The ratio of systolic to diastolic blood pressure variability is a blood pressure-independent predictor of mortality

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Introduction

- Ambulatory blood pressure monitoring (ABPM) provides numerous measures, beyond the arithmetic means. These include:
  - sleep-related BP and heart rate dip;
  - the morning surge;
  - measures of the white-coat and masking effects;
  - measures of BP variability

Editorial Commentary

Ambulatory Blood Pressure Measurement
A Trove of Hidden Gems?

Eoin O'Brien

Introduction

- A measure of the linear relationship between systolic and diastolic BP, called Ambulatory Arterial Stiffness Index (**AASI)** has been recently introduced.
- **AASI** is thought to reflect arterial stiffness characteristics.
- **AASI** has been variably shown to be independent of blood pressure and to incorporate prognostic information.

Introduction

- In this study we describe a new measure, based on ambulatory blood pressure monitoring, that relates to both BP variability and to the AASI.
- This new measure, termed Blood Pressure Variability Ratio, **BPVR**, is a simple to derive BP-independent predictor of mortality.

Objectives

- To explore the prognostic value of ambulatory BP variability and to evaluate possible associations with the AASI.

Methods

- We analyzed 2705 consecutive patients undergoing ambulatory BP monitoring:
  - Age 56±16 years,
  - 55% women,
  - BMI 27.2±4.5 kg/m^2,
  - 59% treated for hypertension,
  - 10% treated for diabetes,
  - 24-hour systolic BP 138±16 mmHg,
  - 24-hour diastolic BP 78±10 mmHg.

Methods

- The **BPVR** was defined as the ratio of 24-hour systolic to diastolic BP variability (expressed by their corresponding SD).
- **AASI** was derived as shown in the figures.

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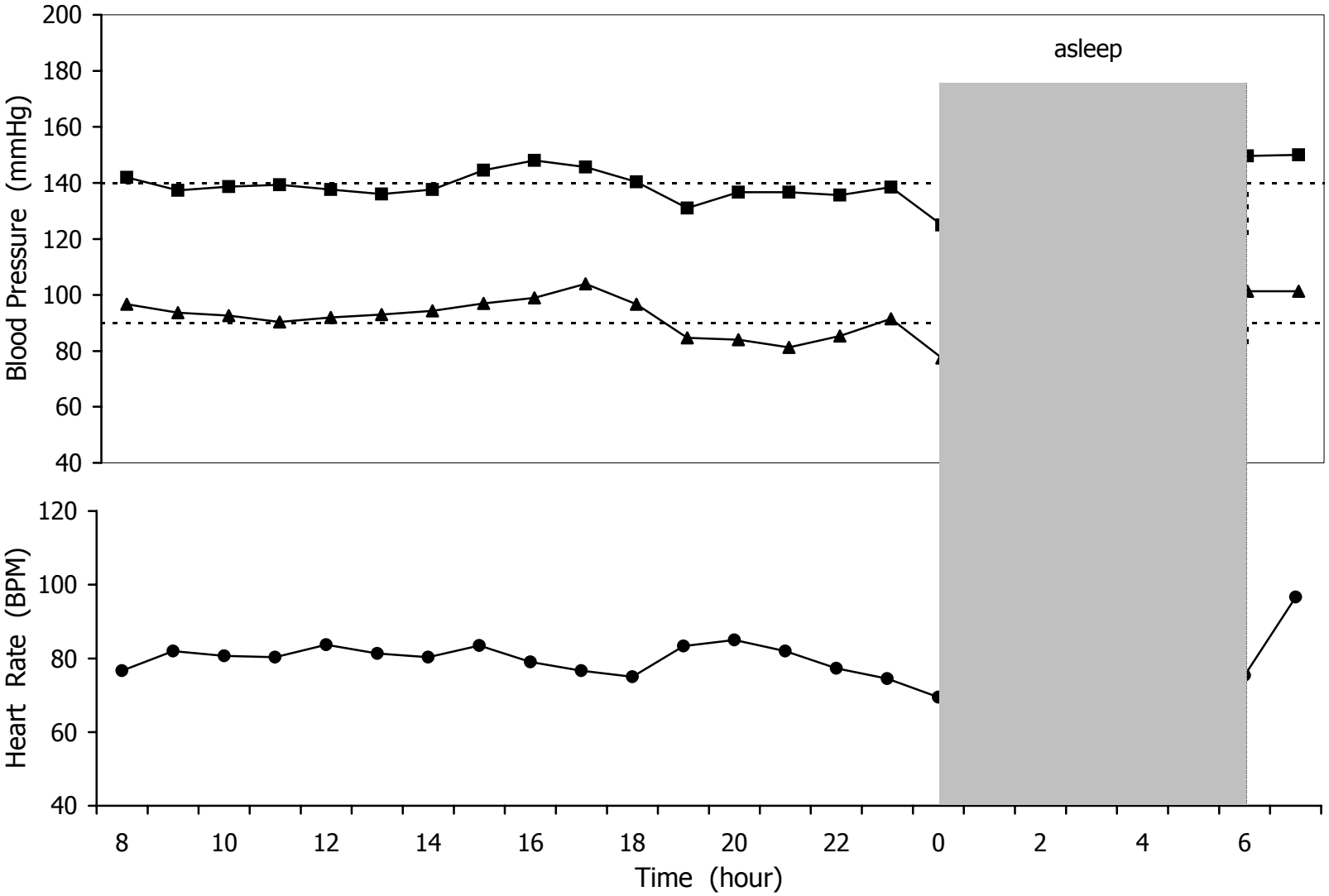
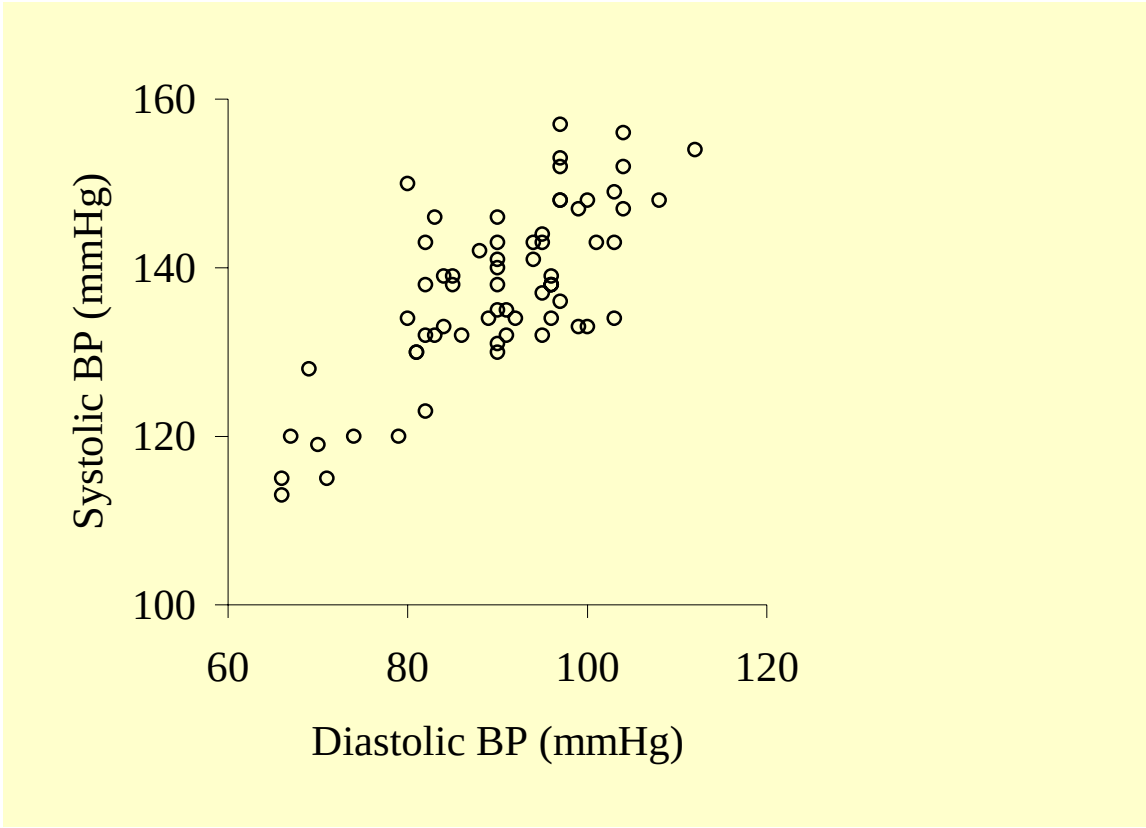
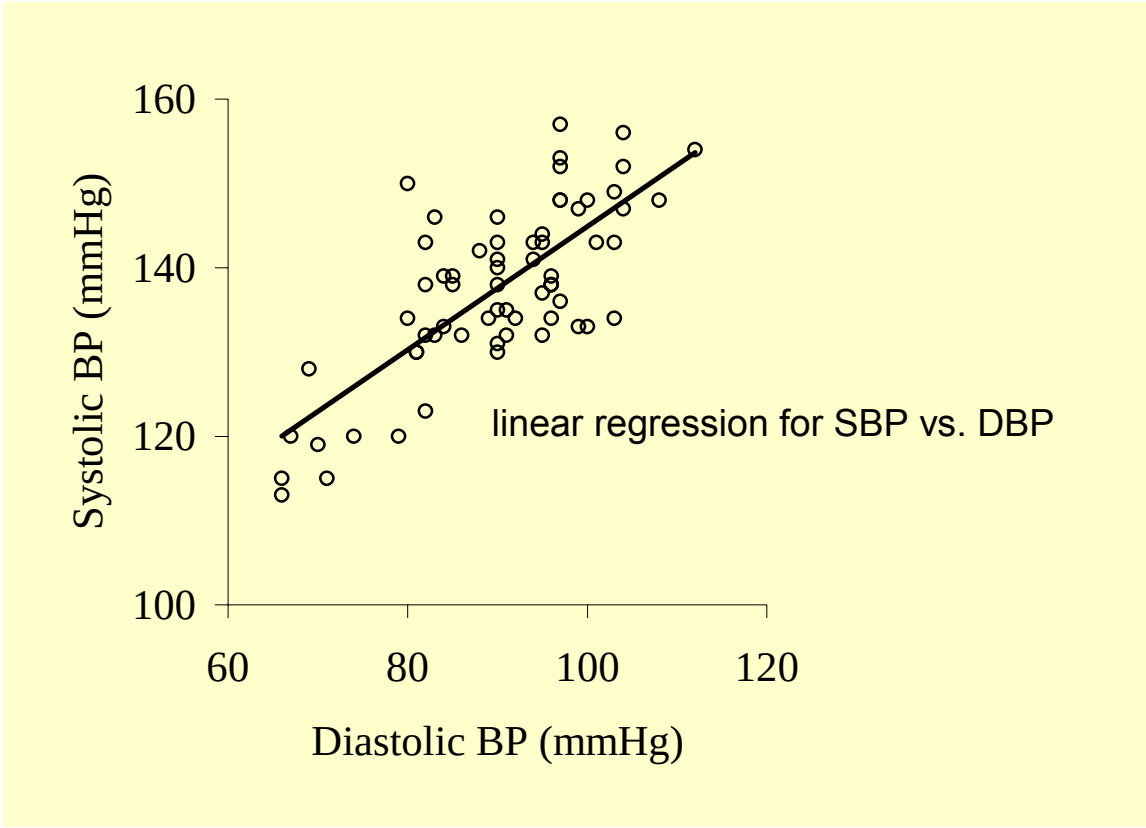
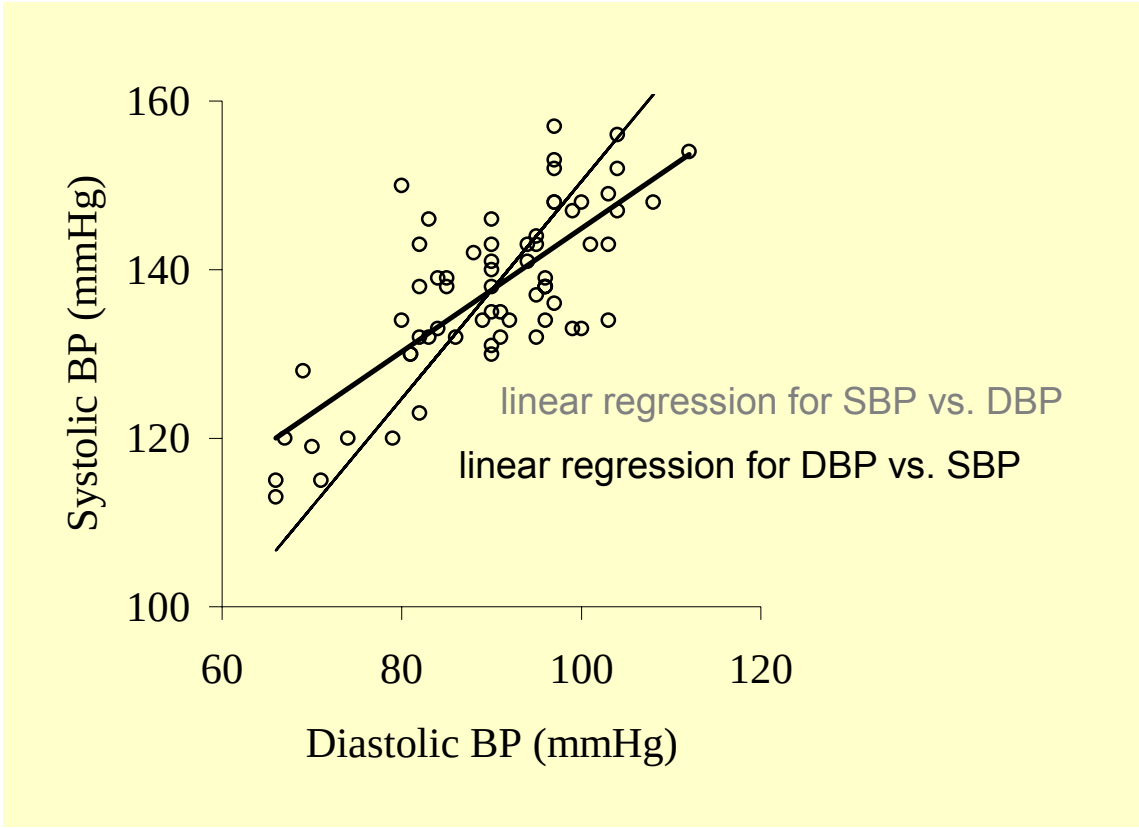




Step 1: Plot systolic vs. diastolic BP

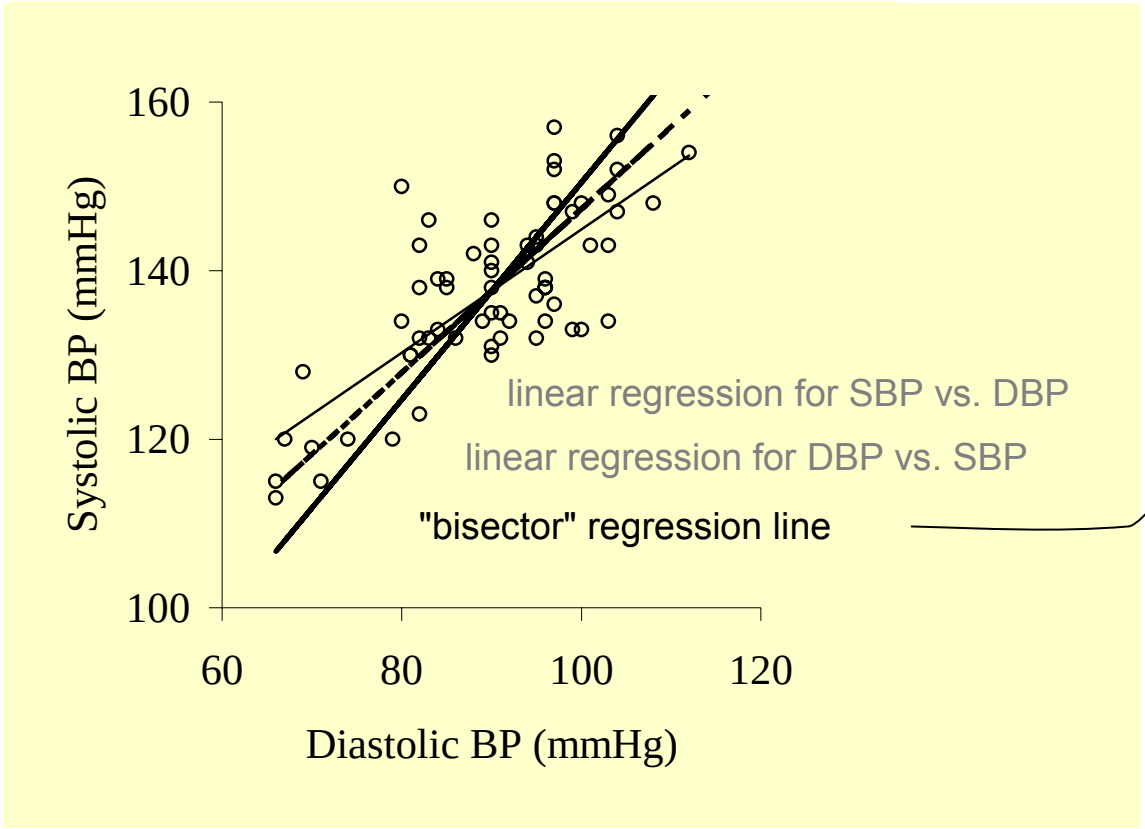


Step 2: SBP vs. DBP regression line



Step 3: DBP vs. SBP regression line

AASI = 1–1/regression slope



Step 4: “bisector” regression line

SBP	DBP	HR	time		
141	90	75	8	:	58
138	96	77	8	:	59
135	90	76	9	:	20
143	95	88	9	:	37
134	96	82	9	:	57
143	90	80	10	:	17
134	92	79	10	:	37
139	96	83	10	:	57
140	90	79	11	:	17
146	90	79	11	:	37
132	91	83	11	:	57
136	97	77	12	:	17
135	91	85	12	:	37
142	88	89	12	:	57
133	99	89	13	:	17
137	95	78	13	:	37
138	85	77	13	:	57
132	86	78	14	:	17
138	96	80	14	:	37
143	101	83	14	:	57
148	100	87	15	:	17
141	94	80	15	:	57
157	97	82	16	:	17
153	97	78	16	:	37
134	103	77	16	:	57
148	108	80	17	:	17
156	104	75	17	:	37
133	100	75	17	:	57
143	103	74	18	:	17
130	90	77	18	:	37

- Calculate the SD of systolic BP (SD_{SBP})
- Calculate the SD of diastolic BP(SD_{DBP})

- **BPVR** = SD_{SBP}/SD_{DBP}

  – It so happens, that BPVR is *similar* to the bisector regression slope derived according to the plots

בשביל מה?

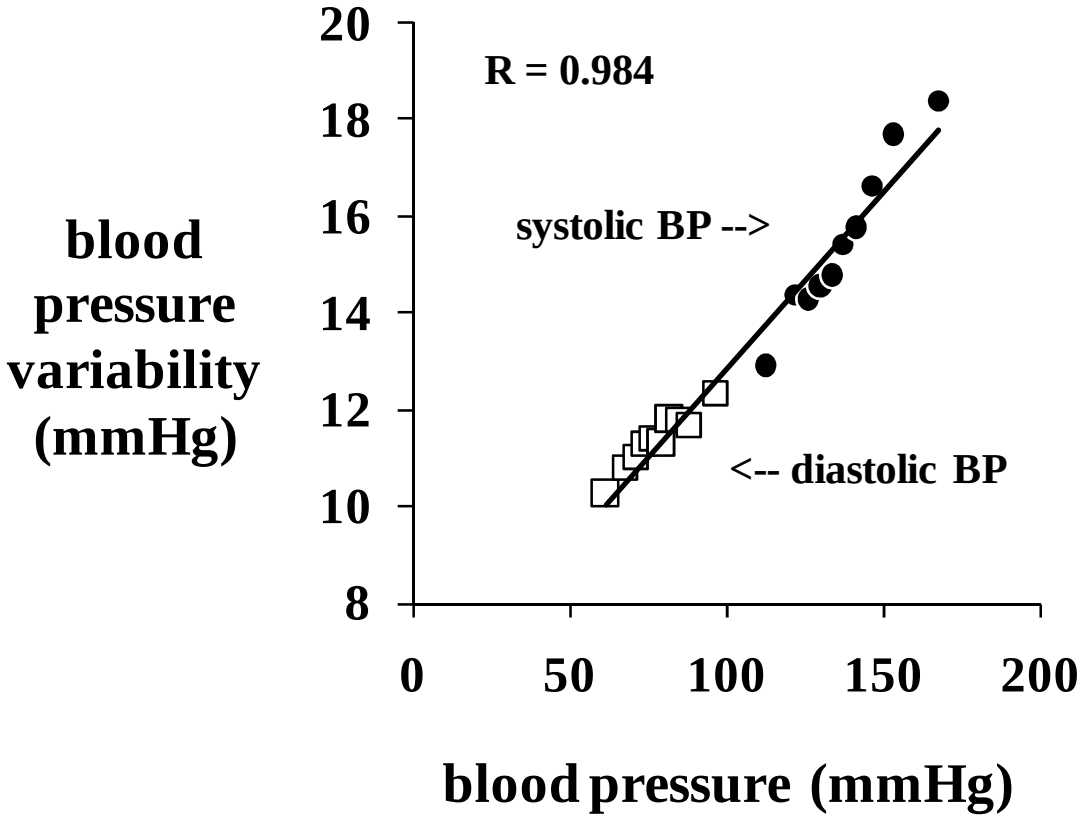
Results

- The standard deviation of systolic BP was 15.1 mmHg (IQR 12.6-18.1 mmHg).
- The standard deviation of diastolic BP was 11.2 mmHg (IQR 9.6-13.0 mmHg).
- The median ratio of standard deviations **BPVR**, was 1.34 (IQR 1.16-1.56).

Results

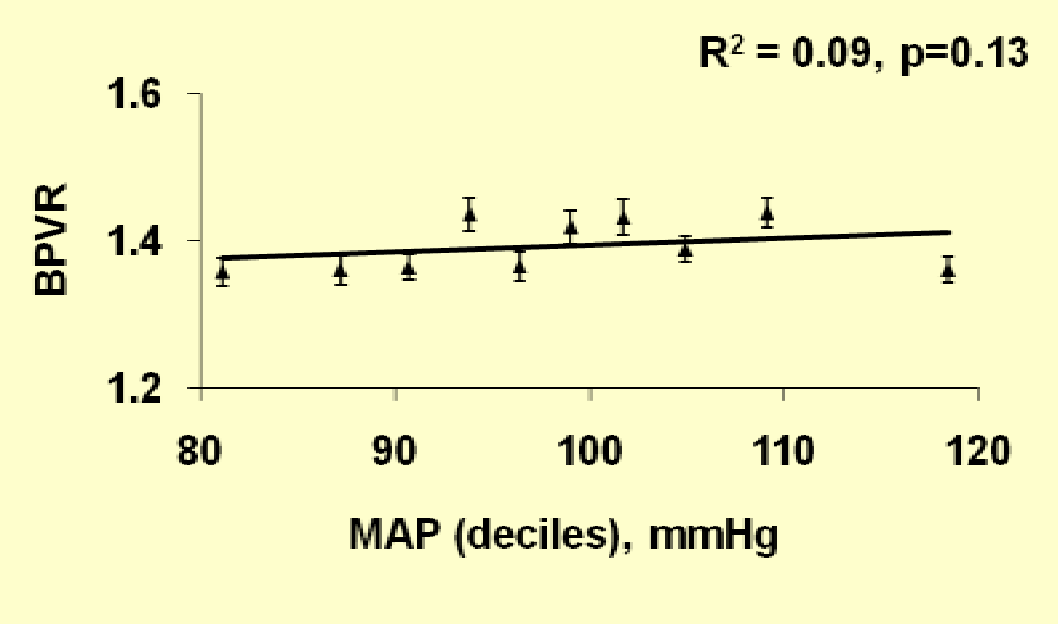
- Pearson correlation between BPVR and the systolic vs. diastolic bisector slope (of AASI) was **0.957**.

Results


20
18
16
14
12
10
8
R = 0.984
systolic BP -->
<-- diastolic BP
0
50
100
150
200
blood pressure variability (mmHg)
blood pressure (mmHg)

Results

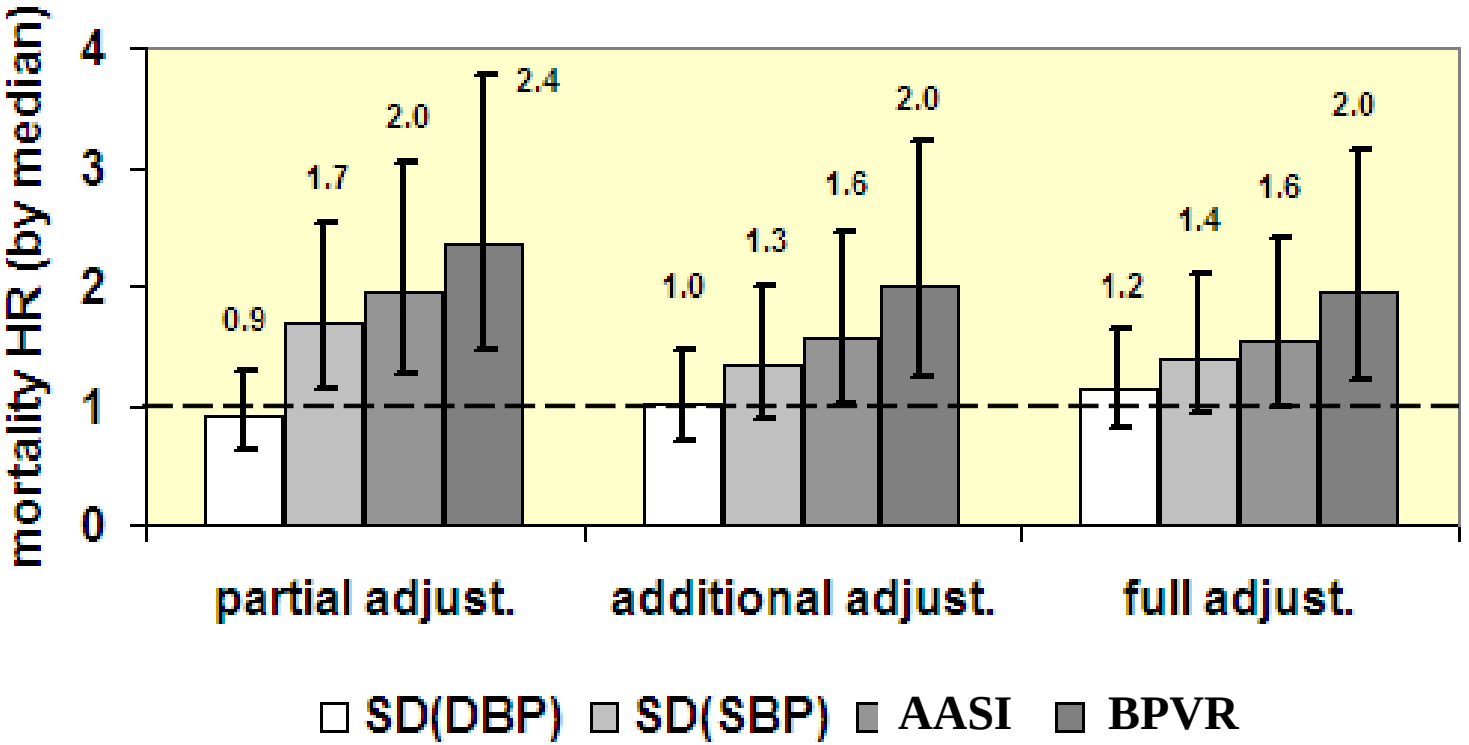
- BPVR is independent of mean arterial pressure (MAP):



Results

- The mortality rate was 10.1 per 1,000 patient-years.
- Survival analysis was conducted upon the first seven years of follow-up; beyond 7 years the proportional hazards assumption was not valid.

Results



- After adjustment for age; gender; BMI; treatment for hypertension and diabetes; 24-hour systolic and diastolic BP and their corresponding nocturnal dip, **BPVR** and Slope were significantly (and similarly) associated with all-cause mortality, while neither systolic nor diastolic BP variability had independent prediction ability.

Conclusions

- BPVR is a simple BP-independent measure, which is readily available from any ambulatory blood pressure monitoring report.
- It resembles the systolic vs. diastolic BP slope (AASI), and has BP-independent prognostic power.

Conclusions

- Physiological characterization of the BPVR, as well as the AASI-related indices, is required for a better understanding of their prognostic ability.