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Investigation of the elderly's response to winter temperature steps in severe cold area of China

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Abstract

Twelve seniors were enrolled in the two-day observatory experiment which was carried out in winter (January 2016) of Qiqihaer, Harbin. Their subjective responses including thermal perceptions and discomforts were recorded by questionnaires. Besides, blood pressure was also monitored before and after temperature steps. Results show that cold hands or feet, accelerated heart rate, runny or stuffy nose and shivering are sensitive self-reported symptoms in response to temperature step changes. Thermal sensation and comfort witnessed significantly changes under sudden heating or cooling. Even short temperature alteration also led to rapid and remarkable changes in both systolic and diastolic pressures.

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Keywords: health discomforts; thermal perception; blood pressure; the elderly

1. Introduction

The aging society is universally regarded as a major challenge for China. At the end of 2015, the number of Chinese over-60-year-old adults was approximately 205 million, taking up around 15% of the country's total population. It is also predicted that by 2050, older adults will account for about 33% of China's total population. Some body functions like cardiovascular and sensory responses, basal metabolism, and body composition vary with age [1, 2]. As a result, seniors may be less sensitive to environmental temperature changes, and they may fail to make proper reaction to prevent fluctuations in core temperature, thus causing potential thermal discomfort and health risks.

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Both indoor and outdoor microclimates have influence on human [3-5]. Temperature step change is a common phenomenon in daily life as people always enter/exit air-conditioned buildings from/to outdoor place. Actually, there are many surveys and chamber studies with regards to the effect of temperature steps on people, but the vast majority of them focused on young people [6-8]. The risk of such environmental stimulus on old people still need more research [9].

We conducted an investigation with senior subjects in the winter of severe cold area of China (Qiqihaer, Harbin). During the two-day survey, we minimized our interference and let subjects remain their normal life. Subjects would fill out the questionnaire about discomforts and thermal perception whenever they walked into indoor from outdoor. In addition, blood pressure was also measured three times a day.

2. Methodologies

The investigation was conducted in winter (January 2016) of Qiqihaer, Harbin. During the experimental period, the mean daily minimum and maximum outdoor temperatures were -20.9±1.9ºC and -11.4±1.4ºC. Twelve old people (six males and six females) were randomly selected. Their anthropometric information including body mass index (BMI) [10] and body surface area (As) [11] is shown in Table 1. All subjects have resided in severe cold area of China for several decades.

Instead of a well-controlled chamber study, this survey is more like an observation which could reflect the circumstance in real life. All subjects were retired and spent most time at home in cold wintertime. For every subject, the experiment lasted 2 days during which subjects remained their normal life except that they were asked to fill out the questionnaire whenever they entered indoors from outdoors. The questionnaire covered contents of health discomforts and thermal perceptions. When returning to warm indoor environment, subjects not only reported their perception at the present time but also recalled their feelings in cold outdoor just now. Blood pressure was measured three times a day (10:00, 14:00, 16:00) after 'artificial' temperature steps. Subjects' blood pressure was firstly measured at home before they stepped into cold outdoor for about 1 minutes and had the second measurement. The third measurement was performed immediately after they came back home from the cold outside environment. All blood pressure tests were carried out by the same experimenter with the electronic blood pressure meter (TKBP-H01, dftaihua Ltd, China. Accuracy: ±1 mmHg; Range: 0 mmHg ~ 300 mmHg). To eliminate the posture effect, standing position was required. Besides, a temperature data logger (Pyrobutton-L, OPULUS Ltd., USA) with the accuracy and range of ± 0.2ºC and -40 ºC ~ 85 ºC was attached to the zipper pullers of subjects' overcoats (referred as button temperature). By this means, the temperature logger could help identify the occurrence of temperature steps.

To reduce the influence of confounders like sleep, data of daytime (9:00-17:00) was collected and included into analysis. In addition, the first day was regarded as adaption; only data of the second day was kept. Paired significance tests, consisting of McNemar's test (Paired chi-square test), Paired t test and Wilcoxon Matched-Pairs Signed Ranks test were used to analyze binominal, normally distributed and abnormally distributed data respectively. The statistical analysis was conducted by the software SPSS 19.0 with the significance level of 0.05.

Table 1 Anthropometric data of the subjects.

Gender	NO.	Age (years)	Height (cm)	Weight (kg)	BMI (kg/cm2)	As (m^2)
Male	6	62±5	167.3±5.0	70.7±6.4	25.3±2.8	1.7±0.1
Female	6	56±5	159.5±2.3	61.4±9.0	24.1±3.1	1.6±0.1
All	12	59±6	163.4±5.5	66.0±8.9	24.7±2.9	1.7±0.1