Ideal Cardiovascular Health and Arterial Stiffness in Spanish Adults—The EVIDENT Study

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Background: Studies concerning ideal cardiovascular (CV) health and its relationship with arterial stiffness are lacking. This study examined the association between arterial stiffness with ideal CV health as defined by the American Heart Association, across age groups and gender. *Methods:* The cross-sectional study included 1365 adults. Ideal CV health was defined as meeting ideal levels of the following components: 4 behaviors (smoking, body mass index, physical activity, and Mediterranean diet adherence) and 3 factors (total cholesterol, blood pressure, and glycated hemoglobin). Patients were grouped into 3 categories according to their number of ideal CV health metrics: ideal (5-7 metrics), intermediate (3-4 metrics), and poor (0-2 metrics). We analyzed the pulse wave velocity (PWV), the central and radial augmentation indexes, and the ambulatory arterial stiffness index (AASI). *Results:* The ideal CV health profile was inversely associated with lower arterial radial augmentation index and AASI in both genders, particularly in middle-aged (45-65 years) and in elderly subjects (>65 years). Also in elderly subjects, adjusted models showed that adults with at least 3 health metrics at ideal levels had significantly lower PWV than those with 2 or fewer ideal health metrics. *Conclusions:* An association was found between a favorable level of ideal CV health metrics and lower arterial stiffness across age groups. **Key Words:** Ambulatory arterial stiffness index—Health behaviour—Health factors—Pulse wave velocity.

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Introduction

Evidence supports that lower arterial elasticity is directly associated with increased risk of cardiovascular (CV) disease manifestations.[1] Artery stiffening appears to promote damage in target organs, such as kidney and brain, through penetration of pulsatile energy into them.[2] Arterial stiffness measured using pulse wave velocity (PWV), the gold-standard measure of aortic stiffness, has been shown to be a strong independent predictor of CV morbidity in the general population.[3] Augmentation index, often reported along with indexes of arterial stiffness, is a measure of the wave reflection impact on the rise of central systolic and pulse pressure, and it can predict clinical events.[4]

In 2010, the American Heart Association proposed including in the 2020 Strategic Impact Goals reduction of CV disease and increase in CV health by promoting a healthy lifestyle.[5] Ideal CV health is defined as optimal levels of 4 behaviors (ideal body mass index [BMI], nonsmoking status, regular physical activity, and healthy diet) and 3 CV risk factors (optimal profile of blood pressure [BP], fasting plasma glucose, and total cholesterol). Ideal CV health metrics are inversely associated with the incidence of CV disease,[6] stroke,[7] and the increase in the number of deaths for all causes.[8] However, studies concerning ideal CV health and its relationship with arterial stiffness are lacking. Specifically, Aatola et al[9] demonstrated that every 1-metrics increase corresponded with a .09-m/s decrease in PWV. Crichton et al[10] reported that better CV health (≥5 metrics) is related to lower arterial stiffness assessed by PWV and pulse pressure. However, both studies did not consider the possible interaction between age and gender with arterial stiffness.[11] Using data from the Estilos de vida y envejecimiento arterial, in Spanish (EVIDENT) study,[12] we examined whether the American Heart Association's construct of ideal CV health is associated with arterial stiffness in a Spanish population according to age groups and gender.

Methods

Study Design

This was a cross-sectional analysis evaluating the association of lifestyles with the circadian pattern of BP, arterial stiffness, and endothelial function in a cohort of subjects. This is a secondary analysis of the EVIDENT study. The protocol of the EVIDENT study (trial registration number: NCT01083082) has previously been published elsewhere.[12] The study was approved by the ethics committee of Salamanca University Hospital (Spain), and all participants gave written informed consent according to the general recommendations of the Declaration of Helsinki.

Study Sample

Participants aged 20-80 years were selected through random sampling from general practitioner's offices belonging to 6 primary care centers from Spain. From the 1553 subjects included in the EVIDENT study, 188 were excluded for lack of radial augmentation index measurement (n = 51) or accelerometer data (n = 154). Finally, 1365 patients were included in the analysis. Sample size calculation indicated that the 1365 participants included were sufficient to detect a difference in the radial augmentation index of 8% between ideal and poor groups, assuming a standard deviation of .2 with a significance level of 95% and a power of 80%.

Measurements

Resting BP

Systolic BP and diastolic BP were measured 3 times with a 5-minute interval in the clinical setting and using a validated OMRON M7 sphygmomanometer (Omron Health Care, Kyoto, Japan). Before the first measurement, at least a 5-minute rest was required. The participant was seated, in relaxing conditions, with the right arm semiflexed at heart level; the cuff size for BP measurement was used according to the patients' arm circumference. The average of the last 2 measurements was considered. Then, the mean arterial pressure was calculated using the following formula: diastolic BP + [.333 × (systolic BP – diastolic BP)].

Biochemical Determinations

Blood sample was taken from the cubital vein between 8:00 AM and 9:00 AM, after at least 12 hours of fasting and abstaining from smoking, alcohol, or caffeinated beverages. We determined several biochemical parameters, including lipoproteins, fasting plasma glucose, and glycated hemoglobin (HbA1c).

Anthropometric Measurements

Weight was measured twice (Seca 770 scale [Seca Inc., Hanover, Maryland]) with the participant barefoot and in light clothing. Height was also measured twice using a wall stadiometer (Seca 222 [Seca Inc., Hanover, Maryland]), with the participant barefoot, upright, and with the sagittal midline touching the backboard. For both variables, the mean of the 2 measurements was recorded. BMI was calculated as weight (kg) divided by height squared (m^2).

Physical Activity

ActiGraph GT3X accelerometers (ActiGraph, Shalimar, FL) were used to assess physical activity. Participants were verbally instructed to use the accelerometer, which was fastened with an elastic band to the right side of the waist during 7 consecutive days. All subjects were instructed to wear the accelerometer throughout the day from the time they woke up in the morning until they went to