

# Family history of hypertension enhances age-dependent rise in blood pressure, a 15-year follow-up, the Tampere adult population cardiovascular risk study

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## Abstract

A family history (FH) of hypertension is known to predispose to high blood pressure. We wanted to study whether it associates with blood pressure and hypertension in the Tampere adult population cardiovascular risk 15-year longitudinal study. A 50-year-old Finnish cohort having hypertension and their controls was examined retrospectively. The groups were combined and stratified to 396 subjects with a positive FH of hypertension and 384 with a negative FH. A 15-year follow-up was done from their periodic health examinations at the ages of 35-, 40-, 45-, and 50 years. In follow-up from the age of 35 years, systolic blood pressure ( $P < .001$ ), diastolic blood pressure ( $P < .001$ ), and the annual increase of systolic blood pressure ( $P < .010$ ) were higher in the group with positive FH, compared to the negative FH group. Positive FH associated with diagnosed hypertension by the age of 50 years (OR 3.52,  $P < .001$ ). The FH groups were not associated with body mass index. Our findings show that the prevalence of hypertension at the age of 50 years was significantly higher in those with a positive FH of hypertension. Asking about FH can provide the clinician with a simple instrument for recognition of subjects at risk of hypertension for closer monitoring at a younger age.

**Abbreviations:** BMI = body mass index, CI = confidence interval, FH = family history, PHE = periodic health examinations, TAMRISK = Tampere adult population cardiovascular risk study.

**Keywords:** blood pressure, family history of hypertension, hypertension

## 1. Introduction

Hypertension is the biggest single contributor to the global burden of noncommunicable disease and to global mortality.<sup>[1]</sup> The prevalence of hypertension is significantly higher in subjects with a family history (FH) of hypertension.<sup>[2]</sup> FH of hypertension has also been shown to be associated with lifestyle factors, such as obesity.<sup>[3]</sup> Hypertension may be considered a complex disease trait that is a combination of both genetic predisposition and environmental factors. Nevertheless, risk for hypertension crosses generations in the community,<sup>[4]</sup> underlining the genetic component. However, over 1400 single nucleotide polymorphisms identified in genome-wide association studies explain only approximately 27% of the 30% to 50% estimated heritability of blood pressure.<sup>[5]</sup> While awaiting the promise of precision medicine, asking patients about a FH might seem a relatively simple instrument, but nevertheless a useful routine approach.<sup>[6]</sup> We wanted to study whether FH associates with

blood pressure and hypertension in the Tampere adult population cardiovascular risk (TAMRISK) 15-year longitudinal study.

## 2. Subjects and methods

### 2.1. Subjects

TAMRISK study data was collected from periodic health examinations (PHE) done by a public health nurse for men and women living in Tampere, a city in southern Finland with 220,000 inhabitants.<sup>[7,8]</sup> The 50-year-old PHE for the present cohort was during years 2003 to 2006. Height (cm) and weight (kg) were recorded, and blood pressure measurement (mm Hg) was done using a calibrated mercury sphygmomanometer. Participants filled out a structured questionnaire about health, including family history of hypertension (yes/no). The frequency of physical exercise comprised both leisure

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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and work-related activity. Current and previous diseases were identified based on self-report, including hypertension, which had been diagnosed by a physician using normal healthcare procedures. At that time, physicians diagnosed hypertension when blood pressure readings were consistently 140/90 mm Hg or above. Cases were subjects who had reported hypertension at the age of 50 years ( $n = 409$ , 58% men) (as diagnosed by a physician) and for each case, at least 1 normotensive control subject was chosen ( $n = 757$ , 57% men). For retrospective follow-up, the original cases and controls were combined. All the subjects of the above 1166 participants who had information on their 35-, 40-, 45-, and 50-year-PHE formed the study group ( $n = 780$ ). All participants gave informed consent, and the Ethics Committee of the Tampere University Hospital approved the study.

## 2.2. Statistical analysis

Logistic regression, 1-way analysis of variance for repeated measures, *T* test for continuous variables and Chi-square test or Fisher exact test for categorical variables were applied. Analyses were carried out using SPSS 26.0 for Windows (SPSS Inc., Chicago, Illinois).

## 3. Results

Clinical characteristics of 396 subjects with a positive FH of hypertension and 384 with negative FH at the age of 50 years are shown in Table 1. Those with a positive FH of hypertension had more hypertension, higher prevalence of blood pressure medication, higher systolic- and diastolic blood pressure, and lower frequency of daily smoking, compared to those with a negative FH. There was no association of body mass index (BMI) or physical exercise with FH of hypertension. The positive FH of hypertension group had proportionally

less men compared to the negative FH group. The prevalence of hypertension at the age of 50 years was significantly higher in those with a positive FH of hypertension with an OR of 3.41 ( $P < .001$ , confidence interval [CI] 2.634–4.420). When prevalence of hypertension at the age of 50 was adjusted by BMI, physical exercise at least twice/week, current smoking, and gender, the OR for positive FH of hypertension was 3.52 ( $P < .001$ , CI 2.465–5.021), compared to negative FH. Since there was quite a large gender difference between the groups, a sub analysis was done for women and men separately, also adjusting by BMI, physical exercise at least twice/week, and current smoking. For women, the unadjusted OR for hypertension with positive FH was 3.71 ( $P < .001$ , CI 2.134–6.463); the adjusted OR was 3.86 ( $P < .001$ , CI 2.120–7.046), compared to negative FH. For men, the unadjusted OR for hypertension with positive FH was 3.45 ( $P < .001$ , CI 2.288–5.197); the adjusted OR was 3.657 ( $P < .001$ , CI 2.316–5.775), compared to negative FH.

From the age of 35 years, by analysis of variance for repeated measures, there was a statistically significant increase in time for systolic- ( $P < .001$ ) and diastolic ( $P < .001$ ) blood pressure and BMI ( $P < .001$ ) in both positive and negative FH groups (Fig. 1). The between groups test indicated that the positive and negative FH groups differed significantly for systolic- ( $P < .001$ ) and diastolic ( $P < .001$ ) blood pressure but not for BMI ( $P = .341$ ). Furthermore, there was a statistically significant interaction between time and enhanced increase of systolic blood pressure for the positive FH of hypertension group compared to the negative FH group ( $P = .010$ ).

## 4. Discussion

We have previously shown in the TAMRISK study that BMI and blood pressure were higher in subjects with hypertension at 50 years of age, in comparison with controls, already at baseline at 35 years, and the differences were not favorably changed during the follow-up.<sup>[7]</sup> In the present study, the subjects were stratified according to a positive or negative FH of hypertension. Now the risk of hypertension that was associated with FH appeared to be independent of other risk factors, since it did not change after adjusting for anthropometric parameters (BMI) and lifestyle factors (physical activity and smoking).

Subject phenotype and lifestyle factors did not seem to go hand in hand with the positive FH group higher blood pressure readings. The positive FH group had a lower frequency of daily smokers and did not differ from the negative FH group in physical activity or BMI. However, they had over twice the frequency of diagnosed hypertension, compared to the negative FH group.

From the age of 35 to 50 years, systolic- and diastolic blood pressure and BMI increased in both positive and negative FH groups. However, the positive and negative FH groups differed significantly for systolic- and diastolic blood pressure, but not for BMI. Furthermore, the increase rate of systolic blood pressure was more in the positive FH of hypertension group compared to the negative FH group. This is in line with a previous report, where the rate of blood pressure annual increase was slightly higher for systolic, but not diastolic, blood pressure in men with parental hypertension.<sup>[9]</sup> Our data support the concept of genetic predisposition to hypertension since the difference in blood pressure was already seen at a relatively young age of 35 years.

The prevalence of hypertension has been shown to increase with the number of generations with a positive FH.<sup>[2,4]</sup> It also known that several environmental factors, such as dietary habits and levels of physical activity affect blood pressure.<sup>[6]</sup> These may also be heritable to a certain extent, but it has been shown in the Framingham study that grandparental

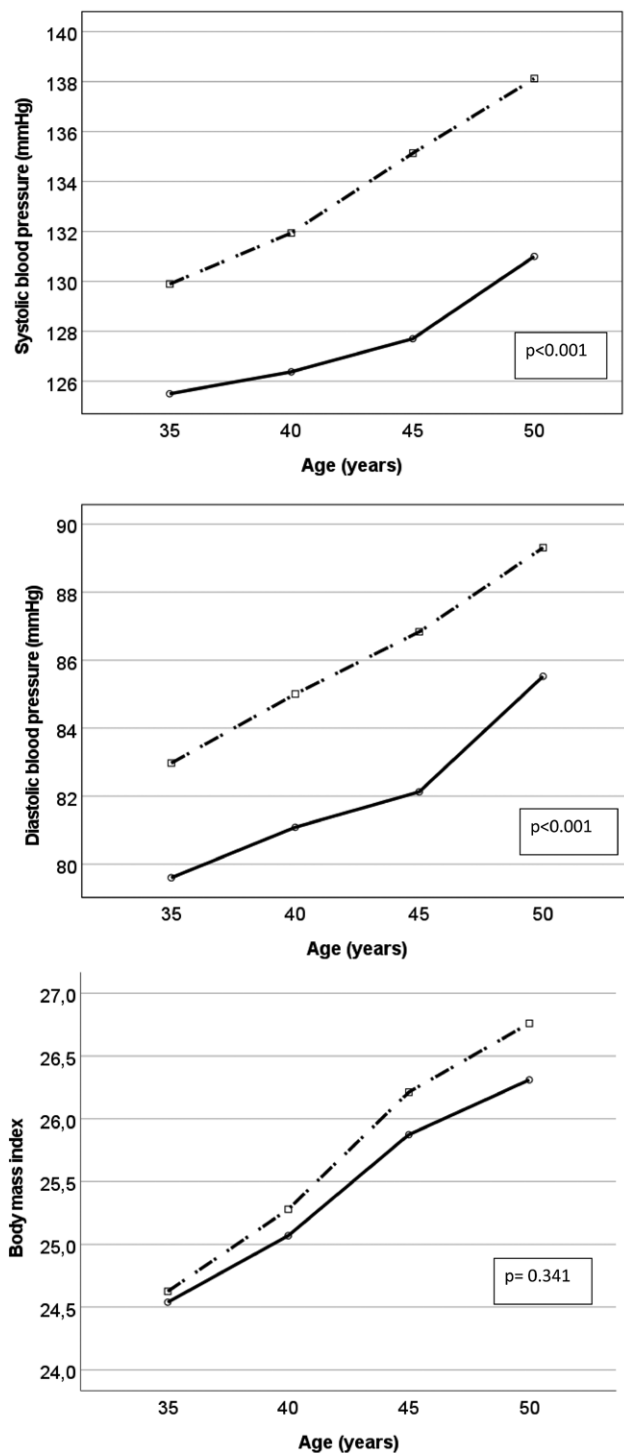
**Table 1**

**Clinical characteristics of the study population at the age of 50 years stratified according to family history (FH) of hypertension.**

	Positive FH of hypertension (n = 396)	Negative FH of hypertension (n = 384)	P-value*
Hypertension, % (n)	46.8 (185)	20.3 (78)	<.001
Blood pressure medication, % (n)	34.2 (135)	12.9 (50)	<.001
Ischemic heart disease, % (n)	2.3 (9)	2.0 (8)	.844
Diabetes, % (n)	5.8 (23)	4.4 (17)	.387
Male gender, % (n)	53.3 (211)	68.0 (261)	<.001
Physical exercise at least twice/wk, % (n)	69.2 (274)	68.9 (265)	.932
Current daily smoker, % (n)	20.0 (79)	31.2 (120)	<.001
Mean body mass index, kg/m <sup>2</sup> (SD)	26.8 (4.5)	26.3 (4.2)	.085
Mean systolic blood pressure, mm Hg (SD)	138.2 (18.7)	131.0 (14.3)	<.001
Mean diastolic blood pressure, mm Hg (SD)	89.3 (10.7)	85.5 (9.2)	<.001

SD = standard deviation.

\* T test or chi-square test.



**Figure 1.** The development of blood pressure and body mass index in the positive FH of hypertension group (dashed line) and the negative FH group (continuous line) during the time the periodic health examinations were conducted. The *P* values reflect difference between the groups. FH = family history.

positive FH extended even to grandchildren of whom only 10% were living in Framingham, thus emphasizing the genetic component.<sup>[4]</sup>

The strength of present study is the followed cohort, all born in the 4 years period 1953 to 1956 and followed up for 15 years.<sup>[7]</sup> Thus, there was no confounding by age. However, since the study group was restricted to a Caucasian population in a large city in Finland poses a challenge to how broadly 1 can apply the findings. Another limitation is that the information of family history of hypertension was collected at the end of the follow-up at age 50. With this design, there is a considerable risk of recall bias.

## 5. Conclusion

In conclusion, the differences in blood pressure between the positive and negative FH of hypertension groups were seen already at the 35-year-old PHE and they were not corrected during the 15-year follow-up time when PHE were conducted. Positive FH of hypertension can provide the clinician with a simple instrument for early recognition of subjects at potentially higher risk of hypertension for closer monitoring.<sup>[6]</sup>

## Author contributions

**Conceptualization:** Seppo T Nikkari.

**Data curation:** Tarja Kunnas.

**Formal analysis:** Seppo T Nikkari.

**Investigation:** Tarja Kunnas, Seppo T Nikkari.

**Validation:** Seppo T Nikkari.

**Writing – original draft:** Seppo T Nikkari.

**Writing – review & editing:** Tarja Kunnas.

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