Study on the strength development level in children with Down syndrome

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Abstract

Children diagnosed with Down syndrome can live an almost normal life if they benefit from appropriate care and the application of specialized intervention programs. Among the clinical features encountered in these children, we can mention the deficit in strength that affects them at different degrees. This study valorizes the results obtained in the initial testing – five strength-related items – by the three children with Down syndrome included in a post PhD research. This paper is made and published under the aegis of the National University of Physical Education and Sports from Bucharest, as a partner of program co-funded by the European Social Fund within the Operational Sectorial Program for Human Resources Development 2007-2013 through the project Pluri- and interdisciplinary in doctoral and post-doctoral programs Project Code: POSDRU/159/1.5/S/141086, its main beneficiary being the Research Institute for Quality of Life, Romanian Academy.The performances of our subjects are compared with the arithmetical mean of the results obtained in the initial testing by V. Şuţă (2010), on pupils (boys and girls) of the same age as our subjects – 13 years old. Finally, we drew the conclusion that the subjects of our study seldom reached and/or exceeded the data taken as a reference.

***Key words**: special motricity, children with Down syndrome, strength, initial testing, reference value*

Rezumat

Copiii diagnosticaţi cu sindromul Down pot duce o viaţă aproape normală dacă beneficiază de îngrijirea adecvată şi de programe de intervenţie specializate, aplicate timpuriu. Dintre caracteristicile clinice pe care le întâlnim la aceştia se numără şi deficitul de forţă care-i afectează într-un grad diferit. Studiul valorifică rezultatele obţinute la testarea iniţială – cinci itemi de forţă, de către trei copii cu sindrom Down cuprinşi într-un proiect de cercetare postdoctorală. Acest studiu este elaborat şi publicat sub egida Universităţii Naţionale de Educaţie Fizică şi Sport din Bucureşti, ca partener în programul co-finanţat de Fondul Social European prin Programul Operaţional Sectorial pentru Dezvoltarea Resurselor Umane 2007-2013, dezvoltat prin proiectul Pluri- şi interdisciplinaritate în programe doctorale şi postdoctorale, Cod proiect: POSDRU/159/1.5/S/141086, al cărui principal beneficiar este Institutul de Cercetare a Calităţii Vieţii, Academia Română. Performanţele realizate de subiecţii noştri sunt comparate cu media aritmetică a rezultatelor obţinute la testarea iniţială de V. Şuţă (2010) pe elevi (fete şi băieţi) de aceeaşi vârstă cu subiecţii noştri – 13 ani. În finalul, am ajuns la concluzia că subiecţii studiului ating şi/sau depăşesc rar datele luate ca referinţă.

***Cuvinte cheie**: motricitate specială, copii cu sindrom Down, forţă, testare iniţială, valoare de referinţă*

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Introduction

Strength is the motor quality necessary to perform any motor act, no matter how simple or complicated it is. This statement is supported by specialty studies that have confirmed that no movement can be performed without strength, the inappropriate development of this quality making impossible the construction and consolidation of motor skills.

Strength is "the body's capacity to overcome an internal or external resistance through a muscular contraction" (1). Being a conditional motor quality, it is influenced by a series of factors, among which we mention (2, 3, 1 and 4) age and gender. Strength preparation in children (particularly during the intense growth periods) is developed with some restrictions, due to their morphofunctional particularities. But after puberty, strength preparation gets more importance, being integrated into the development system of the other qualities:

- number of muscle fibers working at a certain moment – the greater the number of muscle fibers used in an action, the more the strength necessary to perform the respective movement tends to reach its maximum value. When performing a strength effort, a smaller or greater number of muscles and fibers contract, depending on the effort difficulty;
- muscular thickness (cross-section area) – the strength of a muscle depends on its thickness and is proportional with its cross-section area. The greater the cross-section area of a muscle, the greater the strength it can develop;
- the quantity of energy sources possessed by the muscle and the enzymes that facilitate burning;
- continuity of the instruction process;
- diurnal (circadian) rhythms – within 24 hours, strength has oscillations mainly determined by the rhythms of the other body's functions, which is also reflected by the muscle activity. Maximum strength can be achieved between 9:00 – 10:00 a.m. and 6:00 – 7:00 p.m.; minimum strength is manifested between 4:00 – 5:00 a.m.;
- structure of the muscle fiber – it refers to the muscle composition, from the point of view of the quantitative ratio between phasic and tonic fibers, the muscle which is richer in phasic fibers being more apt for the strength effort;
- the degree of muscle stretch and elasticity – the muscle stretches through a resistance-type contraction that produces the motor-type contraction;
- frequency of the lessons focused on strength development – long-duration contractions facilitate a faster growth in strength than those lasting 2 to 3 seconds;
- quality of ligaments and of support segments – respectively, of the osteoarticular system. This is a mechanical factor of resistance against stretch, bending, torsion, pressure, friction etc. existing in bones and joints;
- the angular value of working segments and the muscle length;
- psychic factors – motivation, emotional states, attention focusing and, in some situations, will (endurance strength);
- the development level of other motor qualities involved in performing the strength action, especially speed, endurance and suppleness.

As to its manifestation forms, strength benefits from numerous systematizations: maximum or absolute strength, explosive strength, endurance strength (4), dynamic strength and static strength (5) etc.

Down syndrome is a genetic chromosomal disorder affecting about 1.5 out of 1,000 new-born children (6). This is caused, in most cases, by the existence of a third copy of chromosome 21.

Although this syndrome is an illness that can't be healed, the children born with it can live an active life if they benefit from appropriate care and the application of specialized intervention programs.

Children with Down syndrome present a deficit in the development of their psychic functions, accompanied by disorders in their somatic develop-pment and by injuries in their central nervous system. Associated to mental retardation, children with Down syndrome display "more than 80 clinical features" (7). Among them, we can mention a low level of their strength development. Hypotonia affects each child at a different degree. In some cases, the effect is minimal, while in other cases, it is very pronounced.

The increase in muscular strength is important, because these children compensate the deficit of this motor quality by using some easier movements, but which affect over time the body's general alignment. That is why, within the complex intervention program, "the exercises used will aim to increase the muscle tone and to reduce the joint hypermobility" (7). At the same time, strength development contributes to the stimulation of some skills that the child can use in his daily life and that can facilitate his integration into family and society.

Purpose

This study valorizes the results obtained in the initial testing – five strength-related items – by the three children with Down syndrome included in a research project.

Hypothesis

The strength indices of children with Down syndrome are situated around the data/ values taken as a reference in the specialty literature.

Material and method

To achieve our study, we used five strength-related items included in the Brockport test battery, which was adapted, modified and validated through research conducted by Şuţă (8) on mentally retarded pupils. The assessed test items were the following: supine pushups, which consisted of pushing upwards a 15.9kg weight from the chest level, at an imposed pace; holding the prone position with anterior support on palms, forearms stretched on arms at 180º, arms bent at 90º in the scapular-humeral joints; holding the hang position on the pull-up bar, arms bent at 180º in the scapular-humeral joints, forearms stretched on arms at 180º, palms in prone position; holding the hang position on the pull-up bar, forearms bent on arms, palms in supine position; trunk bending from prone position, thigh bent in the coxofemoral (hip) joints, shanks bent at 90º on thighs, soles on the support area.

The content of these items was performed by the children with Down syndrome included in our study, within their initial testing. The results achieved were compared with the arithmetical mean of the results obtained in the initial testing by Şuţă (8), on pupils (boys and girls) of the same age as our subjects – two boys (S1 and S3) and a girl (S2) with Down syndrome, aged 13 years.

Our entire approach aimed to identify the strength development level of some muscle groups in the children with Down syndrome involved in the above-mentioned project. The results obtained in strength assessment, correlated to other data collected after the assessment of the other motor qualities, represented the starting point in designing the intervention on the subjects included in our project.

Besides the assessments performed on the basis of the Brockport battery items, we also used in our study the comparative analysis of the available data.

Results

After the initial testing and the comparison of the data obtained by our subjects with the arithmetical mean obtained by Şuţă (8), we arrived at the results presented in tables I to V. In order to facilitate their understanding, we mention that, in the first column of each table, we displayed the mean of the results achieved by Şuţă (8) in the initial testing of pupils (boys and girls) aged 13 years:

Table I. The test for supine pushups – to push upwards a 15.9kg weight from the chest level, at an imposed pace

Şuţă (2010)	Result S1	Result S2	Result S3
3.2 repetitions	0 repetitions	0 repetitions	0 repetitions

Following the available data analysis, we could notice that none of the subjects of our study had succeeded in pushing the weight from the chest level. These results indicated us a very low strength development level in their pectoral and triceps brachii muscles.

Table II. The test for holding the prone position with anterior support on palms, forearms stretched on arms at 180º, arms bent at 90º in the scapular-humeral joints

Şuţă (2010)	Result S1	Result S2	Result S3
17.30 seconds	18 seconds	10 seconds	15 seconds

The results obtained by our subjects encompass the reference value (according to Şuţă, 8). Thus, we can notice that subject S1 achieved in his initial testing a value exceeding by 1 second that of the reference group. Subject S2 managed to hold the position with 7.30 seconds less than the reference value and S3 managed a better holding, his result being with 13.3% lesser than the value obtained by the pupils tested by Şuţă (8).

Table III. The test for holding the hang position on the pull-up bar, arms bent at 180° in the scapular-humeral joints, forearms stretched on arms at 180°, palms in prone position

Şuţă (2010)	Result S1	Result S2	Result S3
11.20 seconds	25.09 seconds	0 seconds	0 seconds

From the result analysis, we can notice that the results obtained by S1 are clearly higher than the reference value. Unlike him, S2 and S3 don't succeed in holding the position even for one second. We should mention that S3 hasn't been focused enough at the test recording, but he could hold the position when he was shown what he had to do.

Table IV. The test for holding the hang position on the pull-up bar, forearms bent on arms, palms in supine position

Şuţă (2010)	Result S1	Result S2	Result S3
1 second	6.63 seconds	0 seconds	0 seconds

In this test, too, S1 has a much better initial value than the group of pupils taken as a reference. S2 and S3 don't succeed in holding the testing position.

Table V. The test for trunk bending from prone position, thigh bent in the coxofemoral (hip) joints, shanks bent at 90° on thighs, soles on the support area

Şuţă (2010)	Result S1	Result S2	Result S3
23.9 repetitions	24 repetitions	0 repetitions	25 repetitions

Data analysis showed us that the result obtained by S1 was similar to the result achieved by the control group and that S3 even managed to exceed it. Unlike them, S2 didn't succeed in performing any repetition.

Discussions

From the results achieved in the initial testing by the subjects involved in the present study, we can conclude that they have a different strength development level. S1 has a good strength level, as compared to the reference group. This assertion is based on the results obtained in the five tests performed by him.

We can't say the same thing about the other two subjects of our study. S2 has a very low strength development level. The investigated girl managed to perform only the test addressed to "the upper body" (8) – item 2, table II. But even in this test, the result obtained by her is more than 42% below the mean of the results proposed by Şuţă (8). In the other tests, she wasn't able to perform any repetition or to hold the position that had to be adopted. That is why we can state that this subject has a very low strength level.

As to the third subject (S3), his results are very different. Thus, he obtained good results in two tests and null results in the others. We also noticed his lack of concentration in the key-moments – item 3: the test for holding the hang position on the pull-up bar, arms bent at 180° in the scapular-humeral joints, forearms stretched on arms at 180°, palms in prone position. His failure in the case of this item wasn't due to the fact that he couldn't perform it, but to the fact that he hadn't been focused enough.

Conclusions

Children diagnosed with Down syndrome can live an almost normal life if they benefit from appropriate care and the application of specialized intervention programs.

Strength is a motor quality that can and must be developed in children with Down syndrome. Increasing the indices of this quality is very important, because it enables them to solve with much more easiness the daily activities and, on the other hand, to hold the position of their body both at rest and while moving.

Children with Down syndrome have a low muscle strength that can and must be improved through practice.

The results obtained by the subjects included in our study seldom reach and/or exceed the data taken as a reference.

All the results achieved through this study represent the starting point of the intervention that we are to have on the three subjects. The intervention will have an impact on their bio-psycho-social level and will valorize the means rendered available by swimming, as a sports discipline. All over the duration of our intervention, we shall have in view that strength manifestation is closely related to endurance in the water environment, with direct effects on the learning, consolidation and improvement of specific motor skills.

Conflict of interests

None. We have agreements signed by the parents of children with Down syndrome involved in our study to use and publish the results.

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