

## LONGITUDINAL STUDY OF BLOOD PRESSURE IN SCHOOLCHILDREN

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**Abstract:** *The authors examined the characteristic of changes of blood pressure in a follow-up study of 206 schoolchildren (104 boys and 102 girls) for a 8-year period. There were no significant differences between the means for blood pressures of girls and boys during the years. Significant positive tracking correlations were found both for systolic ( $r = 0.71 - 0.40$ ) and diastolic ( $r = 0.41 - 0.37$ ) blood pressure readings in the same individual. The tracking-phenomenon was examined not only with correlation analysis, but also with analyses of level, trend, and variability of systolic and diastolic blood pressure. As to the individual prevention of high blood pressure, these data imply that it is not yet possible to detect future hypertensives early in life by measuring blood pressure. Preventive measures should be directed towards the entire population of young people.*

**Key words:** *Systolic blood pressure; Diastolic blood pressure; Tracking-phenomenon; Prevention; Hypertension.*

### Introduction

The earlier the start of primary prevention of a disease the more likely it is to be effective (WHO, 1985). As concerns essential hypertension the important question is whether public health measures ("population strategy") or individual medical care practices can influence the adult level of blood pressure. The individual approach ("high-risk strategy") necessitates the selection of children who will certainly become hypertensive later in life. This selection meets difficulties because there are not enough prospective examinations from childhood to adult age, and Hungarian data were not yet available at all.

### Material and Methods

In the school-year 1977/78 1886 pupils aged 7 to 14 years were examined in a cross-sectional study in the Kaposvár schools. (Kaposvár is the county town of Somogy, an agricultural-industrial town, of about 70 000 residents.)

Out of the pupils 110 boys and 112 girls were seven year-old, attending the first class of the school. These subjects were subsequently re-examined in their schoolroom yearly and are referred to as the longitudinal cohort. This cohort represents 28% of the contemporaries in Kaposvár. Only 206 pupils (104 boys and 102 girls who were examined in all eight years) were included in the final analysis, presented here.

The measurements of blood pressure, both systolic (SBP) and diastolic (DBP) were taken according to the internationally accepted methods, used in the cardiologic practice. The mean of three measurement were used for the elaboration (Környei et al. 1988).

### Results and Discussion

The mean systolic and diastolic blood pressure (SBP, DBP, mmHg) by age and sex are given in *Table 1* and *2*.

*Table 1. Systolic blood pressure by age and sex (mean and SD)*

Age (year)	Girls (n=102)	Boys (n=104)
7.0 ± 0.5	100.8 ± 8.9	101.6 ± 10.5
8.0 ± 0.5	99.0 ± 7.5	99.9 ± 8.3
9.0 ± 0.5	99.9 ± 9.9	99.5 ± 8.7
10.0 ± 0.5	101.3 ± 8.9	100.5 ± 9.9
11.0 ± 0.5	99.5 ± 10.1	97.4 ± 9.7
12.0 ± 0.5	100.3 ± 10.4	98.5 ± 8.5
13.0 ± 0.5	102.2 ± 10.8	101.6 ± 10.3
14.0 ± 0.5	105.9 ± 10.9	106.8 ± 11.5

*Table 2. Diastolic blood pressure by age and sex (mean and SD)*

Age (year)	Girls (n=102)	Boys (n=104)
7.0 ± 0.5	66.8 ± 9.3	67.8 ± 10.2
8.0 ± 0.5	61.7 ± 5.9	63.7 ± 6.2
9.0 ± 0.5	64.6 ± 7.4	65.0 ± 6.9
10.0 ± 0.5	62.4 ± 7.2	65.5 ± 9.9
11.0 ± 0.5	60.9 ± 7.0	62.4 ± 7.3
12.0 ± 0.5	60.0 ± 6.5	60.4 ± 7.4
13.0 ± 0.5	63.7 ± 7.4	62.1 ± 6.5
14.0 ± 0.5	66.3 ± 6.1	66.7 ± 7.5

The values for boys and girls are similar. There were no significant differences between the means for blood pressures of girls and boys during the years.

Tracking is defined as the maintenance, over time, of a relative rank for a variable, and thus an ability to predict subsequent observations based on earlier values (Woynarowska, Mukherjee, Roche and Siervogel 1985). At the time of planning our study there were only a few indications that tracking might occur in children and juveniles. Blood pressure tracking has usually been examined to determine whether children with high levels maintain their rank and whether they are likely to be hypertensive as adults. The magnitude of correlations of blood pressure rank order over time varies in various studies, from 0.25 to 0.66 for systolic blood pressure, and from 0.125 to 0.52 for diastolic blood pressure (Szklo, 1986). Significant positive tracking correlations were found in our study for both SBP and DBP between the initial and follow-up BP readings (*Table 3*).

*Table 3. Correlation coefficients between initial and follow-up (FU) blood pressures\**

Correlations	Systolic	Diastolic
Initial vs 1-yr FU	0.71	0.40
Initial vs 2-yr FU	0.61	0.32
Initial vs 3-yr FU	0.48	0.40
Initial vs 4-yr FU	0.48	0.39
Initial vs 5-yr FU	0.40	0.27
Initial vs 6-yr FU	0.48	0.30
Initial vs 7-yr FU	0.48	0.32
4-yr FU vs 5-yr FU	0.65	0.49
4-yr FU vs 6-yr FU	0.61	0.33
4-yr FU vs 7-yr FU	0.59	0.39

\*All correlations significant at  $p < 0.001$

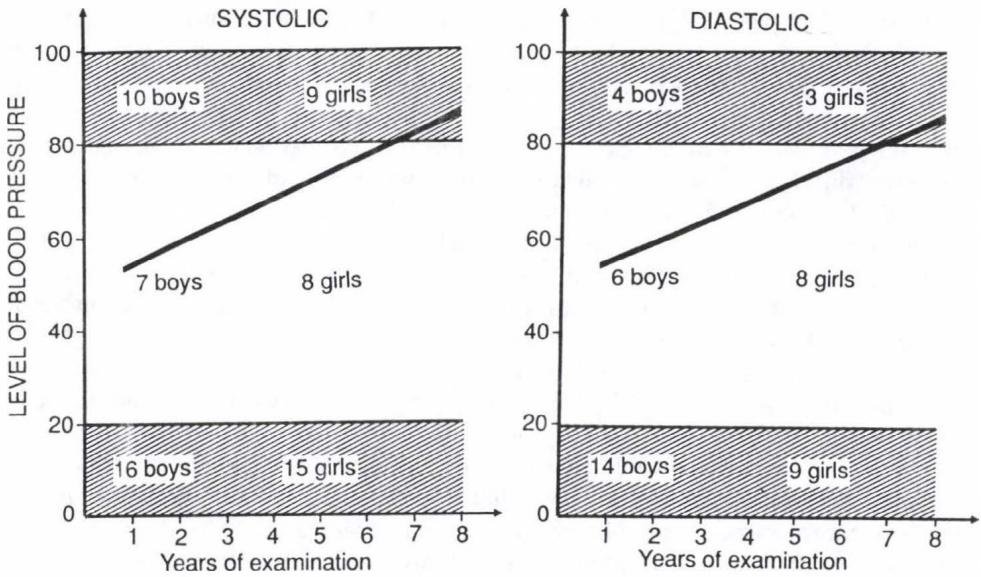


Fig. 1: A longitudinal study of blood pressure in schoolchildren Kaposvár

The correlation seems to become weaker the longer the follow-up is, as well as to be somewhat stronger for systolic than for diastolic blood pressure. These correlations are generally higher than those reported from other studies in children. It seems that, although initial BP levels are on the average relatively strongly associated with subsequent levels, prediction cannot be done very accurately at the individual level in children.

Since examination of tracking including all children (with correlation analysis) ignores a possible heterogeneity that may exist among sub-groups, we have attempted another approach to examine BP trends over time (after Lauer, Clarke and Beaglehole 1984).

We suggested that there may be different homogeneous strata of children in relationship to BP temporal behavioral (slope). One group with initially high BP levels, would tend to remain stable over time. Another group characterized by stability over time, but at low BP levels. Finally, there are also children whose BPs, initially in the middle percentiles, would either increase or decrease over time. Classification of subjects according to the slope of temporal BP changes has important practical implications, for associated factors may well be specific to each stratum.

It is in addition of interest to determine if individuals in the upper percentiles whose BPs have remained constant are comparable in risk of future cardiovascular disease to those who have achieved equally high level but whose BP's had increased in the past.

To provide this – more complete – description of blood pressure in children, we calculated for each subject the three statistics: level, trend, and variability. For this analysis all parameters (height, weight, Quetelet-index, systolic and diastolic BP) were

transformed into age and sex specific percentile ranks, for each survey year. In this hypothetical example of a single subject systolic blood pressure percentiles observed over a 8-year period: level of systolic blood pressure is given by the mean of age, sex, and examination-specific percentiles, trend is given by the slope of the least squares line describing percentiles over time, and variability the residual standard deviation, the "average" difference from regression of the line-describing trend, a measure of closeness of fit. Each of these variables was divided into quintiles.

Different groups with blood pressure tracking in different way could be identified (Fig. 1). Ten boys and nine girls had consistently high systolic pressures, and four boys and three girls high diastolic pressures with a flat trend and low variability. A number of 16 boys and 15 girls had consistently low levels of systolic, 14 boys and nine girls of diastolic blood pressures with a flat trend and low variability. Seven boys and eight girls had increasingly high systolic, six boys and eight girls had increasingly high diastolic blood pressure increasing trend and low variability.

Surely we would understand better the pathomechanism of essential hypertension if we knew the typical characteristics of children in the upper quintile of dispersion, and the differences between these children and the children with mean or low blood pressure. We will continue our examinations: from the analysis of the new fact we hope to draw conclusions about the characteristics of the different groups.

The result of our examinations show that over the years only the minority of the children remained in the same region of blood pressure.

Today we cannot yet satisfactorily select the children who will become hypertensive later in life. So, for the time being primary prevention of the essential hypertension should be include the whole population of children.

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