



Comparison of the Characteristics of Elderly Persons Living in Rural and Urban Areas in Japan and Thailand Using Machine Learning Principal Component Analysis

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Abstract

Background: Japan and Thailand have been classified as aged societies. To the best of our knowledge, there is no studies have compared the features in urban and rural elderly people in Japan and Thailand.

Methods: After obtaining informed consent, we enrolled 26 Japanese (age: 71.6 ± 6.0) in Nanao city as a Japanese rural population (JR), and 59 Japanese (age: 74.9 ± 5.4) in Kyoto and Nagakute city as a Japanese urban population (JU). In Thailand, we enrolled 27 Thai (age: 68.8 ± 5.0) in Mae Wang, Mae Rim, San Kamphaeng, Hang Dong, Saraphi and San Sai District as a rural population (TR), and 30 Thai (age: 69.0 ± 0.9) in Mueang District as an urban population (TU). The Montreal Cognitive Assessment (MoCA)-Japan and MoCA-Thailand were used to assess cognitive function. Percent body fat, weight, water, minerals, protein, and limbs muscle weight and length were measured. BMI and skeletal muscle index were calculated as body weight and limb muscle weight in kg divided by height in meters squared (kg/m^2), respectively. Blood was collected by venipuncture and serum total cholesterol, neutral lipids, and 25OHD and glucose concentrations were measured. The Python environment was used to identify new principal components from the mean data for MoCA, anthropometric factors, and blood tests in the 4 groups (JR, JU, TR and TU).

Results: The cumulative contribution rates of PC1 and PC2 were approximately 90-100%, which meant two-dimensional compression could be done. For MoCA, JR and JU were classified in the near group and were linked to "Attention" and "Abstract Concepts", respectively. For anthropometric factors, TR and TU were classified in the near group. For blood components, JU was linked to blood glucose and triglycerides, while the other groups were not linked with any blood parameters.

Conclusion: Different measures are needed in the two countries to prevent dementia and obesity. Considering a report that obesity is common in Thailand, elderly living in the rural and urban areas of Thailand should adopt eating habits and exercise to reduce visceral fat. Japanese elderly who live in urban areas need to pay attention to avoid overeating and high-fat meal intake.

Introduction

The world is facing the challenge of aging populations. In 2020, there were more than 737 million (9.4% of total population) older peoples in the world. In Japan, the percentage of the population aged over 65 years old was 29.0% in 2022 [1]. In Thailand, the percentage of the population over 60 years old was 17.6% in 2020 [2]. Chiang Mai is a province in northern Thailand with a high population of older adults. Japan and Thailand have both been classified as aged societies and aging is associated with degenerative conditions in physical and cognitive function.

Urban and rural populations in Shanghai showed different risk factors for cognitive impairment [3]. The prevalence of depression has been shown to be significantly higher among urban residents [4]. In a study in Malaysia, body appreciation was significantly associated with life satisfaction in both the rural and urban subsamples [5].

Conventional classification analysis approaches have been used to analyze morphometric measurements, and the principal component

analysis (PCA) can identify the degree of similarity between cases [6-7]. PCA results are shown in scatter plots of different cases in relation to two or three principal components extracted from the data. Therefore, PCA is used to determine similarities and dissimilarities between groups. It is used in various fields, including agriculture, biology, ecology, finance, health, taxonomy and agriculture [8]. Advances in computing power creates a paradigm shift toward the application of modern tools such as machine learning [9].

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To the best of our knowledge, no studies have compared the features of elderly people living in urban and rural areas in Japan and Thailand. This study aimed to compare the characteristics of elderly persons living in the rural and urban areas in Japan and Thailand using machine learning PCA. The results could be useful for determining measures to be taken in the future in both countries.

Materials & Methods

Subjects and Setting

Prior to conducting this study, approval was obtained from the Aichi Medical University Ethics Review Board (2017-M052) in Japan. Study researchers were present at the adult day-care centers where the study was performed to ensure the proper management of safety and confidentiality. The managers of the adult day-care centers invited clients to participate in the study, and subjects were enrolled from June to August 2023. After obtaining informed consent, we enrolled 26 Japanese men (age: 70.1 ± 4.7) and 17 women (age: 72.4 ± 7.5) in Nanao city as a Japanese rural population (JR), and 22 Japanese men (age: 71.9 ± 3.9) and 37 women (age: 76.8 ± 5.3) in Kyoto and Nagakute city as a Japanese urban population (JU). In Thailand, we enrolled 4 Thai men (age: 68.3 ± 3.8) and 23 women (age: 68.9 ± 5.3) in the Mae Wang, Mae Rim, San Kamphaeng, Hang Dong, Saraphi and San Sai districts as a Thai rural population (TR), and 5 Thai men (age: 67.8 ± 5.8) and 30 women (age: 69.2 ± 7.2) in the Mueang district as a Thai urban population (TU).

Cognitive function test

MoCA-J and MoCA-Thai were used to assess cognitive function. The MoCA assesses visuospatial abilities, executive function, naming, attention, language, abstract concepts, delayed recall, and orientation. The maximum score on the MoCA is 30 points, and the cutoff score for dementia is 25 points [10]. Tests were performed by verbal questioning of 5- to 10-min duration by skilled occupational and physical therapists.

Cognitive function test

Percent body fat, body weight, water, minerals, protein and limb muscle weight were measured using Inbody 430 (Inbody Japan, Tokyo). Height was measured using InLab (Inbody Japan, Tokyo). BMI and skeletal muscle index (SMI) were calculated as the body weight and limb muscle weight in kg divided by height in meters squared (kg/m²), respectively.

Blood components

Blood was collected by venipuncture and serum total cholesterol, triglyceride, 25OHD and glucose concentrations were measured by Kyoto Biken Laboratories Inc. (Kyoto, Japan), Nikken Igaku Co. (Fukui, Japan), Falco Holdings Co. (Kyoto, Japan) and Bangkok R. I. A. Lab Co. (Chiang Mai, Thailand).

PCA

In this study, the Python environment was used to extract new principal components from the mean data for MoCA, anthropometric factors, and blood tests in the 4 groups (JR, JU, TR and TU). After constructing a correlation coefficient matrix, items having higher

correlation and the same component were eliminated. Two principal components (PC1 and PC2) were extracted, and their contribution and cumulative contribution were calculated. A plot of the groups in relation to PC1 and PC2 was analyzed to determine the degree of similarity between the groups.

Results and Discussion

Study subjects

The characteristics of the study subjects are shown in Table 1. Obesity was defined as a BMI of ≥25.0 kg/m². Thus, it was similar to the mean for all 65-74-year-old Japanese (21.5-24.9 kg/m²), in all of the groups except for TR.

Group	Age	No. of participants (% male)	BMI
JR	71.6±6.6	26(34.6)	24.4 ±2.9
JU	74.9 ± 5.4	59(37.3)	23.1 ±3.3
TR	68.8 ±5.0	27(14.8)	25.0 ±4.9
TU	69.0 ±0.9	30(16.7)	24.2 ±4.2

Table 1: Characteristics of study subjects (mean ± SD).

PCA

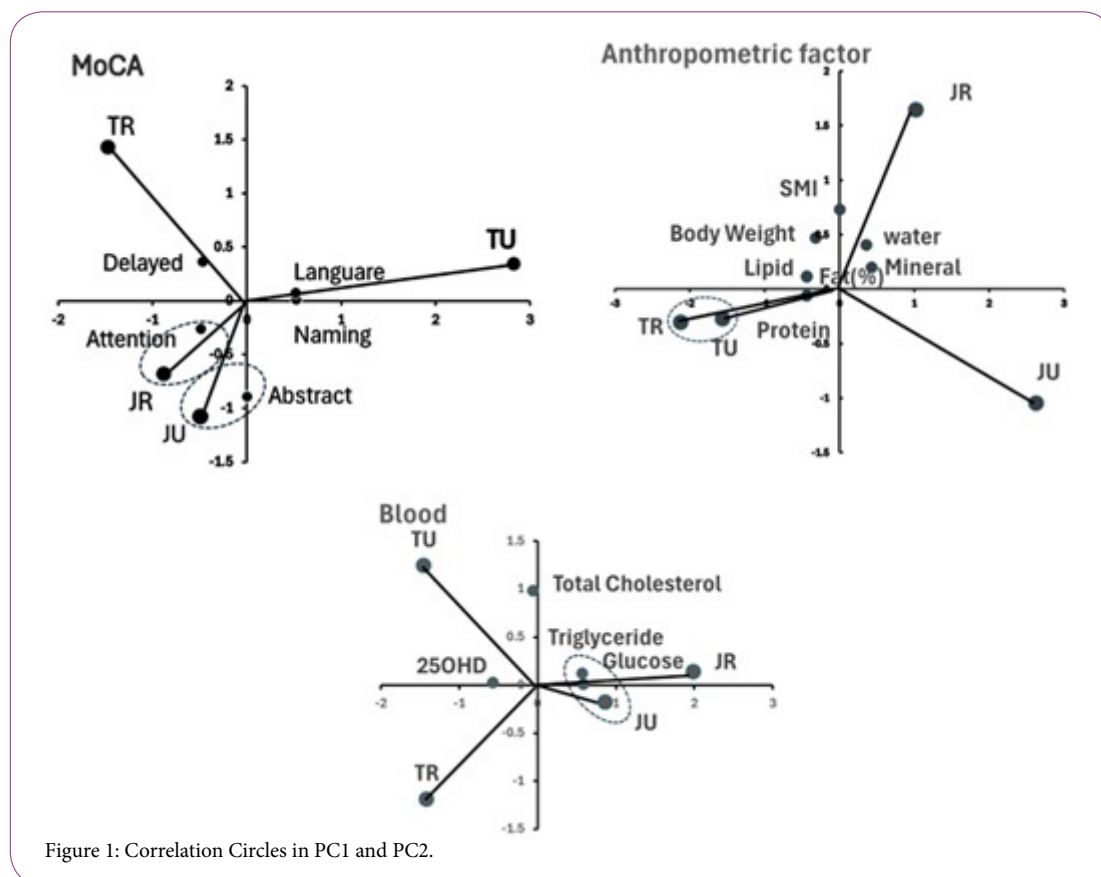
Table 2 presents the individual variables' contribution to PC1 and PC2. The cumulative contribution rates of PC1 and PC2 were approximately 90-100%, which meant two-dimensional compression could be done for 3 parameters.

Parameter	PC1	PC2	Cumulative PC1 and PC2
MoCA	0.734	0.251	0.985
Anthropometric factors	0.709	0.188	0.897
Blood component	0.744	0.252	0.996

Table 2: Contribution and cumulative contribution to PC1 and PC2 of the MoCA, anthropometric factors and blood component.

Figure 1 presents the correlation circles between the variables in PC1 and PC2. In MoCA, JR and JU were classified in the near group and were linked to "Attention" and "Abstract Concepts", respectively. It is thought that the repetition and the understanding of abstract concepts are strongly related to cognitive function in Japanese elderly. TR and TU presented no links with MoCA parameters. These results suggest that the characteristics of cognitive functions are different in Japan and Thailand, and that different measures are needed in the two countries.

For anthropometric factors, TR and TU were classified in the near group. Metabolic syndrome is an important problem in rural Thai populations who live basic lifestyles in non-urbanized and non-industrialized areas [11]. Dyslipidemia and obesity are the most common metabolic syndrome components among women in rural areas of Thailand [12]. These results suggested that a few differences have developed between rural and urban Thai people, and that elderly living in rural areas should eat at low-fat meals and exercise to reduce visceral fat.



In blood components, JU was linked to blood glucose and triglycerides while the other groups were not linked to any blood parameters. This result suggests that Japanese elderly who lives in urban areas need pay attention to avoid overeating and high-fat meal intake.

There were some limitations in this study. First, the Thai participants were younger and had a lower ratio of men in comparison with the Japanese participants. Second, there were no data on hypertriglyceridemia, LDL or HDL.

Conclusion

Different measures are needed in the two countries to prevent dementia and obesity. Elderly people living in rural areas of Thailand should adopt low-fat meals and exercise to reduce the visceral fat. Japanese elderly who live in urban areas need to pay attention to avoid overeating and high-fat meal intake.

Competing Interests

The authors declare that they have no competing interests.

Competing Interests

Dr. Hasegawa was responsible for the study conception, design, interpretation of data, and drafting of the manuscript.

Dr. Shimizu was responsible for checking the manuscript.

Dr. Yamada was responsible for MoCA-J data acquisition and checking the manuscript.

Dr. Umemura was responsible for checking the manuscript.

Dr. Matsunaga was responsible for checking the manuscript.

Dr. Kobayashi was responsible for checking the manuscript.

Dr. Kato was responsible for measurement of physical activity and checking the manuscript.

Dr. Sethabouppha was responsible for checking manuscript.

Dr. Suwankruhasn was responsible for measurement of physical activity and checking the manuscript.

Dr. Suvanayos was responsible for MoCA-Thai data acquisition and checking the manuscript.

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