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## Population-based hypertension screening in preschool children



**Abbildung 1**

Dr. Giacomo Simonetti, Prof. Jürg Nussberger  
(Präsident SHG, von links nach rechts).

### Background

Hypertension is the leading risk factor for cardiovascular diseases in adults. Due to the common lack of clinical symptoms, hypertension frequently remains undiagnosed and untreated until late in the course of disorder [1, 2]. In contrast to adults, hypertension in childhood is preferentially due to secondary causes, most commonly renoparenchymal disease [3, 4]. Routine blood pressure measurements are still rarely performed by general paediatricians, and the prevalence of essential hypertension in children may be underestimated due to diagnostic neglect.

Blood pressure during adolescence clearly tracks at least into early and middle adult age ("tracking" of blood pressure) [5]. Children in the top quintile of systolic blood pressure are 3–4 times more likely to develop clinical hypertension by age 30 than their peers, and 50% of hypertensive adults had elevated childhood systolic blood pressure [6]. The minimal age at which significant blood pressure tracking into adult life becomes manifest has not been de-

termined. There are a number of possible explanations for the phenomenon of blood pressure tracking. The "fetal origins" hypothesis assumes that malnutrition during critical intrauterine growth periods leads to life-long programming of the cardiovascular system [7]. Obesity is another major determinant of childhood blood pressure. A significant association between systolic blood pressure and the body mass index has been demonstrated already in preschool children [8]. Moreover, socio-economic condition may play an independent role; associations of living conditions in childhood with adult blood pressure have been described [9].

Finally, genetic factors predisposing to hypertension would be expected to be operative already in childhood.

The diagnosis of hypertension in childhood is rendered difficult by several factors. Due to the lack of outcome studies, hypertension is defined by the deviation of blood pressure from the distribution in the general population. Since blood pressure changes dynamically throughout childhood [10–12], it is critical to have a firm basis for the normal range of blood pressure at different ages and heights. Another important methodological issue is the unknown equivalence of auscultatory measurements with oscillometric readings. While semi-automatic oscillometric devices are rapidly gaining ground in the pediatric field, very few validation studies have been performed with individual devices. These suggest systematic differences between the methods in the pediatric age group, indicating a need for specific centile curves based on oscillometric measurements.

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The beneficial effect of consequent normalisation of blood pressure on cardiovascular health by staged interventional strategies is beyond doubt in adult patients. As the cumulative duration of untreated hypertension is crucial for the severity and age at manifestation of cardiovascular morbidity, early diagnosis and effective treatment of essential hypertension in childhood may contribute crucially to the preservation of cardiovascular health in many subjects.

The Heidelberg Kindergarten Blood Pressure Project combines school entry examinations with a general blood pressure screening programme in order to address several of the issues outlined above. Furthermore, the project aims at demonstrating the suitability of a public surveillance programme to identify children at risk for essential hypertension at an early age.

### Aims of the project

- Assessment of the prevalence and aetiology of arterial hypertension in preschool children in a representative German urban/rural population
- Validation of two oscillometric blood pressure devices in preschool children
- Development of reference percentiles of casual blood pressure measurements for preschool children
- Assessment of the role of assumed risk factors such as obesity, passive smoking and familial disposition in preschool age hypertension
- Assessment of the role of pre-, peri- and early postnatal circumstances such as birth weight and maternal smoking in preschool age hypertension
- Assessment of the prevalence of microalbuminuria and relationship with blood pressure at preschool age

### Methods

In Germany, children approaching school age undergo a compulsory assessment of physical and cognitive maturation organised and performed by the regional health authorities ("Gesundheitsamt"). In the Rhein-Neckar district, up to 5000 kindergarten children are examined each year. In the project the general physical and neurocognitive examination is supplemented by additional anthropometric assessments (skinfold thickness measurements for estimation of body composition) and a detailed medical and social history, recording both parents' current height and weight, educational and occupational status, ethnic background and previous and current cardiovascular disorders in the family. The child's sitting blood pressure is measured according to standardised procedural guidelines [10] three times by aortic sphygmomanometry and three times by one of two oscillometric devices, using an appropriate cuff size adapted to arm circumference. Moreover, the urinary albumin-creatinine ratio is measured.

Children in whom auscultatory blood pressure is greater than the 90th percentile for age and height undergo a second examination at the kindergarten within two to three weeks. If the second reading confirms a blood pressure level at or above the 95th percentile, 24-hour ambulatory blood pressure monitoring (ABPM) is performed. If ABPM confirms arterial hypertension (systolic and/or diastolic nighttime and/or 24-hour blood pressure >95th percentile), a diagnostic workup of hypertension is initiated.

### Preliminary results and conclusions

The Heidelberg kindergarten blood pressure project is powered to identify risk factors and prevalence of high blood pressure in childhood. Furthermore, this data will allow to quantitate differences between the auscultatory and the semi-automatic oscillometric measurements. The first results in a cohort of 2600 children confirm that blood pressure is influenced already in childhood by genetic and prenatal factors, as well as by dietary habits and environmental factors. These results provide a rationale for the contention that systematic

early detection of children at risk will improve the prevention of cardiovascular complications in adulthood. Moreover, our preliminary results suggest that pediatric blood pressure reference values obtained by auscultatory measurement [10] cannot be utilised readily to interpret oscillometric blood pressure measurements; rather, device-specific reference values or correction factors will be required. The final results of this project will be published over the next years.

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