Pulse Pressure and Cardiovascular Disease–Related Mortality

Follow-up Study of the Multiple Risk Factor Intervention Trial (MRFIT)

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Context The sixth Joint National Committee (JNC-VI) classification system of blood pressure emphasizes both systolic blood pressure (SBP) and diastolic blood pressure (DBP) for cardiovascular disease risk assessment. Pulse pressure may also be a valuable risk assessment tool.

Objective To compare relationships of SBP, DBP, and pulse pressure, separately and jointly, with cardiovascular disease-related mortality in men.

Design and Setting Data from the Multiple Risk Factor Intervention Trial (MRFIT), which screened men aged 35 to 57 years from 1973 through 1975 at 22 US centers, was used to assess cardiovascular disease-related mortality through 1996.

Participants A total of 342 815 men without diabetes or a history of myocardial infarction were divided into 2 groups based on their age at MRFIT screening (35- to 44-year-olds and 45- to 57-year olds). Participant blood pressure levels were classified into a JNC-VI blood pressure category based on SBP and DBP (optimal, normal but not optimal, high normal, stage 1 hypertension, stage 2-3 hypertension), and pulse pressure was calculated.

Main Outcome Measure Cardiovascular disease-related mortality.

Results There were 25 721 cardiovascular disease-related deaths. Levels of SBP and DBP were more strongly related to cardiovascular disease than pulse pressure. Relationships of SBP, DBP, and pulse pressure to cardiovascular disease-related mortality varied within JNC-VI category. Concordant elevations of SBP and DBP were associated with a greater risk of cardiovascular disease-related mortality for both age groups of men. Among men aged 45 to 57 years, higher SBP and lower DBP (discordant elevations) also yielded a greater risk of cardiovascular disease-related mortality.

Conclusion In both age groups, cardiovascular disease risk assessment was improved by considering both SBP and DBP, not just SBP, DBP, or pulse pressure separately.

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SUSTAINED ANTIHYPERTENSIVE drug treatment has reduced the incidence of cardiovascular disease mortality[1,2] and has resulted in a national effort to optimize prevention, detection, evaluation, and treatment of individuals with high blood pressure.[3] Previously reported data from men screened for the Multiple Risk Factor Intervention Trial (MRFIT) demonstrated the prognostic importance of both systolic blood pressure (SBP) and diastolic blood pressure (DBP).[4-6] Additionally, SBP was found to be more strongly associated with cardiovascular disease-related mortality than DBP in individuals aged 45 years or older. The MRFIT data also showed that SBP was related to cardiovascular disease at every level of DBP, including lower levels, underscoring the importance of systolic hypertension.[4,6] Similar results were obtained for women.[7] Together, these findings were important evidence for the fifth Joint National Committee (JNC-V) revised classification system[8] of blood pressure emphasizing both SBP and DBP.[9]

Recently, research has focused on the relationship between cardiovascular disease and elevated pulse pressure, which apparently reflects increased large artery stiffness.[10-28] In this article, we compare the relationships of SBP, DBP, and pulse pressure with cardiovascular disease mortality in 2 age groups of men to

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determine whether the inclusion of pulse pressure as risk assessment tool with the sixth JNC (JNC-VI) revised classification system[29] affects prognosis.

METHODS

MRFIT Design

The design and procedures of the MRFIT have been described.[4-6] Of the 361 662 men aged 35 to 57 years, who were screened between 1973 and 1975, a total of 353 340 had complete blood pressure information. Of these men, 10 525 were excluded because they reported either a prior hospitalization for myocardial infarction or current use of diabetes medication.

Blood pressure levels were obtained by trained technicians using standard mercury sphygmomanometers.[30] Three readings were taken of first and fifth Korotkoff sounds to estimate SBP and DBP. The average of the second and third reading is used here. Pulse pressure is calculated by subtracting the average DBP from the average SBP. Vital status was ascertained through 1996 by using the National Death Index and Social Security files.[31] Deaths were considered cardiovascular disese-related if underlying cause received codes 390 to 459 in the *International Classification of Diseases, Ninth Revision*[32] or I00 to I99 in the *International Classification of Diseases, 10th Revision*.[33]

Statistical Methods

Systolic, diastolic, and pulse pressures were measured on a single occasion and cardiovascular disease-related mortality was compared by grouping each measurement into approximate quartiles and by using continuous measurements. The proportional hazards regression model was used to assess relationships of SBP, DBP, and pulse pressure with cardiovascular disease-related mortality. Age-adjusted rates were determined by the direct method using the age-distribution of all men screened as weights. Adjusted hazard ratios (HRs) for fourth vs first quartile, adjusted risks associated with 1 SD higher blood pressure, and likelihood ratio χ^2 statistics were used to compare the prognostic significance of SBP, DBP, and pulse pressure. Analyses were also performed with both SBP and DBP in models (or equivalently, both pulse pressure and SBP, or pulse pressure and DBP).

Additional analyses were performed with participants classified by the following JNC-VI blood pressure categories: (1) optimal: SBP lower than 120 mm Hg and DBP lower than 80 mm Hg; (2) normal but not optimal: SBP of 120 to 129 mm Hg or DBP of 80 to 84 mm Hg; (3) high normal: SBP of 130 to 139 mm Hg or DBP of 85 to 89 mm Hg; (4) stage 1 hypertension: SBP of 140 to 159 mm Hg or DBP of 90 to 99 mm Hg; and (5) stage 2-3 hypertension: SBP of 160 mm Hg or higher or DBP of 100 mm Hg or higher.[29] Adjusted HRs for cardiovascular disease-related mortality were computed within each JNC-VI stratum for approximate quartiles of pulse pressure, SBP, or DBP. Quartiles 2, 3, and 4 were compared with quartile 1 (lowest quartile) and risk associated with 1 SD higher blood pressure was determined. Analyses were performed to compare cardiovascular disease risk for men with SBP and DBP levels that met both JNC-VI stratum criteria (SBP and DBP termed *concordant*) and for men with only 1 qualifying blood pressure level (SBP and DBP termed *discordant*). For these analyses, the reference group used was men who met the specific JNC-VI stratum criterion based on DBP only (lower SBP). Version 8 of SAS statistical software was used in our analyses (SAS Institute Inc, Cary, NC).

RESULTS

Baseline Findings

Average SBP, DBP, and pulse pressure were lower for men aged 35 to 57 years than for men aged 45 to 57 years (130 vs 132 mm Hg; 84 vs 85 mm Hg; and 46 vs 47 mm Hg, respectively). With older age, more men are classified as hypertensive using JNC-VI criteria for elevated SBP. For example, among 33 238 men aged 35 to 44 years with stage 1 hypertension, 23% are classified based on SBP alone (140-159 mm Hg with DBP <90 mm Hg) vs 30% for men aged 45 to 57 years.[6]

Cardiovascular Disease Mortality

SBP, DBP, and Pulse Pressure. Among the 342 815 men, 25 721 died from cardiovascular disease during follow-up of 22 years. In each age group, both SBP and DBP were more strongly associated with cardiovascular disease-related mortality than pulse pressure (TABLE 1).

For the entire cohort (both age groups), with any 2 of the 3 blood pressure variables (SBP, DBP, pulse pressure) included together in multivariable regression analyses, the coefficients were 0.0178 for SBP ($P<.001$) and 0.0118 for DBP($P<.001$), which is an improvement in the χ^2 statistic of 176 compared with SBP only. The coefficients were 0.0296 ($P<.001$) for SBP and –0.0118 for pulse pressure ($P<.001$), which is also an improvement of 176 in the χ^2 statistic compared with SBP only. The coefficients were 0.0296 for DBP ($P<.001$) and 0.0178 for pulse pressure ($P<.001$), which is an improvement of 1302 in the χ^2 statistic compared with DBP only.

JNC-VI Strata. As previously reported, risk of cardiovascular disease-related mortality was progressively greater according to JNC-VI stratum.[6] The additional prognostic information provided by blood pressure levels varied by JNC-VI stratum and age (TABLE 2 and TABLE 3). Level of SBP, DBP, and pulse pressure provided little or no significant additional prognostic information regarding risk of cardiovascular disease for men aged 35 to 44 years in the categories of optimal and normal but not optimal. For older men in these same strata, SBP and pulse pressure were positively associated with cardiovascular disease.

For men in the categories of high normal or stage 1 or stage 2-3 hypertension, the associations of DBP and pulse pressure with cardiovascular disease-related mortality varied by age. For example, for those with high normal blood pressure, the DBP coefficient was 0.0181 ($P<.01$) for men aged 35 to 44 years and –0.0092 ($P<.01$) for men aged 45 to 57 years. The pulse pressure coefficient was larger for older men (0.0116) than younger men (–0.0023). Similar dif-

ferences between the 2 age groups for DBP and pulse pressure coefficients were evident for those with stage 1 hypertension and stage 2-3 hypertension. The SBP coefficients were positive for each JNC-VI stratum for both age groups. For those with high normal blood pressure, the association between SBP and cardiovascular disease was stronger for men aged 45 to 57 years (0.0198) than men aged 35 to 44 years (0.0071).

SBP and DBP Levels Within JNC-VI Strata. The JNC-VI strata include individuals with either concordant or discordant patterns of SBP and DBP. For men aged 35 to 44 years in each JNC-VI stratum, the greatest cardiovascular disease risk was found with both SBP and DBP at high levels (concordant) (FIGURE A and TABLE 4). For example, among men with high normal blood pressure, age-adjusted cardiovascular disease risk ranged from 12.1 per 10 000 person-years for men with SBP of less than 120 mm Hg and DBP of 85 to 89 mm Hg to 18.4 for men with SBP of 130 to 139 mm Hg and DBP of 85 to 89 mm Hg.

In contrast, for men aged 45 to 57 years with high normal blood pressure (Figure B), the age-adjusted mortality rate for cardiovascular disease was greatest among men with SBP of 130 to 139 mm Hg and DBP lower than 80 mm Hg (discordant) (53.5 per 10 000 person-years). Cardiovascular disease-related mortality risk was 28% (95% confidence interval [CI], 16%-40%) higher for men with SBP of 130 to 139 mm Hg and DBP lower than 80 mm Hg vs men with SBP lower than 130 and DBP of 85 to 89 mm Hg (elevated DBP only) ($P<.001$). Similarly, cardiovascular disease-related mortality risk was 23% (95% CI, 13%-35%) higher for men with SBP of 130 to 139 mm Hg and DBP of 85 to 89 mm Hg vs men with SBP lower than 130 mm Hg and DBP of 85 to 89 mm Hg (elevated DBP only) ($P<.001$). Likewise, among men aged 45 to 57 years with stage 1 hypertension and stage 2-3 hypertension, those with concordant elevations of SBP and DBP had greater risks of cardiovascular disease-related mortality by 47% (95% CI, 35%-61%; $P<.001$) and 70% (95% CI, 47%-95%; $P<.001$) compared with the subgroup meeting JNC-VI criterion for DBP only (ie, with lower SBP). Cardiovascular disease-

Table 1. Association of Systolic and Diastolic Blood Pressure and Pulse Pressure With Cardiovascular Disease-Related Mortality*

	Blood Pressure							
	Systolic				Diastolic			
Variables	HR (95% CI)	χ^2_3	Adjusted Proportional Hazard Regression Coefficient (SE)	Adjusted HR (95% CI)†	HR (95% CI)	χ^2_3	Adjusted Proportional Hazard Regression Coefficient (SE)	Adjusted HR (95% CI)†
Men Aged 35 Through 44 y (n = 148 204), No. of Deaths = 5440								
Quartile cut points, mm Hg‡								
1 (<119, <76, <39)	1.00	751	0.0265 (0.0008)	1.45 (1.41-1.48)	1.00	755	0.0395 (0.0012)	1.50 (1.46-1.54)
2 (119-126, 76-82, 39-44)	1.39 (1.27-1.52)				1.36 (1.24-1.49)			
3 (127-135, 83-88, 45-50)	1.72 (1.57-1.88)				1.60 (1.46-1.76)			
4 (≥136, ≥89, ≥51)	2.79 (2.57-3.03)				2.74 (2.52-2.98)			
Men Aged 45 Through 57 y (n = 194 611), No. of Deaths = 20 281								
Quartile cut points, mm Hg‡								
1 (<120, <79, <40)	1.00	2893	0.0221 (0.0004)	1.45 (1.43-1.47)	1.00	1956	0.0308 (0.0006)	1.39 (1.37-1.41)
2 (120-129, 79-84, 40-46)	1.36 (1.29-1.43)				1.17 (1.12-1.22)			
3 (130-141, 85-91, 47-54)	1.82 (1.73-1.91)				1.47 (1.41-1.54)			
4 (≥142, ≥92, ≥55)	2.93 (2.79-3.06)				2.25 (2.17-2.35)			

	Pulse Pressure			
	HR (95% CI)	χ^2_3	Adjusted Proportional Hazard Regression Coefficient (SE)	Adjusted HR (95% CI)†
Men Aged 35 Through 44 y (n = 148 204), No. of Deaths = 5440				
Quartile cut points, mm Hg‡				
1 (<119, <76, <39)	1.00	124	0.0152 (0.0012)	1.17 (1.14-1.20)
2 (119-126, 76-82, 39-44)	1.03 (0.95-1.11)			
3 (127-135, 83-88, 45-50)	1.14 (1.05-1.23)			
4 (≥136, ≥89, ≥51)	1.45 (1.35-1.56)			
Men Aged 45 Through 57 y (n = 194 611), No. of Deaths = 20 281				
Quartile cut points, mm Hg‡				
1 (<120, <79, <40)	1.00	1465	0.0218 (0.0005)	1.30 (1.28-1.31)
2 (120-129, 79-84, 40-46)	1.13 (1.08-1.18)			
3 (130-141, 85-91, 47-54)	1.33 (1.27-1.39)			
4 (≥142, ≥92, ≥55)	2.01 (1.93-2.10)			

*CI indicates confidence interval; HR, hazard ratio.
†The HR for 1 SD higher blood pressure adjusted for age, race (black or nonblack), serum cholesterol level, and reported number of cigarettes consumed per day.
‡The order of blood pressure is systolic, diastolic, and pulse pressure.

related mortality risk was also higher for those with discordant elevations (higher SBP and lower DBP): 45% higher (95% CI, 28%-64%; $P<.001$) for those with stage 1 hypertension and 51% higher (95% CI, 25%-83%; $P<.001$) for those with stage 2-3 hypertension compared with the subgroup meeting JNC-VI criterion for DBP only.

Table 2. Relationship of Systolic and Diastolic Blood Pressure and Pulse Pressure With Cardiovascular Disease (CVD) Mortality Among Men Aged 35 Through 44 Years (n = 148 204)*

	Blood Pressure											
	Systolic				Diastolic				Pulse Pressure			
Joint National Committee High Blood Pressure Stratum	No. of Men	No. of CVD Deaths	Age Adjusted Rate	Adjusted HR	No. of Men	No. of CVD Deaths	Age Adjusted Rate	Adjusted HR	No. of Men	No. of CVD Deaths	Age Adjusted Rate	Adjusted HR
Optimal Blood Pressure												
Quartiles												
1	6589	111	8.0	1.00	7280	118	7.8	1.00	7595	130	8.0	1.00
2	7913	131	7.8	0.92	6636	129	9.2	1.22	7716	153	9.3	1.11
3	7996	139	8.2	0.97	8421	142	7.9	1.04	6899	117	8.0	0.97
4	9148	204	10.7	1.22	9309	196	9.9	1.30†	9436	185	9.5	1.07
Average blood pressure (IQR), mm Hg		112 (108-116)				72 (69-76)				40 (36-43)		
Coefficient		0.0079				0.0128				–0.0032		
Normal Blood Pressure												
Quartiles												
1	8794	211	11.2	1.00	8899	199	10.9	1.00	8420	205	11.4	1.00
2	9194	245	12.8	1.10	7712	195	12.1	1.08	10 017	284	13.4	1.03
3	9834	246	12.0	1.04	12 264	340	13.1	1.18	10 649	297	13.2	1.11
4	12 602	349	13.2	1.12	11 549	317	12.9	1.15	11 338	265	11.3	0.97
Average blood pressure (IQR), mm Hg		122 (120-125)				79 (76-82)				43 (38-48)		
Coefficient		0.0078				0.0040				0.0016		
High Normal Blood Pressure												
Quartiles												
1	7670	241	14.7	1.00	7767	243	15.2	1.00	7438	242	15.2	1.00
2	8606	286	15.8	1.02	5828	209	16.8	1.13	8630	314	17.1	1.07
3	7217	254	16.6	1.07	9045	302	15.7	1.09	7716	285	17.4	1.07
4	9902	378	18.1	1.13	10 755	405	17.6	1.22†	9611	318	15.8	0.96
Average blood pressure (IQR), mm Hg		130 (126-134)				84 (81-87)				46 (39-52)		
Coefficient		0.0071				0.0181‡				0.0023		
Stage 1 Hypertension												
Quartiles												
1	7544	313	19.3	1.00	7770	383	23.5	1.00	8178	364	20.9	1.00
2	8750	437	23.5	1.16†	6191	290	21.8	0.97	7702	385	23.5	1.10
3	7487	378	23.9	1.15	8472	440	24.3	1.07	8605	492	26.8	1.20†
4	9467	593	29.5	1.38§	10 815	608	26.5	1.16†	8763	480	26.1	1.15†
Average blood pressure (IQR), mm Hg		138 (131-144)				90 (90-94)				48 (39-56)		
Coefficient		0.0136§				0.0137‡				0.0048†		
Stage 2-3 Hypertension												
Quartiles												
1	2293	149	30.8	1.00	1307	94	34.7	1.00	2191	162	35.3	1.00
2	2248	191	40.1	1.22	2697	203	35.4	1.08	2340	210	42.2	1.14
3	2351	239	48.7	1.50§	3081	285	43.8	1.30†	2573	287	53.3	1.47§
4	2599	345	64.4	2.01§	2406	342	69.5	2.09§	2387	265	53.7	1.44§
Average blood pressure (IQR), mm Hg		154 (143-162)				104 (100-108)				51 (39-60)		
Coefficient		0.0160‡				0.0317§				0.0061§		

*IQR indicates interquartile range; HR, hazards ratio. The coefficient is the proportional hazards regression coefficient for blood pressure measure after adjustment for age, race (black or nonblack), serum cholesterol level, and reported number of cigarettes consumed per day.
†$P<.05$.
‡$P<.01$.
§$P<.001$.

COMMENT

Among men screened for MRFIT, pulse pressure was not as strong a predictor of cardiovascular disease-related mortality as SBP and DBP. Any combination of 2 of the 3 blood pressure measures provided more information about cardiovascular disease risk for both age groups than any single measure. Since pulse pres-

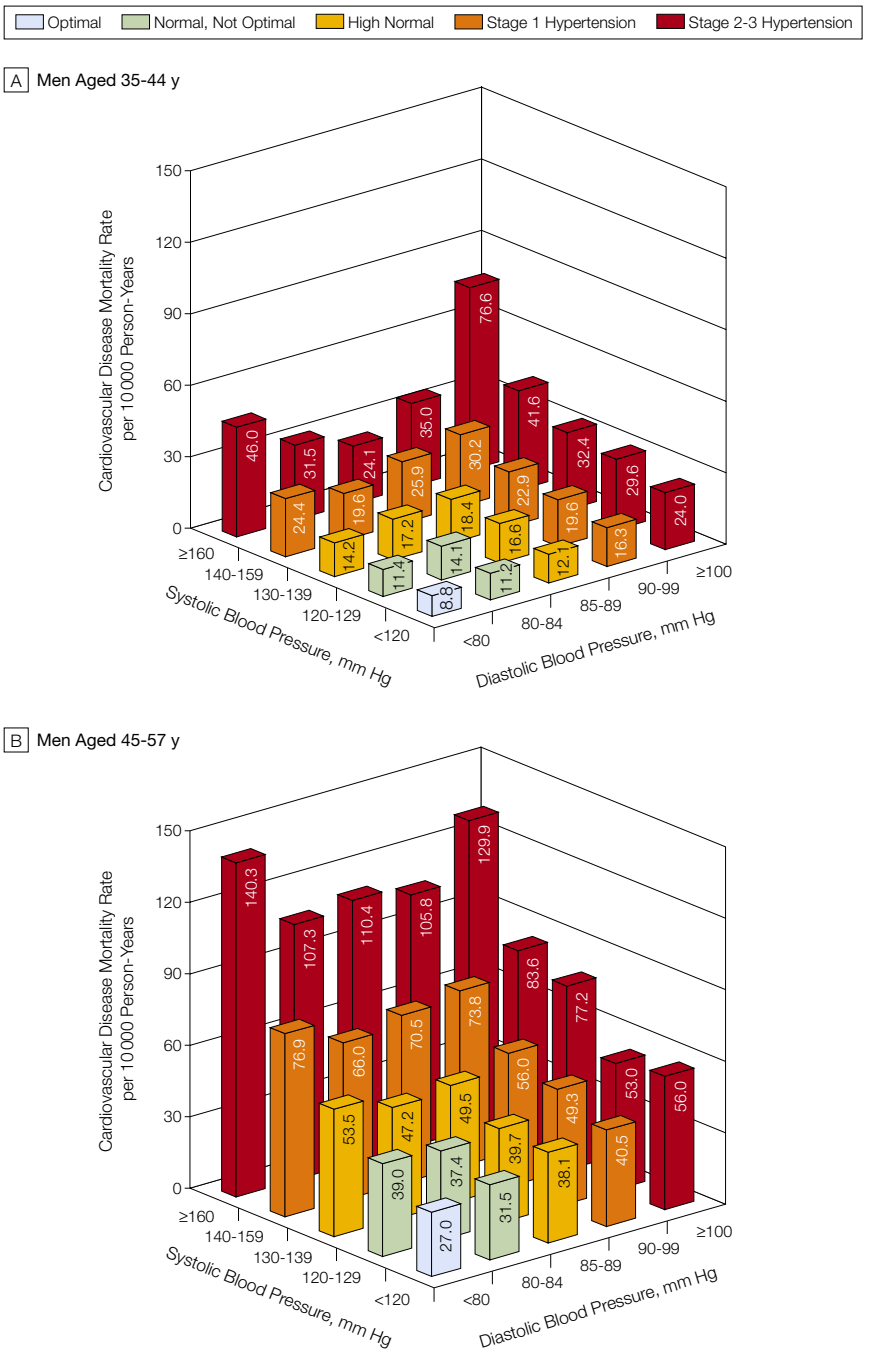
Table 3. Relationship of Systolic and Diastolic Blood Pressure and Pulse Pressure With Cardiovascular Disease (CVD) Mortality Among Men Aged 45 Through 57 Years (n = 194 611)*

	Blood Pressure											
	Systolic				Diastolic				Pulse Pressure			
Joint National Committee High Blood Pressure Stratum	No. of Men	No. of CVD Deaths	Age Adjusted Rate	Adjusted HR	No. of Men	No. of CVD Deaths	Age Adjusted Rate	Adjusted HR	No. of Men	No. of CVD Deaths	Age Adjusted Rate	Adjusted HR
Optimal Blood Pressure												
Quartiles												
1	6737	312	23.4	1.00	6501	346	27.3	1.00	7675	349	23.1	1.00
2	7595	353	23.6	0.97	6866	374	27.5	1.05	7857	410	26.3	1.12
3	7871	434	28.3	1.13	8516	413	24.5	0.92	6832	372	27.5	1.14
4	8970	555	31.2	1.23†	9290	521	28.6	1.06	8809	523	30.3	1.22†
Average blood pressure (IQR), mm Hg		111 (108-116)				72 (69-76)				39 (36-43)		
Coefficient		0.0140†				0.0010				0.0113†		
Normal Blood Pressure												
Quartiles												
1	8785	534	31.5	1.00	10 855	849	39.2	1.00	10 286	653	32.9	1.00
2	9788	662	34.4	1.05	6955	538	38.9	1.00	11 566	811	35.8	1.04
3	13 894	1064	38.6	1.17†	13 601	888	33.1	0.89‡	9906	786	39.9	1.14‡
4	11 470	938	41.0	1.21§	12 526	923	38.2	1.02	12 179	948	38.8	1.09
Average blood pressure (IQR), mm Hg		122 (120-126)				78 (77-82)				43 (39-48)		
Coefficient		0.0134§				0.0004				0.0056†		
High Normal Blood Pressure												
Quartiles												
1	10 237	761	38.9	1.00	10 260	1072	51.5	1.00	10 229	754	38.6	1.00
2	8089	757	47.1	1.19§	8404	803	47.6	0.94	9681	872	45.4	1.17§
3	12 706	1152	45.1	1.12‡	11 085	937	43.2	0.88§	11 627	1123	48.1	1.22§
4	11 744	1294	54.8	1.36§	13 027	1152	45.2	0.93	11 239	1215	53.3	1.31§
Average blood pressure (IQR), mm Hg		131 (128-135)				84 (81-87)				47 (41-53)		
Coefficient		0.0198§				−0.0092†				0.0116§		
Stage 1 Hypertension												
Quartiles												
1	12 937	1248	50.3	1.00	12 408	1800	70.3	1.00	13 380	1352	52.8	1.00
2	14 587	1764	61.5	1.21§	12 881	1526	59.6	0.88§	13 324	1529	58.7	1.11†
3	13 381	1793	66.8	1.29§	12 868	1553	61.2	0.91†	13 178	1897	72.1	1.33§
4	14 189	2380	82.9	1.59§	16 937	2306	70.1	1.06	15 212	2407	77.3	1.40§
Average blood pressure (IQR), mm Hg		141 (135-148)				90 (88-94)				51 (42-59)		
Coefficient		0.0191§				0.0003				0.0113§		
Stage 2-3 Hypertension												
Quartiles												
1	4994	705	74.9	1.00	5407	1156	109.1	1.00	5324	793	79.9	1.00
2	5579	986	92.8	1.23§	4908	838	88.9	0.88†	5469	981	94.8	1.17§
3	5490	1085	101.5	1.30§	5385	940	91.4	0.89‡	5359	1146	111.0	1.34§
4	5568	1504	146.9	1.87§	5931	1346	124.3	1.25§	5479	1360	131.3	1.53§
Average blood pressure (IQR), mm Hg		161 (150-170)				102 (100-107)				59 (46-71)		
Coefficient		0.0141§				0.0120§				0.0092§		

*IQR indicates interquartile range; HR, hazards ratio. The coefficient is the proportional hazards regression coefficient for blood pressure measure after adjustment for age, race (black or nonblack), serum cholesterol level, and reported number of cigarettes consumed per day.
†$P<.01$.
‡$P<.05$.
§$P<.001$.

sure is simply the difference between SBP and DBP, given predictive information from SBP and DBP considered together, pulse pressure cannot add further information. Also, given the various ways a specific pulse pressure can be calculated, it was anticipated and was in fact shown to be the weaker predictor of cardiovascular disease-related mortality vs SBP. For example, a pulse pressure of 70 mm Hg can result from the following combinations of SBP and DBP: (1) 120 and 50 mm Hg; (2) 130 and 60 mm Hg; (3) 140 and 70 mm Hg; or (4) 160 and 90 mm Hg.

Figure. Age-Adjusted Cardiovascular Disease Mortality Rate by Systolic and Diastolic Blood Pressure Level Used to Define Each JNC-VI Stratum



JNC-VI indicates sixth Joint National Committee classification system.

The importance of considering both SBP and DBP for assessing risk is evident from analyses within JNC-VI strata. For example, among men aged 35 to 44 years, cardiovascular disease risk was greatest for those with elevated SBP and DBP levels (concordant). In men aged 45 to 57 years, in the categories of high normal, stage 1 hypertension, and stage 2-3 hypertension, higher cardiovascular disease risk was associated with either the discordant pattern of elevated SBP and low DBP (highest pulse pressure) or with the concordant pattern of elevated SBP and DBP (Figure, B). This pattern of risk within JNC-VI strata among older men supports the practical inference that in such men lower DBP and higher pulse pressure may be markers of end-organ damage. This inference is not amenable to testing in this MRFIT data set, since only limited assessment was made of target organ status at first screening.This limitation aside, it is clear from these data that men with elevated SBP who have either low or high DBP (and correspondingly have either low or high PP) should be vigorously treated.

Our results are generally consistent with findings from other studies[10-28]; however, they lead us to broader emphases: from age 45 years or older, SBP becomes an increasingly important measure of cardiovascular disease risk compared with DBP, but both SBP and DBP give information relevant for risk assessment. Specifically, in older people with adverse SBP and DBP levels (high normal, stage 1 hypertension, and stage 2-3 hypertension), cardiovascular disease risks are higher for individuals with concordant SBP and DBP (high on both, with lower pulse pressure) and for individuals with discordant SBP and DBP (high SBP and low DBP, with higher pulse pressure). For the latter individuals, low DBP and higher pulse pressure serve as markers not only of greater cardiovascular disease risk, but also of pos-

Table 4. Number of Men and Cardiovascular Disease-Related Deaths by Systolic and Diastolic Blood Pressure Levels*

	Diastolic Blood Pressure, mm Hg				
SBP, mm Hg	<80, No. of Deaths/Men	80-84, No. of Deaths/Men	85-89, No. of Deaths/Men	90-99, No. of Deaths/Men	≥100, No. of Deaths/Men
			Men Aged 35 Through 44 Years		
<120	585/31 646	211/8794	65/2488	23/659	1/25
120-129	394/16 611	446/15 019	326/9243	227/5380	11/177
130-139	170/5875	282/7720	316/8069	500/10 255	85/1256
140-159	88/1760	102/2478	193/3532	588/9184	414/4678
≥160	13/134	9/138	11/207	61/828	319/2048
			Men Aged 45 Through 57 Years		
<120	1654/31 173	534/8785	172/2437	54/680	2/15
120-129	1387/17 810	1277/17 342	793/10 263	536/5678	21/203
130-139	808/7435	1067/11 229	1124/11 412	1460/13 443	199/1406
140-159	478/3057	726/5195	1142/8002	2789/19 039	1193/7519
≥160	99/365	103/482	191/867	763/3693	1709/7081

*SBP indicates systolic blood pressure. Age-adjusted rates are given in the Figure.

sible end-organ damage related to greater cardiovascular disease risk.

In summary, our results support the conclusion that the expansion in focus in the early 1990s from DBP only for cardiovascular disease risk assessment to both SBP and DBP[8,9,29] was an important and useful advance. A broad focus, taking into consideration all blood pressure components as predictors, is fully warranted by the findings in older people that higher cardiovascular disease risk is associated with either elevated SBP and DBP, or elevated SBP and low DBP (high pulse pressure).

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