

学位論文の要旨

氏名 Sonia Ishrat Ferdous

学位論文名 Altitudes of Residential Areas Affect Salt Intake in a Rural Area
in Japan: a Shimane CoHRE Study

発表雑誌名 Hypertension Research (in press) 2015 年
(巻, 初頁～終頁, 年)

著者名 Sonia I Ferdous, Kunie Kohno, Tsuyoshi Hamano,
Miwako Takeda, Masayuki Yamasaki, Minoru Isomura,
Kuninori Shiwaku, Toru Nabika

論文内容の要旨

INTRODUCTION

There is growing interest in the association between residential environment and hypertension. Residential environment includes both physical (e.g. climate and geography) and social (e.g. socioeconomic conditions and social capital) aspects that may contribute to individual health. Inconvenience in daily life may be one of such factors. In a previous study, we showed that the distance from an urban area influenced the average blood pressure (BP) of inhabitants. Concerning the mechanisms underlying this observation, we hypothesized that inconvenience due to geographic features might influence salt intake, which might result in increased BP. In this study, we therefore examined the association between altitudes of residence, which is a possible index of inconvenience in Japan, and salt intake in a rural area.

MATERIALS AND METHODS

This is a population-based cross-sectional study. We analyzed data collected in the Shimane CoHRE Study conducted in six counties (Takeya, Mitoya, Daito, Kamo, Yoshida and Kisuki) located in Un-nan City in 2012. A total of 1016 subjects were recruited in health examinations. All the participants gave informed consent and the study was approved by the local ethical committee in Shimane University. Altitude of residence was estimated with a geographic information system (GIS) based on the addresses of the participants (ESRI Japan,

Tokyo, Japan). In the analysis, subjects were divided into quartile groups according to their altitudes of residence: Quartile 1 (Q1): 29–44m, N= 261; Q2: 45–68m, N= 237; Q3: 69–195m, N= 245 and Q4: 196–485m, N= 250. We used two different parameters to evaluate salt intake: (1) estimated 24-h salt intake (e24-h salt intake), which was calculated with the formula proposed by Kawano et al., and (2) the urinary sodium-to-potassium ratio (uNa/K). Spot urine samples were collected at the site of the health examination, and the concentrations of sodium and potassium were measured using the electrode method (TBA-c16000, Toshiba Medical System Corporation, Tochigi, Japan). Regular physical activity, alcohol consumption and smoking habits were obtained in the interview. High-density and low-density lipoprotein cholesterol (HDL-C and LDL-C, respectively), triglycerides (TG) and fasting blood glucose were measured in serum by standard methods. Parameters influencing salt intake were analyzed by the linear regression analysis. All of the statistical analyses were performed using JMP 11 (SAS Institute, Cary, NC, USA) and SPSS (v.23, IBM, Armonk, NY, USA).

RESULTS AND DISCUSSION

We found significant differences in the e24-h salt intakes ($p=0.02$) as well as in the uNa/K ($p=0.01$) among the quartiles according to the altitude of residence. *A post-hoc* analysis indicated that the e24-h salt intakes and the uNa/K were significantly different between Q1 and other quartiles (Dunnnett's test using Q1 as the reference). In Spearman's non-parametric correlation analysis, age, sex, body mass index, systolic and diastolic BP (SBP and DBP, respectively), HDL-C, TG and alcohol consumption were found to have significant correlations with salt intake in addition to the altitude of residence. Besides the factors included in this univariate analysis, the county of residence appeared to have an effect on the e24-h salt intake independent of the altitude. Therefore, we performed a linear regression analysis on the e24-h salt intake with the county of residence as an independent variance. Even after the county of residence was included in the model, the altitude displayed an independent effect ($B=0.27\pm 0.08$, $p=0.001$) on the salt intake. When the analysis was performed on the uNa/K measurements, the altitude was a significant independent factor as well ($B=0.03\pm 0.009$, $p<0.0001$). The addition of SBP (or DBP) in the model did not affect the results; the altitude was still an independent factor affecting the salt intake. Three hundreds and eighty-three subjects were receiving antihypertensive drugs. Therefore, we performed the same analysis on those who were not taking antihypertensive drugs ($N=633$) to avoid potential perturbation by antihypertensive treatment. The results indicated that the effect of altitude was significant ($p=0.001$) in this population as well.

The major finding of our study was that salt intake was associated with altitude in a rural area of

Japan. This association seemed robust because the same significant association was observed with uNa/K, and after excluding the subjects taking antihypertensive drugs.

As the subjects in this study lived at altitudes between 29 and 485m in height, which seemed to too low to impose physical influence (eg., lower pressure, lower concentration of oxygen) on BP. Accordingly, the effects of altitude observed in this study were probably due to inconvenience or remoteness. To examine whether inconvenience was indeed present in our population, we assessed the number of food shops and bus stops in the studied counties according to their altitudes. As expected, the number of these facilities decreased with increasing altitudes, suggesting that living at high altitudes is more inconvenient. Based on the above analysis, it is possible to hypothesize that people living at a higher altitude in this area might consume more processed food with high salt contents because of the reduced access to fresh food. This hypothesis needs to be examined in future studies.

In contrast to salt intake, altitudes did not influence BP. When factors influencing SBP were evaluated by a linear regression analysis, the e24-h salt intake was a strong independent risk factor for increased SBP ($B= 1.1 \pm 0.2$, $P < 0.0001$), along with age and body mass index. This indicated that although the altitude indeed affected salt intake in this population, many other factors, especially those related to the individual's lifestyle, probably had a larger influence on BP of each subject. In addition, it is of interest that the county of residence had an independent effect on the salt intake in addition to the altitude. Potential confounding factors, such as differences in urbanization, might contribute to this observation. Further analyses are warranted on this issue as well.

CONCLUSION

To the best of our knowledge, this is the first study to examine the association between altitude of residence and salt intake. Our study indicated that altitude of residence had a significant positive influence on salt intake in a rural area of Japan.