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Study on the Indoor Environment and the Health of Elderly in China

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ABSTRACT

In this study, questionnaire survey and field measurement were conducted for the houses with the elderly in urban and rural areas across 6 regions of China, during heating period. As the results, the prevalence of hypertension was found around 40% in both urban and rural areas. In the northern regions, the room temperature in urban residences was stable at around 20°C, and in rural areas this temperature rarely reached 20°C but it fluctuated greatly. In the southern regions, the difference between room temperature and outdoor temperature was small in both urban and rural areas, and the room temperature seldom reached 15°C in particular. In this work, it was found that there was a negative correlation between room temperature and blood pressure.

INTRODUCTION

The morbidity and mortality of cardiovascular diseases (CVD) are the highest among other illnesses of the Chinese elderly population. It is said that one of causes is due to the impact of indoor environment. However, there are few studies about the relationship between indoor environment and the elderly health conditions. Moreover, the elderly people generally tend to stay at home more, thus the housing indoor environment is important from the viewpoint of their health. The purpose of this study is to reveal the relationship between hypertension and residential indoor environment. In order to reveal this relationship, questionnaire surveys and field measurements were conducted both in urban and rural areas of six regions from three climate zones in China during the heating period of 2016-2018.

METHODOLOGY

The subject regions are selected from severe cold zone (Harbin for urban area and Qiqihar for rural area in Heilongjiang Province), cold zone (Dalian and Beijing) and hot summer & cold winter zone (Nanjing, Shanghai and Changsha for urban area and Chengbu for rural area in Hunan). The study contained two Phases. In Phase 1, face-to-face questionnaire surveys were conducted for at least 50 households for statistical analysis. The questionnaires

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composed of occupant's characteristics, including illness diagnosed by a doctor, housing features, heating equipment and so on. In addition temperature recording by the liquid crystal thermometers was included. In Phase 2, at least 5 households were selected from urban and rural areas of each region in Phase 1 to conduct the detailed field measurements. The subject was searched through acquaintances such as the author's university relations and relatives.

RESULTS

Phase 1

Results of questionnaire survey. The results of the questionnaire surveys from 737 houses showed that hypertension was the most common disease of the elderly occupants in urban (25-50%) and rural areas (30-60%) among the cardiovascular diseases. For urban areas, the prevalence of high cholesterol and diabetes were the next highest diseases, depending the regions. The ratio is 15-30% and 5-20%, respectively. For rural areas, the prevalence of diabetes was the next highest disease (10-20%). According to the statistical data (2009) reported by the Chinese government, the major causes of death in China were cardiovascular disease, cancer, and chronic respiratory diseases.

Temperature Records by Liquid Crystal Thermometer. Urban areas: All the rooms in the residences located in Harbin, Dalian and Beijing are equipped with district heating system (DHS). The average temperatures of 3 rooms (living room, bedroom and toilet) were found very close staying above 20 degree C in the morning and evening. In comparison with outside, the difference was obvious. In the southern areas, the average temperatures of 3 rooms were also similar but stayed in 10-15 degree C. And the difference between indoor and outdoor was very small. No matter which room type was, the temperature in the morning was lower than that in the evening, but the difference between morning and evening were roughly within 1 degree C. **Rural areas:** For the northern regions, the toilet temperature was much lower than other rooms, because the toilet was mostly located outside in these houses. And no matter in the morning and evening, the average temperatures in living room and bedroom were much lower than those of urban areas staying in 10-15 degree C. In the southern areas, the temperatures of 3 rooms were similar and stayed about 10 degree C, and the difference between indoor and outdoor temperature is very small.

Relationship between Prevalence of Diseases and Indoor Temperature. Figure 1 shows the relationship between the prevalence of diseases and the indoor temperature in the morning and in the evening using all samples. By χ^2 -test using SPSS 25, it was found that indoor temperature and prevalence have significantly negative relationships. In other words, when the indoor temperature is maintained in higher range, the risk of diseases becomes lower. Figure 2 presents the distribution of indoor temperature with the group of elderly individuals who suffer from diseases (the case group) and the group without diseases (the control group). The differences of these temperatures were tested by t-test using SPSS 25. The indoor temperature of the CVD group was lower with statistical significant than that of the group without diseases. The indoor temperature of the hypertension group was also lower than that of the group without diseases, but it was not statistically significant.

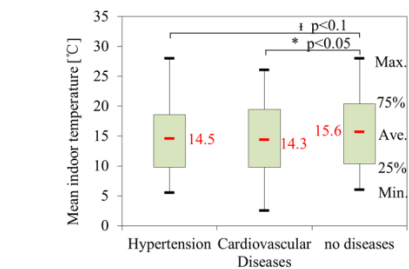
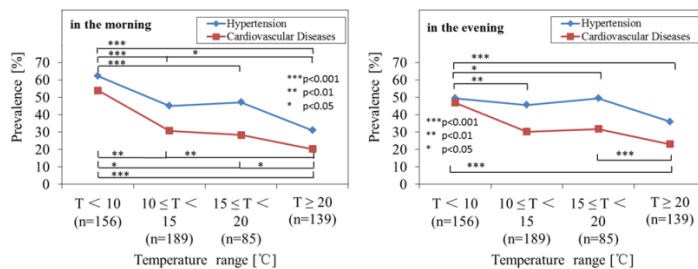


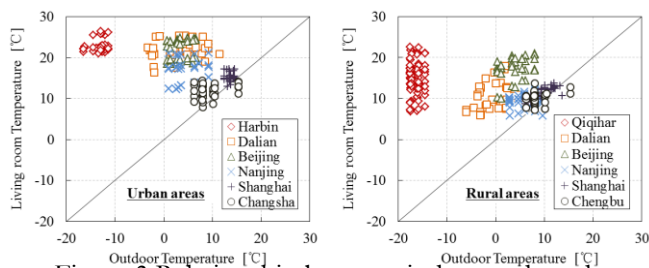
Figure 1 Relationship between prevalence and indoor temperature

Figure 2 Distribution of temperature with group

Phase 2

Relationship between Daily Mean Indoor and Outdoor Temperatures. Figure 3 shows the relationship

between daily mean living room temperature and daily mean outdoor temperature. In the urban areas of northern region, all the rooms were heated by DHS, and were operated for whole day, the indoor temperatures were little influenced by outside. The indoor temperature was stable at about 20 degree C. On the other hand, heating was operated by the individuals according to their demands in the southern areas. The duration of heating of the houses in Shanghai and Chengbu showed very short. Therefore, the difference between indoor and outdoor temperature was very small. In rural areas, the indoor temperature was higher than the outside in the northern parts. It was also found that the difference between morning and evening was large, however, it is not indicated in this paper.



(One point indicates the mean value during one day of one house.)

Figure 3 Relationship between indoor and outdoor temperatures

Blood Pressure and the Exposed Temperature. Umishio et al. (2019) found that the blood pressure increases when the indoor temperature decreases. In this investigation, similar data patterns were found but will not be discussed here due to limited pages. Figure 4 shows the relationship between the room temperature and the blood pressure of all persons, which are the average of all measured values on each subject. In urban areas of the northern region, both temperature and blood pressure were found higher. In each group, there was negative correlation. On the other hand, in the case of rural area, there was no clear difference between two groups, but there was negative correlation between the indoor temperature and blood pressure of all regions.

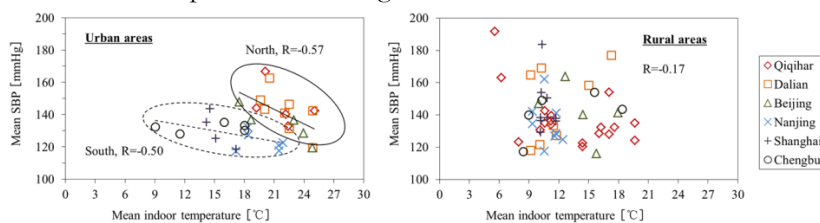


Figure 4 Blood Pressure of the Long-term Exposed Temperature (1 mmHg = 133 Pa)

CONCLUSIONS

1) The results of questionnaires from 737 houses showed that the hypertension was the most common disease of the elderly occupants in both urban and rural areas. For winter indoor environment, in the northern regions with central heating system, the room temperature in urban residences was around 20 degree C, but in rural areas it was between 10 to 15 degree C. In the southern areas with no central heating system, the indoor temperature was less than 15 degree C and close to the outdoor temperature in both urban and rural areas. 2) It was found that there was a negative correlation between room temperature and blood pressure in urban residences of the northern region, and the blood pressure was higher than the southern region. However, the difference of blood pressure between southern and northern regions in rural areas was not obvious.

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