Hypertension Research (2023) 46:2651–2653
https://doi.org/10.1038/s41440-023-01446-0

COMMENT

Long-term changes in blood pressure and their health impact

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Keywords Blood pressure trajectories · Life course epidemiology · Cycle for the next generation · Individual maturity steps

Received: 17 August 2023 / Accepted: 31 August 2023 / Published online: 29 September 2023

Sir William Osler noted that a man is as old as his arteries, and also described blood pressure by age as follows, "In man a mean arterial pressure is maintained about 125–130 mm of Hg, and 140–160 mm in persons over 50" [1]. Blood pressure levels change with age: A linear increase has been reported in the systolic blood pressure for both men and women while the diastolic blood pressure has been reported to show an inverted U-shaped change. On the other hand, a consistent increase was noted in day-to-day systolic blood pressure variability [2]. Longitudinal blood pressure indices predict cardiovascular outcomes better than baseline blood pressure; however, data on the health effects of long-term changes in blood pressure remain inadequate [3].

Blood pressure levels and the increase in blood pressure with age may be of prognostic importance, because rising blood pressure trajectory has been reported to be associated with a high risk of developing chronic kidney disease [4]. Examining blood pressure trajectories in an adult population between the ages of 20 and 50 years revealed a greater risk of cardiovascular disease in individuals with a greater increase in blood pressure over the years [5]. Researchers have also been interested in the time when blood pressure increases during aging. A nonlinear trajectory of blood pressure elevation preceding the onset of hypertension has been reported, with inflection points in the ranges of 112–118 mmHg and 73–77 mmHg for SBP and DBP, respectively, and both SBP and DBP levels increase more rapidly once blood pressure exceeds the inflection point [6].

As mentioned previously, blood pressure changes markedly during maturation and adulthood; however, other life periods are also important in this context. The Japan Agency for Medical Research and Development (AMED), one of the funding agencies for medical research in Japan, has instituted the Project for Baby and Infant in Research of healTH and Development to Adolescent and Young adult - BIRTHDAY. It focuses on the cycle of reproduction and nurturing of the next generation from fertilization and conception through individual stages of maturity, i.e., the fetal, neonatal, infant, school-age, adolescent, sexual maturity, and reproductive stages [7]. Figure 1 shows a modified version of the "cycle for the next generation and

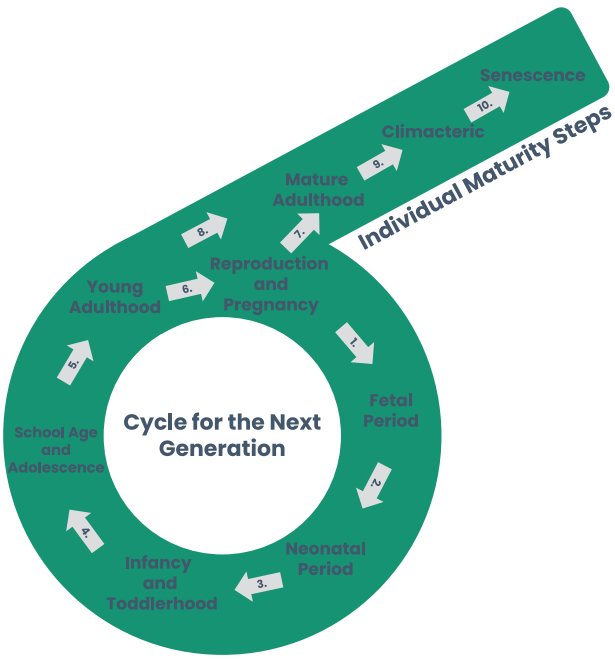

Fig. 1 Cycle for the Next Generarion and Indivisual Maturnity Steps in Terms of Long Term Changes in Blood Pressure

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the individual stages of maturity," with the added perspective of blood pressure trajectories and pre- and post-pregnancy changes in individuals, placing gestational age at the intersection.

Considering the period from reproduction and pregnancy to the fetal period, the trajectories of maternal blood pressure trends are associated with child weight beyond the blood pressure level in early pregnancy (arrows 1 and 2 in Fig. 1) [8]. Furthermore, blood pressure during pregnancy has been reported to predict the trajectory of blood pressure in children beyond the newborn stage up to 5 years of age (arrows 1–3 in Fig. 1) [9]. Blood pressure in children also increases with age [10]. In a study examining the trajectory of scores for cardiovascular health at ages 2-12 years in Chicago, USA, differences in cardiovascular health scores at the age of 2 years were reported to have widened by age 12 years. SBP and DBP tended to increase in the group with worsening health scores (arrow 4 in Fig. 1) [11]. Blood pressure increases from puberty to adulthood; however, in a previous study, it was found to have already increased in boys before puberty (arrow 5 in Fig. 1) [12].

A report on blood pressure changes before and after the perinatal period argued that lifestyle interventions for pre-pregnancy overweight or obesity are not associated with blood pressure trajectories during pregnancy and the post-partum period and that further research is needed to determine the optimal types and timings of interventions to ensure normal blood pressure throughout this critical period (arrows 6 and 7 in Fig. 1) [13].

How blood pressure changes as children transition into adulthood should be a focus. In the Fig. 1, this corresponds to arrows 5–10. The Bogalusa Heart Study reported that trajectories of blood pressure change in children differed by race and were consistently associated with left ventricular hypertrophy in adulthood [14].

The Hanzhong adolescent hypertension cohort study examined changes in blood pressure over 30 years, from childhood to young adulthood and reported the results of several longitudinal analyses. Zheng et al. reported that rate-pressure product trajectories in early life were associated with left ventricular hypertrophy in middle age [15]. The authors newly examined the association between the trajectory of blood pressure change and organ damage in the same cohort of 2430 individuals and found that future organ damage was more significant in the group with greater increases in blood pressure in early life [16]. The results of such longitudinal analyses may provide a key link between prenatal genetic environmental exposure and adult life outcomes for the prognostic impact of non-communicable diseases.

Acknowledgements We thank Editage (https://www.editage.com/) and Grammarly for proofreading the manuscript.

Funding Grants for Scientific Research from the Ministry of Education, Culture, Sports, Science and Technology of Japan (21K10438) and AMED (JP19gk0110039) were used to write and edit this comment.

Compliance with ethical standards

Conflict of interest The authors declare no competing interests (COIs) for this comment, but the following funding is a potential COI: Grants for Scientific Research (24689061, 16H05243, 19H03905, and 21K10438) from the Ministry of Education, Culture, Sports, Science and Technology of Japan; a Grant-in-Aid (19DA1001) for Health Research on Children, Youth, and Families and H21-Junkankitou [Seishuu]-Ippan-004 from the Ministry of Health, Labour and Welfare, Health and Labour Sciences Research Grants, Japan; and a Grant-in-Aid for Japan Society for the Promotion of Science (JSPS) fellows (19.7152). Additionally, academic contributions were received from Pfizer Japan Inc.; Bayer Academic Support; Takeda Research Support; Astellas Research Support, and J&J Medical Research Grant, and scholarship donations were received from Chugai Pharmaceutical Co., Ltd., Daiichi Sankyo Co., Ltd., and Otsuka Pharmaceutical Co., Ltd. Research support was received from Omron Healthcare.

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