Arterial stiffness and cardiovascular health: The importance of age and sex-specific cut-off values

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Aging is a biological process that occurs at varying rates in different organs. In the last decades, the aging process of large arteries has gained increasing interest not only from physiologists but also from healthcare professionals due to the important impact of arteries on blood pressure, particularly systolic blood pressure, and the development of hypertension, the most prevalent cardiovascular disease worldwide. Arterial aging, characterized by increased arterial stiffness, holds significant clinical importance because of its close association with cardiovascular disease (CVD) and overall mortality risk.

As arteries age, they lose elasticity due to structural changes in the arterial wall, including collagen accumulation and elastin degradation. Arterial stiffening leads to a higher pulse wave velocity (PWV). Therefore, PWV has been used as a surrogate for arterial stiffness, mainly for aortic stiffness, in clinical studies. Several methods have been developed to assess artery stiffness, with carotid-to-femoral PWV (cf-PWV) being the most commonly used. Its non-invasive nature has increased its appeal in clinical use. Studies have shown that elevated arterial stiffness is an independent predictor of hypertension, heart failure, stroke, and, particularly, isolated systolic hypertension, a common trait in older people [1, 2]. Moreover, arterial stiffness contributes to the progression of atherosclerosis by increasing hemodynamic stress on the vascular system. Thus, monitoring and managing arterial stiffness is critical for the early detection and prevention of CVD.

The association between cardiovascular risk factors and arterial stiffness is well-documented and indicates that traditional cardiovascular risk factors, such as hypertension, dyslipidemia, diabetes, and smoking, accelerate arterial stiffening and contribute to early vascular aging [3, 4]. These risk factors not only impair arterial function but also increase the risk of adverse cardiovascular outcomes, including heart failure and stroke [1, 5]. In the current issue of the *Polish Heart Journal*, Jin et al. [6] present a compelling study examining the impact of various cardiovascular risk factors on arterial stiffness. A key aspect of their study was the exclusion of participants with prevalent cardiovascular diseases, focusing instead on 501 healthy individuals. This allowed the study to provide valuable insights into how arterial stiffness, measured by cf-PWV, varies by sex and age. The authors found that in men, cf-PWV is positively correlated with factors such as age, blood pressure, and heart rate. In females, metabolic markers like creatinine, triglycerides, fasting blood glucose, uric acid, urea, and cholesterol levels also are correlated with cf-PWV. Interestingly, in a multiple regression analysis, creatinine was independently associated with cf-PWV in women but not in men.

The determinants of arterial stiffness differ significantly between men and women, with physiological and hormonal factors playing key roles. Studies indicate that men tend to exhibit higher arterial stiffness at younger ages compared to women, likely due to differences in cardiovascular risk profiles and the

protective effects of estrogen in premenopausal women [7, 8]. Estrogen has been shown to improve vascular elasticity and reduce inflammation, leading to lower arterial stiffness in women before menopause [9]. However, after menopause, women experience a rapid increase in arterial stiffness, often surpassing that of men of the same age, due to the decline in estrogen levels. Additionally, as Jin et al. [6] demonstrated, age, systolic blood pressure, and heart rate are key determinants of arterial stiffness in both sexes, though the influence of metabolic factors like cholesterol and glucose is more pronounced in women.

Since cf-PWV is considered a biological marker of global cardiovascular risk, its use in clinical settings requires the establishment of clear cut-off values for elevated stiffness. However, because chronological age is the primary factor influencing cf-PWV (increasing by approximately 0.90 m/s per decade), and premenopausal women tend to have significantly lower values, it is essential to establish reference values by age and sex. A single value (10 m/s) has been suggested as a cut-off to define accelerated artery aging [10]. However, in younger adults, particularly premenopausal women, this value may be too high, potentially delaying the implementation of interventions to reduce cardiovascular risk. In older adults, a cf-PWV value of 10 m/s may be considered normal when chronological age is taken into account. A large cohort of Brazilians without cardiovascular or renal diseases helped define cf-PWV percentiles [3]. Similar studies in populations without CVD could help establish more appropriate cut-off values, facilitating the use of artery stiffness data for CVD prevention.

Article information

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