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# Assessment of hypermobility and muscular stiffness in children of younger and older school age

Key words: functional test, locomobility, muscular imbalance, muscular stiffness, hypermobility.

**Abstract**

Functional locomobility test — deep forward bend, called Thomayer test, was used to assess the hypermobility and muscular stiffness in a set of 1,198 children aged from 7 to 15. From the results of functional test it followed that 31.1% boys and 14.9% girls show signs of muscular stiffness and 7.1% of boys and 14.7% girls have increased articular locomobility. Functional locomobility test further indicated the occurrence of muscular imbalance in children, which affects adversely the posture and general physical fitness of the children.

## Ocena nadmiernej ruchliwości i zesztywnienia mięśni u dzieci w niższym i wyższym wieku szkolnym

Słowa kluczowe: badanie sprawności, poruszanie, nie wyważenie mięśni, zesztywnienie mięśni, nadmierna ruchliwość.

## Introduction

Defective posture is the question of muscular imbalance which may result, on one side, from muscular stiffness, i.e. contracted muscles, on the other side it may be manifested by hypermobility, i.e. increased articular locomobility in spine and all body joints. Both extreme conditions, passing over the increased locomobility e.g. in certain types of sports or in acrobats, which require specific motor dispositions and the like, are not desirable conditions for proper posture and, as a consequence, numerous functional defects may develop. Reduced locomobility caused by muscular contraction may cause increased pressure in the given joint and surrounding tissues, after years it is manifested by pain or

inability to perform certain movement, and in the worst case by structural changes already. Similarly, hypermobility as an increased articular locomobility brings numerous problems within the supportive motor system in a form of degenerative changes in relevant segments, as indicated by Rychlíková [11], Lewit [6] and others. According to Tichý [13], stiff people are a little better off than the hypermobile ones because stiff muscles keep the spine and joints together quite well; these are then less prone to functional defects.

It is the objective of the presented partial study to assess the trunk flexibility in children by means of a functional test and to assess the condition of contracted postural muscles on the back side of trunk (trunk erectors), lower limbs (muscles on the back side of thigh and calf) and hypermobility level (fibrous insufficiency).

This study is a result of a partial research realised in terms of research scheme "Research of somatic and psychic conditions of population in the Czech Republic with applications in anthropagogy, pedagogical psychology, clinical anthropology and ergonomics" for the period from 1999 to 2003, investigated by the Department of Anthropology and Hygiene, Teachers Faculty, Palacký University in Olomouc.

## Methodology

The research set includes 1,198 probands (621 boys and 577 girls) aged from 7 to 15. The research took place at seven elementary schools in the Olomouc region in 2001 and 2002. The assignment of probands into age groups from 7 to 15 years was determined according to IBP principles in tenths of year according to Weiner [15] and WHO classification within the yearly range (e.g. 10 years old children: age interval from 10.00 to 10.99 years).

The functional as indicated by Tichý [13], which in this country is usually called Thomayer test, was used to test the locomobility. It is one of the multiple tests used in functional diagnostics of locomotion system to determine hypermobility or muscle stiffness. It is a certain disadvantage of this test that several muscle groups are tested simultaneously — trunk erectors and extensibility of hamstring muscles. Tichý [13], Lewit [6], and Krištofič [3] recommend that, in order to distinguish the condition of postural muscles in the said areas, a sitting position be used for autonomous trunk anteflection and the "Lasegue test" be used for assessment of the back muscles of lower limbs. In spite of the drawback mentioned above, the deep forward bend had been chosen as a locomobility test with regard to its universal application and because it is the most simple indicator of flexibility.

Before the locomobility test, each proband would perform standard and simple warming-up by means of three to four simple forward bends. The warming-up was performed while standing on the floor.

The locomobility test itself was performed as follows, as indicated in Figure 1. The proband stood on elevated surface (box), took the connecting stand (parallel feet, touching each other, foot tips on the edge of the box). After taking the basic position, the proband stretched his arms upwards and gradually bent. Legs had to remain stretched in knees. The examiner checked the stretching of knees by palpation, holding the probands knee with his thumb placed on patella and the other fingers in poples. If the proband bent his knees during the test, the test was invalid and a new attempt was made.

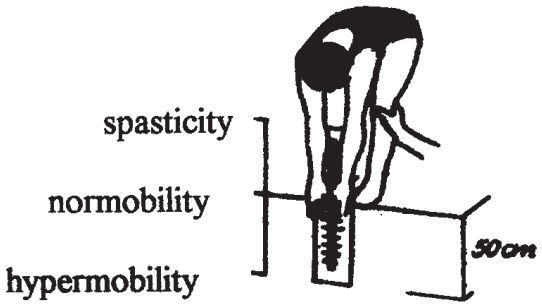


**Figure 1.** The locomobility test

Based on depth of the forward bend and reach of dactylion — plate, where the proband had to stay in the extreme position for at least 2 seconds, the probands were further divided into three groups within their age groups, as indicated by Tichý [13], Rozkydal [10], Krištofič [3] and Pernicová [7]:

The first group indicated as normobility consists of individuals with normal locomobility range, i.e. those whose fingers touched the plate or their fingers were at the distance less then 10 cm from the plate. Hypermobility — the second group featuring reduced muscle tonus and increased articular range; they reached the plate level by palms of their hands or lower; and the last, third group indicated as spasticity consisted of individuals, in which muscular stiffness was determined, which was manifested by reduced locomobility range; they were unable to reach the plate and the distance of their fingers from the plate exceeded 10 cm.

## Results and discussion

Assignment of probands into groups according to frequency and percental representation based on the standard of this functional test is specified in Table

1, 2 and Chart 1, 2. From the result of locomobility testing it was determined that 61.8% boys and 70.4% girls belong to the normobility group. These are probands with normal motor range featuring physiologically correct balance of muscular tonus on the backside of trunk and lower limbs.

A significant sexual dimorphism is obvious in evaluation of spasticity and hypermobility. It was determined according to the locomobility test that spasticity was determined in 31.1% boys and 14.9% girls, which was manifested by muscular stiffness in a form of reduced motor range in deep forward bend. An opposite situation is in the hypermobility group, where approximately 7% girls feature higher hypermobility than boys. In this group there are 7.1% boys and 14.7% girls, in which reduced muscular tonus was determined, which is manifested by increased articular locomobility. The said 7% difference in proportion of boys in the hypermobility group as compared with girls is probably caused by intersexual, morphological functional differences between boys and girls in this age period. In the period of pre-pubertal and pubertal age, higher locomobility is manifested more significantly in girls than boys.

**Table 1.** Evaluation of locomobility in boys

| Age | n | spasticity | | normobility | | hypermobility | |
|---|---|---|---|---|---|---|---|
| | | n | % | n | % | n | % |
| 7 | 67 | 25 | 37,3 | 41 | 61,2 | 1 | 1,5 |
| 8 | 64 | 18 | 28,1 | 44 | 68,8 | 2 | 3,1 |
| 9 | 64 | 19 | 29,7 | 43 | 67,2 | 2 | 3,1 |
| 10 | 83 | 27 | 32,5 | 54 | 65,1 | 2 | 2,4 |
| 11 | 73 | 20 | 27,4 | 51 | 69,9 | 2 | 2,7 |
| 12 | 78 | 27 | 34,6 | 48 | 61,5 | 3 | 3,9 |
| 13 | 68 | 28 | 41,2 | 34 | 50,0 | 6 | 8,8 |
| 14 | 67 | 16 | 23,9 | 37 | 55,2 | 14 | 20,9 |
| 15 | 57 | 13 | 22,8 | 32 | 56,1 | 12 | 21,1 |
| Total | 621 | 193 | 31,1 | 384 | 61,8 | 44 | 7,1 |

In spite of these intersexual differences there are obviously certain common features in development of dynamics of this motor capacity. From the results of functional locomobility test it is obvious that with gradually growing age between 7 and 15 years natural increase of articular locomobility develops both in boys and girls. This knowledge is based on the fact of progressively decreasing percental proportion of individuals with spasticity in the period of pre-pubertal and pubertal development and, on the other hand, the increasing proportion of individuals with increased locomobility in both sexes in this period of ontogenetic development.

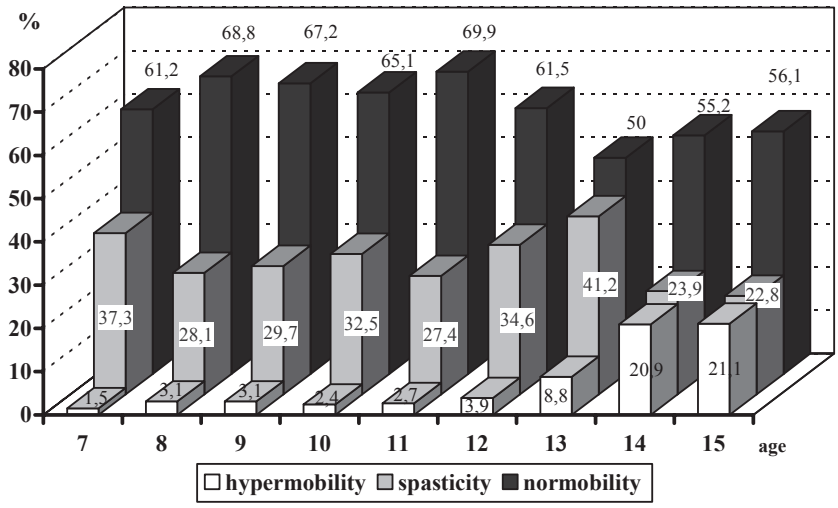


**Chart 1.** Evaluation of locomobility in boys

**Table 2.** Evaluation of locomobility in girls

| Age | n | spasticity | | normobility | | hypermobility | |
|---|---|---|---|---|---|---|---|
| | | n | % | n | % | n | % |
| 7 | 65 | 10 | 15,4 | 52 | 80,0 | 3 | 4,6 |
| 8 | 71 | 13 | 18,3 | 56 | 78,9 | 2 | 2,8 |
| 9 | 65 | 12 | 18,5 | 49 | 75,4 | 4 | 6,1 |
| 10 | 63 | 13 | 20,6 | 47 | 74,6 | 3 | 4,8 |
| 11 | 70 | 16 | 22,9 | 52 | 74,2 | 2 | 2,9 |
| 12 | 76 | 8 | 10,6 | 53 | 69,7 | 15 | 19,7 |
| 13 | 65 | 5 | 7,7 | 39 | 60,0 | 21 | 32,3 |
| 14 | 42 | 3 | 7,1 | 27 | 64,3 | 12 | 28,6 |
| 15 | 60 | 6 | 10,0 | 31 | 51,7 | 23 | 38,3 |
| Total | 577 | 86 | 14,9 | 406 | 70,4 | 85 | 14,7 |

From the monitoring of dynamics of locomobility development in both sexes it is obvious that the locomobility naturally increases especially within the range from 10 years in girls and a little bit later in boys up to 15 years, i.e. in the period that is very favourable for development of locomobility, as indicated by Choutka [1], Pernicová [7], and Kučera [4, 5].

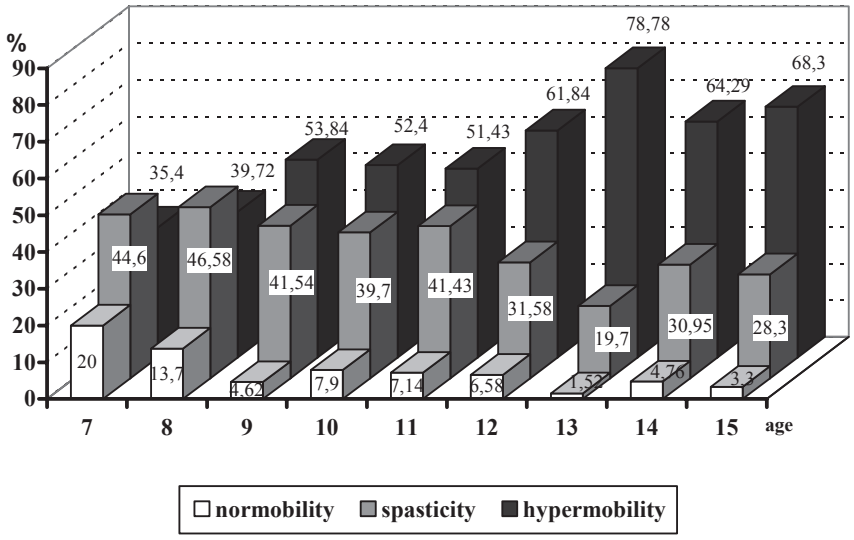


**Chart 2.** Evaluation of locomobility in girls

For the educational, physical-training and couching practice it is necessary to keep in mind that the skeletal system grows quickly in this period, but the muscular strength (back and abdominal muscles) and ligamentous and fibrous strength does not increase at the same rate, nor is the skeletal maturation accelerated. Srdečný [12], Kučera [4] and others note that for girls it is just the period of age from 11 to 13 and for boys approximately two years later, when the biggest increase of spinal defects occurs (m. Scheuermann, m. Osgood-Schlatter); these defects may be caused by overload of static and dynamic character in this period of development, with subsequent pathological adaptation.

Getting back to the functional evaluation of locomobility range in our probands and taking into account the test standard of the Thomayer test as indicated by Tichý [13], Pernicová [7], and Rozkydal [10] we can do the following conclusions based on examination of locomobility in boys and girls: only 61.8% boys and 70.4% girls are within the standard category from the point of locomobility, but 38.2% boys and 29.6% girls report a non-physiological locomobility range in the sense of either muscular stiffness or reduced muscular tonus.

The results of functional test as presented here confirm the conclusions of Riegerová [9], Přídalová [8] and Vařechová [14] as to high occurrence of muscular imbalance and relating high occurrence of postural defects in current children and youth in the Olomouc region.

## Conclusion

Locomobility is mostly considered a separate motor capacity and its significance from the medical point of view is primarily preventive. It followed from the results of the presented study that 34.1% children in pre-pubertal and pubertal period lack the optimum locomobility of supportive motor system. The most startling fact is a relatively high percent of children, in which muscular stiffness and hypermobility was diagnosed, which is manifested by inadequate motor range. The functional test further indicated that there is a large number of children with symptoms of muscular imbalance, which in its specific form is manifested by defective posture.

The described sombre condition of the supportive motor system of current children and youth reflects the growing and by the civilization-conditioned contrast between growing demands for the children's mental activity and decreasing physical load, hypokinesis, which is also reflected in their general fitness. If today approximately 70% of the adult population is reported to suffer from vertebrogenous failures, the main cause is deemed to the muscular imbalance, the manifestation of which starts as soon as in early childhood.

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