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OBSAH

INCLUSION IN EXPERIENTIAL EDUCATION AS A STRATEGY FOR WORKING WITH DIFFERENTNESS

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This paper focuses on the concept of differentness and the unique needs of persons with disabilities and the ways how this concept can be used in the educational environment. At first we focus on the general concepts of differentness and equal opportunities from the perspectives of the Olympic ideals of amateurism and from the point of view of the International classification of functioning and disability of WHO (2001). Later we discuss the meaning of the term inclusion from the historical perspective and from the point of view of the theoretical approach of two central/eastern European authors (Jesenský, 1998; Vítková, 1999). Finally we explore the potential of experiential education programs in understandning differentness and enhancing full inclusion. We provide specific examples of programs and activities which can help to enhance the inclusion of persons with disabilities in the educational environment.

Keywords: Differentness, integration, inclusion, disability, experiential education.

THE RELATIONSHIP BETWEEN DIFFERENTNESS AND TRANSCENDENCE

Differentness was not always a controversial topic. The problem of the one and the many, identical and different, appears to be a fundamental problem in the history of thought. Differentness of beings can be seen not only through their shapes, but also in their backgrounds. Contexts allow us to gain deeper levels of understanding of beings and phenomena. On the other hand, to what point can we talk about unique identity, or about differences? About what differences are we talking? Do we mean differences in shapes, sizes, or differentness in transcending the actual world?

How can we look at disability from the perspective of difference, especially in the area of physical activities and sports? Certainly we could think of differentness in sport in simplistic terms – using scales such as: better–worse, slower–faster, lower–higher, etc. There are different modes of differences and how we use them in this postmodern time is truly essential. Are differences of shapes, sizes, or abilities really something so important? Human life cannot be averaged or generalized. The way of being is always the unique being of a given person, not general animal being. From this perspective, we should not look at disability as something escaping the norm or average (Titzl, 2000). Disability is only one of many types of differentness. Every human is in a way different, specific, and unique. Do all people, regardless of their (dis)abilities have equal opportunities for their own authentic existence?

EQUALITY OF OPPORTUNITIES IN SPORT

The idea of fairness and equal opportunities, construed literally, would be extremely idealistic and even utopian. Equal opportunities would be possible only if all people were born to be identical. Every human being is different from biological, psychological, social and spiritual perspectives. Inequalities exist, differences are natural, and not all inequalities are morally problematic. The principle of equal opportunities could therefore only require eliminating those inequalities which could in turn unfairly advantage those whose physical and psychological dispositions are comparable. Inequality is a typical characteristic of competitive sport, where the principle of difference is used to compare individuals and their differences. The purpose of competition is to find and show differences (inequalities) among athletes or teams. There are winners and losers; we must ask important questions about what justifies the differences (Földesi & Földesi, 1990). It is relatively easy to provide formal access to sport to athletes regardless of their nationality, traditions, or cultural conditions or to eliminate the effects of their personal characteristics (gender, weight, or different kinds of disability). In disability sport, athletes compete in groups (classes) according to their functional abilities. In team sports, athletes have been assigned specific points so that athletes with more severe disabilities would have access to these team sports (i.e. basketball, rugby, volleyball, amputee hockey). What is much more difficult is to change inequalities in material resources (unequal economic conditions

affecting access to equipment and facilities). This is even more evident in disabled sport, where advances in technology allow athletes to take part in a variety of sport activities, but this special equipment (prosthetics, wheelchairs, tricycles) is very expensive and inequality in necessary equipment means unfair disadvantages to some athletes. Only if all athletes have comparable material conditions, would competition be solely affected by differences among athletes (talent, abilities, skills and training).

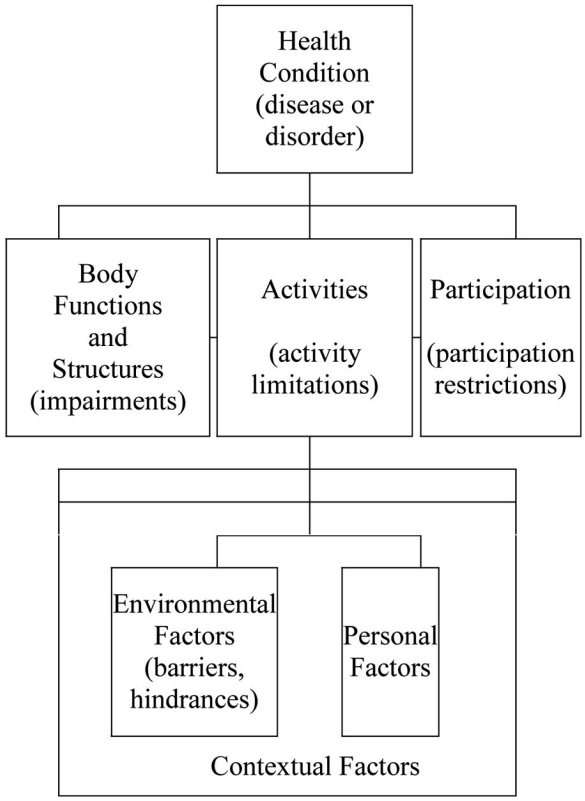
The solution to inequality of opportunity in sport was meant to be the ideal of aristocratic principles and elitism expressed as conditions for total amateurism. A precondition of amateurism (equal opportunities with the assumption of mutual respect characterized as *fair* play) is a certain kind of stratification, specifically material stratification. Only athletes with a sufficient amount of financial resources and available leisure time (in other words: aristocracy practicing sport for its own values) had the opportunity to take part in amateur sports. Purely amateur sports have become far less viable, and the difficulties of defining differences between amateur and professional have become more acute. Therefore the requirement of amateur status was removed from the Olympic games and became history as of 1981. Certainly this situation is very undemocratic as the winner can only be the one, who is professionally paid for the whole time of preparation. The issue of equal opportunities thus no longer is the real value to be fulfilled. Inequalities in access to resources, rehabilitation, finances (including equipment) are undoubtedly examples of sport inequalities, which can also be called "sport apartheid" (Lipiec, 1988). We can today, similarly to the time calling for the values of amateur sports, think about equalities more on a formal level, but most likely not in actual real practice.

DIFFERENTNESS AND DISABILITY FROM THE VIEW OF EQUAL OPPORTUNITIES

Many people would believe that disability is a limiting factor, which hinders equal opportunities to participation in life activities and self actualization. In this part we will discuss the recent model of the World health organisation and try to explain equal opportunities with the use of this model (Fig. 1).

According to WHO (2001, 12): *"Impairments are problems in body function or structure as a significant deviation or loss."* According to Sherrill (2004) disabilities are explained by ICF as: *"Activity limitations. These must be severe enough to interfere with activities of daily living (ADL) like eating and dressing, general education, employment, communication, mobility, and the like."*

Fig. 1
The l CF model of human functioning and disability – World Health Organization (2001)



One of the unique contributions of ICF is that it focuses on the important role of "contextual factors" (personal and environmental, see Fig. 1). Impairments might create some sorts of limitations in activities and restrictions in participation. With modern technological advancements, access to transportation and public buildings is enhanced and restrictions are reduced. Thus greater participation and more equal opportunities are possible. This is true particularly among societies and persons with higher socio-economic status. In turn, greater participation in activities creates greater opportunities for learning social behaviors and interaction among persons with and without disabilities. Personal factors (Fig. 1) are features of the individual that are not part of health conditions or impairment. These might be gender, height, race, fitness, character style, sense of humor, charm, etc. These personal factors can sometimes be more important than the sole fact that one has some kind of impairment. On the other hand many people still hold negative attitudes toward persons with disabilities, but we will discuss this problem later.

INCLUSION VERSUS SEGREGATION (FROM ANCIENT GREECE TO MODERN TIMES)

Inclusion is a relatively modern term meaning different forms of being together, unifying, cohesion or even harmonious connection. Unity created in this way is internally heterogeneous, it is a prerequisite of a truly firm union of different parts in respect to differences, tolerance of uniqueness, and perception of differentness as an opportunity for enrichment.

What could we imagine under this term "inclusion"? Is inclusion identification or becoming the same? Most definitely not. A person who uses a wheelchair is not identical to a person walking on his/her own feet. Is it coequality? From the perspective of the legislature we are all equal, but are civic rights used in the same way by one who is blind and by one who can use sight to his/her advantage? Is inclusion assimilation? If yes, should immigrants assimilate to the culture of their new country or should they try to adjust their new environments and enrich them with new cultural meanings? Is inclusion full inclusion? Could then minorities (a different ethnic, racial, religious, educational or political background, socioeconomic status, sexual orientation or different abilities – unique needs) lose something of their uniqueness? Is such full inclusion really possible? Without clear definition and common understanding, how can we discuss this process of inclusion or integration?

We can not even think about the inclusion of people with disabilities in ancient Greece, where children born with disabilities reportedly were left in the Tayget mountains or killed. Their society, build on fitness as a virtue, did not perceive the personal value of every human and his/her life.

On the other hand we can find in Greek mythology the example of coexistence of the major community and someone with a disability, namely with the god Hefaistos (Hephaestus). The Greek god Hefaistos, the god of fire and the blacksmith's craft, and the son of Zeus and Hera, was so ugly and weak that Hera threw him as weakling off the mountain of Olympus. The other goddesses saved him and brought him up. When Hera saw the beautiful jewel which he made for her, she arranged a blacksmith workshop for him right on mount Olympus. Although the gods laughed at him as a limping cripple, it was Hefaistos who build their palaces in Olympus, made the armor for the hero Achilles, and also made Pandora the woman who brings evil to people (as the punishment for Prometheus' gift of fire to people). Hefaistos (Hephaestus) was worshipped as the patron of craftsmen, and up till modern times serves as an example of the value of the life (hopefully also human life), lived not in the view of being different, but from the point of view of activity and work.

Regardless of this unique example of inclusion the ancient era is regarded as an age of repression, when people with disabilities were driven by the existential needs of society. At this time people were either killed or put aside by society. Under the later influence of religion, mostly Christianity, the attitude of society toward basic human values changed. Among the main principles of Christianity were: a) you shall not kill; and b) you shall help others. In medieval times many hospitals and institutions for the disabled were built to provide for their basic needs. Kábele (1992) called this time the "era of charity care" which was followed by the "era of humanistic care".

The next stage in the development of society in relation to persons with disabilities was the "era of rehabilitative and preventive care" (Kábele, 1992), which can be characterized by long lasting preparation of persons with disabilities for occupation and social inclusion. In the Czech Republic this era is represented by Dr. Rudolf Jedlička, who has created a very precise system of comprehensive rehabilitation (medical, educational, occupational, legislative, economical and social). The goal of this care was to include people with disabilities in society and prepare them for an active and productive life style. The negative aspect of this era was that people with disabilities were being prepared for inclusion outside of mainstream society.

The current phase of care for persons with disabilities is often called the "inclusive era" (Jesenský, 1998; Vítková, 1998, 1999) and is characterized by the effort to include people with disabilities in mainstream society. Jesenský (1998) distinguishes two types of inclusion. These are: a) assimilation and b) coadaptation. Assimilation means acceptance of the identity of mainstream society and rejection of the original identity. An example can be placing children with disabilities in general schools without any support, which may result in potential but many times in false inclusion, unstable in its foundations. On the other hand there is coadaptation, which is based on partner communication and cooperation. An example can be the workplace, where new technologies can allow the same working efficiency of people with disabilities and those without disabilities. This kind of inclusion leads to the creation of a new identity coherent with majority as well as minority status. The result of such inclusion is true and firm inclusion.

POTENTIAL OF EXPERIENTIAL EDUCATION AND INCLUSIVE COURSES (EXPERIENCES FROM THE CZECH REPUBLIC)

Experiential education as a pedagogical discipline is still searching for its specifications, relationships, and systematic inclusion into the group of pedagogical

disciplines. We use the term "experiential education" as a theoretical and practical discipline that uses initiation and analysis of experiences. These experiences can then be transformed into other parts of life. Goals of such educational processes can be practiced in different environments (school, out of school, natural, urban, cultural) with different groups (age, social status, professional status, and other demographic factors) with the use of different activities (games of all kinds, creative and drama workshops, discussions, physically and psychologically challenging activities, self-exploring and team building activities). For experiential education the experience is the means not the goal. The goal of experiential education is the ancient Greek educational ideal of comprehensive development of personality aiming for harmony (Jirásek, 2004).

In the following text we describe inclusive courses from the environment of Outward bound, specifically from the organization the Vacation school of Lipnice. This vacation school is a Czech member of Outward bound working in the Czech Republic since 1977. The main idea at the beginning was quite simple: instead of organizing special courses only for people with disabilities (segregation), courses were initially based on typical courses for persons without disabilities and adapted so that people with disabilities could take part in them (but were not exclusively designed only for the disabled). They were thus inclusive courses. Krump (2004) claims that there is a great danger of misunderstanding the term "inclusion". Inclusion could be stated as simply "being together". Being together is not designed for "them", those who need our help, care and understanding. Such an approach would be just false social feeling, not respecting the fact that experiencing difference is enriching. It appears that this "being together" can be much more beneficial than expected to people who are young, healthy, self-confident and at the same time without any strong experience acquired by confrontations with a different way of life. We can use differences for the enrichment of all involved participants, but simply putting people who are different in the same circumstances might be sometimes contra productive.

According to Sherrill (2004) and Sherrill and Tripp (1991), in the process of inclusion the key role is played by attitudes, which can be defined as the predisposition or readiness to deal with a certain target group (in this case people with disabilities) or behavior (activity with the given target group). In order to alter attitudes toward individuals with disabling conditions, distorted cognition that is supported by deeply felt emotions must be confronted. The first step in the reeducation process must focus on the individual at an emotional level.

The key factor for successful inclusion seems to be a personal approach to differences and uniqueness and our relationship to differentness. Only if we perceive differences as opportunities for enrichment and personal growth, and not as hindrances or threats, can we respect others with their unique needs and succeed in true inclusion. This does not mean that we ignore impairments. This does not mean that we don't take into account differences. This means natural perception of differences. The superficial view that people with disabilities are poor victims of misfortune, who can not do many things, can be changed by experiencing the specific capabilities of these people in areas, where usually people without disabilities are not capable.

Have you ever tried to move using a wheelchair? Well try it – try to sit on the chair and go up the curb, you will see that paraplegics can do much more then you can do. Try to put on blindfolds and you will start to admire blind people who can with little trouble move around the city or in nature. Examples of the efficiency of disability simulation activities can be found in study of Jones et al. (1981). Attitudes of children toward individuals with disabilities changed positively after a 5 hour program that included simulation of disabling conditions. Through the simulation of different disabling conditions, individuals may gain new sensitivity toward individuals with disabilities and what must be faced on a daily basis.

"Simply "being together" is comparable with Plato's words from his seventh letter (focusing also on the meaning of philosophy for human life), where he points out that he will not write anything (about how to teach philosophy) as it can (?) not be taught as other sciences, but can only be learned in life and by being with people, just as the flame is set up from the spark, this learning will be born in the soul and them will grow by itself" (Plato, 1996, 54).

Contact theory posits that contact between individuals with differences tends to produce changes in attitude (Allport, 1954; Amir, 1969; Sherrill, 2004). The direction of change depends largely on the conditions under which contact has taken place; favorable conditions tend to produce positive attitude shifts whereas unfavorable conditions tend to produce negative attitude shifts. According to Amir (1969) some of the favorable conditions that tend to imt social climate promotes contact; (a) the contact is intimate rather than casual; (b) the contact is pleasant or rewarding; (c) the contact situation involves common goals that are higher ranking than individual goals.

Instructors and participants in inclusive courses are certain that this "being together" brings gains to all involved. At the point where rational arguments (about equality, performance, talents, disabilities, strength and weakness) fail, room for experiences, which can be more powerful than a thousand words, arises. There is growing interest in inclusion – there are new inclusive schools, many non-governmental organizations and much profes-

sional and popular literature. Still inclusive principles are not firmly embedded in our society and we need to go much further in order to prepare society for the full inclusion of people who are different. For inclusion in experiential education Deborah Sugerman (2001) suggested two possible approaches: a) a compensatory perspective and b) a transcendental perspective. In using the first approach, instructors try to compensate for missing functions or abilities (often by providing support and special equipment), while in the second approach instructors serve as facilitators of participants in the process of gaining control over their lives and independence from their surroundings.

Below we provide examples of earlier mentioned types of inclusion: a) assimilation and b) coadaptation (Jesenský, 1998) in the area of experiential education. An example of the assimilation approach is: a school group in an outdoor education program, where a student who uses a wheelchair is present at this program, but in most cases does not take part in activities together with the group. He is a spectator or has a supplementary program, because the places are not wheelchair accessible. An example of the coadaptation approach is: adaptation in all activities so that all students (including a student with disabilities) would have equal opportunity to take part or to decide about their participation.

Impairments or disabilities are usually perceived as significant differences, and many people do not know how to be with differences. In the activities of experiential education, their participants can learn not only to be with differences, but to enrich their lives by many differences, impairments being one of these. By learning to open one's mind to differentness each of us can become better prepared to face the challenges of common and not so common days of their lives and be able to accept differences and provide appropriate help if needed. From our experience one of the most appropriate places for such learning can be in the area of experiential education, where there is a place to challenge ones beliefs, try new challenges and receive feedback about who we are and what we do.

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INKLUZE V ZÁŽITKOVÉ PEDAGOGICE JAKO STRATEGIE PRO PŘÍSTUP K JINAKOSTI

(Souhrn anglického textu)

Tento příspěvek se zaměřuje na koncept jinakosti, specifické potřeby osob se zdravotním postižením a způsoby práce s jinakostí v oblasti výchovy a vzdělávání. Nejprve se zaměřujeme na koncepty jinakosti a rovných příležitostí z pohledu olympijských ideálů a teoretického modelu klasifikace postižení (International classification of functioning and disability of WHO, 2001). Dále se věnujeme vymezení pojmu inkluze z historického a teoretického pohledu autorů střední Evropy (Jesenský, 1998 a Vítková, 1999). Nakonec uvádíme příklady

využití zážitkové pedagogiky pro pochopení a přijetí jinakosti a facilitaci plného začlenění jedinců se zdravotním postižením do společnosti. Nabízíme specifické příklady programů a aktivit, které mohou podpořit začlenění osob se zdravotním postižením ve vzdělávacím prostředí.

Klíčová slova: jinakost, integrace, inkluze, postižení, zážitková pedagogika.

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COMPONENTS OF ATTITUDES TOWARD INCLUSION OF STUDENTS WITH PHYSICAL DISABILITIES IN PHYSICAL EDUCATION IN THE REVISED "ATIPDPE-R" INSTRUMENT/SCALE FOR PROSPECTIVE CZECH EDUCATORS

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Submitted in August, 2006

The purpose of the study was to examine the structure of the revised attitudinal scale of the ATIPDPE-R, an instrument based on the theory of planned behavior (TPB) of Ajzen (2000). Participants were 214 prospective educators (155 females and 59 males) of an average age of 21.83 years enrolled in physical education teacher preparation programs at four universities, in one adapted physical education program, one special education program and one general education program in the Czech Republic. Based on analysis, the attitudinal scale of ATIPDPE-R measures III psychological properties (components). Three components, which come from principal component analysis, explain more than 65% of the variance. The three components are: a) positive outcomes for students, b) negative outcomes for teachers, and c) negative outcomes for students.

Keywords: Inclusion, integration, physical disabilities, attitude, adapted physical education.

INTRODUCTION

Inclusion of students with disabilities in general education represents a phenomenon of the last 15 years in Czech education (Kudláček, Válková, Sherrill, Myers, & French, 2002; Michalík, 2000; Válková, 1998). Until the year 1991, most students with disabilities were educated in segregated special schools. Students with physical disabilities have been systematically included in mainstream schools. From year 2000 there have been over 1200 students with physical disabilities included in general schools (Michalík, 2005). On the other hand the area of physical education has been largely overlooked (Kudláček et al., 2002). In accordance with Sherrill (2004) it is important to prepare future physical education (PE) teachers for inclusion of students with disabilities in general physical education (GPE) settings and in order to prepare these students we must be able to measure and to understand their attitudes towards inclusion. According to planned behavior theory (Ajzen, 1991, 2005), behavior (e.g., including students with disabilities) is predicted by intention. The theory of planned behavior (TPB) (Ajzen, 2005) posits that behavioral beliefs, normative beliefs, and control beliefs are predictors of one's intention to perform specific behavior.

The most frequently studied component of both theories is behavioral beliefs, because this component is used to infer attitudes toward the intention to perform a specific behavior. Attitudes are often cited as an important factor in successful work with students with disabilities (Downs & Williams, 1994; Folsom-Meek & Rizzo, 2002; Hodge & Jansma, 1999; Hutzler, 2003; Kozub & Lienert, 2003; Rizzo, 1985; Rizzo & Kirkendall, 1995). Rizzo (1984) was the initiator of theoretically-based research on attitudes toward teaching individuals with disabilities in GPE. Rizzo developed an instrument, now entitled "physical educators' attitudes toward teaching individuals with disabilities" (PEATID), which is based on the theory of reasoned action (Ajzen & Fishbein, 1980). PEATID uses a 5 point Likert-type scale to measure 12 behavioral beliefs about the outcomes of teaching children with disabilities in GPE. Without a doubt, the PEATID has become the most commonly used attitude instrument in adapted physical education (DePauw & Karp, 1990; Downs & Williams, 1994; Folsom-Meek et al., 1999; Hodge & Jansma, 1999; Meegan & MacPhail, 2006; Schmidt-Gotz, Doll-Tepper, & Lienert, 1994). In each of the studies using PEATID or its earlier form, PEATH, an attitude score was inferred by averaging the Likert-type ratings of 12 belief statements. PEATID has developed into its third version examined for its structure by Folsom-Meek and Rizzo (2002), who found that PEATID has three factors: (a) outcomes of teaching students with disabilities in regular classes, (b) effect on student teaching, (c) need for more academic preparation to teach students with disabilities.

Attitude toward the inclusion of individuals with physical disabilities into physical education (ATIPDPE) was developed in the Czech Republic (Kudláček et al., 2002) to assess intentions and belief systems and to

use the results to personalize teacher preparation so that university students develop positive attitudes and strong intentions toward inclusion. The results showed that 23% of variance in intentions can be explained by three belief components based on TPB. Kudláček, Válková and Sherrill (2002) explored the structure of the ATIPDPE instrument and found that it measures three psychological properties (components). The three components were: a) positive outcomes for students, b) negative outcome for teachers, and c) negative outcome for students. However findings of Kudláček et al. (2002) and Kudláček, Válková and Sherrill (2002) suggested that the instrument should include more items to be more balanced. Based on these suggestions, we have decided to look back at the original pilot study of ATIPDPE and include two more items from the list based on the frequency of their occurrences. The purpose of this study was to discover the structure of a revised (12 item) attitudinal scale of ATIPDPE-R by finding components of this scale using principal component analysis and to compare these with components of original ATIPDPE (Kudláček, Válková, & Sherrill, 2002) and the components of Folsom-Meek & Rizzo (2002).

METHOD

Participants

Participants were 214 prospective educators (155 females and 59 males) of an average age of 21.83 years. Ninety participants (37 females and 53 males) of an average age of 22.65 years were enrolled in physical education teacher preparation programs at four universities. Twenty three participants (18 females and 5 males) of an average age 23.35 of years were enrolled in one adapted PE teacher preparation program. 74 females of an average age of 20.64 years were involved in one general education program and 27 students (26 females and 1 male) of an average age of 21.11 years were involved in a special education teacher preparation program. All of these programs were realized in the Czech Republic. The sampling goal was to obtain as many participants as possible. The sampling design was purposive, meaning all students were surveyed who met the criteria of (a) enrollment in the above explained teacher preparation programs, and (b) willingness of the course instructor to allow class time for the survey.

Instrument

We have used the 12 item revised attitudinal scale ATIPDPE-R (attitudes toward inclusion of children with physical disabilities in physical education – revised) instrument. This scale measures behavioral beliefs about the outcomes of inclusion of students with physical disabilities in physical education. The attitudinal scale was selected from three scales to compare the results of attitudes toward inclusion among Czech perspective educators with the results of previous study on components of original ATIPDPE scale (Kudláček, Válková, & Sherrill, 2002) and with the study by Folsom-Meek and Rizzo (2002). Each ATIPDPE item is accompanied by a 7 point scale, as recommended by Ajzen (2000). The scoring system required the use of two 7 point scales: a) 1 to 7 for the likelihood construct, and b) –3 to +3 scale for the evaluation construct. Scores for each statement were then multiplied to create item belief scores as shown in TABLE 1. The results of the multiplications were summed and thereafter referred to as the summative belief index (attitudinal score). The statements from all items can be found in TABLE 2.

TABLE 1
Sample item from the attitudinal scale

Behavioral belief (outcome belief)
Likelihood
Including students with physical disabilities in my PE class will help students without disabilities to learn to interact with persons with physical disabilities.
Extremely unlikely outcome:
____:____:____:____:____:____:____: Extremely likely outcome
1 2 3 4 5 6 7
Evaluation
Students without disabilities learning to interact with persons with physical disabilities is an:
Extremely bad outcome:
____:____:____:____:____:____:____: Extremely good outcome
1 2 3 4 5 6 7

A substantial amount of research has been also conducted outside of adapted physical education that uses this or a similar scoring system as well as this terminology (e.g. Baker, Morrison, Carter, & Verdon, 1996; Yordy & Lent, 1993). The scoring systems and logic of these studies that applied the recommendations of Ajzen (2000) were followed. The internal consistency of ATIPDPE-R reported using Cronbach alpha was at the desirable level of 0.72.

DATA ANALYSIS

Data were analyzed using SPSS PC 13.0 software. One way ANOVA revealed that there were no significant differences between females and males and among students in different years of study. This finding provided the justification for combining data for gender and year of study in the subsequent data analysis. Principal component analysis was used because this procedure analyzes all variance in shared variables and was used in a comparable study of attitudes by Folsom-Meek

TABLE 2
Description of the 12 items on the attitudinal scale of ATIPDPE with means and standard deviations

Component item	Description	M	SD
Positive outcomes for students			
1.	Including students with physical disabilities in my PE class will help students without disabilities to learn to interact with persons with physical disabilities.	16.56	5.18
3.	Including students with physical disabilities in my PE class will encourage students to learn to help others.	17.27	4.43
5.	Including students with physical disabilities in my PE class will teach students greater tolerance.	15.76	5.19
6.	Inclusion will have a positive effect on the development of personalities of students with physical disabilities (e.g. self esteem, feeling of belonging, etc.).	16.11	5.24
9.	Inclusion will cause my students to have better knowledge about persons with disabilities.	17.18	5.66
10.	Including students with physical disabilities in my PE will teach students cooperation.	16.91	5.32
Negative outcomes for students			
7.	Students with physical disabilities will experience discrimination in my regular physical education classes.	−7.23	5.33
8.	Students with physical disabilities will slow down instruction and progress in my PE class.	−4.34	6.96
11.	Students without physical disabilities will experience discrimination in my regular physical education classes.	−4.81	5.48
12.	Including students with physical disabilities in my PE class will reduce the quality of teaching.	−5.64	6.72
Negative outcomes for teachers			
2.	Including students with physical disabilities in my PE class will make teaching physical education more difficult.	6.41	9.27
4.	Including students with physical disabilities in my PE class will make lesson planning and preparation much more difficult.	6.06	9.15

Note
Scores of all items are based on the multiplication of evaluation results and the likelihood of beliefs about the outcomes of the inclusion of students with PD in general PE class. The possible range of scores of every item is from −21 (−3 on evaluation and 7 on likelihood) to +21 (+3 on evaluation and 7 on likelihood).

and Rizzo (2002). The Kaiser measure for sampling adequacy for this study was .77 which was above the recommended minimum of .60 (Tabachnik & Fidell, 2000). Components were required to have eigenvalues above 1.0 to be included.

RESULTS

Based on analysis the attitudinal scale of ATIPDPE-R measures three psychological properties (components). Detailed information on means and standard deviations of each item can be found in TABLE 2. Three components, which came from principal component analysis, explain more than 65% of the variance. The three components are: a) positive outcomes for students, b) negative outcomes for teachers, and c) negative outcomes for students.

TABLE 3 depicts component loadings of the 12 items. Each of the items loaded higher then the .40 cut off point. Most items showed excellent loadings (above .70) with the exception of one item (item 8 = .69). Thus we can conclude that the described attitudinal scale has a sound structure, which is comparable with the structure of the previously studied original instrument ATIPDPE.

DISCUSSION

The purpose of this study was to discover the structure of the revised attitudinal scale of ATIPDPE-R by finding components of this scale using principal component analysis and to compare these to the components of the original ATIPDPE (Kudláček et al., 2002) scale and the PEATID-III scale of Folsom-Meek and Rizzo (2002). Prospective teachers seem to be aware of the potential outcomes of inclusion (Ajzen, 2000) as both positive and negative. Negative outcomes are divided in the same way as in the original study by Kudláček, Válková and Sherrill (2002) as to outcomes on teachers (making teaching and preparation more difficult) and the outcomes on students (students with PD and students without disabilities). Two newly added items, no. 11 “students without physical disabilities will experience discrimination in my regular physical education classes” and no. 12 “including students with physical disabilities in my PE class will reduce the quality of teaching” were loaded together with two original items representing the negative outcome on students. It is interesting to notice that the results of negative outcomes for teachers were not rated as bad outcomes (minus scores) rather they were evaluated as not so good outcomes in the same way

TABLE 3
Component loadings, eigenvalues and percentages of variance using principal components extraction with varimax rotation for total composite scores

Item #	Varimax components		
	1	2	3
Positive outcomes for students			
1	.78		
3	.81		
5	.77		
6	.73		
9	.74		
10	.83		
Negative outcomes for students			
7		.79	
8		.69	
11		.77	
12		.71	
Negative outcomes for teachers			
2			.91
4			.91
Eigenvalue	3.67	2.32	1.81
Percent variance	30.59	19.36	15.12

as the original ATIPDPE scale, suggesting that respondents were likely to respond in a socially desirable way.

It is not possible to compare all items or components of ATIPDPE-R with PEATID-III of Folsom-Meek and Rizzo (2002) as they used a different PEATID – III instrument in a different cultural environment. However we must highlight some similarities of both studies. Folsom-Meek and Rizzo (2002) has 6 items in its first component (outcomes of teaching students with disabilities in regular classes). All outcomes are negative apart from one item, which, based on Ajzen (2000), should not be included: "Students labeled ...should be taught with non-disabled students in my PE classes whenever possible". Component two (negative outcome on teachers) and three (negative outcome on students) from our study is comparable to Folsom-Meek and Rizzo's (2002) first component. Folsom-Meek and Rizzo's (2002) second component (effects on students' learning) includes four positive items, which are comparable to six items from our first component (positive outcomes on students).

If we consider the fact that two instruments (PEATID and ATIPDPE-R) were developed by two separate pilot studies, where researchers have asked respondents to list the possible outcomes of the inclusion of students with PD in general physical education classes, in two different countries with a different state of inclusion, the similarities of the results are surprising. (For differences in the scoring of these instruments see Kudláček et al., 2002). In relation to ATIPDPE-R the results showed that while the explanation of variance remained the same as in original ATIPDPE (Kudláček, Válková, & Sherrill, 2002) the 65% revised version is more sensitive to beliefs about the potential outcomes of inclusion. The revised scale has a sound structure and an internal consistency of 0.72 and therefore it is recommended to use it with students of Czech teacher preparation programs in physical education, adapted physical education, general education and special education. This instrument can be used to measure impacts of different courses and educational programs on the attitudes of the above mentioned students toward the inclusion of students with physical disabilities in general physical education.

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STRUKTURA POSTOJŮ K INTEGRACI ŽÁKŮ S TĚLESNÝM POSTIŽENÍM V TV V REVIDOVANÉM DOTAZNÍKU ATIPDPE-R U BUDOUCÍCH UČITELŮ V ČESKÉ REPUBLICE

(Souhrn anglického textu)

Cílem této studie bylo prozkoumat strukturu revidované postojové škály dotazníku ATIPDPE-R, který je založen na Ajzenově (2000) teorii plánovaného jednání (Theory of planned behavior). Této studie se účastnilo 214 budoucích učitelů (155 žen a 59 mužů) průměrného věku 21,83 let, kteří studovali studijní obor učitelství TV na čtyřech univerzitách, studijní obor aplikovaná

tělesná výchova, speciální pedagogika a učitelství prvního stupně základní školy v České republice. Analýza postojové škály ATIPDPE-R poukázala na tři psychologické ukazatele (komponenty). Zmíněné komponenty (na základě analýzy základních komponent – principal component analysis) objasňují více než 65 % variance. Tři komponenty jsou: a) pozitivní důsledky pro studenty, b) negativní důsledky pro učitele a c) negativní důsledky pro studenty.

Klíčová slova: inkluze, integrace, tělesné postižení, postoje, aplikovaná tělesná výchova.

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MOTOR SKILLS ASSESSMENT AND EARLY INTERVENTION FOR PRESCHOOLERS WITH MENTAL AND DEVELOPMENTAL DISORDERS (CASE STUDIES)

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The purpose of the present study was to assess the motor skills performance of preschoolers with mental and developmental disorders and to propose individualized intervention programs. Participants included 6 children, 5 boys and 1 girl, 48 to 79 months old, who were attending the same special kindergarten. Both quantitative and qualitative aspects of their performance were examined. With regards to quantitative examination, participants were measured using the following test – the movement assessment battery for children (Henderson & Sugden, 1992). Meanwhile qualitative results were obtained through personal observation. Finally a motor skill intervention program was planned for each child according to his/her results.

Keywords: Mental and behavioral disorders, preschool age, MABC, motor skill assessment, intervention.

INTRODUCTIONS

Past investigations in the area of motor performance have repeatedly shown that children with special needs, and specifically children with mental retardation (MR) and developmental disorders (DD), demonstrate delays in the development of motor skills (Francis & Rarick, 1959; Malpass, 1959; Rarick, Widdop, & Broadhead, 1970; Reid, Collier, & Morin, 1983; Bouffard, 1990; Berkeley, Zittel, Pitney, & Nichols, 2001; Valentini & Rudisill, 2004).

The average scores of mildly mentally retarded children in some gross and fine motor skills have been reported to be 3 to 5 years behind non-handicapped children of similar ages (Rarick et al., 1970). With regards to autism, Manjiviona and Prior (1995) found that 66.7% of children with autism have definite motor problems as measured on the test of motor impairment, which Henderson revised, and performed at a level significantly lower than their same age peers. The same evidence was reported by Berkeley et al. (2001). Measurements done on a group (n = 59) of 4 year old children who were identified as at risk for developmental delays, reported a low level of locomotor and object-control skills, as measured by TGMD (Goodway & Branta, 2003). Object-control skills were measured also in a research project conducted by Hamilton, Goodway and Hanbenstricker (1999). The participants, 15 preschoolers (3 to 5 years old), at risk for developmental delay or academic failure, performed in the lower 20th percentile of the object-control subscale of TGMD.

The importance of motor skills has been well established by many authors (Eichstaedt & Lavay, 1992; Payne & Isaacs, 2002; Doty, McEwen, Parker, & Laskin, 1999; Haywood & Getchell, 2001). Gallahue (1989, p. 73) stated that: "The development of fundamental movement abilities is basic to the development of all children. A wide variety of movement experiences provide them with a wealth of information on which to base their perceptions of themselves and the world about them."

Proficiency in the performance of fundamental motor skills (FMS) has been considered to be an underlying factor for the success of the more complex movements used in aquatics, dance, games, and sports (Wickstrom, 1982). However, "sports" is not the only domain where motor skills "mastery" is important. According to Eichstaedt and Lavay (1992) competence in these skills caries over to functional skills necessary to perform movements required in daily living activities. Further, the continual failure to perform culturally normative skills within the range of acceptable proficiency may lead to serious secondary emotional and behavioral problems (Cratty, 1967).

Taking into consideration the importance of motor skills, as well as the problems that a delay in their development can result in, the necessity for early intervention is clearly demonstrated. This is also supported by a large number of studies (Casto & White, 1984; Cowden, Sayers, & Torrey, 1998; Guralinick, 1991; Odom, 1988; Orr, 1990; Sayers, Cowden, Newton, Warren, & Eason, 1996; Stedman, 1988; White & Casto, 1985).

THE MAIN AIM

With respect to the above the main aim of the present study was to identify the level of motor skills development of the preschool participants with mental retardation and/or developmental disorders according to the movement assessment battery for children (MABC – Henderson & Sugden, 1992). As the MABC instrument measures the quantitative as well as the qualitative picture of the childrens' movement level, the main aim had to be completed with the aid of three tasks:

a) to evaluate basic items of fine motor skills with quantitative data,
b) to provide information about the qualitative aspects of their motor performance according to personal observation and
c) to suggest a motor skill intervention program for each participant according to the quantitative results of MABC and qualitative information obtained by personal observation.

METHODS

The kindergarten design

The school is a public special kindergarten, founded in 1991 and located in the city of Olomouc in the Czech Republic. During its functioning it has participated in cooperation with other regular schools in several social activities (cinema, concerts, etc.) offered by the local educational department. Also, it often organizes outdoor activities, as well as short weekend camps for both students and their families. The kindergarten consists of 2 "playrooms", where physical education class takes place (1 hour per day), a dining room, a sleeping room, a hygiene room, a room for social events, and a small garden. The kindergarten is visited by 18 children. They are educated by three teachers as well as supportive assistants (APA or special education students). Three teachers are MA level special education graduates who have attended additional courses relevant to the understanding of the special developmental disorders of preschoolers. There is very good cooperation between the school and parents. All children-participants are attending the same school.

Participants

Preschoolers were recruited based upon the following criteria: a) diagnosis and b) age. Participants included 6 children, 5 males and 1 female, who were diagnosed with mental and/or behavioral disorders. It should be mentioned that none of them receives medication that can affect his/her motor performance. The age range was from 48 to 79 months old. All of them were attending the same special kindergarten.

M. A.: is a 68 month old boy. He was diagnosed with atypical autism and a specific developmental disorder of speech and language and there are suspicious about his cognitive ability. He has attended the kindergarten since 1. 3. 2004. M. A. is usually impulsive, impatient, disorganized and easily distracted. He starts an activity spontaneously without waiting for instructions. During the activity he presents no systematic way of doing it and he shows no patience. He becomes confused, he loses his concentration and finally he forgets how to do the activity.

M. T.: is a 60 month old boy. He was diagnosed with childhood autism and mild mental retardation (the exact IQ was not available to the author). He has been kept under psychological supervision. He has attended the kindergarten since 1. 9. 2005. M. T. is hyperactive and impulsive, easily distracted, as well as easily upset by failure. Usually he likes running around without a purpose, he doesn't pay attention when he is given instructions and, as a result, he needs assistance in order to accomplish a task. While he is engaged in an activity he loses his concentration because of other circumstances and he starts a new attempt but again, without following any instructions.

S. L.: is a 64 month old boy. He was diagnosed with moderate mental retardation (IQ = 46) and significant impairment of behavior requiring attention or treatment as well as with other childhood disintegrative disorder. He has had speech therapy. He has attended the kindergarten since 14. 3. 2005. S. L. is usually overactive and nervous while on some other occasions he exhibits passive behavior followed by day dreaming. Additionally, his characteristic is to lack persistence and he needs support and stimulation during controlled activities.

V. I.: is a 79 month old boy. He was diagnosed with expressive language disorder and a specific developmental disorder of motor function. He has attended the kindergarten since 1. 1. 2004. V. I. is usually nervous and stuffy. He enjoys participating in an activity and he wants to do his best but, in order to do it, he needs support and encouragement.

J. A.: is a 78 month old boy. He was diagnosed with Asperger's syndrome and his mental ability is unbalanced. He has attended the kindergarten since 1. 9. 2004. He is passive, disorganized and he lacks persistence. Another of his characteristics is day dreaming. J. A. presents no systematic way of doing things during his participation in an activity, he gets confused and he ends up tired and frustrated. As a result he often needs motivation and encouragement.

M. O.: is a 48 month old girl. She was diagnosed with expressive language disorder. She has attended the kindergarten since 1. 9. 2005. M. O. is usually passive, disorganized and she exhibits either fear or lack of will to be engaged in an activity. During it she gets confused, easily tired and she needs support and help to accomplish it. In addition, she lacks in facial expressivity and it looks like participating in an activity doesn't give her any pleasure.

Instrument

The instrument used to measure the motor skills performance of the participants in this study was the movement assessment battery for children (MABC), which was published in 1992 and is an updated version of the test of motor impairment (TOMI) (Henderson & Sugden, 1992). The test battery is focused on evaluation of basic items of fine motor skills development in three sets (see Fig. 1):

a) manual dexterity (M. D.) with items – 1. posting coins (P. C.), 2. threading beads (T. B.), 3. bicycle trial (B. T.),
b) ball skills (B. S.) with items – 4. catching bean bag (C. B. B.), 5. rolling a ball between goalposts (R. B.),
c) static & dynamic balance (S. & D. B.) with items – 6. one leg balance (O. L. B.), 7. jumping over a cord (J. O. C.), 8. walking with heels raised (W. H. R.).

It is a standardized test with strict permission to use only the original MABC package. The purpose of the test is to identify movement and coordination disorders in children, including those with developmental disabilities (Barnett & Henderson, 1998). Although MABC was validated on children without disabilities, it can be used also with children with disabilities who have the ability to acquire normal motor patterns such as children with mental retardation, autism, visual impairments, and hearing impairments (Horvat, Block, & Kelly, in press). The worldwide use of MABC, in a clinical as well as in a research context, proves its popularity in the field (Crawford, Wilson, & Dewey, 2001; Geuze, Jongmans, Schoemaker, & Smits-Engelsman, 2001).

According to the MABC manual, the test has acceptable validity and reliability (Henderson & Sugden, 1992). Correspondingly it has shown a high inter-rater and test-retest reliability with novice test administrators (Chow, Chan, Chan, & Lau, 2002; Croce, Horvat, & McCathy, 2001). Inter-rater reliability ranges from .70 to .89, and test-retest reliability is .75 (Henderson & Sugden, 1992).

The administration of the test is easy and not time consuming, while children are likely to participate willingly. The test is designed for use with children aged 4 to

Fig. 1
Description of age band

The following description is in accordance with the manual of MABC (Henderson & Sugden, 1992).

1) Manual dexterity (M. D.)
Posting coins (P. C.)

The purpose of this task is to drop 12 coins in a bank box (through a slot on the surface of the box) as quickly as possible. The participant has 1 practice attempt and 2 formal trials for each hand. The score corresponds to the number of seconds taken to complete each correct trial.

Threading beads (T. B.)

In this task participants who are 5 and 6 years old are asked to place 12 cube shaped beads on a lace as quickly as possible, while for participants who are 4 years old the task consists of 6 cube shaped beads. The child has 1 practice attempt and 2 formal trials, after choosing the hand which he/she will use. The score corresponds to the number of seconds taken to complete each correct trial.

Bicycle trail (B. T.)

The purpose of this task is to draw a single continuous line, following the trail without crossing its boundaries. The child has 1 practice attempt and 2 formal trials. The score corresponds to the number of errors that is the number of times the drawn line crosses the boundaries.

2) Ball skills (B. S.)
Catching bean bag (C. B. B.)

In this task the examiner tosses a bean bag from a distance of 2 m and the participant is asked to catch it. The participant is given 5 practice attempts and 10 formal trials. The score corresponds to the number of correctly executed catches out of 10 trials.

Rolling ball into goal (R. B.)

The purpose of this task is to roll a tennis ball into a goal which is placed in a 2 m distance from the starting line. The participant must stay behind the starting line and he/she is given 5 practice attempts and 10 formal trials. The score corresponds to the number of correctly executed goals out of 10 trials.

3) Static & dynamic balance (S. & D. B.)
One leg balance (O. L. B.)

The purpose of this task is to stand on one leg for up to 20 s. Both legs are tested and the child is given 1 practice attempt (10 s) and 2 formal trials for each leg. The score corresponds to the number of seconds (up to 20) that the child maintains balance.

Jumping over a cord (J. O. C.)

In this task the child is asked to jump with feet together over a cord which is placed on the level of the lower border of his/her knee cap. The participant is given 1 practice attempt and 3 formal trials. The score can be either P for a successful jump, or F for a failed jump.

Walking with heels raised (W. H. R.)

The purpose of this task is to walk along a straight line with heels raised without stepping off the line. Fifteen steps are required. The participant is given 1 practice attempt, which consists of 5 steps, and 3 formal trials. The score corresponds to the number of correct consecutive steps that the child accomplished.

12+ years. A total of 32 items are divided into four sets of eight, each intended for use with children of specific ages. The first set of items, which was the one used in the present study, labeled age band 1 is designed for use with 4 to 6 year old children, the second set, age band 2 for 7 and 8 year old children, the third for 9 and 10 year olds and the fourth for children 11 years old and above. Within each age band the structure of the test is identical. All children complete three items designed to assess manual dexterity, two items designed to assess ball skills and three items which assess static and dynamic balance.

Scoring of the MABC is a multi-step process. First, the examiner scores the child's raw score on each item. Raw scores are converted to scaled scores ranging from 0 to 5, with higher scores indicating poorer performance. Item scores are then summed to produce total scores, ranging from 0 to 40. Finally, percentile tables are consulted to determine how an individual compares with his/her age peers.

As the test is recommended mainly for clinical using (for the next intervention process) it should be supported with observation and a follow up qualitative description of child behavior. Attentive observation is guided with a specially structured check-list of items and a record list.

Procedure

The first step of the research process was to obtain the original MABC package and receive permission for its use in a Czech environment. Prior to the measurement a visit to the kindergarten took place for the purpose of providing appropriate conditions and contact with children for further, better communication between the administrator and the children. The parents were informed and signed their agreement with applying the MABC and afterwards, with the presentation of the results and an explanation of the intervention plan (at the request of parents).

The testing procedure was completed in the 2 following days. The protocol from the MABC was followed, and standardized testing procedures were used. The test permits the administrator to give verbal directions, as well as a physical demonstration of the task.

Real measurement was processed with cooperation between the tester administrator (English speaking) and the examiner, both of whom were master's degree program students in adapted physical activities. An examiner was engaged with the task to translate the instructions into the Czech language for the participants, and to observe their motor performance with regards to qualitative patterns. The teacher of the children was also present, in order to make the students feel more comfortable and secure. The participants were randomly assigned to perform the 8 items of the movement ABC test and the time needed for each participant was approximately 40 minutes.

The individual motor skills interventions were developed according to an example of an "Individual physical education program" proposed by Auxter, Pyfer, & Huettig (2005). The present level of performance was presented and three annual goals were selected for each participant. The three goals were selected correspondingly to the three items for which the participant obtained the higher scores. In case the participant had the same score in more than three items the selection of the goals was done according to the qualitative results.

RESULTS AND DISCUSSION

In this chapter quantitative and qualitative results are presented. Related to the MABC manual, both aspects should be analyzed in case studies for follow up intervention. The quantitative results include the Total Impairment Score (T. I. S), the scores in the three sets of MABC: manual dexterity (M. D.), ball skills (B. S.) and static & dynamic balance (S. & D. B.) and the item scores, altogether 8 items. T. I. S. is compared with the table of percentile equivalents from 1 to 93/96 for the determined age band (Henderson & Sugden, 1992, p. 17).

The qualitative results include personal observations and they are reported according to the following 8 items of MABC: 1. posting coins (P. C.), 2. threading beads (T. B.), 3. bicycle trail (B. T.), 4. catching bean bag (C. B. B.), 5. rolling ball into goal (R. B.), 6. one-leg balance (O. L. B.), 7. jumping over cord (J. O. C.), and 8. walking heels raised (W. H. R) (TABLE 1, 2).

Both domains are discussed.

Case studies

1) **M. A.** (68 months old, diagnosed with atypical autism, specific developmental disorder of speech and language, suspicious about his cognitive ability)

Quantitative results

M. A. obtained a T. I. S. of 19 which placed him on the 4th percentile for his age. In the subtest of M. D. he scored 10, while on B. S. he scored 0, and as for S. & D. B. his score was 9. His item scores were: P. C.: 3, T. B.: 5, B. T.: 2, C. B. B.: 0, R. B.: 0, O. L. B.: 4, J. O. C.: 0, W. H. R.: 5

M. A. had a T. I. S. of 19, which indicates a serious developmental delay, but his score on the subtest of ball skills was 0. This score (which corresponds to a very good performance) comes into contrast with the findings of Doty et al. (1999) who showed that 5 year old children with developmental disabilities are delayed in their ball skills. However, according to Auxter et al. (2005) learners with autism may exhibit unusual motor

TABLE 1
Quantitative results

Item scores

	P. C.	T. B.	B. T.	C. B. B.	R. B.	O. L. B.	J. O. C.	W. H. R.
M. A.	3	5	2	0	0	4	0	5
M. T.	4.5	5	5	5	2	5	5	3
S. L.	0	0	0	1	5	0	0	5
V. I.	4.5	5	0	1	1	4	0	2
J. A.	4	5	0	5	5	4.5	5	0
M. O.	4	5	5	5	0	5	5	5

Note
P. C. = posting coins, T. B. = threading beads, B. T. = bicycle trail, C. B. B. = catching bean bag, R. B. = rolling ball into goal, O. L. B. = one leg balance, J. O. C. = jumping over cord, W. H. R. = walking heels raised

TABLE 2
Quantitative results

Total impairment scores and subtests scores

M. T.	34.5	14.5	7	13
S. L.	11	0	6	5
V. I.	17.5	9.5	2	6
J. A.	28.5	9	10	9.5
M. O.	34	14	5	15

Note
T. I. S. = total impairment score, M. D. = manual dexterity, B. S. = ball skills, S. & D. B. = static & dynamic balance

behaviors. Although it has been previously suggested that formal testing would be difficult to administer to autistic subjects (Reid & Morin, 1981), no resistance was noted with regards to M. A. On the contrary he seemed to enjoy the testing procedure. A possible explanation could be that the presence of the children's teacher made him feel comfortable, or the fact that the whole procedure took place in a familiar environment.

Qualitative results

In the first item he was not concentrating and many times he was looking around. He seemed hyperactive, making unnecessary movements and also speaking quietly (like talking to himself). Nevertheless he was holding the box on the mat and he was picking up the coins fluently, using the pincer grip. He exhibited a particular strategy in the selection of the beads, but he had difficulties during their placement on the string and he dropped it on the mat several times. When he was tested in the bicycle trail he was grasping the pen, placing it vertically to the paper, drawing a line in order to reach the end as quickly as possible and without respecting the borders. But he improved in the second attempt. In the fourth item he had a correct body posture while waiting for the bean bag as well as while catching it. However, for some minutes he seemed lost in his thoughts without paying attention to the activity. Although M. A. accomplished fluently the fifth item, he had problems in the next one (one leg balance) as he couldn't keep his balance for more than a few seconds. In the item of jumping over the cord he showed no difficulty and as for the last item he was able to stand with heels raised but only in a stationary position.

Intervention plan

Present level of performance

1) M. A. was unable to accomplish the task of threading 12 beads within the given time of 55 s. The best time he obtained was 129.43 s.
2) M. A. was unable to balance on one leg for 20 s. The best time he obtained was 4.79 s (both legs were tested).
3) M. A. was unable to obtain 15 steps walking with his heels raised. He failed in all trials.

Annual goals

1) M. A. will be able to accomplish the task of threading 12 beads within 55 s. The objectives will be to thread within 55 s first 6, then 8 and finally 10 beads.

2) M. A. will be able to balance on one leg for 20 s (both legs will be tested). The objectives will be to balance on one leg, first for 15 s while holding his teacher's hands, then for 10 s independently and finally for 15 s independently.
3) M. A. will be able to obtain 15 steps walking with his heels raised. The objectives will be able to walk with his heels raised, first for 10 steps while holding his teacher's hands, then for 5 steps independently and finally for 10 steps independently.

2) M. T. (60 months old, diagnosed with childhood autism and mild mental retardation)

Quantitative results

M. T. had a total impairment score of 34.5, indicating that he fell below the 1st percentile for his age. Additionally he scored 14.5 in manual dexterity, 7 in ball skills, and 13 in static and dynamic balance. His item scores were: P. C.: 4.5, T. B.: 5, B. T.: 5, C. B. B.: 5, R. B.: 2, O. L. B.: 5, J. O. C.: 5, W. H. R.: 3.

M. T. obtained his highest score (34.5) in comparison to the rest of the participants. In case of a score like this Henderson and Sugden (1992) mentioned that "additional help for the child is imperative". Morin and Reid (1985) stated that the depressed motor behavior of lower functioning autistic subjects might be more a reflection of accompanying mental retardation than autism. Regarding the qualitative aspects of his performance M. T. seemed to have a problem in the comprehension of the instructions. This problem, which is probably one of the main reasons that resulted to M. T.'s low performance, could be due to an attentional deficit, which is a common characteristic of autistic individuals (Frith & Hermelin, 1969; Fulkerson & Freeman, 1980; Varni, Loovas, Koegel, & Everett, 1979; Wing, 1976).

Qualitative results

M. T. appeared to have problems in holding the box steady on the mat while afterwards he exhibited concentration and good eye contact with the coins and the slot. He was using the pincer grip for the collection of the coins. With regards to the second item, he started to thread the beads from the end of the string after observing it carefully for a while. After receiving supplementary instructions he developed a personal strategy changing hands according to the side of the beads he was picking up. However, he dropped the string on the mat a few times. As for the bicycle trail M. T. didn't seem to understand the instructions since he insisted on drawing a line directly from the beginning to the end without following the trail. He was grasping the pen instead of holding it with the fingers. In the fourth item he didn't seem able to catch the bean bag, since he was using only one hand, while in the fifth one it seemed to be easier for him to roll the ball using both hands. Finally he managed to roll the ball with one hand staying behind the starting line. In the static and dynamic balance subtest he was jumping on one leg without being able to stand on it, while he seemed to enjoy stepping over the cord but not being able to jump over it. Regarding the last item of this subtest he managed to walk on the line but without raising his heels.

Intervention plan

Present level of performance

1) M. T. was unable to catch the bean bag 10 times from a distance of 2 m. He failed in all trials.
2) M. T. was unable to balance on one leg for 20 s. He failed in all trials (both legs were tested).
3) M. T. was unable to jump (with feet together) over a cord placed on a height under his knees. He failed in all trials.

Annual goals

1) M. T. will be able to catch the bean bag 10 times from a distance of 2 m. The objectives will be to catch the bean bag, first 4 times from a distance of 1.5 m, then 4 times from a distance of 2 and finally 7 times from a distance of 2 m.
2) M. T. will be able to balance on one leg for 20 s (both legs will be tested). The objectives will be to balance on one leg, first for 15 s while holding his teacher's hands, then for 10 s independently and finally for 15 s independently.
3) M. T. will be able to jump (with feet together) over a cord placed on a level under his knees. The objectives will be to jump (with feet together), first on a stationary position, then over a cord placed on the floor and finally over a cord placed on the half of the initial goal level.

3) S. L. (64 months old, diagnosed with moderate mental retardation, significant impairment of behavior requiring attention or treatment and other childhood disintegrative disorder):

Quantitative results

S. L.'s total impairment score was 11 which correspond to the 14th percentile for his age. With reference to the subtests, his scores were 0 for manual dexterity, 6 for ball skills, and 5 for static and dynamic balance. His item scores were: P. C.: 0, T. B.: 0, B. T.: 0, C. B. B.: 1, R. B.: 5, O. L. B.: 0, J. O. C.: 0, W. H. R.: 5.

Despite a substantial body of literature that children with mental retardation (M. R.) are 3 to 5 years delayed in their gross and fine motor skills (Francis & Rarick, 1959; Rarick, 1973; Rarick et al., 1970). S. L. had a T. I. S. of 11 which means that he has a degree of difficulty almost on the borderline (Henderson & Sugden, 1992). His performance was the best among all the

participants. In some occasions he seemed able to develop a strategy and in some others he had a remarkable degree of progress even if past investigations regarding strategy production and progress toward goals have provided different evidence (Bray, 1987).

Qualitative results

Although S. L. showed a systematic way of posting the coins, and his body posture was also appropriate, it should be mentioned that he turned several times to his teacher looking for some support or ascertainment. In the threading beads item he was holding the string very high and he was changing hands every 3 beads. Referring to the bicycle trail he didn't seem to have any problem following the instructions as well as holding the pencil correctly. In the fourth item, even if his waiting position was not totally correct (arms wide apart, fingers extended), he exhibited remarkable improvement during the ten attempts to catch the bean bag. While rolling the ball into the goal, S. L. tried different grips, possibly looking for the most convenient way to do it. He fluently accomplished the one leg balance item; but as for the last two (jumping over the cord and walking with heels raised) he had great difficulties.

Intervention plan

Present level of performance

1) S. L. was unable to catch the bean bag 10 times from a distance of 2 m. He obtained 6 successful trials.
2) S. L. was unable to roll the ball into the goal for 10 times from a distance of 2 m. He obtained 1 successful trial.
3) S. L. was unable to obtain 15 steps walking with his heels raised. He accomplished 4 steps in his best trial.

Annual goals

1) S. L. will be able to catch the bean bag 10 times from a distance of 2 m. The objectives will be to catch the bean bag, first 8 times from a distance of 1.5 m and finally 8 times from a distance of 2 m.
2) S. L. will be able to roll the ball into the goal 10 times from a distance of 2 m. The objectives will be to roll the ball into the goal, first 4 times from a distance of 1.5 m, then 4 times from a distance of 2 m and finally 8 times from a distance of 2 m.
3) S. L. will be able to obtain 15 steps walking with his heels raised. The objectives will be to walk with his heels raised, first for 10 steps while holding his teacher's hands, then for 5 steps independently and finally for 10 steps independently.

4) V. I. (79 months old, diagnosed with expressive language disorder and specific developmental disorder of motor function):

Quantitative results

V. I.'s performance resulted in a total impairment score of 17.5 which placed him on the 1st percentile for his age. In the subtest of manual dexterity he scored 9.5, on ball skills he scored 2 and on static and dynamic balance he scored 6. His item scores were: P. C.: 4.5, T. B.: 5, B. T.: 0, C. B. B.: 1, R. B.: 1, O. L. B.: 4, J. O. C.: 0, W. H. R.: 2.

V. I.'s results (T. I. S. = 17.5) replicate the findings of previous studies, which demonstrated that children with D. D. have motor deficits (Zittel & McCubbin, 1996; Valentini, 1977; Hamilton et al., 1999). Hamilton et al. (1999) reported serious delay with reference to five object control skills (kicking, throwing, bouncing, striking and catching). However it should be mentioned that V. I.'s score and correspondingly his qualitative performance in ball skills was at a good level.

Qualitative results

V. I. was very focussed on, but quite slow in carrying out the item of posting coins. He exhibited a systematic way of picking up the coins and he used the pincer grip. His body posture was correct and he seemed to have good eye contact with the coins and the slot.

With reference to the threading beads item he was holding the string at an appropriate distance from his body even if he was changing hands continuously. The bicycle trial was accomplished easily. With regards to the fourth item (catching the bean bag) he seemed fluent and focussed. As for the task of rolling the ball into the goal despite some comprehension problems he finally managed to be successful. Although V. I. had no significant problems during the one leg balance and the jumping over the cord items, the last item (walking with heels raised) appeared very hard for him since he couldn't avoid stepping off the line.

Intervention plan

Present level of performance

1) V. I. was unable to accomplish the task of posting 12 coins within the given time of 17 s. The best time he obtained was 25 seconds (both hands were tested).
2) V. I. was unable to accomplish the task of threading 12 beads within the given time of 47 s. The best time he obtained was 124.5 seconds.
3) V. I. was unable to balance on one leg for 20 seconds. The best time he obtained was 6 s (both legs were tested).

Annual goals

1) V. I. will be able to accomplish the task of posting 12 coins within the given time of 17 (both hands will be tested). The objectives will be to post within the time of 17 s first 6, then 8 and finally 10 coins.

2) V. I. will be able to accomplish the task of threading 12 beads within 47 s. The objectives will be to thread within 47 s first 6, then 8 and finally 10 beads.
3) V. I. will be able to balance on one leg for 20 s (both legs will be tested). The objectives will be able to balance on one leg, first for 15 s while holding his teacher's hands, then for 10 s independently and finally for 15 s. independently.

5) J. A. (78 months old, diagnosed with Asperger's syndrome and unbalanced mental ability):

Quantitative results

The total impairment score of J. A. was 28.5 which pointed out that he fell below the 1st percentile for his age. As for manual dexterity, ball skills and static and dynamic balance, his scores were 9, 10, and 9.5 respectively. His item scores were: P. C.: 4, T. B.: 5, B. T.: 0, C. B. B.: 5, R. B.: 5, O. L. B.: 4.5, J. O. C.: 5, W. H. R: 0.

Similar to the findings of Ghaziuddin, Butler, Tsai and Ghaziuddin (1994), Ghaziuddin and Butler (1998) and Manjiviona and Prior (1995), J. A. had a high T. I. S. (28.5) which indicates a poor motor performance. Regarding the qualitative patterns of his performance J. A. seemed to have motor coordination difficulties (especially in the task of jumping over the cord) as well as sensory motor dysfunction (in the task of catching the bean bag). These are two characteristics of individuals with Asperger's syndrome which have also been mentioned in past investigations (Ghaziuddin & Butler, 1998; Iwanaga, Kawasaki, & Tsuchida, 2000).

Qualitative results

In the first item J. A. exhibited good eye contact with the coins and the box and a high level of concentration. His body posture was correct and he was selecting the coins systematically using the pincer grip. In the item of threading beads he seemed focussed and careful. In spite of the fact that he had a very slow rhythm (because of driving the beads until the end of the string) he developed his own strategy and he followed it until the end of the task. With reference to the bicycle trial he was holding the pen using the pincer grip. Meanwhile he was holding carefully the paper with the other hand. Next item – he had good eye contact with the bean bag. As for the fifth item J. A. seemed to react spontaneously, either without using a specific grip to roll the ball, or just pushing it instead of rolling. Before testing the item of one leg balance he seemed to concentrate and to be able to keep his balance easily, finally (during the actual attempts) he lost his concentration and the ability to accomplish the task. In the following item he was able to step over the cord but not to jump with his feet together. Contrarily he showed great fluency when he was asked to walk on a straight line with his heels raised.

Intervention plan

Present level of performance

1) J. A. was unable to catch the bean bag 10 times from a distance of 2 m. He obtained 4 successful trials.
2) J. A. was unable to roll the ball into the goal for 10 times from a distance of 2 m. He obtained 2 successful trials.
3) J. A. was unable to jump (with feet together) over a cord placed on a height under his knees. He failed in all trials.

Annual goals

1) J. A. will be able to catch the bean bag 10 times from a distance of 2 m. The objectives will be to catch the bean bag, first 6 times from a distance of 1.5 m, then 6 times from a distance of 2 m and finally 8 times from a distance of 2 m.
2) J. A. will be able to roll the ball into the goal 10 times from a distance of 2 m. The objectives will be to roll the ball into the goal, first 4 times from a distance of 1.5 m, then 4 times from a distance of 2 m and finally 8 times from a distance of 2 m.
3) J. A. will be able to jump (with feet together) over a cord placed on a level under his knees. The objectives will be to jump (with feet together), first on a stationary position, then over a cord placed on the floor and finally over a cord placed on the half of the initial goal level.

6) M. O. (48 months old, diagnosed with expressive language disorder):

Quantitative results

M. O. obtained a total impairment score of 34. This score placed her below the 1st percentile for her age. In manual dexterity she scored 14, in ball skills 5, and in static and dynamic balance she scored 15. Her item scores were: P. C.: 4, T. B.: 5, B. T.: 5, C. B. B.: 5, R. B.: 0, O. L. B.: 5, J. O. C.: 5, W. H. R.: 5.

It has been stated that the coexistence of language and motor problems is a well-known phenomenon (Bishop, 1990; Nicholson & Fawcett, 1994). M. O. had a very low motor performance (T. I. S. = 34) that reflects the above statement. Initially she seemed to have attention problems which have long been known to be associated with language disabilities (Cooper, Moodley, & Reynell, 1979; Lahey, 1988; Whitehurst & Fishel, 1994; Tirosh, Berger, Cohen-Ophir, Davidovitch, & Cohen, 1998). Generally M. O. had limited interaction with the environment and even more limited expressiveness during the whole testing procedure. In point of these characteristics, past investigation has demonstrated that social-skill deficits as well as different kinds of behavioral problems seem to co-occur with attention, motor, and language problems (Szatmari, Offord, & Boyle, 1989; Moffitt, 1990; Frick, Kamphaus, Lahey, & Loeber, 1991; Kavale & Forness, 1996).

Qualitative results

Regarding the item of posting coins M. O. had a very slow rhythm and a low level of concentration as she was mainly looking at her teacher. Nevertheless an improvement was obvious during her attempts. Her rhythm was slow also in the threading beads item. She was often looking around, while sometimes she needed time in order to find the hole of the bead. In addition she insisted driving every bead carefully to the end of the string until she was sure that it was placed correctly. She had great difficulty in holding the pen appropriately during the bicycle trial test. In the item of catching the bean bag M. O. was either not placing her hands in the right position (while waiting) or she was using only one hand. Besides, her reaction to the arrival of the bean bag was delayed. In spite of the fact that she managed to accomplish the task of rolling the ball into a goal without significant difficulties, she appeared to have problems in the next item (one leg balance) keeping her free foot in front of the standing leg. However, apart from these position problems she seemed able to balance. With respect to the seventh item, jumping over the cord, she was able to step over the cord as well as to jump in a stationary position but not to jump over the cord with her feet together. When she was asked to walk on a straight line with her heels raised she was able to stay on the line but without raising her heels.

Intervention plan

Present level of performance

1) M. O. was unable to accomplish the bicycle trail task. She failed in both trials she was given.
2) M. O. was unable to catch the bean bag 10 times from a distance of 2 m. She failed in all trials.
3) M. O. was unable to obtain 15 steps walking with her heels raised. She failed in all trials.

Annual goals

1) M. O. will be able to accomplish the bicycle trail task. The objectives will be to accomplish first both trials with the help of her teacher and finally one trial with the help of her teacher and the second trial independently.
2) M. O. will be able to catch the bean bag 10 times from a distance of 2 m. The objectives will be to catch the bean bag, first 4 times from a distance of 1.5 m, then 4 times from a distance of 2 m and finally 7 times from a distance of 2 m.
3) M. O. will be able to obtain 15 steps walking with her heels raised. The objectives will be to walk with her heels raised, first for 10 steps while holding her teacher's hands, then for 5 steps independently and finally for 10 steps independently.

SUMMARIZED DISCUSSION

The physical/motor domain has been identified as one of the five areas of developmental delay: a) self-care, b) receptive and expressive language, c) learning, d) capacity for independent living, e) mobility (PL 99–457, 1986; PL 105–17, 1997). Despite numerous studies on early intervention (Casto & White, 1984; Cowden et al., 1998; Guralinick, 1991; Odom, 1988; White & Casto, 1985; Zittel & McCubbin, 1996), little has been reported about the developmental status of preschool children who are at risk in the motor skill area. To effectively intervene in the lives of these children it is critical to plan a motor skill program based upon empirical evidence (Hamilton et al., 1999).

The importance of motor skills as well as the effectiveness of early intervention has been repeatedly stated (Gabbard, 2000; Haywood & Getchell, 2001; Payne & Isaacs, 2002; Seefeldt, 1980; Cunningham, 1988; Dunst, 1990; Goodway & Branta, 2003; Zittel & McCubbin, 1996). Nevertheless early intervention literature is mainly focused on cognitive, academic and social variables (Casto & White, 1984; Guralnick, 1991; White & Casto, 1985; Zigler & Muenchow, 1992). Contemporary literature on the benefits of motor skill intervention is limited; considering motor skill intervention for specific populations, as past investigations of preschoolers with mental retardation or developmental disorders are really few (Connolly, Morgan, Russel, & Richardson, 1984; Mahoney, Robinson, & Fewell, 2001; Goodway & Branta, 2003; Zittel & McCubbin, 1996).

In addition most of the studies which refer to motor skill assessment and development focus only on the gross motor skills (Morin & Reid, 1985; Di Rocco, Clark, & Phillips, 1987; Berkeley et al., 2001). Fine motor skills though are equally important and they should be taken into consideration before reaching assumptions about motor skill performance. The quantitative results of this research revealed great differences between fine and gross motor skills. This could be a sign of disharmony and unbalanced development, as well as an indication for further investigation. The achievements of the quantitative results of the skills should be combined with qualitative assessment as a similar percentile can be accompanied by different individual behavior relevant to individual diagnosis. Scores as well as skills design and a behavior picture is the basis for evaluation of any educational and/or therapy effect.

LIMITATIONS AND RECOMMENDATIONS

The main limitations associated with this study are the following three: a) the participation of only six children, b) time limitations and c) the difference of

language between the participants (Czech) and the test administrator (English).

Regarding future research, the same objectives could be investigated in a larger population, so that generalization of the results would be acceptable and meaningful.

Additionally more information could be collected not only for the participants but also for their families, so that parent-assisted intervention programs could be planned. Correspondingly another recommendation could be the actual implementation of the intervention plans and the discussion of possible effects on the participants' motor skill performance. Last but not least, since this study was the first one that used MABC in a Czech population, a proposal would be the translation of the test and its standardization in Czech population so that its use would be easier for future research.

CONCLUSION

The assessed children achieved very low scores in items of MABC. In general the results of the present study verified previous findings and showed the developmental delay of the participants. Nevertheless in some cases there were unexpected scores or behaviors which contrast with previous research. The quantitative results of this research revealed great differences between fine and gross motor skills, great differences in assessed items related to the individual diagnosis of each child. This could be considered as a denotation for further and deeper investigation.

It should also be mentioned that MABC, through its use in the present study, mainly combines an exact score with a qualitative description and has been confirmed as a precise and valuable instrument for motor skills assessment, as well as for intervention and further development of children's skills. The proposed intervention plans and specifically the goals set could be accomplished through the implementation of common games as drawing, small toys' manipulation, ball games, running, jumping, etc.

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HODNOCENÍ MOTORICKÝCH SCHOPNOSTÍ A ČASNÁ INTERVENCE U DĚTÍ PŘEDŠKOLNÍHO VĚKU S MENTÁLNÍMI A VÝVOJOVÝMI PORUCHAMI (PŘÍPADOVÉ STUDIE)

(Souhrn anglického textu)

Cílem této studie bylo hodnocení výkonu motorických schopností u dětí předškolního věku s mentálními a vývojovými poruchami a navrhnout individualizované programy intervence. Mezi účastníky bylo 6 dětí, 5 chlapců a 1 dívka, ve věku 48 až 79 měsíců, které navštěvovaly tutéž speciální mateřskou školu. Zkoumány byly jak kvantitativní, tak i kvalitativní aspekty jejich výkonu. Pokud jde o kvantitativní zkoumání, byli účastníci posuzováni pomocí následujících testů – baterie pro posuzování pohybu u dětí (Henderson & Sugden, 1992). Kvalitativní výsledky byly získávány osobním pozorováním. Podle výsledků byl nakonec u každého dítěte naplánován intervenční program pro rozvoj motorických schopností.

Klíčová slova: mentální a behaviorální poruchy, předškolní věk, MABC, hodnocení motorických schopností, intervence.

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KNEE EXTENSOR MUSCLES' TORQUE DURING ISOMETRIC EXERCISES AND RUSSIAN ELECTRICAL STIMULATION FOLLOWING A KNEE LIGAMENT INJURY

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Voluntary isometric exercise (VOL) and neuromuscular electrical stimulation (NMES) are both methods of static muscle strength and girth training. They are applied in strength training programs to healthy muscle as well as for muscle function recovery under certain orthopaedic conditions. Both methods are used to retard muscle atrophy and strength loss resulting from post injury knee immobilization (Eriksson & Häggmark, 1979; Ingemann-Hansen & Halkjær-Kristensen, 1985; Johnson, 1988; Wigerstad-Lossing, Tromby, Jonsson, Morelli, Peterson, & Rentröm, 1988). NMES can elicit twitch or tetanic muscle contractions, determined by current pulse frequency. During tetanic stimulation, the main features of training regimes are:

1) on/off cycle (or duty cycle), made up of the time of contraction plus rest time,
2) the number of contractions and
3) the intensity of contractions (determined by the current amplitude and/or the subject's tolerance).

Keywords: Knee ligament injury, disuse atrophy, isometric exercise, Russian electrical stimulation.

INTRODUCTION

Tetanic NMES is employed as an autonomic method or as a supplement to static (isometric) exercises. VOL and NMES differ in the mechanisms of muscle activation and contraction involved. It has been traditionally assumed that recruitment order during NMES is the reverse of that seen in voluntary contraction. During VOL, motoneurons are activated in an orderly manner, according to Henneman's "size principle": there is a slow twitch (ST), the least fatigable motoneurons are activated first and then, as the intensity of effort increases, there is a fast twitch (FT) and more fatigable motoneurons are recruited. During NMES, the order of contractions is believed to be dependent on the motoneurons' excitation threshold. It seems that NMES recruits the largest, fastest conducting and most fatigable motor units with the lowest intensities, and elicits the smallest, slowest conducting and least fatigable motor units at higher intensities of stimulation (Binder-Macleod, Halden, & Jungles, 1995; Sinacore, Delitto, King, & Rose, 1990). As a result, metabolic differences between NMES and VOL may occur. Another difference is the "central command" mechanism, which means that the voluntary contraction is commanded by the central nervous system, whereas the "artificially" evoked NMES contraction is the effect of local phenomena (Eriksson & Häggmark, 1979; Sinacore, Delitto, King, & Rose, 1990). Moreover, mechanical and spatial differences in motor unit recruitment patterns exist. Electric current elicits the response of muscle fibres in the area of the current flow, whereas voluntary contractions engage the whole muscle mass (Adams, Harris, Woodard, & Dudley, 1993; Ogino et al., 2002). Despite the number of published research papers, especially regarding physiological phenomena, there is still a lack of evidence and agreement when discussing the two methods as training and rehabilitation tools. Both stimulation and isometric exercises are conducted in accordance with various methodologies. Moreover, the applied currents differ in their characteristics (frequency, polarity, and waveform). Still little is known about the methodological aspects and efficacy of isometric exercise and electrical stimulation in muscle disuse atrophy, such as the number of contractions, the duration of each contraction, rest periods, and stimulation parameters. In my study I compared knee extensor muscles' torques measured during stimulated and voluntary contractions. Two well established and popular methods were chosen: Russian electrical stimulation and isometric exercise performed as part of a typical procedure (Babkin & Timtsenko, 1977; Ward & Shkuratova, 2002). The maximal voluntary isometric contraction (MVIC), the maximal electrically evoked contraction (MEEC) and the muscle torques of each contraction during exercise and stimulation sessions were measured. Results were compared to a control group.

MATERIAL AND METHODS

26 volunteers (13 females, 13 males), aged 18–28 (with a mean age of 21.92) years, after 21–23 days of knee immobilization following ligament injury, participated in the study. The control group consisted of 65 healthy subjects (32 females, 33 males), aged 20–22 (with a mean of 20.94) years. The subjects had no history of neuromuscular nor cardiovascular disease and no other contraindications. Sedentary persons and competitive sportspeople were excluded – our selection was made using the Halkjær-Kristensen's and the Ingemann-Hansen's scale of physical activity (Ingemann-Hansen & Halkjær-Kristensen, 1985). A selection criterion was also a knee joint range of motion of at least 90°. All participants were informed of the testing procedure, its purpose and the risk factors of the study before giving their informed consent. Characteristics of the subjects are shown in TABLE 1.

TABLE 1
Characteristics of the subjects

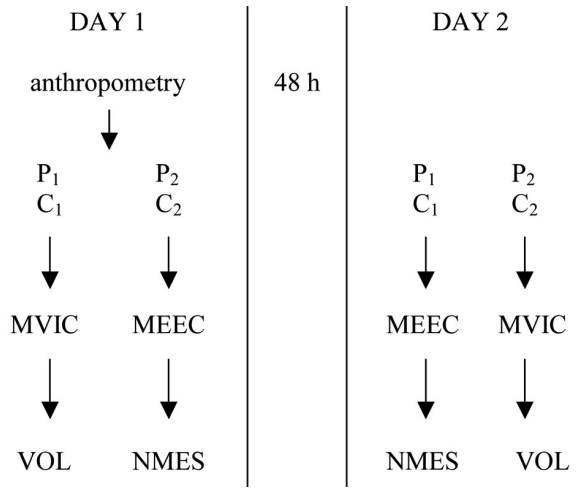
Group		Number of subjects	Age [years]		Height [cm]		Weight [kg]	
			$\bar{x}$	± SD	$\bar{x}$	± SD	$\bar{x}$	± SD
Patients	♀	13	22.31	2.84	166.2	4.21	55.9	5.94
	♂	13	21.54	3.43	178.0	4.24	71.69	5.58
Controls	♀	32	20.88	0.66	166.0	5.57	56.6	5,85
	♂	33	21.00	0.61	177.3	6.11	71.5	7.15

♀ – females; ♂ – males; $\bar{x}$ – mean value; SD – standard deviation

Isometric exercise (5 seconds of contraction, 10 seconds of rest, 10 repetitions, maximal effort) and NMES ("Russian current" according to Kots, medium frequency, sine wave, 2500 Hz/50 Hz, bipolar (Babkin & Timtsenko, 1977; Ward & Shkuratova, 2002). Sonicator® 992 Plus, Mettler Electronics) of the quadriceps muscle of the dominant extremity in a supine position, with hip and knee flexed to 90°, were performed. For the NMES, two 8 cm × 8 cm flexible carbon electrodes (one circuit) were used. The distal electrode was placed on the skin over the fibres of the vastus medialis muscle, and the second electrode was positioned over the proximal fibres of the vastus lateralis muscle. Tetanic contractions (10 s on/50 s off) were elicited, to the subject's level of tolerance (below pain threshold). Forces were measured with a tensometric force transducer (S2/1000, Hottinger messtechnik), attached to the ankle cuff and the frame anchor. Peak values were recorded.

Each subject performed the trials 1–3 days after the cast immobilisation had been removed. For the sake of full recovery and to avoid any muscular fatigue, there was a rest period of 48 hours between VOL and NMES (Wigerstad-Lossing, Grimby, Jonsson, Morelli, Peterson, & Renström, 1988) and the two sessions were conducted in a random order. For this reason both groups – patients (P) and controls (C) – were divided into two subgroups – P_1 (n = 13), P_2 (n = 13), C_1 (n = 33), and C_2 (n = 33). Before the first trial (VOL or NMES) basic anthropometric measurements (body mass and height) were collected. Then MVIC and MEEC were measured in subgroups P_1, C_1 and P_2, C_2, respectively. The best of three measurements were accepted as MVIC and MEEC. For MVIC and MEEC, forces were measured for both extremities (injured and non injured), whereas exercises and stimulation were conducted using the injured leg. In the control group a dominant leg was chosen. The measurements were performed in the same manner as exercises and stimulation. Fig. 1 describes the design of the study.

Fig. 1
Experimental setup, abbreviations explained in the text



DATA ANALYSIS

The subjects were divided by gender for analyzing and comparing the forces of knee extensor muscles between experimental (patient) and control groups. For MVIC and MEEC results, a paired t-test was performed to determine whether the maximal forces were statistically different in patients and controls, as well as between injured and non injured extremities. Significance was determined at the 0.001 and 0.05 levels. Mean values and standard deviations of measured values in subsequent contractions during VOL and NMES as well as percentage values were also computed.

RESULTS

MVIC was lesser than in controls and in the non injured extremity – in females by 222.24 N (50.57%, $p < 0.001$) and 204.54 N (52.64%, $p < 0.001$), in males by 361.04 N (50.08%, $p < 0.001$) and 313.23 N (53.64%, $p < 0.001$), respectively. Similarly, MEEC was lesser in females by 62.79 N (36.45%, $p < 0.05$) and 71.96 N (39.68%, $p < 0.001$), in males by 234.06 N (63.80%, $p < 0.001$) and 112.08 N (46.85%, $p < 0.001$). Contraction forces decreased in subsequent contractions during VOL in both genders. In women, the first contraction's force was 93.20% MVIC (44.3% MVIC of the control group). The tenth contraction (75.19% MVIC, 35.60% MVIC of the control group) was weaker than the first one by 18.01% MVIC. In men, the results are as follows: 91.22% MVIC (42.24% MVIC of the control group) in the first contraction, 85.78% MVIC (39.77% of the control group) in the last contraction. In NMES, subsequent measurements differed less, with no tendency towards a linear decrease. Forces were (change commas to points in the following numerals!) 83.5–89.0% of MEEC (45.7–48.8% MVIC, 21.7–23.1% MVIC of the control group) in women and 69.7–79.8% MEEC (28.4–32.5% MVIC, 13.2–15.1% MVIC of the control group) in men, respectively. Fig. 2 and 3 show the peak force values in subsequent measurements during VOL and NMES in both groups and genders.

DISCUSSION

The inclusion criteria (age, activity level) indicate that factors other than injury and immobilisation had no influence on muscle function and the collected evidence (Booth, Weeden, & Tseng, 1994; Halkjær-Kristensen & Ingemann-Hansen, 1985). MVIC measurements, as a reliable, quantitative method of measuring muscle function (Edwards, Young, Hosking, & Jones, 1977; Morrissey, Brewster, Shields, & Brown, 1985; Wigerstad-Lossing, Grimby, Jonsson, Morelli, Peterson, & Renström, 1988), proved that injury in the subjects and three week immobilisation in the experimental group led to a significant muscle force decrease. There was

Fig. 2
Mean values of peak forces produced during subsequent stimulated contractions (NMES) by male and female patients and controls

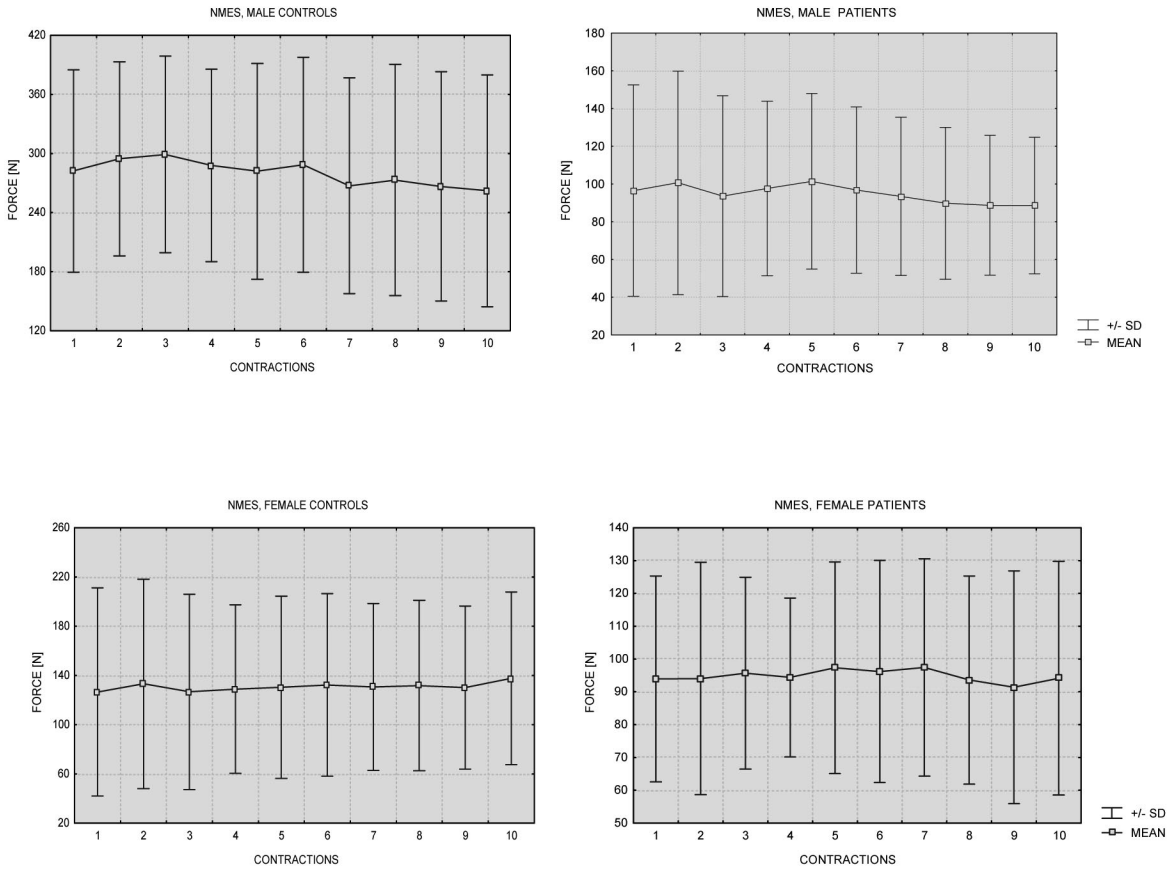
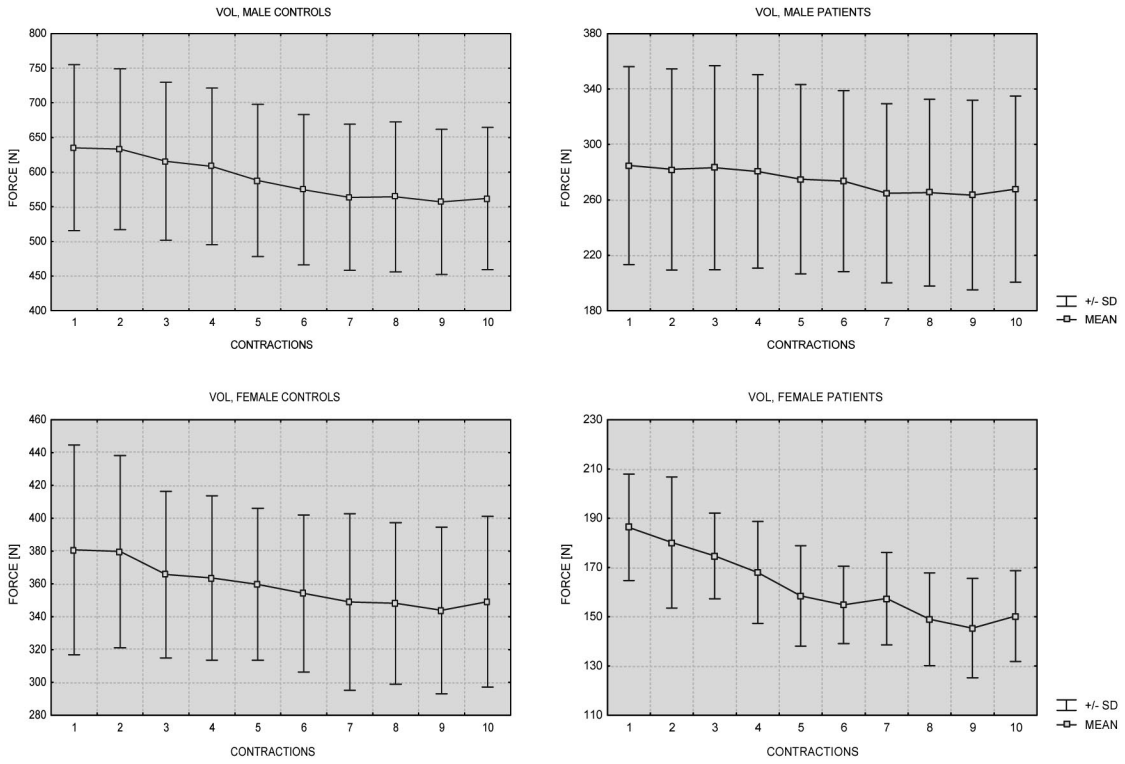


Fig. 3
Mean values of peak forces produced during subsequent voluntary contractions (VOL) by male and female patients and controls



no force loss in the healthy extremity. The ratio of body mass and quadriceps force was 73.76% in women and 88.93% in men, which is in accordance with normal values, according to Edwards et al. (1977). There are no such normal values for MEEC and such measurements are not common. However, values ranging from 37.72% MVIC to 54.75% MVIC (Binder-Macleod, Halden, & Jungles, 1995; Duchateau & Hainaut, 1988; Eriksson & Häggmark, 1979; Lorentzo, Elmqvist, & Sjostrom, 1989; Morrissey, Brewster, Shields, & Brown, 1985). Stimulation was conducted to the level of tolerance, and the contractions were subjectively maximal. It suggests that NMES does not engage the whole muscle, but only motoneurons in the current flow area, which is in accordance with other authors (Adams, Harris, Woodard, & Dudley, 1993; Ogino et al., 2002). We observed no force decrease in subsequent stimulated contractions, in contrast to voluntary exercises. This finding supports Kots's claims of the role of long rest periods between stimulated contractions to avoid fatigue.

CONCLUSIONS

1. Three weeks' post injury knee immobilization leads to a significant quadriceps force decrease.
2. Russian electrical stimulation elicits superficial motoneurons.
3. Isometric exercises of ten strenuous 5 second contractions with 10 second rest periods are more fatiguing than 10/50 second stimulated contractions.

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TORZE KOLENNÍCH EXTENZOROVÝCH SVALŮ BĚHEM IZOMETRICKÝCH CVIČENÍ A RUSKÁ ELEKTRICKÁ STIMULACE PO ZRANĚNÍ KOLENNÍCH VAZŮ

(Souhrn anglického textu)

Dobrovolné izometrické cvičení (VOL) i neuromuskulární elektrická stimulace (NMES) jsou metody rozvoje statické svalové síly. Používají se v programech pro rozvoj síly u zdravých svalů a také pro zotavování svalové funkce za určitých ortopedických podmínek. Obě metody se používají pro zpomalování svalové atrofie a ztráty síly v důsledku imobilizace kolena po zranění (Eriksson & Häggmark, 1979; Ingemann-Hansen & Halkjær-Kristensen, 1985; Johnson, 1988; Wigerstad-Lossing, Tromby, Jonsson, Morelli, Peterson, & Renträm, 1988). NMES může vyvolat záškuby nebo tetanické svalové kontrakce, a to v závislosti na frekvenci proudových impulsů. Během tetanické stimulace jsou hlavními rysy nácvikových režimů:

1) cyklus zapnutí/vypnutí (pracovní cyklus), tvořený dobou kontrakce a dobou uvolnění,
2) počet kontrakcí a
3) intenzita kontrakcí (dána proudovou amplitudou nebo tolerancí subjektu).

Klíčová slova: zranění kolenních vazů, atrofie z nečinnosti, izometrické cvičení, ruská elektrická stimulace.

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CORRELATION BETWEEN THE LENGTH OF THE SKI TRACK AND THE VELOCITY OF TOP SLALOM SKIERS

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Theoretically, the shortest possible line of skiing (ski track) is the best one. But in practice it is very difficult to carry this out and besides it is very risky. It can therefore be only a part of the tactics of the best competitors.

With the help of a kinematic analysis, differences in the choice of a line of skiing between individual competitors were established based on a sample of top competitors in the World Cup in Kranjska Gora. We tried to establish whether the competitors achieved higher velocities with such a line of skiing, thus achieving faster sliding among the slalom gates and in the end a better time.

In the first part of our research it was proven that none of the competitors had an extremely short line of skiing in the first two successive turns. It was also found out that the competitors who had the shortest lines of skiing in the first analysed turn had, as a rule, the longest lines of skiing in the second turn and vice versa. Based on these findings, it could be claimed that under present conditions, it is extremely difficult, possibly even impossible, to ski in such a way that the line of skiing would be very short in several successive turns.

The second part of our research focussed on the establishment of the correlation between the trajectories of the skis and the velocity of skiing. The calculations of the correlations proved a statistically significant correlation between the average velocity of skiing and an average distance of the length of the line of skiing from the y-axis in the entire measured segment. It was established that the measured space was covered faster by the competitors whose line of skiing was shorter, which means more direct.

Keywords: Alpine skiing, technique, slalom, kinematics, velocity of skiing, line of skiing.

INTRODUCTION

In top Alpine skiing, the choice of technical and tactical elements is still left primarily to the momentary intuitive choices of an individual and his/her coach. These choices are probably most important but many times insufficient. In future, the process of coaching should therefore be more oriented towards the perfection of competitive skiing technique under various conditions and in various circumstances. The use of most modern methods of measuring is thus inevitable.

Due to the tendency towards faster skiing, the most obvious step forward concerning the choice of the line of skiing among the gates has been noticeable lately. The choice of a line of skiing and the distance of the line of turns from the gates is undoubtedly an important factor in competitions, especially in technical disciplines. On the basis of the established trajectories in specific segments of skiing it is possible to precisely analyse the segments of the performed movement. The technique that has been significantly improved in the past few years can be defined by these segments (Müller & Schwameder, 2003).

Modern slalom technique has improved to such an extent also due to the development of equipment (geometry of skis). Interestingly, skis with a pronounced side curve became established as late as the 1999/2000 season. There are numerous reasons for this, among other things also a worse quality of materials from which skis were made at the beginning of their development (worse torsion resistance). To make a turn along the edges is conditioned by a marked angling of edges. Due to this, the angle between the skis and the snow surface increases. Increasingly faster skiing causes great loads in turns (Lüthi et al., 2005). Often the skis did not perform well in the turn because of worse torsion resistance. The consequences of this were side slides and imprecise turns.

Today, top competitors strive for increasingly faster skiing along the shortest possible line of skiing. Such a way of skiing is demanding and risky and consequently often not the right way to success. In a competition, success depends on many factors. From the point of view of technique, a good result is a consequence of the best relationship between the velocity of sliding and the choice of the line of turns in a particular pole setting (Pozzo et al., 2005).

We are interested in what is going on with the velocity of skiing in the slalom track. The fundamental question can be raised as to whether top competitors who ski nearer to the pole with a more direct, i.e. shorter, line also reach higher velocities.

A competitor whose line of skiing is more direct at the entry into a turn probably retains the velocity of skiing to a greater extent or he may even increase it. In this case an optimum direction of sliding can be retained only by a physically strong competitor with a perfect technique. Quick changing and angling of edges as well as steering the skis as directly as possible towards the next gate makes a shorter line of skiing from gate to gate possible. Consequently, the velocity and shorter line of skiing cause increased pressure on skis in the phase of making a turn. If a competitor finds the pressure too strong, he must adjust (decrease) the velocity of skiing. Whenever he fails to do it, he must "correct" the selected line of skiing as soon as he reaches the next gate.

Our aim was to find out the average velocities reached by competitors in the measured space. Therefore average velocities that were reached were calculated for each competitor based on velocities reached at the first and the second poles as well as when they changed edges. Simultaneously, we tried to establish whether the average velocity of competitors who ski along a shorter line of skiing is higher than the velocity of competitors who choose a longer line of skiing.

Does a shorter line of skiing ensure faster skiing among the gates?

A shorter line of skiing means a shorter distance or a shorter route of a skier from one gate to another (in the measured space) and is an important factor when studying a given skiing technique. Skis with a pronounced side curve enable competitors to make turns on edges. The condition that has to be satisfied if a competitor wants to start a turn in an optimum way is unweighting and quick changing of edges, angling of edges and steering the skis into a new turn (Matijevec, 2003). Here it has to be mentioned that greater centripetal acceleration is achieved by means of a shorter line of skiing at the same velocity (Žvan, 1997). A modern competitive technique and shorter skis with a more pronounced side curve make this possible. We have to be aware of the fact that in making such turns, friction between the skis and the snow is increased, which results in a greater reduction in velocity in the final part of the turn. Therefore we are faced with a dilemma in which the manner of steering skis through the turn is faster and consequently more successful in the competitive Alpine skiing (Lešnik, 1999).

The present skis are faster in turns. The aim of each competitor is to make the entire turn along the edges without the so called rotation of the skis, which always causes smaller or greater side sliding. The rotation of the skis into a turn was typical of the old technique, and today, it represents only a method of controlling the velocity when skiing between the gates.

The primary task of each coach is to teach a young competitor how to achieve a perfection of technique in skiing. A correct technical performance is a precondition for the further development of a young skier. An ideal model of movement on skis is determined based on the laws of biomechanics from the point of view of the rationality of movement in space, consumption of time and use of physical quantities (Kugovnik et al., 2000). The study of a competitive skiing technique is most realistically based on the analyses of motor structures under competitive conditions. Here we must concentrate on the movement of the competitors in particular segments of the turn. The sequence of movements of the entire body or its parts (points) is important. With the help of suitable parameters, we are trying to analyse complex movement which is described as a skiing turn along an optimum line of skiing over the course.

The choice of the line of skiing among the gates

As has already been stated, several factors exert influence on success in Alpine skiing. Only some of the most important factors will be discussed. Among them, a more or less direct line of a turn at the highest possible velocity must be stressed.

In every sport, the development of an individual sportsperson is based on a pre-developed and determined programme, and Alpine skiing is no exception. Of course, it happens many times that the programme of work and its effective realization begin to diverge. In this case, the programme must be redesigned and adapted to new circumstances that exist in the programme – competitor relationship. First, young competitors must learn a proper technique which is improved in the course of time until it brings about top performance. Later, the priority of coaching the technique should primarily be the development of the highest quality possible of the method of skiing and retaining the highest possible velocity during skiing. During skiing, the velocity keeps changing and it is the task of a competitor to preserve the optimum relationship between decreasing and increasing the velocity (Kugovnik et al., 2005).

In this study, we aimed to resolve the following research problems

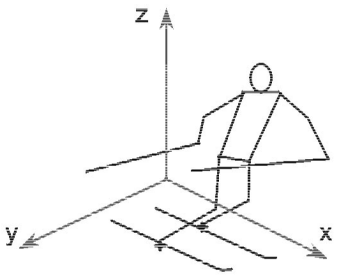
- To establish the differences in the choice of the line of skiing between individual competitors in the World Cup and to determine the distance of their lines of skiing from the pole (fall line) and
- to establish whether the competitors with a shorter line of skiing in the pole setting achieve higher velocities and consequently faster sliding among the slalom gates and finally a better result.

METHODS

The characteristics of the slalom technique were studied on the basis of kinematic measurements taken during the 2004 Vitranc World Cup slalom competition in Kranjska Gora. The test subjects were the best Alpine skiers in the world who competed in the World Cup competitions under the auspices of FIS. The sample of the test subjects comprises 18 competitors chosen from start numbers 2 to 69. This enabled us to take into account the competitors from the whole slalom ranking list who competed in the 2004 World Cup.

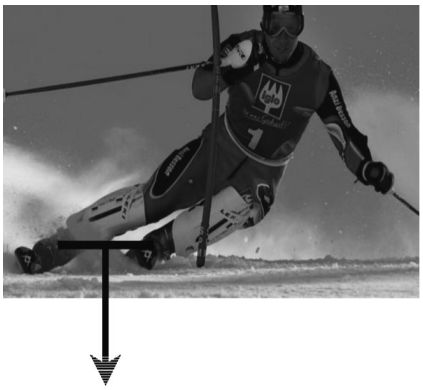
The data obtained were processed at the Institute of sport at the Faculty of Sport of the University of Ljubljana. Each competitor was filmed with three pairs of synchronized cameras with the frequency of 25 Hz (one picture per 0.04 second). We know that the computation of the velocity takes a long period of time, but it was the only one available. The recordings were then analysed with the program for biomechanical analyses (APAS system for kinematic analyses). In this way we obtained the coordinates of the points of ends of segments in space (x and y).

Fig. 1
Model of a human being; 3D system of stiff bodies used for kinematic analysis



On the basis of the distance of points of trajectories of the left and right ankles (arithmetic mean) we calculated for each individual competitor the average distance of the line of skiing from the fall line (y = 0) within the measured space. The measured space comprised two slalom turns. The experience of other researchers shows that the assessment of a skier's successfulness can best be made only if we analyse both turns and we also share this belief. The beginning of the new (and the end of the previous) turn was defined in the measured space for each competitor by means of the moment/place of crossing the trajectories of skis (arithmetic mean of the left and right ankles) and trajectories of the centre of gravity of the skier. The trajectory of the turn is therefore represented by the arithmetic mean of the trajectories of the left and right ankles around two poles (Fig. 2) which were part of the entire pole setting in the first run. The average distance of the line of skiing of the skier from point y = 0 (fall line) was calculated on the basis of the distance of all the points of the trajectory of the skis.

Fig. 2
Representation of the calculation of the arithmetic mean of the position of the skier's ankles. These data were used to calculate the trajectory of the line of skiing (http://www.pranger.cc, 2005)



Arithmetic mean of the position of the skier's ankles

The second variable was the calculation of the average velocities of the skis (arithmetic mean of the ankles) in the measured segment of the slalom course in the competition. The average velocities were calculated on the basis of absolute velocities of the competitors at the first pole, crossing of the trajectories of skis and the centre of gravity of the body (the change of edges) as well as at the second pole. On the basis of the absolute velocity in the points mentioned, the average velocity of an individual competitor was calculated in the measured segment (Vavg) – average velocity of the competitor in the measured segment ($v\ ^{m}/_{s}$).

The average gradient of the slope in the measured space was 23.85 ±2 degrees. After the kinematic analysis the data obtained were processed with the SPSS statistical program. Besides average values of velocities of individual segments of the body (arithmetic mean of the position of the skiers' ankles), the correlation between individual variables which were determined regarding the goals that we had set was calculated.

RESULTS

Analysis of the trajectories of skis of individual competitors in the slalom pole setting

Based on calculation of the trajectory of skis (arithmetic mean of the position of the skiers' ankles), the point of the trajectory closest to the first and second poles was determined for each competitor. In this way we tried to establish whether the distance of the line of skiing at the first and the second poles was similar in top competitors and to what an extent it differed.

TABLE 1 presents the values of the distances of trajectories of skis (from y-axis = 0) at the first pole for each individual competitor and the differences between the lines of competitors in comparison to the competitor (no. 32), who skied closest to the first pole. According to our observations, the lines of skiing can differ by up to more than half a metre. Competitor no. 32 skied closest to the pole at the first gate (difference = 0.0 m), whereas the distance of competitor no. 10 from the first pole was as many as 0.504 metres.

TABLE 1
Differences between competitors regarding the distance of the line of skiing from the y-axis at the first pole

Order	Start no.	Distance at the 1st pole (m)	Difference (m)
1.	32	2.664	0.000
2.	4	2.679	0.015
3.	43	2.718	0.054
4.	9	2.739	0.075
5.	3	2.759	0.095
6.	69	2.795	0.131
7.	2	2.801	0.137
8.	22	2.821	0.157
9.	27	2.832	0.168
10.	21	2.852	0.188
11.	44	2.856	0.192
12.	5	2.870	0.206
13.	55	2.908	0.244
14.	60	2.957	0.293
15.	15	2.964	0.300
16.	6	2.993	0.329
17.	17	3.044	0.380
18.	10	3.168	0.504

TABLE 2 presents the values of the distances of trajectories of skis (from y-axis = 0) at the second pole for each individual competitor and the differences between the lines of competitors in comparison to the competitor (no. 2) who skied closest to the second pole. According to our observations, the distances from the pole do not differ to such an extent (fewer than 30 cm) in comparison to the lines around the first pole. Competitor no. 2 skied closest to the pole at the second gate, whereas the distance of competitor no. 32 from the second pole was as many as 0.289 metres.

It is necessary to point out that the data for the line of skiing of an individual are a result of the arithmetic mean of the position of the skiers' ankles. Different distances between both skis, very often also a more/less stretched out outer leg and therefore the outer ski that is further from or closer to the pole can exert influence on that. The above mentioned data can therefore serve us as mere support in further analyses.

TABLE 2
Differences between competitors regarding the distance of the line of skiing from the y-axis at the second pole

Order	Start no.	Distance at the 2nd pole (m)	Difference (m)
1.	2	3.310	0.000
2.	60	3.350	0.040
3.	15	3.404	0.094
4.	10	3.427	0.117
5.	5	3.443	0.133
6.	43	3.452	0.142
7.	3	3.457	0.147
8.	6	3.480	0.170
9.	22	3.480	0.170
10.	27	3.484	0.174
11.	9	3.489	0.179
12.	4	3.517	0.207
13.	55	3.534	0.224
14.	17	3.540	0.230
15.	44	3.570	0.260
16.	69	3.582	0.272
17.	21	3.590	0.280
18.	32	3.599	0.289

With the help of the calculation of correlations between the distances from the first pole and the distances from the second one, we established whether the distances of the competitors' lines of skiing from the first pole and from the second one were approximately equal. That means that the competitors whose lines of skiing were closer to the first pole were, as a rule, further away from the second pole and vice versa.

TABLE 3
The calculation of the correlation between the distances of the competitors' lines of skiing from the y-axis at the first and second poles

Correlation

		Distance at the 1st pole	Distance at the 2nd pole
Distance at the 1st pole	Pearson correlation	1	-.256
	Sig. (2-tailed)	.	.304
	N	18	18
Distance at the 2nd pole	Pearson correlation	-.256	1
	Sig. (2-tailed)	.304	.
	N	18	18

Legend
Distance at the first pole → distance of the middle part of the ankles along the y-axis at the first pole (in metres)
Distance at the second pole → distance of the middle part of the ankles along the y-axis at the second pole (in metres)
Pearson correlation → value of the correlation coefficient
Sig. (2. tailed) → statistical significance of the correlation coefficient
N → number of test subjects

As a rule, the competitors whose lines of skiing were the shortest in the first turn analysed had the longest lines of skiing in the second turn and vice versa. The shortest line of skiing does not guarantee an optimum entry into a turn, which is also proved by a low and statistically insignificant level of correlation between the distances of the competitors' lines of skiing from the y-axis = 0 at the first and second poles (TABLE 3, Pearson's correlation coefficient = –0.256, Sig. = 0.305). A typical example is competitor no. 32, whose line of skiing was closest to the first pole and furthest from the second pole. At the same time, we have to stress that no competitor had a very short line of skiing at both successive poles in the measured space. No competitor was very far away from both poles from point 0 regarding the y-axis. The question whether it is possible to ski in this way around several successive gates and if it is therefore appropriate. It can be claimed that in slalom it is impossible to talk about the ideal line of skiing and that the optimum line of skiing is the one which guarantees the skier the smallest loss of velocity in turns (Wimmer & Holzner, 1997, 208).

TABLE 4
Competitors listed according to average velocities reached (Vavg) and according to average values of the distance of the line of skiing (line/AVG) from the y-axis (y = 0) in the measured segment

Place	Start no.	Vavg	Place	Start no.	Line/AVG
1	15	12.535 $^{m}/_{s}$	**1**	4	1.267 m
2	10	12.403 $^{m}/_{s}$	**2**	10	1.268 m
3	3	12.389 $^{m}/_{s}$	**3**	55	1.305 m
4	2	12.382 $^{m}/_{s}$	**4**	2	1.344 m
5	5	12.208 $^{m}/_{s}$	**5**	43	1.351 m
6	44	12.166 $^{m}/_{s}$	**6**	5	1.359 m
7	17	12.165 $^{m}/_{s}$	**7**	21	1.366 m
8	4	12.042 $^{m}/_{s}$	**8**	44	1.383 m
9	6	12.038 $^{m}/_{s}$	**9**	32	1.397 m
10	22	11.845 $^{m}/_{s}$	**10**	3	1.410 m
11	55	11.831 $^{m}/_{s}$	**11**	15	1.435 m
12	21	11.796 $^{m}/_{s}$	**12**	9	1.489 m
13	9	11.666 $^{m}/_{s}$	**13**	22	1.525 m
14	27	11.637 $^{m}/_{s}$	**14**	27	1.537 m
15	69	11.532 $^{m}/_{s}$	**15**	6	1.573 m
16	32	11.499 $^{m}/_{s}$	**16**	69	1.574 m
17	43	11.493 $^{m}/_{s}$	**17**	17	1.623 m
18	60	10.82 $^{m}/_{s}$	**18**	60	1.811 m
Mean		**11.914** $^{m}/_{s}$	**Mean**		**1.445 m**

Legend
Vavg → average velocity of the competitor in the measured segment (v $^{m}/_{s}$)
Line/AVG → average value of the distance of the line of skiing (from the y-axis) in the measured segment (in metres)

It is evident from the results (TABLE 4) that competitor no. 15 reached the highest velocity (12.535 m/s) in the measured segment. But as many as 10 competitors skied with a shorter line (1.435 m) in the measured space in comparison to the line of competitor no. 15. The shortest route between the two poles was that of competitor no. 4 (1.267 m), although the same competitor was placed eighth (12.042 m/s) if we take into account the average velocity of sliding within the measured space. Competitor no. 10 is a typical example of fast skiing with the shortest line. He reached the second highest average velocity (12.403 m/s) in the measured space; at the same time, he only slightly lagged behind the first competitor (no. 4) in the distance of the line (1.268 m). Competitor no. 60 was the slowest (10.820 m/s) to cover the measured segment and he also made the longest line (1.181 m). Based on these findings, it can be concluded that individuals can ski faster or the fastest along a shorter or the shortest line (competitor no. 10); on the other hand, competitors whose lengths of lines of skiing exceeded the calculated average (1.445 m) skied, as a rule, through the measured segment with the lowest average velocities.

The sample of test subjects proves that the shortest line of skiing right at the pole does not ensure the optimum entry into the next turn. TABLE 4 shows that competitors with lines of skiing shorter than the average ones covered the measured segment with different velocities. According to the length of lines of skiing (average distance from y-axis = 0), "only" seven out of the first eleven competitors covered the measured segment with velocity higher than the average (no. 4, 10, 2, 5, 44, 3, and 15).

TABLE 5
Calculation of the correlation of average velocities and average values of the length of two turns in the measured segment of the course in the 2004 Vitranc Cup competition

Correlation

		Velocity/AVG	Line/AVG
Velocity/AVG	Pearson correlation	1	–.551*
	Sig. (2-tailed)	.	.018
	N	18	18
Line/AVG	Pearson correlation	–.551*	1
	Sig. (2-tailed)	.018	.
	N	18	18

Correlation is significant at the 0.05 level (2 tailed)

Legend
Velocity/avg → calculated values of the correlation coefficient and statistical significance of velocities in the measured segment
Line/AVG →calculated values of the correlation coefficient and statistical significance of the distance of the line of skiing in the measured segment
Pearson correlation → value of the correlation coefficient
Sig. (2. tailed) →statistical significance of the correlation coefficient
N →number of test subjects

As regards the above mentioned comparisons and results presented in TABLE 4, we also wanted to find

out whether the correlation between the average velocity of skiing and the average distance of the length of the line of skiing from the y-axis in the whole measured segment is statistically significant.

The correlation coefficient (Pearson's correlation coefficient = –0.551) proves that the correlation between the average velocity of skiing and the average distance of the length of the line of skiing from the y-axis in the whole measured segment is statistically significant (Sig. = 0.0018). It has to be pointed out that this is a calculation of the data obtained in two slalom turns skied by competitors using a more or less direct line and reaching particular average velocities. In the measured sample (N = 18), the length of the line of skiing in the whole measured segment (in two successive slalom turns) is correlated with the velocity of skiing in a statistically significant way, which means that the competitors with a smaller average distance from the y-axis in the pole setting (shorter line) reached higher average velocities as a rule. On the other hand, the average velocities of competitors with longer average lines of skiing were lower. It can be concluded that on the basis of an empirical experiment a shorter and more direct line of sliding increases the likelihood of reaching higher velocities and consequently better results.

CONCLUSION

In solving problems in sport it is difficult or even impossible to deal with various aspects; that is the reason why we focussed only on the part of a movement technique that is, in the process of coaching, closely connected with tactics used in the competition; in skiing as well as probably in other sports they are often of crucial importance.

In practice, coaches and competitors believe that a shorter line of sliding is also the fastest one in Alpine skiing. This statement is simple and logical but only if we disregard the fact that the velocity in the turn on skis depends on several factors. When decreasing the length of the radius of a turn the skier's velocity can increase to a borderline and often critical level which still enables the skier to make a turn (using edges). How to choose a line of skiing in a particular pole setting depends on technical and tactical skills, ability, equipment, and numerous other laws (of biomechanics), but the velocity is the factor which conditions the time achieved by a competitor. The limits of the ability to cover the course in a particular pole setting are certainly the highest in competitors who take part in the World Cup competitions. That is why we tried to get the answers to our fundamental questions from these competitors.

In the first part of the study we analysed lines of turns of the competitors at the first and second poles within the measured space and proved than none of the competitors had an extremely short line of skiing in two successive turns (TABLE 1, 2). On the basis of these findings, it can be claimed that under present day conditions, it is extremely difficult, if not impossible, to ski in such a way that the line of skiing would be very short in several successive turns.

In the second part of the study, we investigated the correlation between the trajectories of skis and the velocity of skiing of the measured sample in the measured space (two slalom turns). With the calculated correlation we proved a statistically significant correlation between the average velocity of skiing and the average distance of the length of the line of skiing from the y-axis in the whole measured segment. That means that the competitors whose line of skiing was shorter and more direct skied through the measured segment faster.

It is well known that in skiing among gates the velocity changes during sliding, which depends on the line of sliding (Božič, 2005, 42). In skiing, a competitor decreases or increases the velocity in a turn, which undoubtedly contributes to faster skiing and better results in competitions (Petrović et al., 1987, 85).

The results obtained in the study would certainly be more objective if it had been possible to measure the whole pole setting in the given conditions (World Cup competition). Nevertheless, we managed to obtain some results in a relatively small measured space. These results at least generally prove the orientation towards the coaching of a slalom technique, searching for a possibility of a more direct entry into and performance of a turn. However, it was observed a long time ago that an individual who manages to unite the individual segments of the pole setting into a whole in the best way is successful in a competition.

Today, the difference between a good and the best skier in the World Cup is extremely minor. Therefore it is the selection of the line of skiing through the segment of the length analysed in our study that is an important and often also decisive factor on the basis of which it can be established who will be "only" a good Alpine skier and who the best one.

Tactics is probably the area which is worst developed in our field and we should pay more attention to it. We believe that it is in this area that experts could really make an important contribution to Alpine skiing. We wanted to objectively present the part of a coach's assessments and information that she/he shares with competitors and that are of the utmost importance to everyone. This is the assessment of the velocity of a competitor's skiing.

The difference between a competitor's and coach's perception, on the one hand, and the measured velocity of skiing, on the other, often results in incorrect guidelines in the development of a skier's skiing technique as

well as of his/her tactics. Especially the latter is becoming a decisive factor in the differentiation between good and best competitors.

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KORELACE MEZI DÉLKOU LYŽAŘSKÉ TRATĚ A RYCHLOSTÍ VRCHOLOVÝCH SLALOMÁŘŮ

(Souhrn anglického textu)

Teoreticky je nejlepší co nejkratší lyžařská dráha (lyžařská trať). V praxi je to však těžko proveditelné a kromě toho je to velmi riskantní. Může se proto stát pouze součástí taktiky těch nejlepších soutěžících.

Pomocí kinematické analýzy byly stanoveny rozdíly mezi volbou lyžařské dráhy u jednotlivých soutěžících, a to na základě vzorku vrcholových soutěžících ve světovém poháru v Kranjske Gore. Snažili jsme se zjistit, zda soutěžící dosahovali na takové lyžařské dráze vyšší rychlosti, tedy zda dosahovali rychlejšího pohybu mezi slalomovými brankami a tudíž v konečném důsledku i lepších časových výsledků.

V první části našeho výzkumu bylo prokázáno, že žádný ze soutěžících neměl v prvních dvou po sobě následujících obratech extrémně krátkou lyžařskou dráhu. Bylo rovněž zjištěno, že soutěžící s nejkratšími lyžařskými drahami v prvním obratu měli zpravidla nejdelší lyžařské dráhy v obratu druhém a naopak. Na základě těchto zjištění bylo možno tvrdit, že za současných podmínek je mimořádně obtížné, a snad dokonce nemožné, lyžovat tak, aby lyžařský oblouk byl v několika po sobě následujících obratech velmi krátký.

Druhá část našeho výzkumu se zaměřila na zjišťování korelace mezi trajektorií lyží a rychlostí lyžování. Výpočty korelací prokázaly statisticky významnou korelaci mezi průměrnou rychlostí lyžování a průměrnou vzdáleností délky lyžařské dráhy od osy y v celém měřeném úseku. Bylo zjištěno, že měřený prostor překonávali soutěžící s kratší, tedy přímější, lyžařskou dráhou rychleji.

Klíčová slova: vysokohorské lyžování, technika, slalom, kinematika, rychlost lyžování, lyžařská dráha.

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DEVELOPMENT OF A SKILLS OBSERVATION PROTOCOL FOR SLEDGE ICE HOCKEY – PILOT STUDY

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Over the past few years opportunities have been increasing for individuals with physical disabilities to become involved in physical activities; hence there is a recognition of the importance of mastering sport skills before participation.

Currently there is little research that has been performed on the increasingly popular sport of sledge hockey. A major component of performance is skill analysis. Having recognised its importance and the current unavailability of relevant research in the area, this study used video recordings of the Torino 2006 Paralympic sledge ice hockey tournament to provide a setting in which to produce a skill observation protocol with detailed criteria of what constitutes a mature professional sledge ice hockey skill. Experts in the field were consulted and their feedback enabled the construction of the instrument. Once this protocol was complete a pilot evaluation was done in which players were selected on the basis of statistics from the Paralympics and then evaluated using the protocol. It was determined that the protocol could successfully differentiate between higher and lower level players.

Keywords: Disability, Paralympic games, Torino.

INTRODUCTION

Sledge hockey has been credited as one of the fastest growing winter Paralympic sports. Since its inception as a Paralympic sport in the 1994 Lillehammer games the number of teams, and therefore athletes, participating at an international level has steadily increased. Sledge hockey came into existence in the early 1960's, originating in a rehabilitation centre in Sweden (Lindstrom, 2002). It provided a sport for those who were no longer able to compete (recreationally or competitively) in traditional ice hockey. Norway quickly introduced their own teams and at last count there were approximately ten countries involved in international competition. Eight teams recently competed at the highest level in the 9th Winter Paralympic Games in Torino, Italy (TOROC, 2005a).

When it comes to winter sports, researchers have traditionally focused on able bodied sports which are more established and well known disciplines and much literature exists on ice hockey, Alpine and Nordic skiing. The overall focus of these studies appears to be the optimization of performance as most will agree that this is the main goal in researching sports; to ensure that the competitors have the maximal advantage in technique, physiological variables and psychological techniques. While the research questions vary, the aim or goal of research into competitive sport is to enhance individual and team performance.

To this day there has been little research performed on sledge ice hockey and consequently the information is scarce on performance parameters, psychological variables or physiological comparisons. As there is still so much to be done it is necessary to examine the current availability of research to direct the most appropriate research questions in beginning to investigate sledge hockey. To date, the research on skills and hockey is focused on ice hockey for able bodied athletes and field hockey; however there is much we can learn from these sports as sledge ice hockey shares many characteristics (SLOC, 2001). Where it differs the most is in equipment. The sledge and sticks used in sledge ice hockey are unique to the game (Doyle, n. d.) The sticks allow the athlete to maneuver the sledge as well as to shoot and deal with the puck. In international competition the rules, which have been developed from standard hockey, are governed by the International Paralympic Committee. One major difference is the penalty for teeing, which does not exist in standard hockey (International Paralympic Committee, 2005).

For many years researchers have been investigating ways to maximize the parameters of performance. Much research exists on the psychological aspects of ice hockey. References exist for coaches and athletes, as many believe that improving mental skills is often an excellent way to improve on ice performance (Miller, 2003).

There are countless other tests and methods to investigate general sport performance depending on the

requirements of the sport, the availability of equipment, the desired results, and many more parameters. Field tests and laboratory tests exist for ice hockey; the 20 m shuttle run has been adapted for ice sports (Kuises, 2003) as a way to measure aerobic capacity in the most sport specific way and provide more detailed information on ice hockey performance.

While it can be noted that all components of performance are necessary to maximize individual performance, it is interesting to observe that at least half of the components mentioned in the relevant studies are skill related (Doroshuck & Marcotte, 1965; Hermiston, 1975; Merrifield & Walford, 1968) therefore making the assessment of skills imperative in any sport, including sledge ice hockey.

The weight of evidence seems to suggest that the research into ice hockey skills and their measurement is not altogether recent. However while the evidence base might not be there, there is a significant number of tools being used in clubs and teams all over the world to determine the skill level of ice hockey players. These observational tools are used for many purposes:

a. identifying strengths and weaknesses of players,
b. as a coaching tool to enable coaches to break down skills to better teach their athletes how to perform the given skill to the highest level,
c. in identifying talent,
d. to monitor performance.

Such an observation instrument currently exists for wheelchair basketball but not for sledge ice hockey. Zwakhoven, Evaggelinou, Daly and Vanlandewijck (2003) identified the need for an observation protocol for skill proficiency for similar reasons to those which have been identified for the use of such a tool in the sport of sledge ice hockey. The skills protocol developed by Vanlandewijck and colleagues included 7 skills with between 3 and 6 criteria each. The researchers selected the dribble, bounce stop, bounce spin, passing, catching, the shot and the lay up as the skills they would choose to describe. They used video observation and expert validation to create a useful instrument. This research set out to do the same thing for the sport of sledge ice hockey. This study aimed to develop an observation protocol of the skills used in sledge ice hockey and provide a detailed description of the criteria that constitute a mature skill level.

METHODS

Participants

The players involved in this study were sledge ice hockey players playing at the Paralympics in Torino, March 2006. There were 8 teams and a maximum of 15 players per team. Teams were from Great Britain, Canada, the United States of America, Japan, Norway, Sweden, Italy and Germany. Ages of the players ranged from 15 years old to 58 years old. Of the 40 players whose disability was recorded in the player profiles, over half (22 players) have an amputation, varying from a single leg below the knee amputation to bilateral hip amputations. Other disabilities that are listed include paraplegia, spina bifida, spondyloschisis and cerebral palsy (TOROC, 2005b).

Procedure

In order to be able to describe the most mature skill possible, it was necessary to collect data at the most elite level of competition. In the winter Paralympic games in Torino, March 2006, 8 teams competed in the sledge ice hockey tournament. The competition consisted of 2 pools who then participated in preliminary games. These preliminary games consisted of 12 games over a period of 3 days. All preliminary games were recorded on handheld video recorders (50 HZ) and individual players were filmed on and off for a total time of 10–20 minutes during the games they played. The players were followed regardless of the puck's position and as closely as possible while still ensuring that their figure remained fully visible on the screen at all times.

Formation of the checklist

This recordings data was combined with coaching manuals and IIHF regulations for standard hockey through which the major skills for sledge ice hockey were isolated. The video observations were watched to closely monitor movements and positions of players with respect to their sledges, the puck, and other players. All were designed to glean as much information as possible for each skill. Each skill was listed according to whether it was offensive or defensive and corresponding criteria were listed for each skill. As many criteria as possible were recorded.

Validation by experts and the creation of an observation protocol

This original criterion was sent out to a panel of experts including the coach of the United States sledge hockey team, a previous player with nearly 10 years experience in playing, administration and coaching sledge hockey and a manager from the Czech Republic national team. These experts were able to give feedback, change skill descriptions, change criteria or modify any of the skill descriptions or individual criteria. This information was then used to formulate the observation protocol. Additions were considered and then entered and the criteria were limited to 4 to 6 key points for each skill. This information was tabulated and justifications and observational directions were created for each skill to

aid observers when utilizing the document. A scoring system was also created depending on the number of observations recorded and successful performance of the given criterion.

Pilot evaluation of protocol

Once the observation protocol was finalized, 20 players were selected from the Torino Paralympic video recordings in order to analyse their performance using the protocol. This was done by first selecting the two top teams (Canada and Norway) and two bottom teams (Italy and Great Britain) from the Torino results and statistics. From each of these teams five players were selected based on the scoring leaders and plus minus leaders for the top teams and based on the lowest number of points for the two teams ranked in 7th and 8th position. These players were evaluated using the protocol to observe any differences. Players were scored firstly depending on whether they could be observed performing the criterion. If a player was not observed with regard to a particular criterion they scored a 0 for that point. If they could be observed once or twice with regard to a specific criteria then they received a score of 5 out of 10 for that point and if the player was observed with regard to a selected criterion three or more times then a score was calculated, depending on the ratio of successfully performed criteria to those which were, non-successfully, observed. For example, if a player is observed during pass receiving the first criteria is "immediate control of the puck". If the player was able to show this criterion 4 out of the 5 times they were observed for this, then they received a score of 4/5 or 8 out of 10. The scores for the criteria are tallied to give a score for each skill. The skills were then broken up into groups of similar skills giving 4 sub groups.

To calculate the scores for the sub groups each skill was given a ratio of how often it generally is used in a game, which was determined from the video observations. The scoring for the sub scores then would look as follows:

Sub score 1 = (0.7 * skating with the puck – total) + (0.3 * receiving checks total).

Sub score 2 = (0.5 * passing total) + (0.5 * pass receiving total).

Sub score 3 = (shooting total).

Sub score 4 = (0.8 * body checks total) + (0.2 * stick checks total).

Sum of sub score 1 + sub score 2 + sub score 3 + sub score 4 = TOTAL score.

Statistical analysis

In order to determine whether the group of more successful players could be distinguished from the group of less successful players based on skill observation, a Mann-Whitney U test was done to discover whether there were statistically significant differences between the sub scores and the total scores of the two groups (Canada + Norway as opposed to Italy + Great Britain). Spearman's correlation was performed to determine whether there was correlation between the sub scores to each other and also to the total score.

RESULTS

From the video recordings and ice hockey literature the checklist was created with 14 skills and key points for each. A full list of original key points can be gained from the author. Below is a list of the included skills.

Skills classification

Offensive skills

1. Skating with the puck dribbling.
2. Skating without the puck.
3. Receiving checks.
4. Deke.
5. Passing.
6. Pass receiving.
7. Shooting:
    - wrist shot,
    - slap shot,
    - flip shot.

Defensive skills

1. Checking without contact-angling.
2. Checking with contact:
    - body check,
    - stick check,
    - poke check.
3. Intercepting passes.

After input from the experts who made modifications to criteria and skills, the list was confined to 8 skills with between four and six criteria each. The skills were: skating with the puck, receiving checks, passing, pass receiving, shooting, checking without contact, body checking and stick checking. An example from the final observation protocol is in Fig. 1. A complete observation protocol can be obtained from the author.

After evaluation of 20 players, their sub scores for each skill and total scores were recorded. There was a large difference evident between the top teams in the tournament of Norway and Canada and the lower teams of Great Britain and Italy. The break down between sub scores can be seen in TABLE 1.

Fig. 1
Example of item from observation protocol (skating with the puck)

Control of puck with no loss of speed									
Puck stays within area of control									
Puck should be shielded from defensive players									
Control maintained while changing direction									
Head and eyes not fixed on puck									
Player uses both hands									

TABLE 1
Pilot evaluation results (descriptive information on sub scores)

Team	Sub score 1	Sub score 2	Sub score 3	Sub score 4	Total score
Canada	52.8	50	32	32	166.8
	38.5	50	0	36	124.5
	46.5	45	20	29.6	141.1
	52.2	50	20	22.4	144.6
	46.6	46.75	20	20	133.35
Norway	53.5	50	40	0	143.5
	48	38.75	15	0	101.75
	46.5	48.75	20	16	131.25
	49.25	43	0	20	112.25
	44.85	38.75	20	36	139.6
Great Britain	1.5	35	0	17.8	54.3
	4.5	10	20	11.6	46.1
	22.5	20	0	12	54.5
	7	27.5	0	16	50.5
	22.5	22.5	0	6	51
Italy	3.5	0	0	0	3.5
	1.5	0	0	0	1.5
	8	5	0	20	33
	0	20	0	8.64	28.64
	1.5	4.5	0	6	12

Statistical analysis showed statistically significant differences between the sub scores and the total scores of the successful teams compared to the non successful teams (TABLE 2).

TABLE 2
Differences between sub scores

	Sub 1	Sub 2	Sub 3	Sub 4	Total
Mann-Whitney U	.000	.000	14.500	21.500	.000
Wilcoxon W	55.000	55.000	69.500	76.500	55.000
Z	-3.788	-3.798	-2.985	-2.168	-3.780
Asymp. Sig. (2-tailed)	.000	.000	.003	.030	.000
Exact Sig. [2* (1-tailed Sig.)]	.000	.000	.005	.029	.000

Correlation also showed reasonable correlations between sub scores and total scores with the exception of sub score 4 (checking). While a significant correlation existed, it was considerably lower than the other sub scores (TABLE 3).

TABLE 3
Correlations of sub scores

		Sub1	Sub 2	Sub 3	Sub 4	Total
Sub1	Correlation coefficient	1.000	.827	.702	.354	.881
	Sig. (2-tailed)	.	.000	.001	.125	.000
	N	20	20	20	20	20
Sub 2	Correlation coefficient	.827	1.000	.645	.554	.929
	Sig. (2-tailed)	.000	.	.002	.011	.000
	N	20	20	20	20	20
Sub 3	Correlation coefficient	.702	.645	1.000	.247	.769
	Sig. (2-tailed)	.001	.002	.	.295	.000
	N	20	20	20	20	20
Sub 4	Correlation coefficient	.354	.554	.247	1.000	.600
	Sig. (2-tailed)	.125	.011	.295	.	.005
	N	20	20	20	20	20
Total	Correlation coefficient	.881	.929	.769	.600	1.000
	Sig. (2-tailed)	.000	.000	.000	.005	.
	N	20	20	20	20	20

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

DISCUSSION AND CONCLUSIONS

Skill level is an important and measurable characteristic of performance. As no instruments have previously existed for the observation of skills within the sport of sledge ice hockey there was a conclusive need for such a tool to be developed to further enable players and coaches to evaluate and assess skills and, through this, performance. This study aimed to first provide such a tool, including detailed description of the skills involved in sledge ice hockey and then to perform a pilot

evaluation of the instrument to begin to assess whether it would be useful in the future. The results show that:

- The protocol achieved its goal and showed significant differences in observable skills between players who were more successful in competition compared to those who were less successful.

Researchers have confirmed that much of an ice hockey game is spent waiting for the puck or skating without the puck (Lafontaine et al., n.d.) and this was also clearly evident in the observation of sledge ice hockey. The skill was left out after the validation of experts as it was felt that much like the checking without contact it is impossible to observe in this manner. If future research found a way to include it in an observation protocol it would be interesting as there can be arguments made that it is an essential skill that all players should master before playing at a high level, however it could be seen from the recordings made at the Torino Paralympics that some teams, especially the Italian team, had large amounts of trouble with this as a skill.

Researchers have found in the past that teams play as well as possible regardless of a game's importance in a series (Ferrall & Smith, 1999); however it was clearly seen in the recordings that Norway in particular, played differently when playing a team like Italy than a team like Canada. When opposing Italy, the Norwegian players recovered from checks more slowly, skated less aggressively and were less protective of their puck handling. Therefore it would be interesting in future to apply the observation protocol in different situations and compare the results. For the purposes of this study this phenomenon did not interfere with the results as the more successful teams still scored higher on the skills protocol, however it would be interesting to know whether the difference would have been more pronounced if there was more pressure or whether Norway performed more skills more successfully when playing more challenging games.

Further research should be performed to determine inter and intra tester reliability. Also it is recommended that future studies again closely look at the skills involved in sledge ice hockey and determine whether it is in some way useful or possible to include the skills of skating without the puck and checking without contact as these were determined to be important skills by this research, although the observation was found to be beyond the scope of the current project. Once the protocol has been refined, reliability tested and an extension of the pilot evaluation performed, this observational protocol could be of great use to coaches, trainers and athletes in sledge ice hockey.

A limitation of this study was the number of players that were used in the pilot evaluation. While there were obvious differences found when looking at 10 successful players and 10 less successful players it resulted in the use of non-parametric statistics. While it would have been useful to look at effect size and parametric results the number of participants could not justify using different statistics. Perhaps in future all of the players in the competition could be evaluated and some interesting trends or details that were unavailable in this study could be found.

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VÝVOJ PROTOKOLU O POZOROVÁNÍ DOVEDNOSTÍ PRO SLEDGE HOKEJ – PILOTNÍ STUDIE

(Souhrn anglického textu)

V průběhu několika posledních let vzrostly možnosti jedinců s tělesným postiženým zapojit se do fyzických činností. Z tohoto důvodu je uznáván význam zvládnutí sportovních dovedností ještě před samotnou účastí v soutěžích.

O stále oblíbenějším sledge hokeji bylo dosud provedeno málo výzkumů. Hlavní složkou výkonu je analýza dovedností. Vzhledem k její uznávané důležitosti a současnému nedostatku příslušných výzkumů na tomto poli jsme při této studii využili videozáznamů z paralympijského sledge hokejového turnaje z Turína v roce 2006, které nám poskytly možnost vytvořit protokol o pozorování s podrobnými kritérii toho, co utváří vyspělé profesionální sledge hokejové dovednosti. Proběhly konzultace s odborníky z tohoto odvětví a jejich zpětná vazba nám umožnila vytvořit tento nástroj. Po dokončení protokolu jsme provedli pilotní vyhodnocení, pro které byli hráči vybíráni na základě statistik z paralympijských her. Tito hráči byli poté pomocí našeho protokolu hodnoceni. Bylo prokázáno, že protokol dokáže úspěšně rozlišovat hráče vyšší a nižší úrovně.

Klíčová slova: tělesné postižení, paralympijské hry, Turín.

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FUNCTIONAL AND DYNAMIC ASYMMETRY IN YOUTH AGED 14 AND 16 YEARS (COMPARATIVE RESEARCH)

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This research purpose is an evaluation of the degree of lateralization in 14 year old youth and a comparison of the obtained results with the results of the research carried out in the same group of youth two years later (16 year olds). Effective identification of the level of lateralization is extremely significant for the practice of didactic and educational work, and it is becoming one of the priorities in the fight against difficulties in learning and eliminating developmental dysfunctions. Knowing that lateralization is a characteristic of human development, getting to know its state and determinants may be one of the basic conditions of an effective influence of the teacher.

The research was carried out in one of a number of randomly selected towns in Lower Silesia. For research purposes first grade students were selected (60 students, including 30 girls and 30 boys). Verified tests by Koszczyc and Sekita (Osiński, 2003) were used for the purposes of assessing functional and dynamic asymmetry. The research project enabled its authors to accomplish the objective of the present work. During the two years, changes occurred both in functional and dynamic asymmetry. The percentage of persons with a determined profile and a determined direction of functional asymmetry increased. Also the level of dynamic asymmetry of the examined motor abilities increased. The above described changes pertain to both the group of girls and the group of boys although their intensity was greater in the group of boys.

Keywords: Lateralization, functional and dynamic asymmetry, teenagers.

INTRODUCTION

Among the factors stimulating the proper psychophysical development in children, the importance of a diversified level of efficiency of both sides of the human body, so called lateralization, is underestimated. The term may be translated into "one sidedness" or as a function based dominance of one side of the body over the other one located on its opposite side. The dominance pertains to the upper limbs, lower limbs and paired sense organs, particularly the eyes. Lateralization is a process which is gradually intensified during the general motor development of a child. This process results in morphological and functional diversity in the development of the right and left side of the human body. Such diversity is closely connected with the functional supremacy of one of the cerebral hemispheres. Lateralization is a natural, inevitable process; a process that is characteristic of humans. It is one of the regularities of the psychomotor development of people (Spionek, 1965; Zazzo, 1974; Hurlock, 1985). The process of lateralization is usually completed around the age of 12 years (Bogdanowicz, 1992). There are children, however, whose maturity with regard to the lateralization of motor activities is delayed and is not completed at this stage of life (Zazzo, 1974). When the process of lateralization is accomplished it is usually referred to as the asymmetry of the body. The sciences on physical education single out, e.g. functional and dynamic asymmetry. Functional asymmetry is the privileged position (motor supremacy) of one side of the body to the disadvantage of the other side of the body in the performance of everyday activities. Dynamic asymmetry is diversity existing between the limbs or organs located on the opposite side of the human body, e.g. the difference in speed, agility and other features or properties of human motricity (Koszczyc, 1991).

In the study on adults most frequent is the clear supremacy of one side of the body over the other one regarding motor and sense organs. Such a phenomenon is called unilaterally determined dominance. In the population there are also individuals with determined, although non unilateral dominance (cross dominance), with lateral dominance regarding the motor and sense organs yet on different sides of the body. Apart from those with an established dominance, there are also people without clear differences in relation to the frequency of using organs of both sides of the body. Such persons are described as bilateral. Bilateralness is not a normal phenomenon and it usually involves a delay or lack of the process of lateralization. The view that bilateral children use two sides of their body equally well is wrong. Comparative study of the efficiency of hands in children with different degrees and models of

laterality proved that the efficiency of their hands in primarily ambidextrous children is close to the efficiency of hands among "worse" children, i.e. children strongly lateralized early on (Spionek, 1985). Ambidextrousness is the least favorable formula from the point of view of children's psychomotor balance. Ambidextrous children are usually of little physical efficiency; they tend to have problems with coordination, especially when both hands are involved in the performance of precise movements. More frequently than properly lateralized children, they show spatial orientation disorders. These children have problems with learning to read and write (Spionek, 1965, 1985; Stokłosa, 1980). Difficulties in motor learning, especially in learning complex motor activities are also present (Koszczyc, 1991; Wieczorek, 2001, 2003). Also the occurrence of cross dominance may be the reason for failures at school among those students. The research showed that cross dominance in children quite often causes disorders in reading and writing which consist in confusing letters of similar shapes but of different position (letters d and b, p and b, etc.). Spionek (1965) found that among children with difficulties in reading and writing as many as 60% of cases of cross lateralization were discovered, whereas among children reading properly only 38%. This opinion is not accepted by Zazzo (1974), who claims that cross lateralization (eye – hand – cross – hand – eye) is not the reason for the above described difficulties, sometimes it accompanies them only. The contemporary research leans towards the latter concept for in the population of adults about 1/3 shows left eyedness or two eyedness and as many as around 90% right handedness, which makes the presence of cross lateralization quite common. No correlation between handedness and eyedness has been found, which indicates that these are variables independent from each other (Bogdanowicz, 1992).

The above deliberations present the essence and importance of lateralization for the normal psychophysical development of humans. Knowing that lateralization is a regularity of human development, getting to know its status, its conditions and changes is one of the basic prerequisites for the effective influence of a teacher. Identification of the level of lateralization of a child is extremely important for the practice of didactic and formative work and may become one of the tools in a struggle with difficulties in learning and in elimination of the developmental dysfunctions of a young person. The above views, opinions and data account for the objectives of our paper.

The cognitive objective of the present work is to evaluate the changes regarding lateralization during a span of two years in the life of 14 and 16 year olds. The research by Wieczorek (2001, 2003) carried out on 10 and 13 year olds showed that a significant percentage of the children in question represent a low level of body asymmetry and reveal constant changes in the size and direction of their asymmetry. Yet, research carried out by Koszczyc and Surynt (2000) and by Surynt (2003) indicates that functional asymmetry of the hands and eyes is developed even in 7 year olds and the subsequent changes relate only to the size of the dynamic asymmetry.

With this in mind the question as to whether the process of lateralization is actually completed around the age of twelve, according to professional literature (Hurlock, 1985; Spionek, 1985), becomes more and more important, or whether due to the presence of a secular trend, lateralization has also changed its dynamics and the borderline of the final development of body asymmetry has been shifted.

The practical objective of the paper was to find out whether there is a necessity for didactical effect towards stimulating lateralization among secondary college preparatory school aged youth (14 and 16 year old students), assuming that the level of asymmetry is vital to effective learning and motor activities.

The following assumptions were made at the initial stage of research:

1. In the studied group of girls and boys, during the two years, there were no significant changes concerning the direction and profile of functional asymmetry.
2. Among the subjects significant changes concerning dynamic asymmetry took place.
3. There are dimorphic differences, among both 14 as well as 16 year olds concerning functional and dynamic asymmetry.

MATERIALS AND METHODS OF RESEARCH

The research was carried out in one of a number of randomly selected towns in Lower Silesia (Dolny Śląsk). For research purposes first year students have been selected (60 students, including 30 girls and 30 boys). At the time of research the subjects were not younger than 13 years and 3 months of age and not more than 14 years and 2 months old. Two years later the same group of girls and boys underwent tests.

TABLE 1
Morphological characteristics of examined youth aged 14–16 years

Feature		14 year old girls	16 year old girls	14 year old boys	16 year old boys
Body mass (kg)	$\bar{x}$	51.3	51.6	50.4	52.6
	SD	6.7	6.9	8.5	8.4
Height (cm)	$\bar{x}$	158.9	162.4	158.5	162.2
	SD	6.5	6.4	8.6	7.6

$\bar{x}$ – arithmetic mean, SD – standard deviation

General morphological characteristics and social and living standard assessed in the studied group of subjects. The height and body mass of the students were analysed (TABLE 1). During the two years the morphological parameters of the examined youth changed. First of all, the height of the subjects increased (girls on the average by 3.5 cm and boys on the average by 3.7 cm). The increase of the body mass within the group of girls was insignificant (mean increase by 0.3 kg) whereas in the group of boys their body mass increased by 2.2 kg on the average.

TABLE 2
Sequence of test trials in the study on functional asymmetry

Trial		Evaluation of activity
1.	Hand	Which hand does the subject use to greet a teddy bear with a handshake?
2.	Hand	Which hand does the subject use to draw?
3.	Eyes	Which eye does the subject use to watch the bottom of a mug?
4.	Legs	Which leg does the subject use to leap forward to cover a selected distance?
5.	Hands	Which hand does the subject use to carry a package?
6.	Eyes	Which eye does the subject use to watch the pattern in a kaleidoscope?
7.	Legs	Which leg does the subject use to kick a tennis ball at a target?
8.	Hands	Which hand does the subject use to throw a tennis ball at a target?
9.	Legs	Which leg does the subject use to make the longest jump?
10.	Hands	Which hand does the subject use to greet a teddy bear with a handshake?

Many authors believe that the education level of parents affects quality of life, which means: cultural and hygienic conditions at home and the model of living and consuming (Przewęda, 1985; Ignasiak, 1988). The majority of subjects come from a poorly educated environment. More than half of the parents (56%) have only a vocational education, 12.5% have only a primary school or basic education and only 6.6% have higher education. About 65% of the parents of the subjects regarded their financial status at home as being poor. Among them 39% of the parents are unemployed, with half of them not being entitled to any benefits.

Verified tests by Koszczyc and Sekita (Osiński, 2003) were used for the purposes of assessing functional and dynamic asymmetry. The test consists of two parts. The first part of the test determines the direction of functional asymmetry (TABLE 2) (percentage of individuals with a given sidedness) on the basis of the observation of the free choice of the eye, hand and leg by the subject for the purpose of completing a given motor task. Following the assumption made by the authors of the test the credibility of results is higher, the more focussed on the completion of a task the subjects are, and not on the choice of the limb or eye for completion thereof. Therefore the description of the trials and the way they are carried out have been presented in the form of tasks. On the basis of obtained results the profiles of functional asymmetry in the eye – hand – leg system are developed. In the overall human population, three profiles of asymmetry may be distinguished, and they are as follows:

- a determined homogenous profile, when the tested motor and sense organs dominate on one side of the body;
- a determined non homogenous profile, known also as a cross profile, when motor and sense organs dominate, yet on different sides of the body and
- an undetermined profile, in other words a weak profile, when at least one of the examined organs does not show determined sidedness (Bogdanowicz, 1992).

In the second part of the test based on the difference in the results of tasks performed by means of the right and left upper and lower limb, the degree of dynamic asymmetry is evaluated. The evaluation refers to two motor abilities – power and speed. The employed test encompasses four tests: the tapping on the circles test for the purpose of determining the speed of manual movements, the tapping test by Fleishman to determine the speed of movements of the lower limbs, pushing the medicine ball (1 kg) in a sitting position for the power of upper limbs power and the one legged jump test from the spot to measure the power of lower limb muscles. The statistical quantity of the difference pertaining to the results of the right and the left side of the body translates into the size of the asymmetry. The study by means of the functional asymmetry test had been implemented before the study by means of the dynamic asymmetry test. The tests were carried out in accordance with a given order with the assistance of PE teachers in the school gym, with each part of a test performed during one day. The measurement of the selected morphological features, height and body mass, was made with the help of the school nurse. All acquired data was developed statistically in the computational center at the University School of Physical Education in Wrocław. The data connected with the characteristics of the environment of the examined children comes from the questionnaire for parents/guardians of the high/middle school students which was to be filled in by the parents at the beginning of the school year in the first grade.

TABLE 3
Lateralization profiles in groups of 14 year old girls and boys (%)

Type of lateralization profile	Examined groups	
	Girls	Boys
Determined unilateral	76.6	36.7
Determined crossed	6.7	20.0
Undetermined	16.7	43.3

TABLE 4
Direction of sidedness in groups of 14 year old girls and boys (%)

Examined motor or sense organ	Examined groups					
	Girls			Boys		
	KP	KL	NN	KP	KL	NN
Eye	**80.0**	20.0	0.0	**56.7**	43.3	0.0
Upper limb	**80.0**	13.3	6.7	**73.3**	0.0	26.7
Lower limb	**76.7**	10.0	13.3	**76.7**	6.7	16.6

Legend
KP – right side direction, KL – left side direction
NN – unspecified direction

TABLE 5
Lateralization profiles in groups of 16 year old girls and boys (%)

Type of lateralization profile	Examined groups	
	Girls	Boys
Determined unilateral	76.6	46.7
Determined crossed	16.7	40.0
Undetermined	6.7	13.3

RESULTS

Functional asymmetry in examined groups of 14 year old girls and boys

The comparison of 14 year old girls and boys as regards functional asymmetry showed that both its profile and direction diversified the examined groups. The girls, 83.3%, had a determined profile of functional asymmetry, whereas boys had the determined profile only in 56.7% of the subjects. Among girls with an established profile as many as 76.6% had a homogenous type of profile. Only 16.7% of the examined girls had a non established profile of functional asymmetry and among boys this was the case in as many as 43.3% of the cases (TABLE 3). Among girls, with respect to all examined motor and sense organs, the right side direction prevailed. Lower limbs turned out to be the least directed but the eyes proved to be the most directed, however. Among boys the right side direction dominated, too, yet its domination was manifested in a less vivid way than in the group of girls. The upper limbs, however, showed themselves to be the least directed (TABLE 4). The presented research results, concerning profiles and directions of functional asymmetry in the group of girls and boys, show that in the group of 14 year old girls the process of lateralization is by far more advanced than in 14 year old boys. In the group of boys more subjects had a non determined profile and an unspecified direction of functional asymmetry. This fact indicates that the process of lateralization in the group of 14 year old boys is not finished yet. This may be connected with the later maturity of boys. For girls the time referred to in this work is already adolescence and the above discussed processes are faster.

Functional asymmetry in the examined groups of 16 year old girls and boys (the same group examined two years later)

The comparison of 16 year old boys and girls in connection with the profile and direction of functional asymmetry showed us that both its profile and its direction diversified the studied groups. Girls (93.3%), and 86.6% of boys, demonstrated a determined profile of functional asymmetry. Yet, an established homogenous profile definitely dominated in the group of girls (76.6%). Only 6.7% of the tested girls, and respectively as many as 13.3% of the boys, had a non determined profile of functional asymmetry (TABLE 5). The right side direction prevailed in both girls and boys in relation to all studied motor and sense organs. The least directed were the lower limbs whereas the eyes were most directed. As far as the direction of the upper limb was concerned girls had an established direction and among boys 6.7% still had an undetermined direction (TABLE 6). The presented research results concerning the directions and profile of functional asymmetry in the group of girls and boys show that within the group of 16 year olds the process of lateralization is more advanced among girls. Boys have undetermined profiles and undetermined directions more frequently as regards the asymmetry of body functions.

TABLE 6
Direction of sidedness in groups of 16 year old girls and boys (%)

Examined motor or sense organ	Examined groups					
	Girls			Boys		
	KP	KL	NN	KP	KL	NN
Eye	**80.0**	20.0	0.0	**56.7**	43.3	0.0
Upper limb	**86.7**	13.3	0.0	**90.0**	3.3	6.7
Lower limb	**83.3**	10.0	6.7	**80.0**	13.3	6.7

Legend
KP – right side direction, KL – left side direction
NN – unspecified direction

TABLE 7
Characteristics and differences in motor efficiency of right and left side of the body in 14 year old girls and boys

Feature	Side		Examined groups of 14 year olds		Student's t-test
			Girls	Boys	
Speed of movements: upper limbs [number]	P [right]	$\bar{x}$	66.60	72.07	-3.39**
		SD	5.23	7.11	
	L [left]	$\bar{x}$	62.93	65.27	-1.38
		SD	5.89	7.15	
Speed of movements: lower limbs [number]	P	$\bar{x}$	57.20	60.87	-2.37*
		SD	4.66	7.01	
	L	$\bar{x}$	53.27	55.40	-1.39
		SD	4.71	7.03	
Strength of muscles: upper limbs [cm]	P	$\bar{x}$	43.27	63.40	-5.99***
		SD	7.58	16.79	
	L	$\bar{x}$	37.73	56.13	-6.45***
		SD	7.70	13.68	
Strength of muscles: lower limbs [cm]	P	$\bar{x}$	111.73	121.87	-3.09**
		SD	8.20	15.96	
	L	$\bar{x}$	109.23	114.57	-1.58
		SD	9.14	16.01	

Legend
P – right side, L – left side
$\bar{x}$ – arithmetic mean, SD – standard deviation
* – statistically significant values (number of asterisks accounts for the degree of statistical significance)

The comparison of research results among 14 year old and 16 year old girls and boys (the same group examined two years later) in relation to functional asymmetry

The comparison of the studied groups of 14 and 16 year old youth in relation to functional asymmetry proved that changes took place, thus showing that lateralization is still at the stage of formation. Of 14 year old girls, 83.3% had a determined profile of functional asymmetry, whereas in 16 year old girls the determined profile was demonstrated by 93.3% of the female subjects. Even a bigger increase of established profiles was present in the group of boys. In 14 year olds it accounted for only 56.7% and in 16 year olds it increased to 86.6% (TABLE 3, 5). Also changes in the direction of functional asymmetry were noticed. In the group of boys a decreased number of those with an undetermined direction of functional asymmetry concerning the upper and lower limbs was observed. Among 14 year old boys it accounted for 26.7% in relation to the upper limbs and 16.6% in relation to the lower limbs. Among 16 year olds it amounted to only 6.7% as regards the upper and lower limbs. Among 14 year old girls an undetermined direction of functional asymmetry regarding the upper limbs was observed in 6.7% and of the lower limbs in 13.3% of subjects. An undetermined direction of asymmetry concerning only lower limbs accounted for 6.7% of the16 year old girls. In groups of 14 and 16 year olds, an undetermined direction of functional asymmetry connected with the eyes was not found (TABLE 4, 6).

The results presented in this paper pertaining to the directions and profile of functional asymmetry in the group of girls and boys show that, in the group of 14 year old girls, the process of lateralization is far more advanced in comparison to 14 year old boys. Such differences are blurred when comparing the groups of 16 year olds, for in the studied group of boys a considerably bigger increase took place in the determined profiles and directions. This growth is connected with the fact that boys at the age of 14 years are still at the beginning of adolescence. For girls, however, this is adolescence and the above processes are faster. Such a big difference in relation to established profiles between the groups of 14 year old girls and boys signifies a dimorphic difference at this age. In groups of 16 year olds these differences are less visible.

The dynamic asymmetry in the studied groups of 14 year old girls and boys

In the examined groups of 14 year old girls and boys in all measurements of motor efficiency carried out on the right and the left side of the body respectively, the dominance of the right side of the body over the left one has been found. The comparison of results obtained on the right and left side of the body between the groups of girls and boys showed many statistically significant differences. The biggest significant difference relates to the strength of muscles of the upper left and right limb (TABLE 7). Subsequently, the significance of the differences in the results from the right and left side of the body was assessed for each of the studied groups. Student's t-test for dependent features showed that in all tested abilities of motor efficiency there are statistically significant differences between the right and the left side of the body. Only the measurement of the strength of the muscles of lower limbs in girls did not show statistically significant differences. Within the examined group of girls, the highest level of dynamic asymmetry was characteristic of the strength of muscles of the upper limbs followed by the speed of movements of lower limbs. Insignificant asymmetry was reported in relation to the strength of muscles of the lower limbs. In the group of boys in connection with all studied motor abilities significant dynamic asymmetry was found. The highest level of dynamic asymmetry was attributed to the speed of the movements of the upper and lower limbs. The comparison between the examined groups as regards the size of dynamic asymmetry showed statistically significant differences in favor of the boys in all examined motor abilities except for the strength of muscles of the

upper limbs where the higher level of asymmetry was demonstrated by girls (TABLE 8).

TABLE 8
Student's t-test for results of right and left side of the body in the studied motor abilities of 14 year old girls and boys

Feature	Student's t-test	
	Girls	Boys
Speed of movements: upper limbs	2.96**	4.57***
Speed of movements: lower limbs	3.52**	5.00***
Strength of muscles: upper limbs	3.54**	2.85**
Strength of muscles: lower limbs	1.53	3.47**

Legend
* – statistically significant values (number of asterisks accounts for the degree of statistical significance)

The dynamic asymmetry in the examined groups of 16 year old girls and boys (the same group examined two years later)

In the examined groups of 16 year old girls and boys, for all measurements of motor efficiency carried out for the right and left side of the body the dominance of the right side of the body over the left side was found. The comparison of results obtained in tests of motor efficiency on the right and left side of the body within the groups of girls and boys showed many significant differences. The biggest significant difference was found in the strength of muscles of the upper left and right limb followed by the strength of muscles of the right lower limb (TABLE 9).

Subsequently the significance of the differences in the results of the right and left side of the body was assessed in each of the examined groups. Student's t-test for dependent features showed that in all examined properties of motor efficiency both among boys and girls there are statistically significant differences between the right and left side of the body (TABLE 10). In the examined group of girls the highest level of dynamic asymmetry was characteristic of the speed of the movements of the upper limbs followed by the strength of muscles of the upper limbs. The lowest index of dynamic asymmetry was found in relation to the strength of the muscles of the lower limbs. The highest level of dynamic asymmetry in the examined group of boys was characteristic of the speed of the movements of the lower and upper limbs. The lowest level of dynamic asymmetry was characteristic of the strength of the muscles of the upper limbs (TABLE 10). The

TABLE 9
Characteristics and differences in motor efficiency of 16 year old girls and boys

Feature	Side		Examined groups of 16 year olds		Student's t-test
			Girls	Boys	
Speed of movements: upper limbs [number]	P	$\bar{x}$	70.20	77.93	-2.16*
		SD	6.40	18.54	
	L	$\bar{x}$	62.27	68.07	-1.36
		SD	6.80	22.37	
Speed of movements: lower limbs [number]	P	$\bar{x}$	59.60	64.00	-2.60*
		SD	5.52	7.45	
	L	$\bar{x}$	53.47	55.13	-1.09
		SD	5.75	6.88	
Strength of muscles: upper limbs [cm]	P	$\bar{x}$	45.07	64.33	-5.66***
		SD	8.51	16.60	
	L	$\bar{x}$	38.07	55.53	-6.10***
		SD	7.89	13.56	
Strength of muscles: lower limbs [cm]	P	$\bar{x}$	113.50	125.67	-4.07***
		v	8.52	13.82	
	L	$\bar{x}$	107.50	114.83	-2.13*
		SD	10.88	15.40	

Legend
P – right side, L – left side
$\bar{x}$ – arithmetic mean, SD – standard deviation
* – statistically significant values (number of asterisks accounts for the degree of statistical significance)

comparison between the examined groups in relation to dynamic asymmetry showed the presence of statistical differences only as regards the strength of the leg muscles in favor of boys. Another interesting item of information that comes to light in this paper is the fact that asymmetry of the strength of muscles of the upper limbs was still higher among girls.

TABLE 10
Student's t-test for results of the right and left side of the body in 16 year old girls and boys

Features	Student's t-test	
	Girls	Boys
Speed of movements: upper limbs	4.52***	5.23***
Speed of movements: lower limbs	3.70***	6.14***
Strength of muscles: upper limbs	3.84***	3.21**
Strength of muscles: lower limbs	2.24*	3.95***

Legend
* – statistically significant values (number of asterisks accounts for the degree of statistical significance)

TABLE 11
Motor efficiency and its differences in 14 and 16 year old girls

Feature	Side		Examined groups		Student's t-test
			14 year old girls	16 year old girls	
Speed of movements: upper limbs [number]	P [right]	$\bar{x}$	66.60	70.20	−2.49*
		SD	5.23	6.40	
	L [left]	$\bar{x}$	62.93	62.27	0.76
		SD	5.89	6.80	
Speed of movements: lower limbs [number]	P	$\bar{x}$	57.20	59.60	−2.01*
		SD	4.66	5.52	
	L	$\bar{x}$	53.27	53.47	−0.31
		SD	4.71	5.75	
Strength of muscles: upper limbs [cm]	P	$\bar{x}$	43.27	45.07	−1.34
		SD	7.56	8.51	
	L	$\bar{x}$	37.73	38.08	−0.48
		SD	7.70	7.89	
Strength of muscles: lower limbs [cm]	P	$\bar{x}$	111.73	113.50	−1.31
		SD	8.20	8.82	
	L	$\bar{x}$	109.23	107.50	−1.29
		SD	9.14	10.89	

Legend
P – right side, L – left side
$\bar{x}$ – arithmetic mean, SD – standard deviation
* – statistically significant values (number of asterisks accounts for the degree of statistical significance)

The comparison of results between 14 and 16 year old girls and boys (the same group examined two years later) in relation to dynamic asymmetry

Having compared the motor effectiveness of the right and left side of the body of 14 and 16 year old girls and 14 year old boys with 16 year old boys it is possible to see significant differences. In the group of girls, motor efficiency was improved most vividly in the case of the speed of movements of the right upper limb and the speed of movements of the right lower limb. The other properties of motor efficiency have not changed in a statistically significant manner. In the group of boys motor efficiency was improved most in the speed of movements of the right upper limb, the strength of the muscles of the right lower limb, the speed of movements of the right lower limb and the speed of the movements of the left upper limb. In the case of other features of motor efficiency no statistically significant changes took place (TABLE 11, 12).

Next, the change in the level of dynamic asymmetry was checked in the examined groups of 14 year olds and 16 year olds. In the group of girls and boys the level of dynamic asymmetry increased in relation to all examined motor abilities. Statistically significant changes took place however, only in the asymmetry of the speed of movements of the upper limbs among girls and boys and in the asymmetry of the strength of muscles of lower limbs among boys (TABLE 13, 14).

TABLE 12
Motor efficiency and its differences in 14 and 16 year old boys

Feature	Side		Examined groups		Student's t-test
			14 year old boys	16 year old boys	
Speed of movements: upper limbs [number]	P	$\bar{x}$	72.07	77.93	−4.91***
		SD	7.11	18.54	
	L	$\bar{x}$	65.27	68.07	−2.15*
		SD	7.15	22.37	
Speed of movements: lower limbs [number]	P	$\bar{x}$	60.87	64.00	−2.85*
		SD	7.10	7.45	
	L	$\bar{x}$	55.40	55.13	−0.37
		SD	7.03	12.48	
Strength of muscles: upper limbs [cm]	P	$\bar{x}$	63.40	64.33	−0.14
		SD	16.79	16.60	
	L	$\bar{x}$	56.13	55.53	−0.69
		SD	13.69	13.56	
Strength of muscles: lower limbs [cm]	P	$\bar{x}$	121.87	125.67	−3.18**
		SD	15.96	13.82	
	L	$\bar{x}$	114.57	114.83	−0.37
		SD	16.09	15.40	

Legend
P – right side, L – left side
$\bar{x}$ – arithmetic mean, SD – standard deviation
* – statistically significant values (number of asterisks accounts for the degree of statistical significance)

TABLE 13
Differences in the level of dynamic asymmetry of 14 and 16 year old girls

Feature	Student's t-test results
Speed of movements: upper limbs	−2.01*
Speed of movements: lower limbs	−0.70
Strength of muscles: upper limbs	−0.79
Strength of muscles: lower limbs	−1.26

Legend
* – statistically significant values (number of asterisks accounts for the degree of statistical significance)

TABLE 14
Differences in the level of dynamic asymmetry of 14 and 16 year old boys

Feature	Student's t-test results
Speed of movements: upper limbs	–3.23**
Speed of movements: lower limbs	–1.58
Strength of muscles: upper limbs	–1.79
Strength of muscles: lower limbs	–2.23*

Legend
* – statistically significant values (number of asterisks accounts for the degree of statistical significance)

DISCUSSION

The determined profile and direction of the functional asymmetry of movement and sense organs is characteristic of adults with a completed process of lateralization. Having examined children and youth one may notice a significant diversity in the arrangement of sidedness. According to numerous authors (Spionek, 1965, 1985; Zazzo, 1974; Bogdanowicz, 1992) only around the age of 12–13 years the majority of children have already determined functional asymmetry in relation to the upper limbs, lower limbs and the eyes. No unilateral lateralization is considered to be a manifestation of pathology and a delay in lateralization or at least not until the age of 14 years (Bogdanowicz, 1992). The delay, even though intellectual development is normal, may cause many failures at school (Spionek, 1985). The contemporary research literature indicates that functional asymmetry concerning hands and eyes is formed even in 7 year olds and the subsequent changes pertain only to the size of the dynamic asymmetry (Koszczyc, 1991; Koszczyc & Surynt, 2000; Surynt, 2003). According to research carried out by Zazzo (1974) at the age of 6 years the same number of children demonstrate unilateral lateralization, as well as cross and undetermined lateralization. When comparing the results of 6 year olds and 14 year olds one may notice: doubling of the presence of homogenous lateralization (from 31% to 65%), more than double the decrease of undetermined lateralization (from 34% to 12%) and cross lateralization (from 35% to 22%). Having compared the results obtained by Zazzo with the ones obtained in our research on 14 year olds, it should be noted that they are close to the results concerning girls. Among boys there are much more people of an undetermined profile (43.3%) and fewer/less of a homogenous profile (36.7%). Results similar to those obtained by Zazzo have also been obtained in 16 year old boys. Only 13.3% hand us an undetermined profile. The research carried out by Wieczorek (2005), also on 14 year olds, shows the dominance of homogenous profiles among girls and boys (56%), and among the rest of the group of youth, the dominance of cross profiles in boys (21%) and undetermined profiles in girls (34%). Such a big percentage of undetermined profiles within the group of 14 year old girls does not correspond with the results obtained in our tests.

The researchers of lateralization (Spionek, 1965, 1985; Zazzo, 1974) claim that with age, in children, the number of determined profiles of functional asymmetry increases. The same regularity may be noticed when comparing the results of research carried out by Wieczorek (2001) on 10 year old children with the present research carried out on 14 year old children.

A vast majority of the examined 10 year olds had an undetermined profile of functional asymmetry (girls 72.2%, boys 71%), whereas among examined 14 year olds a determined profile dominated (girls 83.3%, boys 56.7%). In the group of 16 year old youth the number of determined profiles of functional asymmetry has increased and amounts to: girls –93.3%; boys –86.6%.

In the vast majority of the examined 14 and 16 year old youth the right direction prevailed. This result pertains to all the examined motor and sense organs of boys and girls. The dominance of the right side of the body over the left one is definite. The right side dominance is most vivid in the upper limbs, followed by the lower limbs, and is least visible in connection with the eye. The results correspond with those obtained by Mleczko and Szopa (1988) which implied that the dominance of the right upper limb amounts to 85.5%, the lower limb 80% and the eye 65–70% respectively. In the research by Wieczorek (2005) in all examined sense and motor organs the right side direction prevails, too, which is most clearly seen in relation to the upper limb (girls 95% and boys 94%).

In the research carried out by Stokłosa (1998) the most dimorphic differences in functional asymmetry have been noted among 11–12 year olds, but intersexual diversity decreased in adolescence. In our study there are dimorphic differences regarding functional asymmetry both among 14 and 16 year olds, although among the latter group they are less visible. In the study carried out by Wieczorek (2005) dimorphic differences regarding functional asymmetry are visible in terms of a cross profile and undetermined profile as well as the direction of leggedness.

In the study on dynamic asymmetry carried out in the group of 14 year old girls and boys, a clear dominance of the right side of the body over the left one was found. Similar results were obtained two years later. In 16 year old girls and boys the difference in motor efficiency between the right and left side of the body was intensified. Similar results have been achieved by Wolański and Siniarska (1986) in the study of the Polish

population aged 2 to 80 years, Koszczyc (1991) in the study of 7–10 year old children, Drabik (1984) in the study of the children of Gdańsk aged 7–15 years as well as Stokłosa (1998) in the study of 7–15 year olds. An insignificant level of dynamic asymmetry occurred only in the group of 14 year old girls in connection with the strength of the muscles of the lower limbs. The result is in agreement with the study on 14 year old girls carried out by Wieczorek (2005). In her research, asymmetry was most noticeable in the strength of hand muscles. In our study this was only the case in the group of girls. Among boys the highest level of dynamic asymmetry was characteristic of the speed of movements of the lower limbs. This is quite a specific phenomenon, for the strength of hand muscles is the fastest and the most intensely diversifying lateral motor ability. It is also the most dimorphic ability in favor of the male sex (Przewęda, 1985). In our research, dynamic asymmetry turned out to be a dimorphic property both among 14 year olds and 16 year olds. Boys demonstrated a higher level of asymmetry than girls. In the research carried out by Wieczorek (2005) no differences were found as to the size of dynamic asymmetry of 14 year old girls and boys.

CONCLUSIONS

The research project enabled its authors to accomplish the objective of the present work. The hypotheses posed have been confirmed only in part. During the two years changes occurred both in functional and dynamic asymmetry. The percentage of persons with a determined profile and determined direction of functional asymmetry increased. Also the level of the dynamic asymmetry of the examined motor abilities increased. The described above changes pertain to both the group of girls and the group of boys although their intensity was bigger in the group of boys. Among girls as early as at the age of 14 years lateralization was highly advanced, which was demonstrated in the dominance of a determined profile and determined direction of functional asymmetry. In the group of 14 year old boys a higher level of dynamic asymmetry occurred.

Among 16 year olds an increase in the determined profile and determined direction of functional asymmetry was observed. Particularly visible changes occurred in the group of boys. Boys still dominated in the level of dynamic asymmetry of the examined motor abilities.

The obtained results indicate that during a two year period, changes pertaining to the lateralization of the body in middle school youth occurred and they indicate the occurrence of dimorphic diversity in relation to functional and dynamic asymmetry both in the group of 14 year olds and 16 year olds.

The interpretation of obtained results may be found in the environmental conditions of human development. Environment is understood as the whole of biological and financial conditions significant to life and development (Osiński, 2003). Environment affects us in the period of ontogenesis and this influence is of a special nature in childhood and youth. The environmental elements with the most significant influence on the development of a child are socioeconomic factors such as: education of parents, earnings, general level of culture, family value system, and the manner of distribution of material property (Ignasiak, 1988; Przewęda, 1985; Wolański, 1983). Within the group examined by the authors of the present paper the majority of youth came from poorly educated backgrounds. More than half of the parents (56%) had only a vocational education, 12.5% had only primary education and only 6.6% had higher education. About 65% of the parents of the examined children defined their material status at home as bad. Among them 39% of parents were unemployed including more than half of parents who were without the right to any benefits. The described environmental factors of the studied group of girls and boys have probably had a significant influence on physical development and thus on the course of lateralization.

The research results caused its authors to formulate the following conclusions:

1. Lateralization in the studied group of youth was not completed, according to the related literature, around the age of 12 years.
2. Between ages 14 and 16 years there were changes in both the direction of functional asymmetry and in the size of dynamic asymmetry. It is particularly strongly noticeable in the group of boys.
3. The obtained results may be connected with a specific environment, from which the examined youth came, in which more than half of the subjects came from families under poor financial conditions.
4. The results of the research allow its authors to state that stimulating the process of lateralization through intentional didactic activities of the teacher seems to be possible or even necessary, even in youth older than 14 years.

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FUNKČNÍ A DYNAMICKÁ ASYMETRIE U MLÁDEŽE VE VĚKU 14 A 16 LET (KOMPARATIVNÍ VÝZKUM)

(Souhrn anglického textu)

Cílem tohoto výzkumu je vyhodnocení stupně lateralizace u mládeže ve věku 14 let a srovnání získaných výsledků s výsledky výzkumu provedeného u stejné skupiny mladých lidí o dva roky později (16 let). Úspěšná identifikace úrovně lateralizace je pro didaktickou a vzdělávací práci mimořádně významná a stává se jednou z priorit v boji proti poruchám učení a při odstraňování vývojových dysfunkcí. Vzhledem k tomu, že lateralizace je pro vývoj člověka charakteristická, může být poznání jejího stavu a určujících faktorů jednou ze základních podmínek účinného vlivu pedagoga.

Výzkum byl prováděn v jednom z náhodně zvolených měst v Dolním Slezsku. Za účelem provedení výzkumu byli vybráni studenti prvního ročníku (60 studentů, z nich 30 dívek a 30 chlapců). Pro vyhodnocení funkční a dynamické asymetrie byly použity ověřené testy Koszczyce a Sekity (Osiński, 2003). Výzkumný projekt umožnil autorům naplnit cíl této práce. V průběhu dvou let se jak u funkční, tak i u dynamické asymetrie projevily změny. Zvýšilo se procento osob s vyhraněným profilem a vyhraněnou stranou funkční asymetrie. Vzrostl rovněž stupeň dynamické asymetrie u zkoumaných motorických schopností. Výše popsané změny se vztahují jak na skupinu dívek, tak i na skupinu chlapců, přestože u druhé skupiny byla jejich intenzita vyšší.

Klíčová slova: lateralizace, funkční a dynamická asymetrie, dospívající mládež.

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Scientific orientation

The research purpose is evaluation of the degree of lateralization in 14 year old youth.

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HEART RATE AS AN INDICATOR OF SPORT CLIMBING INTENSITY

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The objective of our research project was to introduce heart rate during sport climbing as one of the possible indicators of climbing intensity. For the purpose of our research, 11 sport climbers climbed three routes of varying grades of difficulty. The heart rate of the climbers was measured and climbing intensity was calculated. It was shown that, in spite of high local climbing intensity, general climbing intensity was rather low. Analysing the results, we wondered if the measured values actually reflected increased intensity or if they were a sign of some other phenomenon that was not monitored. Changes in heart rate during sport climbing can appear due to various factors, which can not all be completely controlled. Therefore, monitoring heart rate during sport climbing as an intensity indicator seems quite dubious.

Keywords: Sport climbing, heart rate, climbing intensity.

INTRODUCTION

The success of a climber depends mostly on climbing technique (Goddard & Neumann, 1993). The best climber in a competition is the one that makes the least mistakes during climbing. Although movement appears rather slow, climbing is a race with time. When not in a competition, a climber has to reach the top before the muscles are completely exhausted and co-ordination collapses, which is a common cause for the termination of climbing (by falling). In climbing competition, however, the available time is set before the competition and is equal for all competitors. In both cases, rational use of energy is of the utmost importance. A climber can make the best use of energy available with suitable psychological preparation and technically faultless tactical climbing (Leskošek, 2003).

Climbing involves the factors of physical strength (power, endurance, flexibility) as well as technique (co-ordination) (Goddard & Neumann, 1993). Those factors are closely related to success in climbing (Ulaga, 1999). Apart from movement abilities, an important role in successful sport climbing is played also by the morphological characteristics of a climber (Watts, 1999). Together with muscular strength, anaerobic and aerobic strength, and lung capacity, they form the profile of a climber. Scientists still argue about the role of general endurance in the achievement of success in climbing. Watts (1999) finds research on various indicators of general endurance to be sensible. According to Goddard and Neumann (1993), general endurance has no considerable impact on climbing, except in the case of the effect of aerobic endurance on body mass regulation, regeneration and handling stressful situations.

Climbing is a physical activity that is stressful for the human organism. Stress is each (psychophysical) activity that changes the natural balance of the organism. During climbing, numerous processes establishing a new balance are triggered in the organism. Reactions of an individual to the load present while climbing can be observed by means of various subjective (feeling assessment, shortness of breath, sweating, facial blush) and objective indicators (heart rate, lactate concentration in the blood, VO_2, ventilation, V CO_2, acid-basic balance, etc.) (Fox et al., 1993).

Within the framework of our research project, we tried to establish the best method for monitoring heart frequency during climbing, which is a mature procedure as it has long been studied and used in the assessment of load intensity. Heart rate reflects the intensity of the given load reasonably well if the intensity of the load is sub maximal and lasts for a sufficiently long period of time (Ušaj, 1995). In climbing, however, this does not appear very often. Apart from the quality of measured data during climbing, we were interested in the intensity of loads while climbing walls of varying difficulty (climbing intensity).

METHODS

Sample of subjects

Our sampling group consisted of 11 sport climbers (body mass 71 ± 8.7 kg, height 176 ± 9.2 cm,

age 25 ± 4.2 years, HR_{max} 199 ± 7.8 beats. min^{-1}, HRmin 54 ± 7.9 beats. min^{-1}, climbing period 7 ± 3.7 years). The subjects were all capable of climbing walls of the 7th grade of difficulty. They felt healthy on the day of the test.

Sample of variables

The average heart rate was monitored at two different moments: during climbing and at standstill. Each subject measured their own heart rate and their maximal heart rate while running was measured, too. Climbing intensity was calculated according to the following formula:

$$HR\ (\%) = \frac{100 \times (HR_{aver} - HR_{min})}{(HR_{max} - HR_{min})}$$

HR_{min} – heart rate at standstill (in the morning before getting up)
HR_{max} – maximal heart rate during the 400 m run
HR_{aver} – average heart rate in the last 15 s of climbing and
$(HR_{max} - HR_{min})$ – maximal heart rate reserve

Conducting the test

- The subjects were acquainted with the objective of the research project and their assignments. They all signed a statement that they were co-operating of their own free will.
- The measurement on each one of the subjects was carried out in the course of one day, in one hour's time.
- The subjects warmed up for 10 minutes before the test started (static and dynamic gymnastic exercises for general and specific warming-up), during which there was no climbing. After the tests were taken, the subjects were resting for as long as their heart rate took to decrease to approximately the same level as the one measured before the climb.
- Each subject climbed three routes. The routes were assessed by 4c, 5c and 6b French grades. Each subject climbed each route for about two minutes. The average heart rate was calculated from the four samples acquired within the last 15 seconds. After the climb, each subject rested for 15 minutes. During the rest period the heart rate measurements showed that it decreased to approximately the same level as the one measured before the climb.
- Each subject had to measure HR_{min} in the morning in a lying position. They measured their HR_{max} in 400 m run.
- All subjects climbed the routes "on sight" (making a first attempt at climbing via an unknown route), fixing their protection as they went along.

Methods of data analysis

The heart rate was measured by means of a Polar heart rate meter. The data were then analysed using a SPSS statistical program.

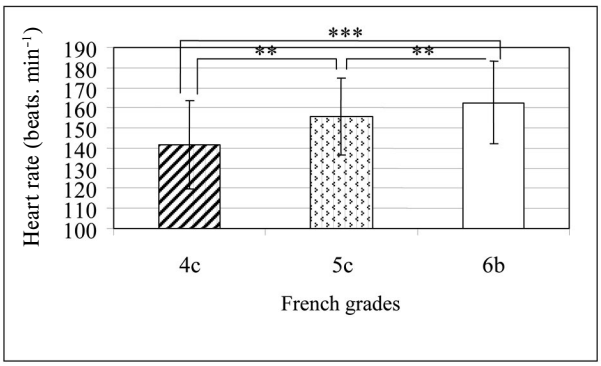
The main statistical parameters, i.e. arithmetic mean, standard deviation, were measured.

The differences in heart rate in climbing routes of difficulty 4c, 5c and 6b were tested with variance analysis and t-test for dependent samples.

RESULTS AND DISCUSSION

The results of heart rate measurement during climbing routes of different grades show that the average heart rate in the last 15 seconds of climbing a 4c grade route is 142 ± 22 beats. min^{-1}, 5c is 156 ± 19 beats. min^{-1} and 6a is 163 ± 21 beats. min^{-1} (Fig. 1). Similar results were obtained also by Mermier et al. (1997). The subjects had an average heart rate of 142 ± 19 beats. min^{-1} while climbing a 5a grade route. During the climbing of the route which had a 5c grade, the heart rate was 155 ± 15 beats. min^{-1} whereas while climbing a 7a grade route the heart rate was 163 ± 15 beats. min^{-1}. Janot et al. (2000) found that in the case of beginner climbers their heart rate was higher in comparison to recreational climbers. Dominic et al. (1999) tested subjects who climbed a 10 m vertical wall. There were differences found between the heart rate of inexperienced and experienced climbers. The differences between both groups were found only during vertical wall climbing, while horizontal wall climbing showed no differences. The differences in vertical wall climbing can be explained as being caused by fear of heights (Mace, 1979), which is very distinctive in novice climbers. In cases of horizontal walls, by contrast, there is no influence of fear of heights and hence there are smaller heart rate differences.

Fig. 1
Average heart rate in the last 15 seconds of climbing and standard deviations (** P < 0.01, *** P < 0.01) – statically significant

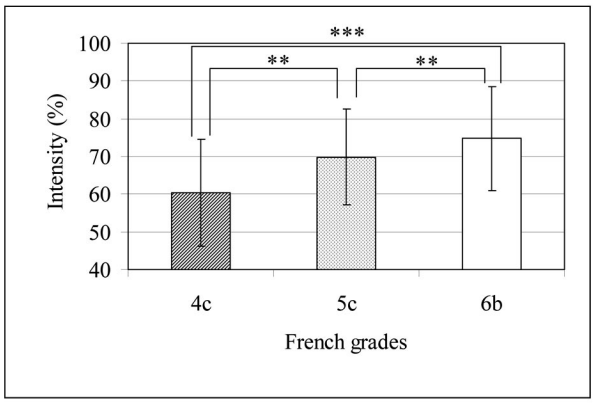


It can be concluded that a reaction of the human organism to load is only one of the possible causes for the increase of heart rate during climbing. The increases in heart rate were attributed to the occurrence of increased isometric muscular contractions in the upper limbs (Mermier et al., 1997). Another cause can also be anxiety caused by fear of heights (Billat et al., 1995), which is manifested in muscular tension. The blood pressure increases and consequently the heart rate also increases (Goddard & Neumann, 1993). Scientists have also found out that arm movements above the shoulder level can much more greatly increase heart rate in comparison to arm movement below the shoulder level (Parker, 1989). It is not necessary, therefore, for heart rate to increase as a consequence of increased load during climbing. It can also increase as a consequence of the fear of heights or changed arm position during climbing.

The difference in heart rate between routes of difficulty 4c and 5c was 14 beats . min^{-1}, and 7 beats . min^{-1} between routes 5c and 6b (Fig. 1). The differences in intensity in single routes are statistically significant (P = = 0.001 and P = 0.006). This difference can be explained by different configurations of climbing routes. The two most difficult routes (5c and 6b) ran across an overhang, which required different climbing technique than the easier route (4c), which ran across steep plates, but didn't include an overhang. Climbing overhangs require a climber to activate the abdominal muscles, which causes an increase in blood pressure, and consequently a higher heart rate (Goddard & Neumann, 1993). While climbing, overhang blockades are also used. A blockade is the isometric holding of a cling with the hand bent in the elbow, lasting for a few seconds. It is a well know fact that the isometrically produced force of the muscles of the forearm, as well as the shoulder and neck muscles, while working above the head, increases the heart rate (Åstrand et al., 2003; Larsson et al., 1996). Regarding the stated facts, no single factor causes changes to heart rate during climbing. It would be equally impossible to identify only one prevailing factor. There is probably a number of factors that, each in its own way, influence heart rate changes.

Heart rate (climbing intensity) in the routes of difficulty 4c, 5c and 6b is shown in Fig. 2. The intensity in the route of difficulty 4c was 60 ± 14%. In the direction of difficulty 5c it was 70 ± 13% and, in the route of difficulty 6b it was 75 ± 14%. The difference in intensity between the routes is 10% and 5% and is statistically significant (P = 0.001 and P = 0.006). The intensity between 60% and 70% can be classified only into the second degree of intensity estimation (Swaim & Edwards, 2002) and is very low. The climbing intensity in the route of difficulty 6b is 75%, but is still low. As the difficulty increases, the difference in intensity also increases. In spite of that, general intensity during climbing is still rather low. Heart rate during climbing can increase due to factors such as fear of heights, isometrical development of force, change in arm position, increased tension of abdominal muscles, etc. It can therefore be concluded that the need for more blood, which is characteristic for the activities of general endurance, is not the cause of increased heart rate during climbing (Goddard & Neumann, 1993). The increased heart rate is due to the presence of the mentioned factors. General endurance, therefore, is probably not the restrictive factor in climbing and is not of significance for success in climbing.

Fig. 2
Intensity in the last 15 seconds of climbing and standard deviations (** P < 0.01, *** P < 0.01) – statically significant



CONCLUSIONS

The increase of heart rate during climbing is due to numerous factors. Some of them are very hard to measure. Their estimation would be too subjective for being further used in scientific research. At the same time, the load to the organism is far too local and doesn't have any significant impact on the change in heart rate during climbing. For all these reasons, the use of heart rate as an indicator of climbing intensity is dubious.

During climbing, the heart muscle is never fully loaded. As a rule, the large muscles are only partly activated, while small muscles are fully activated. Small muscles tire easily (because blood lactate is increased), (Booth et al., 1999; Mermier et al., 1997) therefore coordination collapses and climbing is stopped (Goddard & Neumann, 1993). As the exhaustion of arm muscles (local exhaustion), and not the exhaustion of the entire organism (general exhaustion), is a limiting factor, training of general endurance is recommended, but not absolutely necessary, for sport climbers.

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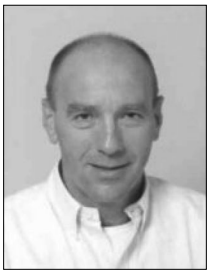
SRDEČNÍ FREKVENCE JAKO INDIKÁTOR ZÁTĚŽE PŘI SPORTOVNÍM LEZENÍ

(Souhrn anglického textu)

Cílem našeho výzkumného projektu bylo zavést srdeční frekvenci jako jeden z možných indikátorů zátěže při sportovním lezení. Za účelem našeho výzkumu absolvovalo 11 sportovních horolezců tři trasy o různých stupních náročnosti. Byla měřena srdeční frekvence horolezců a počítána zátěž při lezení. Při analýze výsledků jsme sledovali, zda naměřené hodnoty skutečně odrážejí zvýšenou zátěž, nebo zda jsou znakem nějakého jiného jevu, který nebyl monitorován. Změny srdeční frekvence při sportovním lezení mohou nastat v důsledku různých faktorů, které nelze v úplnosti kontrolovat. Monitorování srdeční frekvence jako indikátoru zátěže při sportovním lezení se tedy jeví jako značně pochybné.

Klíčová slova: sportovní lezení, srdeční frekvence, zátěž.

Ass. prof. Stojan Burnik, Ph.D.



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The Acta Universitatis Palackianae Olomucensis. Gymnica is an independent professional journal. The content of the magazine is focused on presentation of research notifications and theoretical studies connected with the problems of kinanthropology. The Editorial Board is looking forward to all manuscripts written on the above subject.

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The text of the contribution is in English. The contribution is not to exceed a maximum limit of 15 pages (including tables, pictures, summaries and appendices). A summary will be in the Czech language, and by rule 1 page at the most.

The text is to be presented in MS Word editor and also as a printout.

All contributions are reviewed anonymously.

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Title of the contribution, name(s) of its author(s), workplace, date of handing in the contribution, summary of the text in English, key words.

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We look forward to our further cooperation!

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