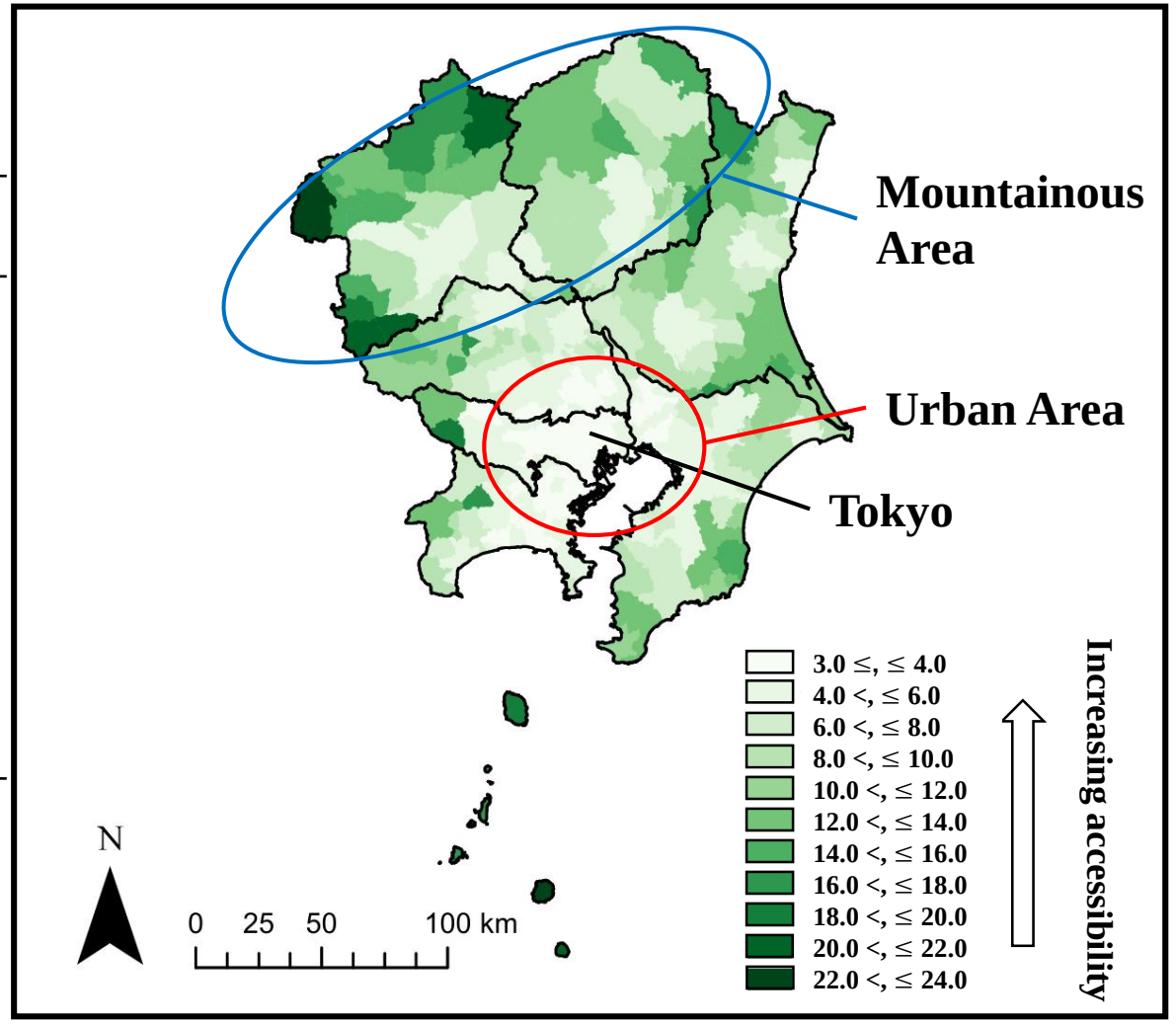

Figure 5. Regional distribution of PWM-J-AMI scores by municipalities in the Kanto region.

Results (3)

Table 3. Association between PWM-J-AMI scores and life expectancy by municipality in the Kanto region (n = 335)

	Male mean life expectancy		Female mean life expectancy	
	Correlation coefficient	p value	Correlation coefficient	p value
PWM-J-AMI	-0.459	<0.001	-0.546	<0.001

PWM-J-AMI; population-weighted municipal J-AMI

Discussion (1)

- **This study developed the J-AMI, which simultaneously assessed accessibility to medical institutions of different sizes, and visualized the scores on maps.**
  - **This is the first study when evaluating physical accessibility to medical institutions.**
- **J-AMI scores were lower in urban areas and higher in mountainous areas.**
  - **This indicates good access to medical institutions in urban areas and poor access to medical institutions in mountainous areas.**
  - **It is significant that the previously abstract subject of accessibility has now been objectively quantified and visualized.**

Discussion (2)

- **The PWM-J-AMI score was negatively correlated with mean life expectancy by municipalities.**
  - **This indicates that the better a region's access to medical care, the longer the life expectancy in the region.**
  - **Accessibility to medical institutions can be associated with cancer life expectancy.**

    Kou K, Cancer Epidemiol. 2020.
    Agata C, Int. J. Environ. Res. Public Health. 2022.
  - **Inaccessibility to medical institutions may increase the risk of asthma mortality.**

    Jones AP, Int J Epidemiol. 1999.

Conclusions

- **This study developed the J-AMI as a new healthcare access index for the Kanto region.**
- **The PWM-J-AMI score was negatively correlated with mean life expectancy by municipalities, indicating that the better a region’s access to medical care, the longer the life expectancy in the region.**
- **A future nationwide analysis is needed to confirm the study findings.**