CHILDREN'S ANTHROPOMETRY IN RELATION TO SCHOOL FURNITURE

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- IGA LDF MENDELEU project, id. no. 32/2010 (Anthropometry of children with disabilities in relation to furniture);
- NIS MPO ČR FR-TI1/050 project (Information system to support research, development, innovation and quality of furniture)
- OPVK IPo, CZ.1.07/2.2.00/18.0017 project: (The inovation of pregradual secondary teacher education in part-time form).

Abstract: The paper presents results of a research investigation obtained under the support to the IGA LDF MENDELU project, NIS MPO ČR project, and OPVK project. It gives an account of theoretical and methodological starting points, presenting the project's research aims. Its chief objective is to introduce professionals to the existing results of the completed research investigation focusing on the determination of dimensional requirements for furniture intended for children with disabilities. The questions raised belong to a broader context of the issue at hand, related to the project of setting up protection and safety standards in relation to the health condition of children and youth, in the context of the "Long-term programme to improve the health status of the population of the Czech Republic - Health for everybody in the 21st century" paper, namely objective 4: YOUTH HEALTH – TO YIELD CONDITIONS FOR YOUNG PEOPLE TO BECOME HEALTHIER AND APTER TO FULFILL THEIR ROLE IN THE SOCIETY BY 2020.

Keywords: Furniture for children, education; anthropometry; functional capacity; disability.

1 Introduction

The issues covered by the paper are related to the methods of anthropometric measurements and the actual research conducted on groups of kids classified as per school division. Taking somatic measurements produces primary input to define the methodology of requirements for furniture intended for children with disabilities. The terms functional ability, disability and health as defined in the International classification of functional abilities, disabilities and health paper (hereinafter referred to as the MKF) must be included in the research conducted with a great deal of emphasis. Depending on the classification of disability, degree of functional ability of children and the somatic measurements taken, relations must be sought in order to determine the optimum evolution index to serve as key input to dimensional requirements for children furniture. In principle, children, and people with a limited functional ability and disability must be given a chance to lead dignified lives and integrate them adequately into society.

2 Aim

The aim of the paper is to introduce professionals to the existing results of the completed research investigation focusing on the determination of dimensional requirements for furniture intended for children with disabilities. The research results will be used within the arising assessment methodology for requirements applying to furniture for children with disabilities, which forms the object of a dissertation paper by one of the originators of the present paper. Presently, the research is based on the measured somatic measures for healthy children belonging to several children age categories. Mutual relations are sought between these values, taking the shape of body segment indices having an impact on the determination of dimensional requirements applying to furniture for children.

3 Material and methods

3.1 Material

The supporting expertise used throughout the paper consists of the following specialised interdisciplinary documents, standards, methodologies and other specialised literature used as sources:

- Methods of Anthropological Research [academic support Biology UJEP];
- ČSN EN ISO 7250 Basic human body dimensions for technological design [ČSN EN ISO 7250];
- The long-term programme to improve the health condition of the population of the Czech Republic - Health for everyone in the 21st century [Ministry of Health];
- Information concerning assessment of the degree of dependence for persons aged 18 or less [Ministry of Labour and Social Affairs];
- International classification of functioning, disability and health [MKF];
- International Classification of Diseases [MKN];
- Information system to support research, development, innovation and quality of furniture [NIS], etc..

The aforementioned sources were used by the originators of the paper to obtain information they complement with their own views regarding the issues of children with disabilities and discuss the need for determining dimensional requirements for children furniture with regard to the needs of children with disabilities.

The originator of the paper (Ing. Martin Zach) is a researcher/co-researcher for the projects below, with whose support the results of the research instigation were processed. Namely, these involve the IGA LDF MENDELU project, id. no. 32/2010 (Anthropometry of children with disabilities in relation to furniture) and NIS MPO ČR FR-TI1/050 project (Information system to support research, development, innovation and quality of furniture).

3.2 Methodology

3.2.1 Research methodology – anthropometry

Anthropometry is a science, which deals with measurements of the human body and the method of functional anthropology. At the same time, the science is a set of techniques to measure the human body. The discipline where the intention is to capture the body shape of living people is referred to as **Somatometry**. On the contrary, the discipline where the intention is to reconstruct proportions of the human body based on the skeletal remains is referred to as **Osteometry**. Anthropometric methods are subject to global standardisation drawing on precisely defined anthropometric points. (Řeháková et al., 2010). Standardised anthropometric tools are used to determine standardised anthropometric points and measures.

3.2.1.1 Anthropometric instrumentation

Anthropometric instrumentation is required for the measurements of body dimensions to be measured. The **basic anthropometric** and, by inference, somatometric **instrumentation** includes:

- anthropometer (picture 1);
- personal scale (lever, precision step-on)
- large contact calliper = pelvimeter (picture 4);
- anthropometric sliding calliper (picture 2);
- tape meter to measure circumferential dimensions (picture 3);
- standardised plug to measure reach distance.

Picture 1: Anthropometer
(source: URL: <http://alumet.republika.pl/>)

Picture 2: Sliding calliper to measure width dimensions (source: URL: <http://www.fsps.muni.cz/laborator>)

Picture 3: Tape meter - length 150 cm (source: URL: <http://www.optingservis.cz>)

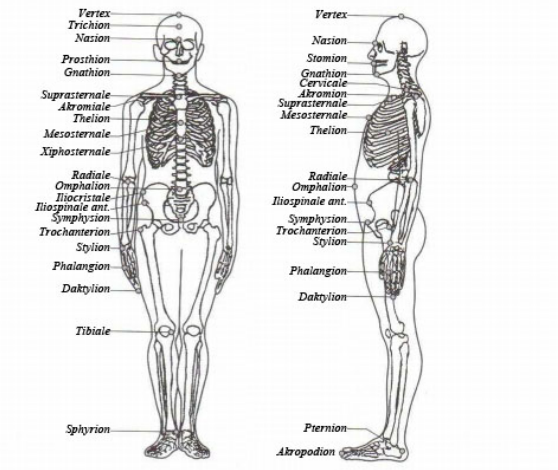
Picture 4: Pelvimeter (source: URL: <http://www.trystom.eu>)

3.2.1.2 Measured indicators – body dimensions

Taking the measurements on children using indicators recorded in the measurement report for each individual. In addition to the measured indicators, the measurement record states an identification code, date and time of examination and date of birth of the proband.

Examples of measured indicators: *body mass; chest circumference; width of the pelvis – (bicristal); body height in a sitting position, eye line height in a sitting position; thigh height above the seat; arm length bent in the elbow; reach distances, etc.*

The indicators are based on anthropometric points that are identical with the points defined in the human skeleton (see: picture 5) and are reflected on the surface of the human body.



Picture 5: Anthropometric points (source: ŘEHÁKOVÁ, a kol., *Metody antropologického výzkumu;* own.)

The anthropometric points are generally measured on:

- the trunk and limbs;
- on the head.

Somatic dimensions based on the anthropometric points are divided to height, width and circumferential points. The anthropometer is used in measuring the height dimensions (see: picture 1). The width dimensions on the trunk are measured by a small and large contact caliper = pelvimeter (see: picture 4). The width dimensions on the limbs are measured by a modified sliding calliper--under our research, limb widths were not measured. picture 2). Circumferential parameters are measured using a tape meter (the tape meter resembles a measuring tape but is made of soft steel or waxed canvas - see: picture 3) while a standardised plug is used for measuring the reach distance (the proband grips the plug in the palm of their hand and their reach is measured - forward towards the grip and the elbow-grip length). Moreover, a modified sliding anthropometer is used in anthropometric measurements, using which height dimensions may be measured.

Measuring the human body is based on the so-called basic anatomical position. Healthy individuals (probands) are measured on the right half of the body standing upright next to a wall with the heels, buttocks, shoulder blades, head and the feet remaining together. The head is in the so-called reference plane, which is defined by the edges of the ear canal circumference (tragion) and the lower edge of the orbit (orbitale). The plane is horizontal. The anthropometer is always held perpendicular to the ground when determining the dimensions. (Řeháková et al., 2010).

As an example, somatic dimensions may be used to determine the maximum reach zones for storage furniture, height and width of the seat, the minimum space per person for dining purposes, etc. The current average human body dimensions are laid down in related standards while furniture designing is governed by ČSN EN ISO 7250 Basic human body measurements for technological design. (Brunecký et al., 2011).

The ČSN EN ISO 7250 standard defines the dimensions to be measured when standing upright and in a sitting position, dimensions of the individual body parts (such as palm length, head width, etc.), functional dimensions (such as the forward reach toward the grip, chest circumference, gripping height, etc.), and mass. The standard follows the total of 56 anthropometric dimensions. As part of the measurements, 36 somatic dimensions are investigated while 32 somatic dimensions are based on the ČSN EN ISO 7250 standard, and the following dimensions to be measured are added: height of the suprasternale, elbow height in 90° flexion, stylion point height and arm span. (Brunecký et al., 2011).

People/children with disabilities generally exhibit impaired mobility due to the disability. With regard to furniture and operating the, this applies to: ***seating depth and height, maximum reach while using storage furniture,*** etc.

3.2.2 Statistic methods

In ontogenetic development, the major changes in growth and individual development mainly occur in the pre-school age, school ages and in adolescence. The change processes are primarily determined by hereditary factor, on the other hand, though, factors of the environment surrounding the individual also have a role to play. Ontogenetic changes are best described by the so-called **Rohr's index**, or the physical fullness index and **F-index**, or the stout lean index. For adult population, the **BMI** (body mass index) is most commonly used.

$$BMI - index: \ H / V^2 \text{ (in meters)}$$
$$Rohr's\ index: \ H \cdot 10^5 / V^3$$
$$F - index: \ (H^{1/3} / V) \cdot 10^3$$

The indices are determined from the absolute dimensions measured. Mostly, this involves a mutual ratio of two

dimensions expressed in per cent. The indices give an indications as an individual's proportionality or non-proportionality. The values of most indices vary as a function of the individual's ontogenetic development.

As part of our research, it will be more appropriate to keep a track of the **physical segment indices** and their evaluation. Specifically, we mean the "**evolution index**", which is used to monitor growth development of the lower limbs. It is appropriate that *the length of the trunk (height in a sitting position), width of the pelvis (bicristal width)* should be monitored; in relation to the use of furniture (seating important where the height, width and depth of the seat are the crucial factors). The aforementioned physical segment indices thus have an impact on the determination of dimensional requirements for children's furniture.

Country-wide anthropometric researches were carried out in 10-year intervals, with the last one taking place in 2001. In principle, no other anthropometric measurements are performed on children at the time being in the territory of the Czech Republic.

3.2.3 Percentile method

Use of the Percentile method--an alternative to statistic data treatment--is recommended for evaluating the measurement results. The averages are insufficiently applicable as a result of major differences in the individual body parts, and therefore, a range must be worked with instead. It was proven statistically that measuring the human body in any given population sample will be distributed in such a way that (majority) will fall somewhere to the middle while a small number of extreme measurements will alternatively be recorded in either end of the spectrum. As it is impossible to carry out the design for the entire population sample, it is crucial that the segment be chosen out of the middle portion. As a result, today, it is customary to ignore the extreme results on both ends of the range and work with the 90% of the population group. Most anthropometric data is therefore expressed in terms of percentiles. For the purposes of the present study, the population is divided into 100% categories ranked from the smallest to the biggest with regard to some specific types of body measurements. The initial percentile for the figure or height, as an example, indicates that 99% of the population sample the study deals with is of a bigger height. And similarly, the 95th percentile implies that only 5 % of the study's population is of a bigger height and 95 % of the study's population is of either the same or smaller height. The percentiles indicate the percentage of persons within the population (population sample), which have body dimensions of a certain size (or smaller). (Brunecký et al., 2011).

4 Theoretical background

The furniture used by children should be "tailor made". Both in terms of the material used in production, shapes, weight, dimensions, coloration and functionality in use, or for children who are "disadvantaged" by a certain degree of disability, and their increased operability and linkage to the aforementioned aspects.

4.1 Disability

First of all the degree of physical handicap must be realised for the individual concerned and their handicap must be classified=disability. The term handicap is here already replaced by the term disability, which is one of the pillars of the MKF paper by the World Health Organisation (WHO). The MKF paper defines disability as follows: *"Disability denotes reduced functioning on the level of the body, individual or society, which emerges once encounters external barriers as a result of their health state (heath condition).* (National Council of People with Disabilities of the Czech Republic, 2010, p. 9). The MKF paper does not classify the persons but rather describes and classifies the situations of each individual in a number of circumstances relating to their health. This may be considered to imply that each individual has a specific health state that confronts them with various life situations and therefore often gets them into diversely disadvantaging positions.

According to the World Health Organisation, people with disabilities account for 9 to 13 % of Europe's population. The indication reveals that people with disabilities account for a "sizable minority of the population". National Council of People with Disabilities of the Czech Republic, 2010).

4.2 Functioning

It refers to all functions of the body, activities and participations as an overarching term; similarly, disability is used to express disorders, reduced activity or limited participation. The MKF paper also registers environmental factors that contribute to all the constructions. They have an impact on all components of functioning capacities and disability and are organised across the range from the individual's immediate vicinity to the environment in general. National Council of People with Disabilities of the Czech Republic, 2010).

The functioning and disability of individuals are conceived of as dynamic interactions between health issues (diseased, accidents, injuries) and co-factors.

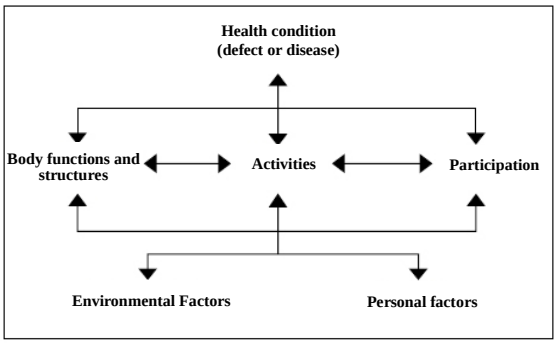
4.3 Heath/disability classification

Health and health-related states associated with all health problems. The unit used in the classification is a ***category*** inside each health domain and health related state. Situations of individuals are described rather than personal classification. The description is created in the context of the environment and personal factors.

4.4 Co-factors - according to the MKF paper

Representing the integral background of an individual's life. They contain two components: *environmental factors and personal factors*, which may have an impact on the indivdiual's health problems and health-related states (see: see Chart in picture 6).

The environmental factors form the physical, social and positional environment, in which people live their lives. These involve external factors, to which the individual may be exposed and which may either have a positive or negative impact on the specific manner in which the individual performs their activities as a member of the society, or on their capacity or functions of the body, or the structure of the given individual. The environmental determinants co-factor alongside the components of bodily functions and structures and activities and participation. Disability is regarded as an outcome or result of a complex relationship between health problems of an individual and personal and external factors that represent the circumstances surrounding the individual. National Council of People with Disabilities of the Czech Republic, 2010).



Picture 6: Chart – mutual interactions of the components (source: own)

4.5 Disability classification

The commonest internal differentiation of people with disabilities employs a model based on the prevailing disability. Disability classification into:

- **physical**;
- mental;
- visual;
- auditory;
- speech.

Physical disability corresponds to a single group only. The issue of subdivision within the physical disability group may be conceived of according to a number of criteria. The commonest is the one that employs ***depth (degree)*** of disability. A number of criteria, including the official, employ a division of physical disability to:

mild - moderate - severe.

In principle, it is a very generic classification since each of the aforementioned groups includes a very diverse group of states, diseases, disabilities and, in particular their bearers=the individuals. (Michalík a kol., 2011).

Tracing the results of the selected investigation among people with disabilities conducted in 2007 by the Czech Statistical Office, we reach the conclusion that the number of people with disabilities towards the end of 2006 was 1,015,548 in total. Out of that number, 46 208 of people with disabilities belonged to the group 0 – 14-year-olds. There were 16,687 ***people with physical disabilities*** within the age group. (ČSÚ, 2007).

For the group of 0-14 year-olds, there were 26,264 people with inborn disabilities. On the other hand, people with acquired disability had 19,944 representatives in the group. Inborn disability within the said group accounted for 56.84 %. (ČSÚ, 2007).

<u>*People with physical disabilities may be further subdivided to:*</u>
- inborn and acquired muscoskeletal defects;
- inborn upper limbs defects;
- finger deformations;
- pelvis defects;
- deformations of the femoral neck;
- lower limbs defects, knee defects;
- foot defects;
- acquired spinal deformity - scoliosis;
- acquired through injury, operation - infections of bones and joints, etc.

4.5 Requirements for furniture for children with disabilities

The requirements for furniture are looked at from the following viewpoints: workmanship, testing, structure, materials, dimensions, safety, ergonomics, equipment, main defects and conditions.

The general requirements define that marketed furniture must reliably, safely and reasonably meet the purposes, for which it has been designed. It must be constructed in such a way as to guarantee its utility properties in the long run. At the same time, it must be constructed using materials and joints customary for the given typological group of products, or verified by an accredited testing centre, or at least such that possess a material certificate. The product structures and components must adequately allow for the replacement of the elements crucial for its utility properties. In addition to the utility parameters and the prescribed features, the furniture must also display adequate resistance to dynamic loading when used. (Brunecký et al., 2011).

If the requirements are met, the furniture for children with physical disabilities should be fully functional, easily operable so as to ensure easy usage for the children.

If these results based on a thorough investigation among children are taken into account, the principles may easily be adhered to in the relationship of the furniture to children with disabilities with a view to removing the "barrier" the children must overcome so as to be able to use the furniture in very much the same way as their peers, classmates or brothers and sisters,

5 Results and Discussion

The classification of children, on whom the following measurements have been provided, takes place in keeping with the values used for the classification for the purposes of school attendance.

- **pre-school age** (4 - 7-year olds);
- **junior school age** (7 - 11-year-olds);
- **senior school age** (11 - 15-year-olds);
- **teenagers** (15 - 18-year-olds).

36 somatic dimensions were investigated while 32 somatic dimensions are based on the ČSN EN ISO 7250 standard, and the following dimensions to be measured were added: *height of the suprasternale, elbow height in 90° flexion, stylion point height and arm span*.

The outcome of the anthropometric measurements completed was summary statistics of somatic dimensions of healthy children divided as per the classification for school attendance purposes to be used for research and development of a model example for both healthy children and, by inference, children with limited functioning and disabilities. The measurement results imply an increase in the median values for the basic somatic dimensions within the development of the individual groups of children divided as per the classification used for school attendance purposes. It is important for the determination of requirements to be imposed on the furniture intended for children with physical disabilities that the basic somatic dimensions, and, by inference, the **body segment indices**, and/or the ***"evolution index"***, which is used to monitor growth of the lower limbs, be followed. This primarily applies to the ***length of the trunk (height in a sitting position), width of the pelvis (bicristal width)***; in relation to the use of the furniture. In a sitting position where height, width and depth of the seat are the crucial factors. The "evolution index" referred to above will thus have an effect on the determination of the dimensional requirements for children's furniture.

The provisional values obtained through measurements may only be worked with as long as they are regarded as aggregate statistics for children divided as per the classification used for school attendance purposes (4 to 7 year-olds; 7 to 11-year-olds; 11 to 15 year-olds; 15 to 18-year-olds) as only 126 probands have been measured by December 2012. The measured values are not statistically valid (as of yet, they do not correspond to 400 probands), if for no other, than for the reason that the statistical sample within the measurement is insufficient (proband = an individual submitted to the investigation). Once a sufficient number of children have been submitted to the measurements in all of the age groups (6 to 18-year-olds), adequate values for all measured somatic dimensions may be obtained for all individual one-year categories. Then, the somatic dimension, using which the current **dimensional requirements for children (school) furniture** will be determined, will be regarded as statistically proven.

At the present, it is virtually impossible to ensure the measurement are statistically valid. This is due to a number of factors referred to below:

- consent of the parents is required for the measurement;
- the staff of the health care establishment and the anthropologists must be trained to carry the measurements out (and the consent of their superior must be obtained);
- children may no longer be measured at educational establishments as the latter introduce restrictions that

prevent anybody else from touching the children. In a health care setting, that is a part of the medical profession.

These facts render it impossible for us to complete the research in the short run and still arrive at a valid sample. Therefore, the measurements take place gradually and individually with an account taken of the aforementioned facts.

The values that have been measured so far under the aggregate statistics for the individual age groups of children imply that the number of **N** values is not identical for all somatic dimensions measured. The reason is that the probands concerned had injuries during the measurements that made it impossible to measure the given somatic dimension. The **SD** value determines the standard deviation for each somatic dimension measured. The ***Median*** value - a range of mean values - is used to process the indices and dimensional requirements for children furniture. It is given by the 50th percentile of the series of measured values (see table 1 - 4) and for explanation of the method see chapter 3 Material and Methods, and subchapter 3.2.3 Percentile method.

The development of children in terms of anthropometry is highly variable in time, After all, development of somatic dimensions may be followed for the individual age groups of children on charts 1 and 2 below. The variability is also observed within ethnicities. If the attempt to determine dimensional requirements for children furniture is based on the currently measured somatic values, an account must be taken of the variability of children development in the time frame of the upcoming decades.

The measured values will be the input for a model example that may be applied to school children furniture (in terms of the age groups of children and their division as per the classification for school attendance purposes).

Table 1: **Pre-school age 4 – 7-year old**

Aggregate statistics All children 4-7-year olds	**N**	**Average**	**Median**	**Minimum**	**Maximum**	**SD**
Mass	13	22.7	21.8	18.8	29.6	3.5
Height	13	119.7	118.1	110.0	132.5	6.4
Head circumference	11	50.6	50.5	48.2	52.5	1.3
Chest circumference	11	59.4	58.7	55.2	64.6	3.4
Eye line height	13	109.0	108.2	99.8	123.8	6.5
V_ac	13	95.0	94.2	86.4	109.3	6.2
V_sst	13	94.9	94.4	85.5	107.5	6.2
V_ra	13	72.5	72.5	66.0	82.5	4.8
V-elbow	13	70.8	70.9	64.5	80.5	4.1
V_iliospin	13	66.3	66.4	60.5	77.2	5.1
V_ti	12	33.9	33.8	29.7	38.9	2.6
V_sty	13	56.7	56.3	51.3	64.5	3.6
Hrud_sagit	13	13.9	14.0	12.8	15.2	0.9
Hrud_trans	13	20.1	20.2	19.0	22.7	1.0
Bicristal width	13	20.1	20.2	17.8	21.1	1.0
Biacrom_width	13	26.1	26.0	22.0	29.0	2.1
Bideltoid_width	13	30.1	29.8	28.0	32.3	1.3
Reach_grip	12	52.5	52.0	47.5	61.7	3.6
Elbow_grip	12	24.2	24.3	20.9	26.2	1.7
Arm_span	12	116.4	115.7	107.0	133.0	7.8
Height_sitting	12	64.0	64.3	59.7	68.4	2.6
Eye-line_height_sitting	12	51.6	51.5	46.4	56.1	3.2
Cervicale_height_sitting	11	43.4	43.3	40.0	47.1	2.4
Acr_height_sitting	12	39.0	38.9	35.3	42.3	1.9
Shoulders_height_sitting	12	18.2	18.8	15.5	19.9	1.5
Elbow_Height_sitting	12	15.5	14.6	13.0	18.4	2.0
Popliteal_height_sitting	12	30.4	30.5	27.0	35.0	2.3
Thigh_above_seat_height	12	8.9	9.1	7.1	10.4	1.0
Knee_height_sitting	12	36.6	35.9	32.9	41.8	2.5
Arm_length_sitting	12	23.8	23.6	21.0	28.8	2.0
Foreoarm_length_sitting	12	19.3	18.9	17.8	21.7	1.3
Elbow_width_sitting	12	42.4	42.8	28.5	61.1	10.2
Width_sitting	12	25.1	25.5	20.7	29.0	2.2
Stomach_depth_sitting	12	16.6	16.8	15.1	17.7	0.9
Chest_depth_sitting	12	15.2	14.7	13.3	17.9	1.4
Popliteal_length_sitting	12	31.7	31.7	27.7	34.9	2.1
Knee_length_sitting	12	38.8	39.2	34.2	43.5	2.6

(source: own)

Table 2: **Junior school age 7 - 11-year-olds**

Aggregate statistics All children 7-11-year olds	**N**	**Average**	**Median**	**Minimum**	**Maximum**	**SD**
Mass	29	29.9	28.1	21.6	49.6	7.8
Height	29	134.6	135.5	121.4	149.4	8.1
Head circumference	30	52.0	51.6	48.4	56.3	1.9
Chest circumference	30	65.4	63.3	58.1	82.3	6.9
Eye line height	29	123.6	123.9	109.6	139.5	8.3
V_ac	29	108.3	108.7	94.5	122.1	7.4
V_sst	28	107.8	108.2	96.9	121.1	7.1
V_ra	28	83.5	83.5	73.1	95.3	5.9
V-elbow	27	81.0	81.5	70.2	93.4	5.7
V_iliospin	29	76.3	75.9	67.6	88.6	5.9
V_ti	29	38.1	37.9	33.4	43.0	2.8
V_sty	29	65.3	66.3	56.8	75.0	4.6
Hrud_sagit	30	14.7	14.7	12.3	19.6	1.6
Hrud_trans	30	21.8	21.5	19.1	26.4	1.9
Bicristal width	30	21.2	20.9	18.8	27.0	2.1
Biacrom_width	30	29.4	29.1	26.0	35.0	1.9
Bideltoid_width	30	33.6	32.3	29.1	40.8	3.5
Reach_grip	29	58.1	58.1	49.1	66.4	4.0
Elbow_grip	29	27.1	27.1	23.4	32.2	2.1
Arm_span	29	131.3	130.5	118.0	147.0	8.0
Height_sitting	29	71.0	70.8	64.1	78.1	4.1
Eye-line_height_sitting	29	59.1	58.3	53.2	66.9	4.3
Cervicale_height_sitting	28	48.9	48.1	43.3	54.9	3.5
Acr_height_sitting	29	44.3	44.9	39.5	50.8	3.2
Shoulders_height_sitting	28	18.9	18.8	14.7	24.7	2.3
Elbow_Height_sitting	27	16.7	16.4	11.2	21.5	2.2
Popliteal_height_sitting	29	33.5	33.5	29.0	38.0	2.1
Thigh_above_seat_height	29	10.2	9.9	7.9	13.9	1.6
Knee_height_sitting	29	41.4	41.9	36.7	48.8	3.0
Arm_length_sitting	28	27.0	27.1	23.9	31.3	1.8
Foreoarm_length_sitting	28	21.6	21.7	18.8	24.1	1.2
Elbow_width_sitting	26	49.1	48.1	27.7	73.3	11.4
Width_sitting	29	27.5	26.4	23.2	40.3	3.7
Stomach_depth_sitting	29	17.5	16.7	13.2	27.1	3.1
Chest_depth_sitting	29	16.8	16.2	13.9	22.3	2.4
Popliteal_length_sitting	29	37.1	36.9	32.0	44.0	2.9
Knee_length_sitting	29	45.0	45.1	38.9	52.8	3.6

(source: own)

Table 3: **Senior school age 11 - 15-year-olds**

Aggregate statistics All children 11-15-year olds	**N**	**Average**	**Median**	**Minimum**	**Maximum**	**SD**
Mass	41	51.0	45.9	29.1	96.1	17.2
Height	41	159.2	159.2	133.6	187.6	12.4
Head circumference	39	53.8	53.6	49.8	59.0	2.0
Chest circumference	38	79.0	77.3	59.5	106.5	11.8
Eye line height	41	148.5	147.7	123.2	176.7	12.4
V_ac	41	130.0	128.7	107.9	154.3	10.8
V_sst	41	129.5	129.5	108.1	154.7	10.7
V_ra	41	100.3	100.2	84.6	119.3	8.6
V-elbow	40	98.1	97.8	81.8	117.1	8.5
V_iliospin	41	91.5	90.4	76.7	107.8	7.4
V_ti	41	46.0	45.0	39.5	56.2	4.4
V_sty	40	78.1	77.4	65.0	92.0	6.8
Hrud_sagit	41	17.5	17.0	13.0	24.0	2.6
Hrud_trans	41	25.7	25.0	20.0	34.9	3.5
Bicristal width	41	25.3	24.5	19.9	35.4	3.6
Biacrom_width	41	34.5	34.0	29.0	41.0	3.3
Bideltoid_width	41	39.6	38.8	31.8	49.0	4.6
Reach_grip	41	67.8	66.5	54.2	81.7	6.0
Elbow_grip	41	32.1	32.3	25.2	37.2	2.8
Arm_span	39	158.2	156.8	132.0	188.0	12.6
Height_sitting	41	81.6	80.4	70.2	95.7	6.8
Eye-line_height_sitting	41	70.1	68.7	58.9	82.6	6.6
Cervicale_height_sitting	41	58.3	57.1	49.5	69.4	5.5
Acr_height_sitting	41	52.7	51.8	44.3	64.1	5.1
Shoulders_height_sitting	41	22.1	21.9	14.8	28.8	4.0
Elbow_Height_sitting	41	19.9	19.5	13.5	27.8	3.7
Popliteal_height_sitting	40	39.9	38.9	34.0	46.0	2.7
Thigh_above_seat_height	41	12.8	12.2	8.8	18.9	2.3
Knee_height_sitting	41	49.5	48.8	42.2	58.6	3.8
Arm_length_sitting	41	32.2	32.2	25.9	38.4	2.9
Foreoarm_length_sitting	41	26.1	26.1	21.2	31.9	2.4
Elbow_width_sitting	40	64.2	65.9	39.6	85.7	9.9
Width_sitting	41	33.8	33.4	25.3	47.3	5.5
Stomach_depth_sitting	40	21.3	20.1	16.9	32.8	4.0
Chest_depth_sitting	40	20.6	18.9	15.7	30.6	4.1
Popliteal_length_sitting	40	44.7	43.9	39.8	53.0	3.5
Knee_length_sitting	41	54.2	53.8	48.1	64.9	4.5

(source: own)

Table 4: **Teenagers 15 - 18-year-olds**

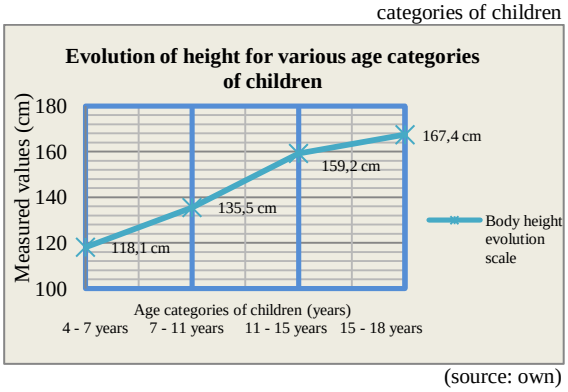
Aggregate statistics All children 15-18-year olds	N	Average	Median	Minimum	Maximum	SD
Mass	42	57.9	56.2	36.6	87.8	12.0
Height	42	168.5	167.4	153.8	192.3	8.4
Head circumference	42	55.2	54.9	52.0	61.0	1.8
Chest circumference	42	84.4	83.6	42.0	104.8	7.1
Eye line height	42	158.0	157.2	143.9	179.3	8.11
V_ac	42	137.6	136.7	124.0	157.8	7.4
V_sst	42	137.0	136.6	124.0	157.8	7.4
V_ra	42	106.7	106.4	96.4	125.1	5.9
V-elbow	41	104.3	103.8	93.7	124.4	6.0
V_iliospin	41	94.8	94.2	84.1	107.5	5.7
V_ti	41	47.4	47.2	41.2	52.9	2.9
V_sty	41	83.7	83.2	74.5	98.9	4.7
Hrud_sagit	42	17.7	17.1	13.8	26.7	2.9
Hrud_trans	42	26.4	26.7	15.2	35.0	3.4
Bicristal width	42	26.9	26.5	21.6	34.2	2.5
Biacrom_width	42	37.0	37.0	34.0	42.0	2.2
Bideltoid_width	42	41.9	42.0	36.2	51.3	3.5
Reach_grip	41	71.5	70.7	65.7	81.0	3.7
Elbow_grip	41	33.8	33.7	30.3	38.9	2.0
Arm_span	38	166.8	167.0	149.0	191.0	9.7
Height_sitting	41	88.1	87.5	80.2	102.3	4.2
Eye-line_height_sitting	41	76.6	75.7	68.5	87.6	4.0
Cervicale_height_sitting	41	63.6	63.1	56.4	74.0	3.4
Acr_height_sitting	41	57.1	56.5	50.7	67.3	3.2
Shoulders_height_sitting	41	25.5	25.5	19.4	30.4	2.4
Elbow_Height_sitting	41	23.6	23.2	19.4	29.5	2.3
Popliteal_height_sitting	41	40.6	41.1	34.0	50.0	3.0
Thigh_above_seat_height	41	13.5	13.3	10.5	19.7	1.8
Knee_height_sitting	41	51.3	51.6	45.2	55.9	2.5
Arm_length_sitting	41	33.7	33.6	30.0	39.0	2.1
Foreoarm_length_sitting	41	27.0	27.0	23.3	30.8	1.7
Elbow_width_sitting	39	65.3	67.0	41.3	87.5	10.1
Width_sitting	41	37.3	37.2	30.0	47.4	4.4
Stomach_depth_sitting	40	20.8	19.8	15.4	28.4	3.0
Chest_depth_sitting	41	22.6	22.4	18.5	30.4	2.8
Popliteal_length_sitting	41	47.6	47.2	42.3	54.2	2.7
Knee_length_sitting	41	57.4	57.7	50.4	64.4	3.1

(source: own)

The measurements are taken by the Institute of Anthropometry of the Faculty of Natural Sciences, Masaryk University, under the leadership of Mgr. Martin Čuta, Ph.D.

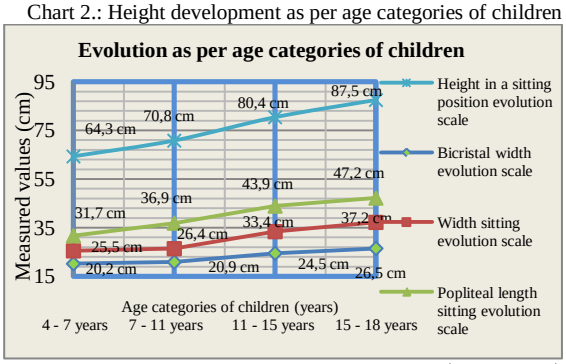
Based on the ongoing measurements, requirements are stipulated for children furniture as well as dimensional requirements. As regards the priorities, these concern sitting, working (school) and bed furniture for children.

Chart 1.: Development of somatic dimensions as per age categories of children



(source: own)

Chart 2.: Height development as per age categories of children



(source: own)

The MKF paper notes it is not only ethical and moral but also cost efficient to objectively and as soon as possible evaluate the functioning capacities of patients following diseases, injuries or inborn defects and restrict or mitigate their disability by physiotherapy. In the event the defects persist, the people concerned must be given an opportunity to lead a dignified life and optimally integrate them into society. National Council of People with Disabilities Czech Republic, 2010). The same applies to children and their disabilities. In our opinion, we have the obligation to offer to them not only in the school environment, standard school furniture that will optimally integrate them into the group of their peers and will not pose barriers in regular usage.

6 Conclusion

The selected issue discussed by the paper is in accord with Oliver Speck (1991 in Horňáková, 1999, p. 30), who notes that "*everyone lives in a real environment as its integral part*" The quote corresponds to the new theories of treatment and education (a term coined by Dannemann, Schober and Schulze, 1911), it is based on anthropology, namely its object of study, which was and is in accordance with the investigation carried out and described by the originators of the text in the previous chapters. Generally, the issues of treatment and education form a part of the current attempts at integrating its area of expertise, which defines it, into Czech special education, for which the knowledge obtained by the former become an added value in terms of building a higher-quality environment for individuals and the society with varying degrees of disability. The facts described form a part of a broader discussion which is connected with integration and, ideally, inclusive reception of such excluded individuals (pupils and students) in full-fledged social life (including the school environment). The discipline referred to above mainly focuses on the ecological factors, where it points to the importance of dealing with the variables, in this case the

furniture parameters in relation to children anthropometry, where their true knowledge is an undisputed factor in the healthy development (growth) of individuals and forms conditions for the successful implementation of the said societal processes, which is supported by the National Action Plan for Inclusive Education of 15 March 2010, which is compatible with (Government Resolution no. 1046) Health 21 - Long-term programme to improve the health state of the population of the Czech Republic – Health for everyone in the 21st century. (Government of the Czech Republic, discussed on 30 October 2002).

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Primary Paper Section: J

Secondary Paper Section: JP, AM, FS