Hypertension Research (2023) 46:806–808
https://doi.org/10.1038/s41440-022-01151-4

COMMENT

Management of seasonal variation in blood pressure through the optimal adjustment of antihypertensive medications and indoor temperature

Keisuke Narita[1] · Kazuomi Kario[1]

Keywords BP Measurement · BP Variability · Seasonal Variation · BP Management

Received: 1 December 2022 / Revised: 12 December 2022 / Accepted: 14 December 2022 / Published online: 28 December 2022

Comment on two original articles, Ye et al.'s "Seasonal variation in the effect of antihypertensive treatment with the irbesartan/hydrochlorothiazide combination" and Kinuta et al.'s "Associations of indoor and outdoor temperatures and their difference with home blood pressure: The Masuda Study".

Seasonal fluctuations in blood pressure (BP) are closely related to outdoor and indoor temperatures [1, 2], and increases in the incidence of cardiovascular disease during the winter are well recognized. The optimal adjustment of indoor temperature may thus be useful for preventing a winter increase in the incidence of cardiovascular disease by inhibiting BP elevation and excessive BP surge in winter. In a prospective observational study in which 352 healthy participants underwent home BP monitoring for 2 years, Kinuta et al. reported that an increase in indoor temperature of 1°C reduced systolic BP by 0.37 mmHg and 0.45 mmHg in the morning and evening, respectively, and the magnitude of association was stronger for indoor temperature than for outdoor temperature [3]. Kinuta et al. concluded that controlling indoor temperature is useful for stabilizing home BP. Other previous studies have demonstrated the relationship between indoor or outdoor temperature and BP levels [1, 4–7]. Saeki et al. reported a stronger association of indoor temperature with BP levels evaluated by ambulatory BP monitoring compared to outdoor temperature [8]. Umishio et al. used home BP monitoring and reported an association between indoor temperature and home BP levels [1]. Notably, Kinuta et al. conducted a prospective observational study of home BP monitoring over a period of 2 years and found a strong relationship between indoor temperature and home BP compared to outdoor temperature [3]. Optimization of room temperature is a useful method to suppress increasing BP levels in the winter. Umishio et al. reported that the indoor ambient temperature at which there is a < 50% probability of elevated morning home systolic BP (SBP) (≥135 mmHg) is >12 °C for men aged 60 years, >19 °C for men aged 70 years, >24 °C for men aged 80 years, >11 °C for women aged 70 years and >16 °C for women aged 80 years [1]. Additionally, a cohort study in Scotland reported that people in housing heated to less than 18 °C had a greater risk of elevated BP [9]. The WHO Housing and Health Guidelines recommend that the room temperature be >18 °C in winter [10].

In winter, it would be useful to adjust or initiate antihypertensive medications to suppress BP elevation. Ye et al. reported that decreases in BP due to initiating antihypertensive medications were stronger in autumn/winter (cold seasons) than in spring/summer (warm seasons) [11]. They compared decreases in BP due to the administration of irbesartan/hydrochlorothiazide for hypertensive participants not taking antihypertensive medications between spring/summer and autumn/winter. The mean change in SBP at the 12-week follow-up was greater among participants who commenced treatment in autumn/winter (−34.2 mmHg) than among those who commenced treatment in spring/summer (−27.1 mmHg), with a between-season difference of 7.0 mmHg (95% confidence interval, 4.7–9.3 mmHg; $P < 0.001$). In the winter, when the incidence of cardiovascular disease increases, untreated hypertensive patients should start antihypertensive medication treatment. Moreover, early adjustment of antihypertensive medications to anticipate the winter increase in BP would be useful to prevent cardiovascular events. Hanazawa et al. previously reported that the winter-summer difference in home BP was smaller in an early titration group (September–November) than in a later

✉ Keisuke Narita
m06073kn@jichi.ac.jp

[1] Division of Cardiovascular Medicine, Department of Medicine, Jichi Medical University School of Medicine, Shimotsuke, Japan

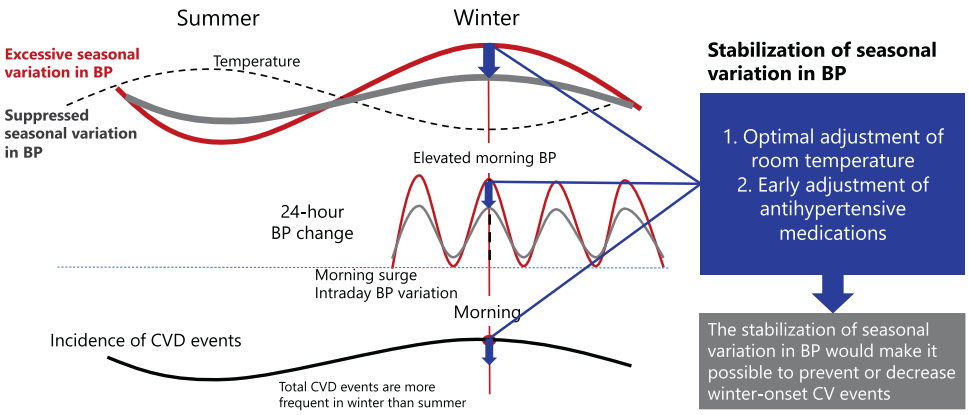

Fig. 1 Stabilization of seasonal variation in blood pressure through the optimization of antihypertensive medications and room temperature. Excessive seasonal fluctuations in blood pressure (BP) may induce winter-onset cardiovascular disease (CVD) events. (1) The optimal adjustment of room temperature and (2) early adjustment of antihypertensive medications can suppress this excessive seasonal variation in BP and may be able to prevent winter increases in the incidence of CVD

titration group (December–February) (BP changes in summer and winter, 3.9/1.2 mmHg vs. 7.3/3.1 mmHg; $p < 0.001$) and was also smaller in an early tapering group (March–May) than in a later tapering group (June–August) (BP changes in winter and summer, 4.2/2.1 mmHg vs. 7.1/3.4 mmHg; $p < 0.001$), which indicates that early adjustment of antihypertensive medications using home BP monitoring would be effective in suppressing the amplitude of seasonal BP variation [12].

Winter increases and variability in BP levels are associated with target organ damage and cardiovascular risk [5, 13–16]. Based on the abovementioned research articles by Kinuta et al. [3] and Ye et al. [11], optimizing indoor room temperature and adjusting antihypertensive medications would be useful to decrease the incidence of cardiovascular disease in winter (Fig. 1). Seasonal variations in BP, especially excessive increases in BP levels in the winter, are an important therapeutic target in the management of hypertension. Prospective studies and interventional trials are needed to assess options for stabilizing seasonal fluctuations in BP.

Compliance with ethical standards

Conflict of interest K. Kario received research funding from Omron Healthcare Co., Fukuda Denshi, and A&D Co.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

References

1. Umishio W, Ikaga T, Kario K, Fujino Y, Hoshi T, Ando S, et al. Cross-Sectional Analysis of the Relationship Between Home Blood Pressure and Indoor Temperature in Winter: A Nationwide Smart Wellness Housing Survey in Japan. Hypertension. 2019;74:756–66. https://doi.org/10.1161/hypertensionaha.119.12914.
2. Narita K, Hoshide S, Kario K. Seasonal variation in blood pressure: current evidence and recommendations for hypertension management. Hypertens Res. 2021;44:1363–72. https://doi.org/10.1038/s41440-021-00732-z.
3. Kinuta M, Hisamatsu T, Fukuda M, Taniguchi K, Komukai S, Nakahata N, et al. Associations of indoor and outdoor temperatures and their difference with home blood pressure: The Masuda Study. Hypertens Res. 2023;46:200–7. https://doi.org/10.1038/s41440-022-01059-z.
4. Modesti PA, Morabito M, Bertolozzi I, Massetti L, Panci G, Lumachi C, et al. Weather-related changes in 24-hour blood pressure profile: effects of age and implications for hypertension management. Hypertension. 2006;47:155–61. https://doi.org/10.1161/01.HYP.0000199192.17126.d4.
5. Yang L, Li L, Lewington S, Guo Y, Sherliker P, Bian Z, et al. Outdoor temperature, blood pressure, and cardiovascular disease mortality among 23 000 individuals with diagnosed cardiovascular diseases from China. Eur Heart J. 2015;36:1178–85. https://doi.org/10.1093/eurheartj/ehv023.
6. Saeki K, Obayashi K, Kurumatani N. Short-term effects of instruction in home heating on indoor temperature and blood pressure in elderly people: a randomized controlled trial. J Hypertens. 2015;33:2338–43. https://doi.org/10.1097/hjh.0000000000000729.
7. Park S, Kario K, Chia YC, Turana Y, Chen CH, Buranakitjaroen P, et al. The influence of the ambient temperature on blood pressure and how it will affect the epidemiology of hypertension in Asia. J Clin Hypertens. 2020;22:438–44. https://doi.org/10.1111/jch.13762.
8. Saeki K, Obayashi K, Iwamoto J, Tone N, Okamoto N, Tomioka K, et al. Stronger association of indoor temperature than outdoor temperature with blood pressure in colder months. J Hypertens. 2014;32:1582–9. https://doi.org/10.1097/hjh.0000000000000232.
9. Shiue I, Shiue M. Indoor temperature below 18 °C accounts for 9% population attributable risk for high blood pressure in Scotland. Int J Cardiol. 2014;171:e1–2. https://doi.org/10.1016/j.ijcard.2013.11.040.
10. World Health Organization (WHO). Housing and Health Guidelines. 2018. https://www.who.int/publications/i/item/9789241550376. 2018. Accessed December 26.

11. Ye XF, Huang QF, Li Y, Wang JG. Seasonal variation in the effect of antihypertensive treatment with the irbesartan/hydrochlorothiazide combination. Hypertens Res. 2022. https://doi.org/10.1038/s41440-022-01084-y. Online ahead of print.
12. Hanazawa T, Asayama K, Watabe D, Tanabe A, Satoh M, Inoue R, et al. Association Between Amplitude of Seasonal Variation in Self-Measured Home Blood Pressure and Cardiovascular Outcomes: HOMED-BP (Hypertension Objective Treatment Based on Measurement By Electrical Devices of Blood Pressure) Study. J Am Heart Assoc. 2018;7:e008509. https://doi.org/10.1161/jaha.117.008509.
13. Gasparrini A, Guo Y, Hashizume M, Lavigne E, Zanobetti A, Schwartz J, et al. Mortality risk attributable to high and low ambient temperature: a multicountry observational study. Lancet 2015;386:369–75. https://doi.org/10.1016/s0140-6736(14)62114-0.
14. Narita K, Hoshide S, Fujiwara T, Kanegae H, Kario K. Seasonal Variation of Home Blood Pressure and Its Association With Target Organ Damage: The J-HOP Study (Japan Morning Surge-Home Blood Pressure). Am J Hypertens. 2020;33:620–8. https://doi.org/10.1093/ajh/hpaa027.
15. Narita K, Hoshide S, Kario K. Relationship Between Home Blood Pressure and the Onset Season of Cardiovascular Events: The J-HOP Study (Japan Morning Surge-Home Blood Pressure). Am J Hypertens. 2021;34:729–36. https://doi.org/10.1093/ajh/hpab016.
16. Narita K, Hoshide S, Kario K. Seasonal Variation in Day-by-Day Home Blood Pressure Variability and Effect on Cardiovascular Disease Incidence. Hypertension. 2022;79:2062–70. https://doi.org/10.1161/HYPERTENSIONAHA.122.19494.