

EPIDEMIOLOGY & RISK FACTORS

## Relationship of Blood Pressure and Erectile Dysfunction in Men Without Previously Diagnosed Hypertension



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### ABSTRACT

**Background:** Erectile dysfunction (ED) is the most common male sexual disorder that affects all age groups and has a close association with essential hypertension.

**Aim:** To characterize the relation of blood pressure and ED in detail.

**Methods:** A cross-sectional population-based study of 45- to 70-year-old men without previously diagnosed hypertension, cardiovascular diseases, renal disease, or diabetes was conducted from 2005 to 2007 in south-western Finland. A total of 665 men with at least one cardiovascular risk factor were studied. ED was defined by the five-item International Index of Erectile Function.

**Outcomes:** We found a U-shaped association between diastolic blood pressure (DBP) and prevalence of ED.

**Results:** The average age of the study subjects was  $56 \pm 6$  years and 52% had ED. After adjustment for age, cohabitation status, education, fasting plasma glucose level, waist circumference, and prevalence of depressive symptoms, the curve relating DBP to the prevalence of ED was U-shaped with a nadir of DBP 90 mm Hg.

**Clinical Implications:** Our findings emphasize the importance of blood pressure measurement in the physical examination of men with ED.

**Strengths and Limitations:** This was a cross-sectional study, which prevents the evaluation of causality between ED and hypertension. However, this community-based study population is well defined and the anthropologic measurements were made by trained medical staff.

**Conclusion:** We found a U-shaped correlation between ED and DBP, which confirms the link between ED and hypertension. **Heikkilä A, Kaipia A, Venermo M, et al. Relationship of Blood Pressure and Erectile Dysfunction in Men Without Previously Diagnosed Hypertension. J Sex Med 2017;14:1336–1341.**

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**Key Words:** Erectile Dysfunction; Hypertension; Diastolic Blood Pressure; Pulse Pressure

### INTRODUCTION

Erectile dysfunction (ED) is defined as the persistent inability to achieve or maintain penile erection sufficient for satisfactory sexual performance.<sup>1</sup> ED is the most common male sexual

disorder; it affects all age groups and has a significant impact on quality of life.<sup>1–3</sup> More than 50% of men 40 to 70 years old have experienced ED at some level, with 10% having severe ED.<sup>2</sup>

The pathophysiology of ED ranges from a lack of neuronally derived nitric oxide in the arterial endothelium and loss of penile parenchymal smooth muscle cells to psychological and social factors.<sup>4–6</sup> The ability to attain and then maintain an erection requires a dynamic balance between inflow and outflow of blood within the cavernosal bodies. This balance is affected by several factors including blood pressure (BP).

The relation between essential hypertension and ED is well established.<sup>7–11</sup> It is even hypothesized that the pathophysiology of these two disorders is the same.<sup>12,13</sup> However, there are numerous overlapping comorbid conditions and risk factors influencing this relation.<sup>9</sup> Our aim was to investigate the association between BP and ED in a general male population.

Received July 11, 2017. Accepted September 10, 2017.

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<https://doi.org/10.1016/j.jsxm.2017.09.007>

## METHODS

### Subjects

The subjects were participants in a population survey, the Harmonica Project, which was carried out in southwestern Finland from 2005 to 2007. Inclusion criteria were age 45 to 70 years and at least one cardiovascular risk factor, including waist circumference of at least 94 cm, hypertension, most recently measured BP of at least 140/90 mm Hg, or a family history of premature cardiovascular disease. For the present analysis, we excluded participants with established hypertension, cardiovascular or renal disease, previously known diabetes, cancer, or neurologic disease (Parkinson disease and multiple sclerosis). Subjects using antihypertensive medication also were excluded, yielding an analytic cohort of 665 men. A detailed description of the enrollment and examination methods has been published previously.<sup>6</sup> Participation and all tests included were free of charge for the subjects.

### Measurements

BP was measured by a trained nurse with a calibrated mercury sphygmomanometer with subjects in a sitting posture after resting for at least 5 minutes. In each subject, the mean of the two readings taken at intervals of at least 2 minutes was used.<sup>14</sup> Pulse pressure (PP) was calculated by subtracting the mean diastolic BP (DBP) from the mean systolic BP.

Height and weight were measured and body mass index was calculated as weight (kilograms) divided by the square of height (meters). Waist circumference was measured at the level midway between the lower rib margin and the iliac crest.

Plasma glucose levels and lipid profiles were determined in blood samples that were obtained after at least 12 hours of fasting. Glucose values were measured from capillary whole blood with the HemoCue Glucose 201+ system (HemoCue, Ängelholm, Sweden). Total cholesterol, high-density lipoprotein cholesterol, and triglycerides were measured enzymatically (Olympus AU640, Olympus, Tokyo, Japan). Low-density lipoprotein cholesterol was calculated according to the Friedewald formula.

Metabolic syndrome was diagnosed according to the criteria of the US National Cholesterol Education Program Third Adult Treatment Panel.<sup>15</sup>

### Questionnaires

Subjects completed self-administrated questionnaires at the clinic before the physical examination was performed: sociodemographic factors, occupational status, physical activity level, smoking status, Beck Depression Inventory (BDI),<sup>16</sup> and the Alcohol Use Disorders Identification Test.<sup>17</sup> A BDI score of 10 was regarded as the cutoff level for depressive symptoms.<sup>18</sup>

The five-item International Index of Erectile Function (IIEF-5) was used to assess erectile function.<sup>19</sup> All men reporting a zero score for any of the questions or leaving any question unanswered

were excluded. A score of at least 22 was considered normal erectile function.

Leisure-time physical activity (LTPA) was classified as (i) high (LTPA  $\geq 30$  minutes at a time at least six times a week), (ii) moderate (LTPA  $\geq 30$  minutes at a time four to five times a week), or (iii) low (LTPA  $\geq 30$  minutes at a time at maximum of three times a week).

### Ethical Approval

The study protocol and consent forms were reviewed and approved by the ethics committee of Satakunta Hospital District (Pori, Finland). All participants provided written informed consent for the project and subsequent medical research.

### Statistical Analysis

The data are presented as mean with SD or as count with percentage. Statistical comparisons of characteristics of subjects without ED vs with ED were made by  $\chi^2$  test or t-test. The normality of the variables was tested by using the Shapiro-Wilk W-test. To model the non-linear relation between BP levels and ED, a restricted cubic spline logistic model procedure was adopted with adjustment for age, cohabitation status, education, fasting plasma glucose level, waist circumference, and depressive symptoms. The U-shaped relation between DBP and ED was tested using the method of Lind and Mehlum.<sup>20</sup>

## RESULTS

We examined 665 men (mean age =  $56 \pm 6$  years) with at least one cardiovascular risk factor but without manifested chronic diseases or medication affecting vasculature. Of these, 345 of 665 (52%) had ED according to the IIEF-5 score. The characteristics and health behaviors of the subjects are presented in Table 1. Men with normal erectile function were younger, more often cohabiting, more educated, had lower systolic BP and PP levels, and less frequently had depressive symptoms than men with ED.

After adjustment for age, cohabitation status, education, fasting plasma glucose level, waist circumference, and prevalence of depressive symptoms, the curve relating DBP to the prevalence of ED was U-shaped with a nadir of DBP 90 mm Hg. The effect of PP on the prevalence of ED was inversely U-shaped. When the reference level for PP was set at 60 mm Hg, lower and higher PP values were associated with a lower prevalence of ED (Figure 1).

## DISCUSSION

In this study, we found a U-shaped association between DBP values and the prevalence of ED. Moreover, the prevalence of ED increased in men with DBP values higher or lower than 90 mm Hg. The effect of PP on the prevalence of ED was inversely U-shaped.

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