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ARTICLE

Influence of Blood Pressure on Left Atrial Size

The Framingham Heart Study

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Abstract: *Abstract* Increased left atrial size has been identified as a precursor of atrial fibrillation and of stroke once atrial fibrillation is manifest. Conflicting data exist regarding the effect of high blood pressure on left atrial size. Our objective was to evaluate the association of contemporary and long-term measures of blood pressure with echocardiographically determined left atrial size in a large, population-based cohort. The study sample consisted of 1849 male and 2152 female participants of the Framingham Heart Study and Framingham Offspring Study. All analyses were sex specific. In correlation analyses, systolic and pulse pressures were identified as statistically significant determinants of left atrial size after adjustment for age and body mass index, although the magnitudes of these relations were very modest (partial $r \leq .10$). Multivariable linear regression models showed the relative contributions of the pressure variables to the prediction of left atrial size to be substantially less than those of age and, in particular, body mass index. Furthermore, inclusion of left ventricular mass in these multivariable models eliminated or attenuated the associations of the pressure variables with left atrial size. In logistic analyses, increasing levels of the pressure variables were significantly predictive of left atrial enlargement. Subjects with 8-year average systolic pressure of 140 mm Hg or higher were twice as likely to have left atrial enlargement as those with values of 110 mm Hg or lower. Overall, in this population-based study sample, increased levels of systolic and pulse pressures (but not diastolic or mean arterial pressures) were significantly associated with increased left atrial size. However, the magnitude of these associations was quite modest, particularly after controlling for age and body mass index.

Key Words: atrial function, left ■ hypertension, essential ■ epidemiology ■ echocardiography

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Increased left atrial size is associated with an increased prevalence of nonrheumatic atrial fibrillation,[1 2 3] and in addition, it is a predictor of stroke, once atrial fibrillation is manifest.[4 5] Although factors predisposing to increased left atrial size may have clinical importance, few studies are available that systematically analyze the determinants of left atrial enlargement.

Factors most commonly associated with the presence of left atrial enlargement include aging,[6] increased body size,[6 7] and mitral valve disease.[8] Although electrocardiographic features of left atrial enlargement have been observed in the setting of hypertensive heart disease,[9 10] data conflict regarding the effect of blood pressure (BP) on echocardiographically determined left atrial size. Of the available investigations, three case-control studies found a significant association of echocardiographically determined left atrial enlargement with hypertensive status,[11 12 13] whereas a larger case-control study did not.[7]

Further examination of the relations between BP and left atrial size may contribute to our understanding of high BP as a determinant of left atrial enlargement. In addition, evaluation of long-term BP patterns may provide insight into the effects of sustained high BP on left atrial size. The Framingham Heart Study has uniformly obtained echocardiographic information and longitudinally gathered BP data. We examined the relations of contemporary and long-term BP patterns to echocardiographically determined left atrial size in subjects of this large, population-based cohort.

Methods

Study Sample

The Framingham Heart Study was initiated in 1948 as a prospective epidemiological investigation of cardiovascular disease in a sample of 5209 residents of Framingham, Mass. The Framingham Offspring Study was undertaken in 1971 and consisted of 5124 subjects who were offspring (and spouses of offspring) of original Framingham Heart Study participants. The study design and methods of recruitment, data collection, and surveillance for the Framingham Heart Study[14 15] and Framingham Offspring Study[16] have been described previously. Subjects of the Framingham Heart Study who participated in the 16th biennial examination (1979 to 1981) and subjects of the Framingham Offspring Study who participated in the second examination (1979 to 1983) comprised the study sample of the present investigation. At these index examinations, M-mode echocardiograms were routinely performed.

Subjects were excluded for any of the following conditions: (1) technically inadequate or unavailable echocardiogram at the index examination, (2) history of clinically apparent coronary heart disease, congestive heart failure, valvular heart disease, or atrial fibrillation at or before the index examination, (3) use of cardiovascular medications at the index examination, (4) age less than 20 years or greater than or equal to 90 years, (5) morbid obesity (body mass index [BMI] >35 kg/m^2), and (6) incomplete BP data.

Subjects were considered to have valvular heart disease if a grade 3/6 or higher systolic murmur or any diastolic murmur was detected on physical examination or if echocardiographic evidence of valvular disease (including mitral stenosis) was found. Subjects meeting the criteria for angina pectoris, coronary insufficiency (prolonged chest pain associated with documented electrocardiographic changes), or myocardial infarction were considered to have clinically apparent coronary heart disease. The criteria for coronary heart disease end points and congestive heart failure in the Framingham Heart Study have been described previously.[17] Atrial fibrillation was determined from 12-lead electrocardiograms routinely obtained on subjects at each clinic examination or through review of electrocardiograms obtained from hospitalizations or office visits to outside physicians.

Methods of Measurement and Definitions

At each examination, systolic and diastolic pressure readings were measured in the left arm with a mercury sphygmomanometer while the subject was seated. Systolic and diastolic pressures were determined by the first and fifth Korotkoff phases, respectively. Two separate BP readings were obtained by the physician examiner. The respective averages of the two measurements of systolic and diastolic pressures were used as the examination systolic and diastolic pressures. At the first Offspring Study examination, only one BP measurement was obtained by the physician examiner; consequently, the first BP reading alone was used. Body height and weight measurements obtained at the index examination were used to calculate BMI (kilograms per meter squared).

Pulse pressure (systolic pressure minus diastolic pressure) and mean arterial pressure (diastolic pressure plus one-third pulse pressure) also were evaluated as potential correlates of left atrial size. The following BP variables were used: (1) index examination pressures were obtained at the baseline examination, when echocardiography was performed, and (2) 8-year average pressures were the averages of pressures obtained at the index examination and at the examination 8 years before. BP information obtained from the examination 8 years before the index examination was used because of its availability in both the original cohort and offspring subjects.

Echocardiographic Methods

Subjects were studied with standard M-mode echocardiography. A 2.25-MHz, 1.25-cm diameter, unfocused transducer (KB Aerotech) and an ultrasound receiver (model 201, Hoffrel Instruments) interfaced with a strip-chart recorder (model 1856, Honeywell) were used.

Left atrial size was determined in accordance with American Society of Echocardiography guidelines with the use of a leading edge–to–leading edge measurement of the maximal distance between the posterior aortic root wall and the posterior left atrial wall at end systole.[18] Wade et al[19] have demonstrated low interobserver (r=.97) and intraobserver (r=.97) variabilities in the M-mode measurements of left atrial dimension using the above guidelines. The modified cubed formula (with end-diastolic left ventricular [LV] measurements obtained in accordance with the Penn convention) was used to calculate LV mass[20] : LV Mass (g)=1.04[(LV Internal Diameter+LV Septal Thickness+Posterior Wall Thickness)^3− (LV Internal Diameter)^3]−13.6. LV mass (in grams) was adjusted for body size by dividing it by the height of the subject (in meters).[21]

Data Analysis and Statistical Methods

All analyses were sex specific. The relations of BP variables to left atrial size were initially examined with simple and partial (adjusted for age and BMI) Pearson correlation coefficients.[22] Linear regression analyses were used for evaluation of the relative influences of BP variables, age, and BMI on left atrial dimension.[22]

Left atrial enlargement was defined as left atrial dimension greater than or equal to 43 mm in men and greater than or equal to 38 mm in women, respectively. These cut points were the 90th percentile values in a younger (age <65 years), normotensive (systolic pressure <140, diastolic pressure <90 mm Hg), and nonobese (BMI <75th percentile) subset of our study sample. Age-adjusted prevalences of left atrial enlargement according to BP groups were calculated using direct age adjustment with age groups of 20 to 29, 30 to 39, 40 to 49, 50 to 59, 60 to 69, and 70 years or older. Logistic regression modeling[23] was used for assessment of the probability of left atrial enlargement according to BP levels. Additional models adjusted for age and BMI.

All statistical analyses were performed with the Statistical Analysis System[24] on a SUN SPARC station 2. A two-sided significance level of .05 was used for each statistical test.

Results

Characteristics of the Study Sample

Of the 2803 men and 3411 women who attended the index examination, 1849 men (66%) and 2152 women (63%) ranging in age from 20 to 89 years were eligible for analysis (Table 1). Sex-specific clinical and echocardiographic characteristics obtained at the index examination are provided in Table 2. For each BP variable, men tended to have higher mean values than women. Mean values of both left atrial dimension and LV mass (corrected for height) also were greater in men.

Simple and Partial Correlation Analyses

Results of analyses correlating BP variables, age, and BMI with left atrial size are provided in Table 3. BMI was a stronger correlate of left atrial size (men, r=.47; women, r=.49) than were other measures of body size such as body weight (men, r=.42; women, r=.42) and body surface area (men, r=.33; women, r=.30). Age was more highly correlated with left atrial size in women (r=.37) than men (r=.17). The simple Pearson correlation coefficients for each of the BP variables suggested modest but statistically significant relations with left atrial dimension.

After controlling for age and BMI, only systolic and pulse pressure variables remained significantly related to left atrial size. The magnitude of the correlation coefficients for each BP variable markedly diminished after controlling for age and BMI. This effect was greater in women than men. Notably, after adjustment for age and BMI, the partial correlation coefficients were similar in men and women. Differences between the sexes in the relations of the BP variables with age and BMI may partially account for this observation. In both sexes, age correlated strongly with systolic pressure (men, *r*=.40; women, *r*=.58) and pulse pressure (men, *r*=.47; women, *r*=.62); the correlations in women were appreciably stronger than in men. Similarly, the correlations of BMI with systolic pressure (men, *r*=.18; women, *r*=.27) and pulse pressure (men, *r*=.0003; women, *r*=.21) were stronger in women than men. Interestingly, age was more strongly correlated with the BP variables than was BMI.

Linear Regression Analyses

Since systolic and pulse pressures remained statistically significantly related to left atrial size after adjustment for age and BMI in the correlation analyses (see Table 3), their relations with left atrial size were the focus of further analyses. Multivariable linear regression analyses confirmed the statistically significant associations of the individual systolic and pulse pressure variables with left atrial size as demonstrated in the previous correlation analyses. For each index examination and 8-year average pressure variable, the association with left atrial size was highly statistically significant after age and BMI were taken into account ($P<.01$); however, the magnitudes of these associations were negligible. In both men and women, the coefficients for the 8-year average pressure variables were slightly greater than the coefficients for the index examination pressure variables.

These multivariable models showed the relative contributions of the pressure variables to the prediction of left atrial size to be substantially less than those of age and in particular BMI. Increments in left atrial size for each 1-SD increment of age, BMI, and individual BP covariates were calculated. The effect of a 1-SD increment of BMI on left atrial size (men, 1.9 mm; women, 1.7 mm) was approximately sixfold greater than the influence of a 1-SD increment of 8-year average systolic pressure on left atrial size (men, 0.3 mm; women, 0.3 mm). Similarly, the influence of a 1-SD increment of age on left atrial size (men, 0.5 mm; women, 0.9 mm) also was greater than was a 1-SD increment of 8-year average systolic pressure.

Effect of LV Mass on Left Atrial Size

In our study sample, the correlation between left atrial size and LV mass was substantial (men, *r*=.42; women, *r*=.50). With inclusion of LV mass in the multivariable linear regression models, the relations between the pressure variables and left atrial size were in general no longer statistically significant. In women, however, the relations of the pulse pressure variables with left atrial size were not significantly altered after adjustment for LV mass.

Prevalence of Left Atrial Enlargement According to BP Levels

Age-adjusted prevalences of left atrial enlargement according to 8-year average systolic pressure and 8-year average pulse pressure are presented in Figs 1 and 2, respectively. In both men and women, a stepwise increase in the prevalence of left atrial enlargement occurred with increasing levels of systolic and pulse pressures. In both sexes, subjects with 8-year average systolic pressure greater than or equal to 140 mm Hg were twice as likely to have left atrial enlargement as those with values less than or equal to 110 mm Hg.

Logistic Regression Analyses

In multivariable logistic regression analyses, the relations of each of the pressure variables to the prediction of left atrial enlargement were statistically significant before and after adjustment for age and BMI. These associations were greater in women than in men and were attenuated after adjustment for age and BMI. Results are shown in Table 4. The odds ratios are expressed in terms of 1-SD increments.

Discussion

Principal Findings

In this study sample, increased levels of systolic and pulse pressures were significantly associated with increased left atrial size, even after adjustment for age and BMI. For each of these pressure variables, the relation with left atrial size was highly statistically significant but very modest in magnitude. In contrast, diastolic and mean arterial pressures were not significantly associated with left atrial size after controlling for age and BMI. Our analyses of temporal BP data demonstrated that measures of long-term systolic and pulse pressures were slightly more predictive of left atrial size than were index examination measures. However, the overall differences between the contemporary and long-term associations were small. Additionally, the associations between the pressure variables and left atrial size disappeared or were attenuated after adjustment for LV mass.

Comparison With the Literature

The results of this population-based investigation contribute to the understanding of the relations of systemic BP to left atrial size and extend the work of previous investigators. In a study of 31 hypertensive subjects without clinically evident coronary heart disease, Dunn et al[11] found that hypertensive subjects with evidence of left atrial abnormality by electrocardiogram or LV hypertrophy by either electrocardiogram or chest roentgenogram had significantly greater left atrial indexes (left atrial size/body surface area) than 14 age-matched normotensive subjects. Miller et al,[12] in an evaluation of 14 hypertensive and 10 normotensive subjects with normal coronary angiography, demonstrated significantly increased left atrial dimension and left atrial index (left atrial size/body surface area) among the hypertensive subjects. A recent study by Pearson et al[13] of 144 participants of the Systolic Hypertension in the Elderly Program (SHEP) trial and 55 age-matched normotensive control subjects found significantly increased left atrial index (left atrial size/body surface area) in the hypertensive group. However, among 234 subjects with mild to moderate hypertension in a study by Savage et al,[7] only 5% of hypertensive subjects were found to have abnormal left atrial dimensions (defined as values above the 95% prediction interval derived from 124 normotensive control subjects).

Each of the earlier studies was a case-control design and involved relatively small study samples. Moreover, different criteria were used for the definition of hypertension: elevated systolic and diastolic pressures (≥140/90 mm Hg),[11] [12] isolated systolic hypertension (systolic ≥160 and diastolic <90 mm Hg),[11] and diastolic hypertension (≥95 mm Hg).[7] In accordance with our findings, the studies that included subjects with systolic hypertension[11] [12] found significant associations of hypertension with increased left atrial size. Conversely, Savage et al[7] evaluated subjects with diastolic hypertension and did not find an increased prevalence of left atrial enlargement among hypertensive subjects. Of note, among subjects in the study by Savage et al with available resting BP readings (n=128), systolic pressure was significantly correlated (r=.20, P<.05) with left atrial dimension, whereas diastolic pressure was not (r=.17, P>.05).

Among the previous studies, body surface area was predominantly used to account for differences in body size. The appropriateness of left atrial indexation by body surface area is controversial, and correction of left atrial size is not widely used clinically. However, as has been previously demonstrated, there are significant sex-specific differences in left atrial dimension.[25] In the absence of validated methods for body size correction, the analyses in the present study were all sex specific and used 90% cutoffs for unindexed left atrial dimension based on a healthy sample of Framingham Heart Study subjects.

Effects of Aging and Obesity on Left Atrial Dimension

In our analyses, the effect of age on left atrial size and on the prevalence of left atrial enlargement was considerable. The influence of aging on left atrial size has been previously reported. Autopsy[26 27] and echocardiographic[6 25] studies have shown modestly increased left atrial size with aging. This effect may be related to changes in atrial tissue composition that occur with advancing age.[27 28]

BMI was the most powerful determinant of left atrial size in our study sample, proving to be a stronger correlate of left atrial size than height or body surface area. Previous echocardiographic studies have found that left atrial size increases as a function of body surface area[6 25 29] and height.[30] Although body surface area is body mass dependent and tends to increase in the setting of obesity, BMI is a better, though still imperfect, correlate of obesity. A small case-control study by Lavie et al[31] suggested that obese subjects (defined as body weight exceeding 150% ideal weight) had increased left atrial size compared with lean control subjects. The mechanisms by which obesity may promote left atrial enlargement are unclear but are likely related to hemodynamic alterations in the obese characterized by increased intravascular volume associated with increased cardiac output and stroke volume.[32 33]

Mechanisms of Association Between Left Atrial Size and BP

Elevated systolic or pulse pressure may directly promote atrial dilatation. Alternatively, the increase in left atrial size in the hypertensive patient may reflect other factors associated with increased systolic and pulse pressures. Previous studies have demonstrated a positive association between systolic pressure and LV mass.[34] [35] [36] Moreover, several studies have demonstrated left atrial functional abnormalities in the setting of increased LV mass.[37] [38] [39] In the present study, the correlation between left atrial size and LV mass was considerable (men, *r*=.42; women, *r*=.50), and adjustment for LV mass negated the significant association of the pressure variables with left atrial size. As such, it is possible that the association of BP with left atrial size and left atrial enlargement may be mediated through the more clearly defined association of hypertension with LV hyper- trophy.[40] [41]

Strengths and Limitations

The present study was based on a large, closely followed population-based sample. Because of the elimination of clinical referral patterns, selection bias was inherently minimized. An additional advantage of the present investigation was the availability of historical BP information that was used in analyses of the long-term BP variables. In view of the frequent, routine longitudinal surveillance of our subjects, exclusions for clinically evident cardiac disease were likely to be more complete. Occult coronary disease, however, cannot be excluded in this study sample.

Several limitations warrant consideration. The generalizability of these results may be limited because the study sample is overwhelmingly white; extrapolation of these results to nonwhite populations may not be applicable. In addition, the anteroposterior left atrial dimension provided by M-mode may not accurately reflect true left atrial chamber size. Although the left atrium tends to enlarge spherically, symmetrical enlargement does not always occur.[42] Furthermore, distortion of the anteroposterior dimension may occur secondary to dilatation of the aortic root (which forms the anterior boundary of the left atrium) or encroachment posteriorly from enlarged posterior structures. Nonetheless, misclassification of left atrial size is unlikely to have resulted in systematic bias. A further limitation of M-mode is its insensitivity for the detection of valvular heart disease. In particular, M-mode cannot evaluate clinically significant mitral regurgitation, well known to be associated with left atrial enlargement.

Implications

The present study demonstrates statistically significant effects of systolic and pulse pressures on left atrial size. The influences appear to be very modest in magnitude and may be mediated by the influence of LV mass on left atrial size. It is not known whether antihypertensive strategies that prevent the development of LV hypertrophy or contribute to its regression materially affect the development of left atrial enlargement.

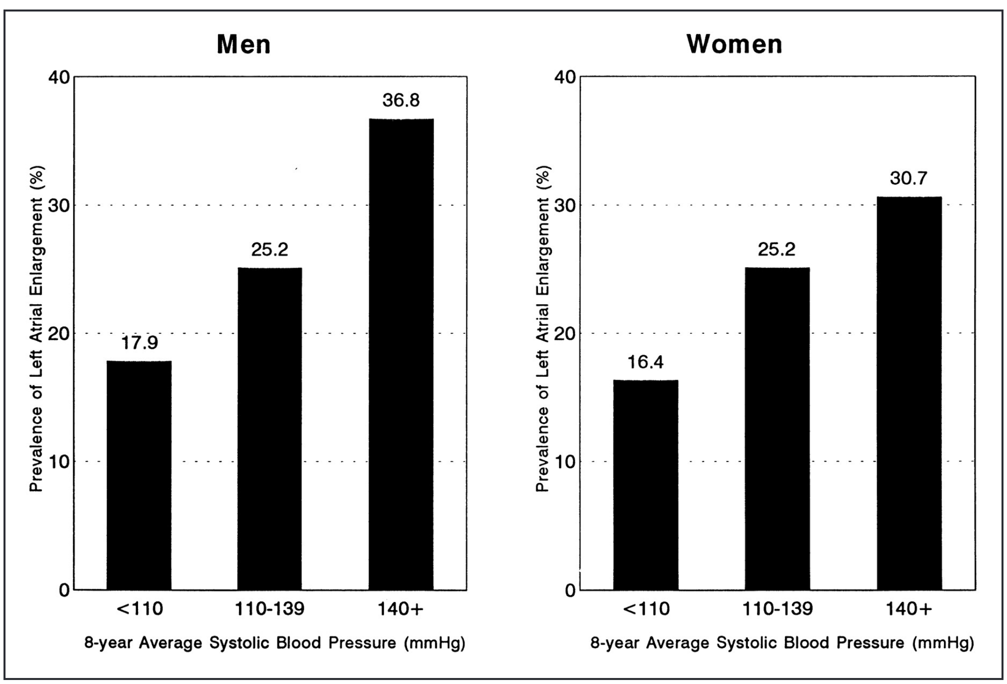

Figure 1. Bar graphs show age-adjusted prevalence of left atrial enlargement according to 8-year average systolic pressure in men and women. Left atrial enlargement is defined as left atrial size ≥43 mm in men and ≥38 mm in women.

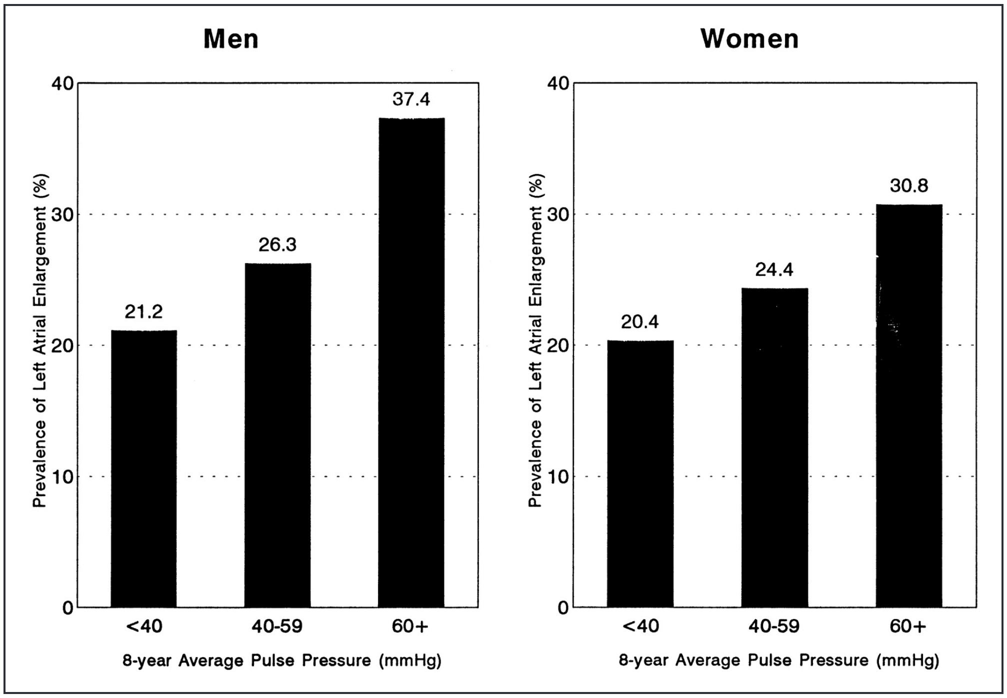

Figure 2. Bar graphs show age-adjusted prevalence of left atrial enlargement according to 8-year average pulse pressure in men and women. Left atrial enlargement is defined as left atrial size ≥43 mm in men and ≥38 mm in women.

Table 1. Study Sample (Table view)

	Men	Women
Attended index exam	2803	3411
Exclusions		
Did not attend prior exam	36	56
Missing blood pressure data	8	25
Echo not available	159	214
Clinically apparent cardiac disease	346	311
Use of cardiovascular medications	362	575
Extreme age or BMI values	43	78
Total eligible subjects	1849	2152

BMI indicates body mass index. Exclusion criteria were applied sequentially as listed.

Table 2. Study Sample Characteristics (Table view)

Characteristic	Men	Women
Age, y	48.1 (13.6)	49.3 (14.3)

Characteristic	Men	Women
BMI, kg/m^2	26.1 (3.2)	24.0 (3.6)
Index examination values		
Systolic pressure, mm Hg	126.6 (16.4)	121.0 (18.5)
Diastolic pressure, mm Hg	79.5 (9.1)	75.5 (8.7)
Pulse pressure, mm Hg	47.1 (13.0)	46.4 (14.5)
Mean arterial pressure, mm Hg	95.2 (10.4)	90.0 (10.9)
8-Year average values		
Systolic pressure, mm Hg	125.8 (13.3)	119.7 (15.2)
Diastolic pressure, mm Hg	79.7 (7.8)	74.7 (7.6)
Pulse pressure, mm Hg	46.0 (10.2)	45.0 (11.4)
Mean arterial pressure, mm Hg	95.1 (8.8)	89.7 (9.4)
Echo variables		
Left atrial dimension, mm	39.6 (4.2)	34.8 (4.2)
Left ventricular mass, g/m	109.2 (26.7)	78.2 (20.4)

BMI indicates body mass index. Values are mean (SD).

Table 3. Correlations of Age, Body Mass Index, and Blood Pressure With Left Atrial Size (Table view)

	Men		Women	
	Simple Correlations	Partial Correlations	Simple Correlations	Partial Correlations
Age	.17[2]	N/A	.37[2]	N/A
BMI	.47[2]	N/A	.49[2]	N/A
Index SBP	.19[2]	.06[1]	.31[2]	.07[1]
8-Year average SBP	.20[2]	.07[1]	.32[2]	.07[1]
Index DBP	.15[2]	−.01	.14[2]	−.02
8-Year average DBP	.18[2]	.01	.16[2]	−.003
Index PP	.13[2]	.09[2]	.31[2]	.10[2]
8-Year average PP	.12[2]	.08[2]	.32[2]	.10[2]
Index MAP	.18[2]	.03	.25[2]	.02
8-Year average MAP	.21[2]	.04	.26[2]	.03

BMI indicates body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; PP, pulse pressure; and MAP, mean arterial pressure. Values shown are simple and partial Pearson correlation coefficients.

1 *P*<.01;

2 *P*<.001; otherwise, *P*>.05. Partial correlations were determined after adjustment for age and body mass index.

Table 4. Relations of Systolic and Pulse Pressures to Prevalence of Left Atrial Enlargement: Logistic Regression Analyses (Table view)

	Unadjusted OR (95% CI)	Age- and BMI- Adjusted OR (95% CI)
Index SBP		
Men	1.36 (1.23-1.51)	1.10 (0.97-1.24)
Women	1.81 (1.64-2.00)	1.20 (1.05-1.36)
8-Year average SBP		
Men	1.37 (1.24-1.52)	1.09 (0.97-1.23)
Women	1.82 (1.65-2.02)	1.19 (1.05-1.36)
Index PP		
Men	1.27 (1.15-1.40)	1.16 (1.02-1.31)
Women	1.79 (1.63-1.98)	1.25 (1.09-1.42)
8-Year average PP		
Men	1.24 (1.12-1.37)	1.13 (1.01-1.28)
Women	1.79 (1.62-1.97)	1.23 (1.07-1.40)

OR indicates odds ratio; CI, confidence interval; BMI, body mass index; SBP, systolic blood pressure; and PP, pulse pressure. Left atrial enlargement is defined as left atrial dimension ≥43 mm in men and ≥38 mm in women.

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Sections

List of Illustrations

1. Figure 1
2. Figure 2

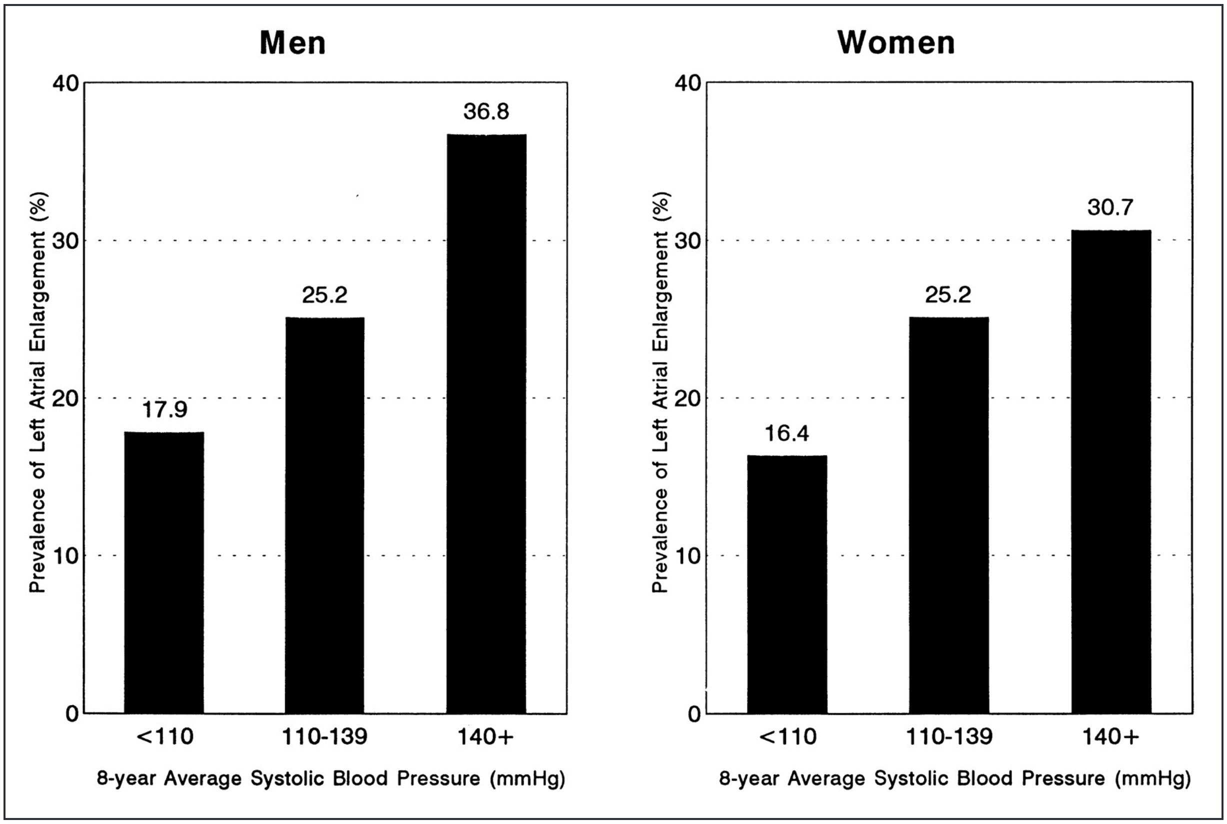

Figure 1. Bar graphs show age-adjusted prevalence of left atrial enlargement according to 8-year average systolic pressure in men and women. Left atrial enlargement is defined as left atrial size ≥43 mm in men and ≥38 mm in women.

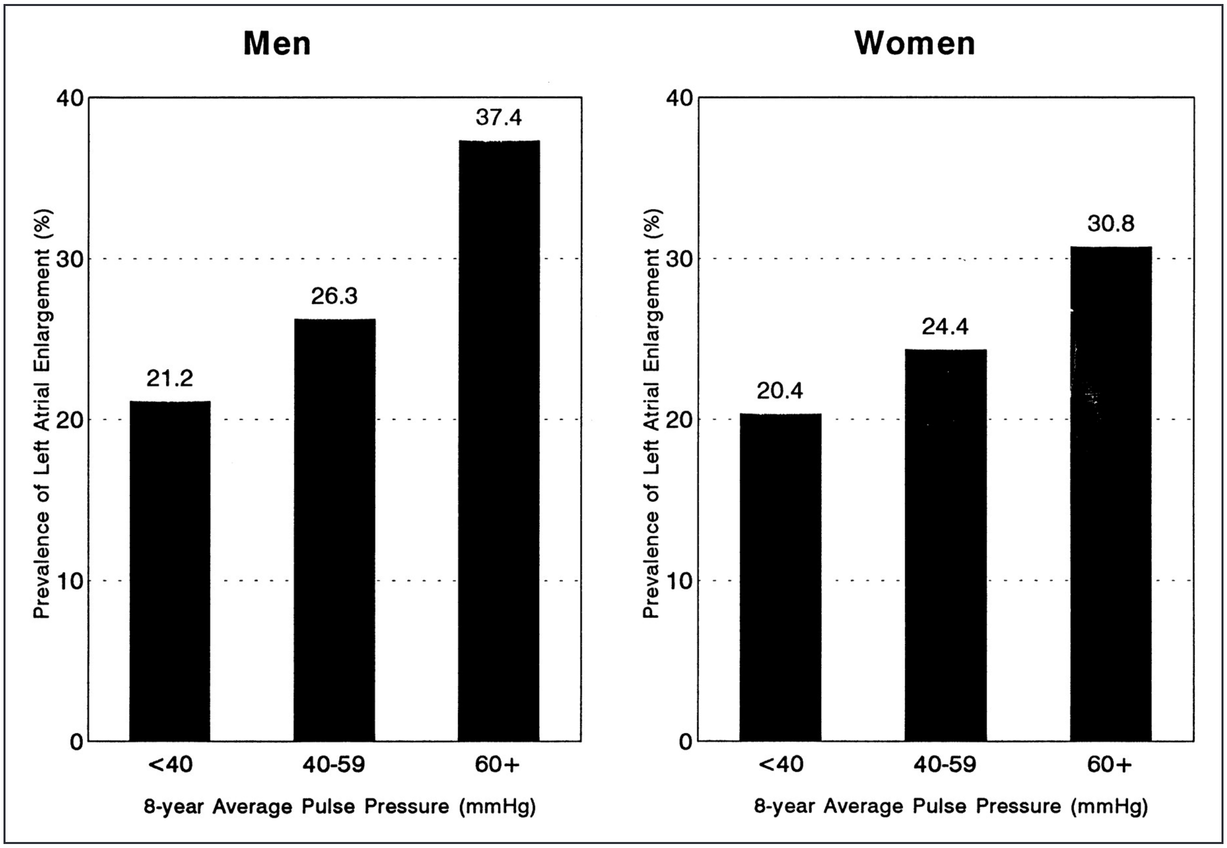

Figure 2. Bar graphs show age-adjusted prevalence of left atrial enlargement according to 8-year average pulse pressure in men and women. Left atrial enlargement is defined as left atrial size ≥43 mm in men and ≥38 mm in women.

Table 1. Study Sample

	Men	Women
Attended index exam	2803	3411
Exclusions		
Did not attend prior exam	36	56
Missing blood pressure data	8	25
Echo not available	159	214
Clinically apparent cardiac disease	346	311
Use of cardiovascular medications	362	575
Extreme age or BMI values	43	78
Total eligible subjects	1849	2152

BMI indicates body mass index. Exclusion criteria were applied sequentially as listed.

Table 2. Study Sample Characteristics

Characteristic	Men	Women
Age, y	48.1 (13.6)	49.3 (14.3)
BMI, kg/m^2	26.1 (3.2)	24.0 (3.6)
Index examination values		
Systolic pressure, mm Hg	126.6 (16.4)	121.0 (18.5)
Diastolic pressure, mm Hg	79.5 (9.1)	75.5 (8.7)
Pulse pressure, mm Hg	47.1 (13.0)	46.4 (14.5)
Mean arterial pressure, mm Hg	95.2 (10.4)	90.0 (10.9)
8-Year average values		
Systolic pressure, mm Hg	125.8 (13.3)	119.7 (15.2)
Diastolic pressure, mm Hg	79.7 (7.8)	74.7 (7.6)
Pulse pressure, mm Hg	46.0 (10.2)	45.0 (11.4)
Mean arterial pressure, mm Hg	95.1 (8.8)	89.7 (9.4)
Echo variables		
Left atrial dimension, mm	39.6 (4.2)	34.8 (4.2)
Left ventricular mass, g/m	109.2 (26.7)	78.2 (20.4)

BMI indicates body mass index. Values are mean (SD).

Table 3. Correlations of Age, Body Mass Index, and Blood Pressure With Left Atrial Size

	Men		Women	
	Simple Correlations	Partial Correlations	Simple Correlations	Partial Correlations
Age	.17[2]	N/A	.37[2]	N/A
BMI	.47[2]	N/A	.49[2]	N/A
Index SBP	.19[2]	.06[1]	.31[2]	.07[1]
8-Year average SBP	.20[2]	.07[1]	.32[2]	.07[1]
Index DBP	.15[2]	−.01	.14[2]	−.02
8-Year average DBP	.18[2]	.01	.16[2]	−.003
Index PP	.13[2]	.09[2]	.31[2]	.10[2]
8-Year average PP	.12[2]	.08[2]	.32[2]	.10[2]
Index MAP	.18[2]	.03	.25[2]	.02
8-Year average MAP	.21[2]	.04	.26[2]	.03

BMI indicates body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; PP, pulse pressure; and MAP, mean arterial pressure. Values shown are simple and partial Pearson correlation coefficients.

1 $P<.01$;

2 $P<.001$; otherwise, $P>.05$. Partial correlations were determined after adjustment for age and body mass index.

Table 4. Relations of Systolic and Pulse Pressures to Prevalence of Left Atrial Enlargement: Logistic Regression Analyses

	Unadjusted OR (95% CI)	Age- and BMI- Adjusted OR (95% CI)
Index SBP		
Men	1.36 (1.23-1.51)	1.10 (0.97-1.24)
Women	1.81 (1.64-2.00)	1.20 (1.05-1.36)
8-Year average SBP		
Men	1.37 (1.24-1.52)	1.09 (0.97-1.23)
Women	1.82 (1.65-2.02)	1.19 (1.05-1.36)
Index PP		
Men	1.27 (1.15-1.40)	1.16 (1.02-1.31)
Women	1.79 (1.63-1.98)	1.25 (1.09-1.42)
8-Year average PP		
Men	1.24 (1.12-1.37)	1.13 (1.01-1.28)
Women	1.79 (1.62-1.97)	1.23 (1.07-1.40)

OR indicates odds ratio; CI, confidence interval; BMI, body mass index; SBP, systolic blood pressure; and PP, pulse pressure. Left atrial enlargement is defined as left atrial dimension ≥43 mm in men and ≥38 mm in women.