

# The Association between Indoor Temperature and Hypercholesterolemia

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See article vol. 29: 1791-1807

In this issue of the Journal of Atherosclerosis and Thrombosis, Umishio *et al.* report the association between indoor temperature in winter and serum cholesterol based upon a cross-sectional analysis of the Smart Wellness Housing Survey in Japan<sup>1)</sup>. The indoor temperatures of 2004 participants (1333 households) were measured for 2 weeks in winter, and they were divided into three categories according to average bedroom temperature: 206 warm houses ( $\geq 18^\circ\text{C}$ ), 940 slightly cold houses ( $12^\circ\text{C}$ – $18^\circ\text{C}$ ) and 858 cold houses ( $< 12^\circ\text{C}$ ). Compared to the participants in warm houses, the odds ratio of total cholesterol (TC)  $> 220$  mg/dL was 1.83 (95% confidence interval [CI]: 1.23–2.71) for slightly cold houses and 1.87 (95% CI: 1.25–2.80) for cold houses. The associations between the bedroom temperature and low-density lipoprotein cholesterol or non-high-density lipoprotein cholesterol were similar to the results for TC. As far as I know, this is the first research that indoor temperature is associated with serum lipids. Thus, these findings show important implications.

Seasonal variation is common in the serum levels of cholesterol as well as blood pressure, and the tendency of these variations is higher in winter. The detailed mechanism of seasonal variation for serum lipids is still unknown, but the evidence is accumulated around the world, including in Japan. Kamezaki *et al.* showed that the seasonal variation of serum lipid levels and the prevalence of hyperlipidemia in Japanese workers were significantly higher in winter than in summer<sup>2)</sup>. There is also a clear association between indoor temperature and blood pressure in several studies. For example, the result based on the HEIJO-KYO cohort study demonstrated a stronger association of indoor than

outdoor temperature with blood pressure in winter<sup>3)</sup>. This result suggested that improving the housing thermal environment can reduce the risk of hypertension and may lead to a reduction in cardiovascular mortality in winter.

According to the Statistics in Japan, death due to coronary heart diseases increases in winter. **Fig. 1** shows the monthly number of death due to acute myocardial infarction (MI) and other ischemic heart diseases (IHD) in 2020<sup>4)</sup>. Apparently, the death due to MI and other IHDs increased in January, February, November, and December. The deaths due to other causes also increase in winter than in summer. Additionally, the trend that mortality during winter is higher than in other seasons is shown in many countries, and half of the excess deaths in winter are thought to be caused by cardiovascular diseases (CVDs)<sup>5)</sup>. Therefore, to reduce excess death in winter, the prevention of CVDs plays an important role.

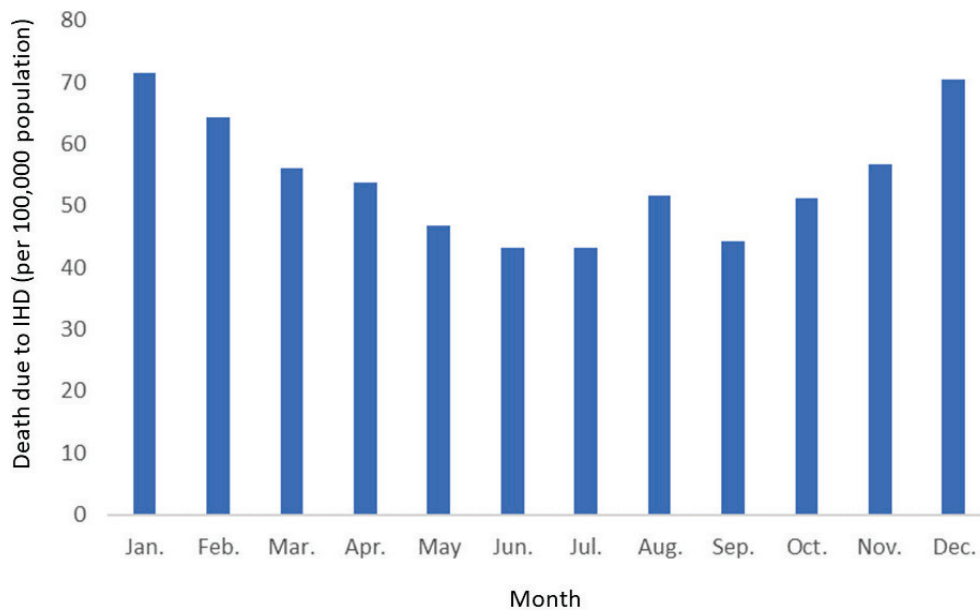
The World Health Organization (WHO) issued housing and health guidelines<sup>6)</sup>, which include the following recommendation in the chapter about low indoor temperatures and insulation: “Indoor housing temperatures should be high enough to protect residents from the harmful health effects of cold. For countries with temperate or colder climates,  $18^\circ\text{C}$  has been proposed as a safe and well-balanced indoor temperature to protect the health of general populations during cold seasons.” Based on previous evidence, this is a strong recommendation. The association between indoor temperature and blood pressure was well-documented in this guideline, but there was no suggestion about the serum lipids. Hyperlipidemia is an important risk factor for CVDs. In Umishio *et al.*'s research, inadequate indoor temperature ( $< 18^\circ\text{C}$ ) was positively associated with hyperlipidemia<sup>1)</sup>. Unlike outdoor temperature, the indoor temperature is an adjustable factor. Adequate control of indoor temperature may be useful in

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Received: July 22, 2022 Accepted for publication: July 25, 2022

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**Fig. 1.** Monthly number of death due to ischemic heart diseases (IHD) in Japan, 2020

The deaths due to IHDs were defined by the death due to acute myocardial infarction and other IHDs such as angina pectoris. The data are taken from Statistics Japan<sup>4)</sup>.

controlling serum lipid levels and blood pressure and help in preventing the onset of CVDs.

### Acknowledgement

The author is grateful to Health Labour Sciences Research Grant (20FA1001).

### Conflicts of Interest

The author has no conflict of interest to declare related to this article.

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