

*hypertension in children, blood pressure,  
measurements interpretation, percentile chart*

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## **BLOOD PRESSURE IN CHILDREN AND ADOLESCENTS – SOME ASPECTS OF MEASUREMENTS INTERPRETATION**

### SHORT NOTE

This work presents new possibilities for interpreting blood pressure measurements of children and adolescents with the use of Internet. A dynamic web site allows for such interpreting and archiving blood pressure measurements in developmental age. Stored measurements results can become a basis for national pressure norm considering specificity of development of Polish children and adolescents. The interpretation system of blood pressure measurements in developmental age can be used both at school and home.

### 1. INTRODUCTION

Hypertension (HT) in children and adolescence is less frequent than in adults and therefore the problem used to be underestimated. It has been scientifically proved that hypertension in developmental age poses a great risk of becoming permanent state in adulthood along with all possible complications such as ischemic heart disease and arteriosclerosis. Correctly and early diagnosis of hypertension has a considerable impact on reduction of morbidity and mortality due to cardiovascular diseases in adults [1, 2, 3, 4].

The latest, updated recommendations concerning the rules for diagnosis, treatment and prevention of hypertension in children and adolescents are based on percentile chart of pressure depending on sex, age and a child's height [11].

In practice both hypertension measurement and its interpretation on the basis of percentile development charts cause a lot of problems and often result in incorrect diagnosis.

This work presents a system of canvassing and interactive interpreting pressure measurements in children and adolescents with the use of Internet. The system facilitates classification of pressure measurements of children and adolescents.

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## 2. RULES OF HYPERTENSION DIAGNOSIS IN CHILDREN AND ADOLESCENTS

Recommendations concerning diagnosis, treatment and prevention of hypertension in children were depicted in two, exhaustive working group reports from 1977 and 1987 on High Blood Pressure in Children and Adolescents in the USA [11]. The reports also constitute a basis for diagnosis of hypertension in children and adolescents in Poland [6, 9, 13].

Basic rules for correct diagnosis of hypertension in developmental age are the following:

1. Correct measurement of blood pressure. It is recommended to use cuff bladders suited for children's arms [1, 7, 8].
2. Correct interpretation of pressure measurement results in compliance with the latest recommendations. According to updated diagnostic recommendations [11] the definition of hypertension in children and adolescents has not changed. Normal blood pressure is below 90<sup>th</sup> percentile for a given age and sex and level of percentile of body height. If pressure measurement results are between 90<sup>th</sup> and 95<sup>th</sup> percentile we deal with high-normal pressure. Hypertension is diagnosed when systolic (SBP) or diastolic (DBP) blood pressure measured on three separate occasions at several week intervals equals to or is above 95<sup>th</sup> percentile. Blood pressure distribution for 90<sup>th</sup> and 95<sup>th</sup> percentile has been normalised for a given age, sex and percentile body height. Such approach, although very precise (considering a stage of child's development) and universal, in practice poses some interpretation problems since it requires to use updated percentile of body height.

## 3. SYSTEM FOR INTERPRETATION OF BLOOD PRESSURE MEASUREMENTS.

Interpretation of blood pressure measurement requires a certain fixed procedure to be implemented in information system. Algorithm of result analysis is implemented in PHP scripting language and data is stored with the use of MySQL data basis [4, 10, 12]. Such a solution allows for data input and use of the service from every computer that has access to Internet and a browser.

The database includes information about:

- current percentile charts for body height and pressure
- registered users
- stored measurement results

Measurement interpretation can be twofold:

- interpretation of a single measurement of non-registered users (see fig.2)
- interpretation of several measurements stored in a database for registered users (see fig.3).

In order to interpret a given measurement following data are needed: age (for registered users it is calculated on the basis of the date of birth put directly for every measurement from the application form), height (directly inserted) and results of pressure measurement (directly inserted). When all data are entered, information on height distribution for a certain age (stored in a database) allows for calculation of percentile body height for a given patient. . The data base comprises boundary line values of blood pressure (mmHg) for 90<sup>th</sup> and 95<sup>th</sup> percentile for age and for height (diagram 1) Linear approximation serving to classify pressure (normal - N, borderline - BHT or hypertension - HT), is used in algorithm allowing for precise calculation of percentile.

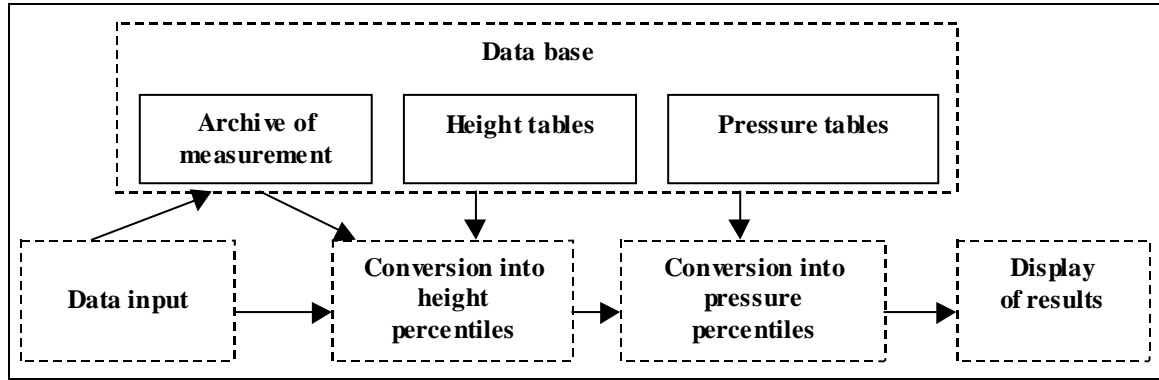


Fig.1. Pattern of calculations used in blood pressure analysis.

The entered data are interpreted on the basis of percentile chart. In order to carry out measurement analysis we need information on measured pressure values, the child’s height and age. The result is presented in a form of graphical representation on percetile chart for a given sex and age group (see: fig.2) along with an exhaustive description of analysis results.

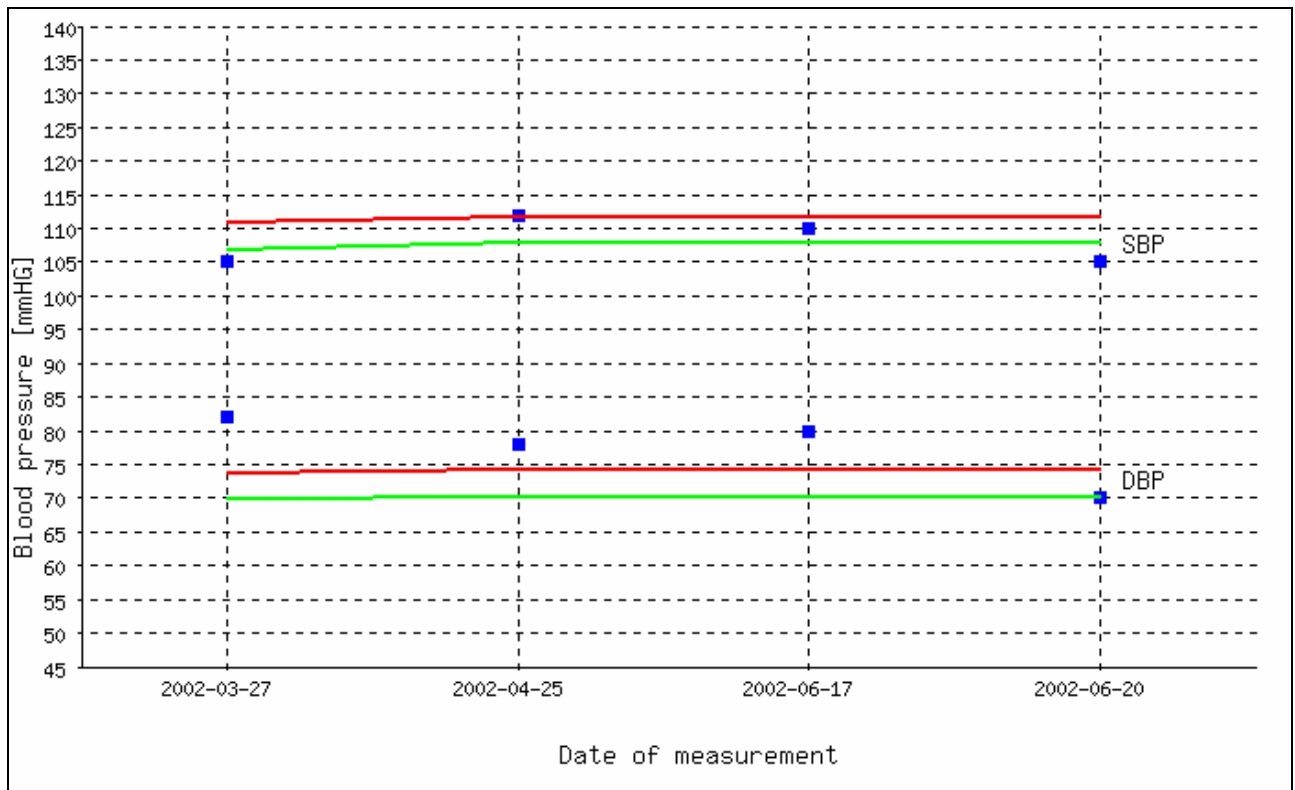


Fig.2. The result of four pressure measurements of 7-year-old boy. Green lines depict 90th percentile and red lines 95<sup>th</sup> percentile.

In order to save individual measurements it is necessary to complete service authorisation and personalisation. Therefore before saving the results for future use we need to register beforehand. Information required for registration includes date of birth (in order to interpret the result correctly) and e-mail address (in order to contact in special cases for instance in case of forgotten password)

and optionally name and surname. Registration is necessary to assure that everyone has access only to his personal data. After completing a service authorisation a person who stores measurement data can at any time: 1/ add new measurement, 2/ edit or erase a measurement, 3/ access interpretation of a single stored measurement or measurement groups.

#### 4. CONCLUSION

Despite applying proper measurement methodology, correct interpretation of blood pressure measurements in children and adolescents may cause practical problems, even for experienced medical personnel. The recent updated recommendations by a working group of High Blood Pressure in Children and Adolescents as for measurement interpretation involve child's developmental stage by application of standard percentile charts for pressure and body height. This approach, though more precise, requires current norms of children's heights. Considering regional differences in the height and its acceleration, the choice of proper norms is crucial in interpretation of pressure measurements. Both auxologists and anthropologists agree that examination of basic antropometric parameters in children should be repeated every 5-10 years. [1, 2, 6, 13].

The presented system of canvassing and interpretation of blood pressure measurement in developmental age is a proposal for a complex approach of early diagnosis and prevention of hypertension with consideration of national child development norms. The authors point out following advantages of the presented solution:

1. easy and fast interpretation of results of pressure measurements based on updated regional percentile development charts. It is especially of high importance in case of children and adolescents who are examined at schools, by family doctors or by parents at home.
2. possibility of long term storage of measurement results along with the evaluation of applied preventive measures for instance impact of physical activity
3. creation of own, complex normative base with results of measurement results of Polish adolescents.

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