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CONSIDERATIONS ON THE PROBLEM OF THE RELATIONSHIP BETWEEN MOVEMENT AND HEALTH

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If we are speaking about the relationship between movement and health, we usually mean activities realized within the sphere of physical culture, activities intended for human beings. Naturally, at the same time we have to count on specific differences between physical education, recreation based on movement or physical exercise, and sports. Unfortunately, physical exercises as intentionally used movements are, in our literature, understood most frequently on a bio-mechanical and bio-medical basis. Less frequently are their psychological, social and psycho-social aspects perceived, and the fewest experts look at their philosophical essence. In addition, we also see that health is primarily perceived by society as the exclusive domain of medicine and healthcare organizations. In this paper, the author deals with the problem of relationships between movement and physical, psychological and social health and differences between humans: those who are both sporters and human as opposed to those who are human, but not sporters. In connection with these problems, attention is also paid to environmental, leisure time and life style problems. Our healthy existence is conditioned by our struggle for it and our fight against all influences which threaten it. Negative tendencies have a global character, their solution, however, is of a regional nature, a problem resulting from concrete conditions. It is also the problem of the education of specialists connected with these problematics.

Keywords: Physical education, movement recreation, sport, environment, education.

INTRODUCTION

The problem of the relationship between movement and health is, at the present time, very often discussed. It is understandable, because it is a problem of human life in our technologically developed world. But, within the framework of the problem of this relationship are, in my opinion, many further problems which need to be covered. I think that these problems are very important, conditioning the solving of the main problem, so they have to be solved as well. Naturally that is not the aim of these thoughts. I would like to point out only some of them.

If we are speaking in relationship to health about intentional movement, we are speaking about physical culture. (Note: Here I must make a small terminology insert. The concept "physical culture", according to me, expresses a system, an environment, in which the scope of various activities of physical character are performed. These, according to their goal and intention, I would divide into "physical education, physical /movement/ recreation and sport" in the sense of performance and competition). I claim that the central point of physical culture, respectively, of the activities implemented within its scope, are human beings and their improvement. If I say that the central point of physical culture is the human, I mean an active human, the human as an individual, even a human as a social being. Among these three basic characteristics, common relationships are obvious. But, even if the human being is understood as "a central point", this does not mean that, within the scope of physical culture, an investigation will take place. This is the domain of specialized scientific disciplines, which are dealt with by the human being. However, on the basis of information obtained from these specialized disciplines, the human being must be understood. The understanding is regarding "...who or what a human is, what is the structure, self perception and activity of this bio-social and spiritual being, what are his/her relationships to other people, beings and things, comprising the world the human being occupies, by which internal factors and how is the human being influenced, what is the human being's relationship to society... It is therefore about recognizing the essence of human beings and their lives. It is not possible to intentionally act with regard to the human being without attempting to answer these basic questions. Whatever are the consideration of actions towards them, the considerations of their developmen, are very reduced without these questions as a starting point and the result is even likely to be misleading" (Hodaň, 2000, 113).

Recognizing and understanding the human being, however, is not an easy task. Feber (1996) understands the human being at the following levels – "the human being is a social, moral and practical creature, a creature who changes and develops over the course of historical time a cultural creature, a creator and bearer of values; a thinking creature gifted with a conscience and in search of discovery; a creature able to communicate with the aid of language". All of these components understandably exist in common relationships, in relationships to other societies and to the environment. The human being as a creature performing and reacting is therefore a multidimensional phenomenon.

Without further amplifying on the individual aspects of human personality, it is necessary to consider the fact that the realization of its existence is, in our case ("movement and health"), very important. This results from the quite simple reality that one of the main resources used within the scope of physical culture, namely physical exercises, has the ability, in contrast to many other activities, "to complexly and simultaneously affect all dimensions of the human being", in some cases only some of them selectively. In this reality, physical exercises significantly differ from other activities of a movement character, which however increases the demands of its implementation. This is exactly this demand which later often causes the opposite – the need to complexly recognize the human being is not respected, the whole process is reduced, and by far doesn't fulfill all the possibilities which could be expected, and in some cases can even have negative effects. This also understandably relates to the relationship of movement and health.

In order for the activities within the scope of physical culture to be implemented in a way that fulfills that which it is theoretically possible to expect, it is necessary to:

- "understand the human being" as a physical, psychological, social and spiritual being, to understand human structure, development, needs...,
- "understand human movement" from the point of view of its physical, psychological and social dimensions,
- "understand the possibility of the use of the intended movement" for positive human development (Hodaň, 2000, 118).

Based on the perception of physical exercise activity generally, and even its individual kinds, we can gather that it is possible to very significantly influence the whole of human life in all of its aspects. Physical exercise activity as a basic component of physical culture participates in:

1. upgrading the quality of activities in all spheres of life,
2. the production and satisfaction of the needs of life,
3. the production and quality of all social and economic relationships, into which people enter during their life,
4. the production of a system of all life values and ideas, upon which individual activities are conditional.

If the point is to primarily understand the human being, we must also consider, in regards to the studied relationships between movement and health, the importance of understanding both of these phenomena. It is a complex problem, so only a note: "Generally, movement is understood primarily in the mechanical sense, which is more or less perceived as its philosophical essence. (Surely, this does not mean that movement can not be philosophically explained, I am only speaking about frequency. Also, in our field of kinanthropology, the number of philosophically thinking specialists is lower than others.) Without even considering its essence, we perceive almost exclusively only the internal expression, the concrete, empirically expressed manifestation. "Human movement" is in this case expressed primarily on the biomechanical level, rarely are its psychological, social and psycho-social aspects taken into consideration, and rarely again do we recognize its philosophical essence. With human movement is understandably, immediately associated the problem of the human body and its perception, the problem of the "philosophy of the body". Although these aspects are presented, nevertheless, for the majority of the expert population, as well as for the overall population, they are only marginal problems. In my opinion however, this is fundamental because it influences the basic approach to the human being and to understanding the sense of human movement. Even if movement is one of the basic phenomena in the existence of the world, thanks to the opportunities of empirical approaches, it is the mechanical aspect which prevails. Movement is then perceived, by the non expert population, as somehow on the perimeter, as a routine part of life and, if a human being is not limited in movement, the individual doesn't feel the need to ponder about it. In the case of the eventuality that someone "cannot move", it is considered to be a health problem."

Routinely, each person considers health to be an assumption of existence. But, in its perception and evaluation, further reductions take place, which are stated above. A problem of health is primarily perceived by society as the exclusive domain of medicine and healthcare organizations. This is however an incorrect opinion – healthcare primarily puts a brain into therapy, whereas prevention, "the production of health", is a problem of the individual person. And exactly here an area for the fulfilling "relationship between movement and health" is opened. Another, very frequent problem results from the incorrect understanding of health only

as absence of illness. With this approach, there are two possibilities in the relationship to health – I have my health (I am healthy = I am not ill), therefore, the problem doesn't interest me (this is the problem primarily of young people), or I am losing my health, perhaps I don't have my health (I am not healthy = I am ill), I will therefore turn to the relevant organization.

In the first case (the feeling or conscience that "I am healthy") one isn't motivated to do anything. In the second case (I am ill, therefore "I am not healthy") we are motivated to use science (by means of the physician) or an organization (healthcare). Therefore the person is motivated to use existing institutional services, which are here for the purpose of returning health to a patient. Such an approach to health has a completely consumeristic character and it is in complete compliance with the philosophy of the consumer society. Health is understood as a good which can be bought or (for free?) received.

The problem of health is much more complicated than what is stated above. Primarily, it is important to understand that health is not a state, *it is a process, a creation, a fight, which never ends; therefore, we speak about creating health or also about health improvement or promotion*.

Here is where we are led to observe significant differences. It is relatively "simple" to test the state of physical health; it is less "simple" however, from this point of view, to deal with the remaining components – psychological and social. We therefore evaluate the entire "complex of health" as being very complicated, and that is why the majority of people perceive physical health as the primary and dominant factor. This is understandably connected with the fact that, although social and psychological problems lower the overall "quality of life", physical health problems can result in death. This perception therefore is associated with the reality of the basic biological, animal essence of the human being (even here it is necessary to keep under consideration the relationship between physical and psychological). In practical activities as well as in research, this leads to the reduction of the entire concept of partial components and the WHO definition is not fulfilled.

In this connection, I must identify with Stokols (2000), who reacts to the above mentioned definition by the WHO of full health (healthfulness), which he considers to be a multisided phenomenon, including physical health, emotional well being and social cohesion. By this, he shifts the whole problem to a somewhat different, more concrete and therefore more understandable position. I must add that he also shifts it to a position corresponding to reality. The concept of emotional well being expresses a balanced psychological state, reflecting a balance between the internal and external environment, adequately reacting to impulses, and so on. This concept results in a relationship to the basic function of physical health. Social cohesion is therefore expressed as a positive relationship between the individual and society, implementing accepted social roles, etc. It is therefore an obvious relationship among the three personality dimensions: physical ⟶ psychological ⟶ and social. This means that the level of social "ascent" is contingent upon the level of the physical and psychological state. By this, it is not meant that these relationships are only one sided. The reverse relationship is also significant – social dysfunction can evoke psychological (emotional) dysfunction, which will reflect on physical dysfunction in the end.

We should realize that these, only briefly sketched relationships, result in the fact that "health is a continuous process reaching for the optimal cohesion among these internal and external factors, by which it is conditioned, even among their individual components" (Hodaň, 2005).

Thanks to the existing developing trends, I see the status of the problem of the relationship between movement and health in these areas:

1. The basic, most primarily relationship we want to look at is understood from the point of view of human movement as a "bio-mechanical movement" and from the point of view of health as physical health. Without a doubt, it is a primary relationship, expressing the biological essence of what it means to be human, but from the point of view of human functions it is insufficient and furthermore, it leads to the understanding of the human being as only more or less a "healthy" and performing organism, a tool. It corresponds to the concept of homo faber, which, in this approach to the human being, is in cohesion with Cartesian dualism, which still endures, namely in a performance oriented society. It is diagnosed relatively easily. It understandably proceeds in the area of quantitative research; all values are measurable, therefore even statistically precisely expressed and interpreted and up until now these studies as such are, in our literature, the most frequent. Even though it is basic, "human health cannot be reduced only to this level". Where the relationship of movement and health is concerned, movement cannot be understood only in the sense of its quality, but must also be understood in the sense of its quantity. From this results the optimal straining of the human being. In this case a strain of a physical character is concerned.

2. The relationship of movement and psychological health has been, up until now, dealt with less often in our literature. This relationship shifts the understanding of the human being to a higher level, connecting the physical side with the psychological side and coming closer to the concept of homo sapiens (I would rather use the concept homo cogitans). I want to focus our

attention only on some of the moments that this area is involved in. Movement (physical exercise) activity is a significant part of spiritual hygiene. For example Míček (1984) speaks of the fact that it is a pre-condition for the prevention of a whole row of so called psychosomatic illnesses and lowers emotional pressure. Rolland (1990) puts movement activity into a relationship with the whole development of the human personality and its overall cognitive capacity. A very interesting and attributed work was published in the 1960s and 1970s by Koch (1960, 1979) about significant differences between the development of intelligence in a child intentionally moving as opposed to not moving. With regards to a large number of physical exercises, which are in themselves physically demanding, with regards to their implementation in demanding situations and in a demanding environment, the human being is also trained in immunity against stress, gradually developing the ability to adapt to stressful life situations (Hošek, 1994; Mota & Cruze, 1998; and others). A whole row of authors points out the influence of movement (physical exercise) activity on the overall psychological state of the human being as a unit. Thanks to the stated physical demands, will, psychological endurance, determination, goal orientation, decision making, courage, stress immunity and so on are trained. Not in vain is an activity named "survival" used in the preparation of managers, where through the demands of activities and environmental demands, exactly these personality traits are trained. Overall, it is possible to speak of gradual adaptation to psychological demands, leading to physical efficiency and psychological health. Again I emphasize, it is not only the result of the relationship of "fyzis" and "psyche", but also a result "focused on the optimal process" in the field of the psyché. The problem is the diagnosis, its process and interpretation. Besides pivotal quantitative methods, qualitative methods are also considered in the interpretation. In connection to both fields, the human being is perceived more as a multi factorial phenomenon. This concept is farther away from Cartesian dualism and comes closer to the phenomenological concept. This area is very often understood as a branch derived from the previous field, therefore from the point of view of human existence as less significant.

All psychological changes and changes of their quality are then influenced by the consequences of social entrance.

3. The least attention is paid in our literature to resolving the relationship of movement and "social health". However, according to my opinion, from the point of view of the human being and society, it is on the highest level, which is conditional upon the level of both previous areas. This area finally shifts the human being to a suitable position. It corresponds to the concept of homo socialis. The human being is understood as a multi factorial phenomenon; with understanding definitely separate from Cartesian dualism. Qualitative methods are enforced, while quantitative methods supplement it in implementation and interpretation. In this connection, it is possible to understand the social area on two levels – the "sociability" of the human being, understood as a quality of social ascent directly dependent upon the physical and psychological level, respectively the "sociability" of the human being as a result of direct influence by the optimization of physical straining. Under demanding conditions and in a demanding environment, "mutual tolerance, mutual respect, responsibility for each other, mutual help, leadership, the ability to realize one's position in a group, the ability to subordinate oneself", and so on, is "trained" (Hodaň, 2005). Common life situations are many times surpassed by the demands of this environment on inter-individual relationships. Such "trained" people make it up more easily, with a larger overview. Some researchers in the past have spoken of these people, even about a lower frequency of social conflicts, about lowering conflicts in the direction of supervision – subordination and so on. A special kind of social environment is the family, which is seen as the basic component in society and which leads to the first social contact and problems associated with it. From this point of view then, there is a specific meaning for parents in doing exercises with children (removing the generation barrier, increasing children's trust in parents, changing their ideas about parents, admiration for their abilities...), which Berdychová was the first in the Czech environment to begin to address, who was joined by a whole row of other authors.

With a view to the above stated terminology, we can say that movement (physical exercise) activities lead to a significant degree of "social adaptation", which increases "social strength" and subsequently increases the level of "social health".

From the points of view of the complex understanding of the human being and human social functions, this area is considered to be the most significant, with a realization that both preceding areas are based on a fundamental assumption. From the research grasp point of view though, it is the most problematic area. Even the very low frequency of publications in the most significant Czech expert periodicals is proof of this.

(Note: Here, I completely intentionally left out the "spiritual" human being and associated health problems, which I now pronounce to be the basis of the philosophical problem I want to address.)

Health is therefore a multi level problem, disallowing any reduction.

Since we are speaking of intentional movement and its relationship to health, and we are moving as was

mentioned above, in the area of physical culture, it is necessary to mention one particularity. In this case, we must see that the above mentioned relationships are on two completely different levels. That is to say, there is a difference, whether we speak about the mentioned relationships on the human – sporter level (in the sense of performance and top sport), or on the human – not sporter level.

In the first case, it is important to realize that the athlete performs very demanding, very hard movement activities of a working character. The activity then is not focused in favor of the human sports being, but in favor of the attained results, which may be considered to be a work product. Movement activities of a top sport character are nevertheless many times more demanding (and not only on the physical, but also even on the psychological and even on the social side) than other demanding professions. In relationship to health, it is then obvious that health (in all its forms) "is the fundamental presumption of its work". Unfortunately, this concept of health is, by the long term demanding preparation focused on performance as well as by the performance itself, threatened. In this case, we are not dealing with the development of health (health promotion) but with "maintaining health as a fundamental presumption to other activities". In comparison to other professions, a top athlete must be absolutely healthy. Above all, a serious problem is, and most likely more than in other professions, "the level of work accident injuries", in our case, injury caused by participation in or preparation for sport. Maintaining health, respectively renewing it is then a problem of medical specialists, physiotherapists, masseurs... and specialized work places. It is a problem of top sport, which is dealt with in this area.

A completely different situation is the case of the human non sporter, who is the object of all physical exercise activities, which are performed to his/her advantage, and if they are performed correctly (which is a problem in educating those, who lead the training process), can have a positive effect on the development of health, its "maintenance", and in the case of illness, also on a return to the individual's pre-illness state. This domain of recreational activities is much in demand, being a domain in which the relationships between movement and health can be realized at the highest level and which really respects the human universality mentioned above. Unfortunately, in the Czech Republic this is not done by the system and it is only in the hands of each individual to do this. "Thanks" to this the preventive activities, such as "healthy school", "healthy town" and so on, have a campaign character only.

In both cases, we are dealing with individual categories, between which there are fundamental differences in the researched relationship between movement and health, which means that each one must be dealt with separately.

It can therefore be said that movement, whose accompanying phenomenon is physical strain, is directly divided into the creation of physical, psychological and social health. We have to be careful, if we are speaking about physical strain, then it is necessary to respect the problem of its optimal measure (see the negative results of top sport caused by strain) and selection of activities. What we are speaking of here, this form, does not concern physical, movement activities focused on objects outside of the human being (any possible positive impact is automatically connected with the accompanying "devastating" impact). In its full range, the positive relationship of movement to health concerns physical exercises because these can be characterized as "intentional movement behavior, which is targeted, consciously focused on the physical and with it the associated psychological and social development of the human being".

All effects of physical activity in relationship to health in the sense of physical, psychological and social well being are in addition positively influenced by the reality that in its process, a certain kind of enjoyment takes place. The enjoyment is obviously more or less connected not only with whatever kind of human activity, but also with perceiving external subjects (events, change of environment, nature, artistic performance...). Enjoyments of this character are however connected with certain analyzers, so they have a limited character – aesthetic enjoyment from perceiving paintings or music, feeling of enjoyment from a well performed activity, enjoyment from a successful examination, etc. Movement (physical exercise) activity brings enjoyment of a different character. Its basis is in "corporality, in concrete physical and psychological feelings accompanied by other aesthetic and social sensations" etc. Physical enjoyment is therefore very complex and stronger than other experiences and as an experience it is, then, longer lasting (Hodaň, 2005). Enjoyment is then shifted to enjoying oneself, therefore also into enjoying one's own health. Thanks to this, the whole problem is shifted to the "spiritual" area, as the highest dimension of human personality.

The human (sporter as well as non sporter) live in some kind of environment (geographical, demographical, economical, ecological...), which is continually changing by means of civilized development. By this, the primarily researched relationship of movement to health is getting into the secondary relationship of the "human being to the environment". With regards to the character of work in this field, qualitative methods are continually being used. The realization of these relationships, including the problem of the basic relation-

ships between (intentional) movement and health, are causing completely different consequences connected with traditions and habits and with the historical development of individual cultures, with average population age, economical level of the given society, with ecological problems, and so on. The basic conditional agent is however again (primarily in a mature society) predominantly the philosophy of the society. Unfortunately however, on the global scale, this still is of a consumer philosophy character. Currently, extended world wide research is taking place and noting changes in human behavior (in the movement sense), in dependency on these transformations. Interesting information about how the situation in individual parts of the world looks will definitely be found. Questions have arisen about what next, how to positively change the given state of affairs. According to me, this however is associated with the fundamental problem of how to change the currently prevailing philosophical orientation in a world where consumerism, entertainment, and virtual reality prevail, in a world which is focused on a comfortable attainment of whatever, even health. What is the chance of us, who offer an active and uncomfortable activity against those who offer a comfortable passive consumption for attaining that kind of what is therefore considered to be health? I am not well informed on the exact details, but I think that the percentage, in this sense, of active people, with a certain fluctuation, doesn't change too much. I therefore think that we are basically dependent on "an overall change of the philosophical climate". Here there arise fundamental questions for us, professionals in kinanthropology: Are we able to contribute to it? Are we able to solve the problems of a more general character? Are we not remaining too concerned with only our specific issues? Are we able to withstand, in the face of "competition" with the influence on the public which advertising agencies gain by offering just comfortable consumption? I don't want to be too pessimistic, but I am worried that we will continue to stay too closed in our own selves. The public perceives sport in the sense of a beautiful sport performance but it doesn't perceive the problem which we are solving here, the problem of the relationship of movement and health and its cultural, social, economic, and other types of impact. I have to therefore ask: Does the public sufficiently know about this problem? If yes, and up until now it hasn't changed its behavior, are we able to convince it of the need to change? Can we do it? Does medicine sufficiently aid us in enforcing prevention? Have we become a respected part of preventive medicine? Are we using sufficient strength to push through changes in consumption philosophy? Do we have sufficient empirical evidence of an economic character dealing with the final economic effects and employment? Are we able to enter into the field of ergonomics in the sense of prevention and compensation for negative impacts by work activity alone? Are we sufficiently convincing employers with our evidence? Do we have sufficient demographic proof? Do we have sufficient proof about movement as prevention of dangers to social health (drugs, crime...) and are we able to accordingly influence society away from these negative phenomena? Do we have a sufficient and, according to me, a necessary political lobby? To reach a sufficient effect, I think we will have to find answers to these questions. Otherwise the existing situation will continue on – we are mainly addressing and convincing, in a reduced form, ourselves, and together with us the ten percent of the population, who, for various reasons, is active in this sphere.

Activities which we offer that is intentional movement activity focused on the development of health, have a "leisure time" character. But this is not only a certain tradition, but also a reduction of this problem. From this emerges that we have gotten used to dividing time into "work", "not work" and "leisure". Dumazedier came up with this division some decades ago and up until now, even though with certain repetitive variations, we repeat, or, respectively, vary it. This traditional division, however, corresponds to a certain level of technological development and the dominating character of working professions. With the continuing speed of technological development, the relationship of work × not work, respectively, work × leisure time is, however, significantly changing. Therefore, it is this time which is left over after fulfilling all responsibilities and with which we can completely freely manipulate. The problem of leisure time is very extensive, and the views on it are very controversial. So it is not possible to deal with them here. But I would like to add that it is not possible to reduce the problem of movement and health to a problem of leisure time only. In this connection it is a problem of individual life style first of all, which is crucial for "health promotion" and in which is also a problem of the leisure time covered. But if we want to solve the problem of life style in connection to health promotion, we have to investigate the geographical environment and the level of development of the concrete society, furthermore then the characteristics of the social status of the individual, such as gender, age, health status, family status, education, profession, qualifications, economic/material provisions, and level of responsibility. Furthermore, then factors such as location of residence, influence of the family environment, examples of concrete subcultures, value orientation of the individual, including psychological, temperament and structure of interest, etc. All these are parts of the problem of movement and health.

In regards to all of the above mentioned contradictions, and in regards to the current state of our civilization, the concept of "leisure time" to me seems to

be outdated, from my point of view, it is, to a certain measure, even useless. It seems to me that the concept of "lifestyle" is completely sufficient to express all possibilities which "our time", in which our life continues, offers. This is understandably a problem of values and preferences which are individually very diverse.

Due to this thought, however, there emerges a very important conclusion: *Solving the relationship of movement and health, respectively its positive contribution is not a problem of a certain delimited time into which we are entering, but a problem of the whole of day to day life and its organization. It is the problem of perceiving oneself and one's possibilities in relationship to oneself and to society. It is the problem of perceiving movement as a basic presumption of personal healthy existence.* This healthy existence is conditional upon our struggle for it, our fight against all influences which threaten it. The negative tendencies have a global character, its solution is however that of a regional problem, resulting from concrete conditions.

From what has been mentioned so far, it follows that the problem of the relationship of movement and health extends into many fields of individual and social life, it is therefore a real socio-cultural problem and in its essence also a philosophical problem. To be able to reach that which can theoretically be assumed, it is also necessary to prepare sufficiently funded specialists. In the world, a line of studied fields exist, which prepare specialists for this field of their professional activity. They are, for example: recreology, recreation, leisure, health promotion, lifestyle management and so on. The terms are various, but the sense of what is studied is similar. It is about individual fields or areas of specialization, which are part of other fields. Not too long ago, at our University, we finished a grant of the European Social Fund focused exactly on the education of these specialists. While analyzing a number of European and domestic workplaces, we found significant differences in defined profiles of graduates and in accordance with this, even in the conception of each study area and its structure. Not only from the point of view of the length of the study but also of its content. Even through the stated differences, it can be said that, generally, in the study there dominates a focus on the above mentioned reduced relationship between movement and health. This means a focus primarily on understanding movement as a means for prevention or the development of physical health, without considering other necessary consequences. Even though it is understandably necessary to thoroughly master this means, as the profession cannot be performed without it, it is also necessary to know into which relationship one is getting into and to where its usefulness can be directed. It is necessary to know the possible theoretical possibilities of using these means, and what are the relationships between global influences and regional resolution possibilities. Moreover, to be able to shift the whole problem to a higher level of effectiveness from the point of view of the addressed population, their education must be in accordance with possibilities devoted to entering into all of the fields mentioned above, so that they could become equal partners in representing these fields. This requirement concerns an exact definition of Bachelor and Master profiles and, with them, associated structures of Bachelor and Master studies and their content, and furthermore also doctoral studies. This can, for sure, be formally solved. However, solving the content and with it the associated personal solving is dependent mainly upon the extent of our scientific research into this field of which was spoken above. There I see the basis of the whole problem. In the corresponding extent of our scientific activity and sufficient evidence of its results, I see the only possibility of shifting the whole problem there, where its realistic and socially significant place is.

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ÚVAHA NAD PROBLÉMEM VZTAHU MEZI POHYBEM A ZDRAVÍM

(Souhrn anglického textu)

Jestliže mluvíme o vztahu mezi pohybem a zdravím, obyčejně máme na mysli činnosti realizované v oblasti tělesné kultury, tedy činnosti, které jsou zaměřeny na

člověka. Přirozeně, zároveň musíme počítat se specifickými rozdíly mezi tělesnou výchovou, pohybovou (tělocvičnou) rekreací a sportem. Bohužel, tělesná cvičení, jako záměrně využívané pohyby, jsou v naší literatuře chápána především na biomechanické a biomedicínské úrovni, mnohem méně je vnímána jejich psychologická a socio-psychologická dimenze a nejméně je vnímána jejich filozofická podstata. Navíc také vidíme, že zdraví je společností vnímáno především jako výlučná oblast medicíny a zdravotnictví. V práci se autor zabývá problémem vztahu mezi pohybem a fyzickým, psychickým a sociálním zdravím a rozdíly mezi člověkem – sportovcem a člověkem – nesportovcem. V souvislosti s těmito problémy věnuje také pozornost problémům prostředí, volného času a životního stylu. Naše zdravá existence je podmíněna zápasem o ni a bojem proti všem vlivům, které ji ohrožují. Negativní tendence mají globální charakter, jejich řešení je však regionálním problémem, vyplývajícím z konkrétních podmínek. S tím souvisí také problém výchovy příslušných specialistů.

Klíčová slova: tělesná výchova, pohybová rekreace, sport, prostředí, výchova.

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SENSATION SEEKING IN SLOVENIAN FEMALE AND MALE MOUNTAIN CLIMBERS

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Our paper focuses on differences in sensation seeking between male and female athletes who engage in high risk sports. There are several studies (Cox, 1994; Tušak & Tušak, 2001; Erjavec, 2002), which indicate that male and female athletes are more similar than males and females in the general population, female athletes thus show more "traditionally male" characteristics. These studies mainly focus on personality, anxiety and aggression; we wanted to address these issues in the area of sensation seeking. Sensation seeking has been well researched in the area of high risk sports – males seem to have higher sensation seeking needs, but gender differences in high risk sports have been quite poorly investigated. Of 33 mountain climbers who participated in our research, 15 of them were male and 18 female and differences in age were not significant. We used Zuckerman's Sensation seeking scale IV, which examines sensation seeking in terms of 5 factors – a general factor, factors of adventure and risk taking, an experience seeking factor, a disinhibition factor and a boredom susceptibility factor. There were no differences found between male and female mountain climbers, except for a tendency toward statistical significance in the factor of disinhibition, which is consistent with some previous research. We conclude that male and female mountain climbers in Slovenia are equal in sensation seeking needs and can be treated as a homogenous sample.

Keywords: Mountain climbing, sensation seeking, high risk sports, gender differences.

INTRODUCTION

Scientists have frequently studied the influence of gender on personality differences (Cox, 1994). Women are more neurotic, less serene and less capable of controlling themselves, respectively, less dominant (more considerate and moderate, tolerant and indulgent and understanding), more suppressed (have more anxieties and are insecure when a decision has to be made), less emotionally stable and show less masculinity and competitiveness (Cox, 1994).

Tušak and Tušak (2001) report that the majority of studies on women and sportswomen's personalities were founded on a bipolar model that represent typical male characteristics (dominance, aggression, self confidence and motivation for achievement) on one side and passivity on the other. On this basis, the conclusion that sportswomen have more male attributes emerges. However, this is a very stiff way of looking at male – female characteristics. It can not be said that men have no emotions, while on the other hand numerous successful sportswomen are very sensitive. This led to the establishment of a new flexible model in the 1960. According to this model, behaviour is considered from a situation – specific point of view. Men as well as women behave according to the situation. In sport, where activity and aggression is required, they are active and aggressive, in love they can be emotional and don't tend to be as assertive. In some other situation they behave in correspondence with that specific situation. Women often become depressed, anxious and dissatisfied when their career is finished. The price of emotional in sport can be, especially where women are concerned, very high. For a woman, success can also be a sort of frustration and stress, respectively. It was found out that male athletes show less fear of success than female athletes.

Besides the result mentioned by Tušak and Tušak (2001), that female athletes display many traditionally male characteristics, such as dominance, aggression, competitiveness, emotional stability, lower neuroticism and lower repression, similar results are reported also by Erjavec (2002) – she found no differences between the personality traits and motivational characteristics of male and female track and field athletes. She explained that this is brought about by the high demands the sport imposes on a female athlete these days, and she agrees with Cox (1994), who states that this can be difficult for a woman, since it conflicts with the traditional image of a woman – quiet, submissive, somewhat repressed and non competitive. Pedersen-Darhl (1997) found different results – the male athletes examined in their research were more active, aggressive, competitive and dominant, whilst the female athletes were more goal oriented, better organized and followed the rules more

accurately. Differences between male and female athletes were established also by Swain and Jones (1991), who found female athletes to be higher in both trait and state anxiety.

Motivated human activity is regulated by the central nervous system, which is situated in the area of the hypothalamus and reticular formation. The first one is in charge of the survival of an organism, while the second one sustains an optimal level of excitement. Among the first formal theories concerning an optimal level of excitement appeared that of Zuckerman (1994). He stated ten postulates within which he determined the characteristics of the following factors: the current level of excitement at a given moment, the activation potential of sensations, an optimal level of stimulation, as well as the boundary between cortical and autonomous stimulation, and the factors that trigger one or the other. The results of his studies show that the performance of the cortex is disturbed when it is over or understimulated. That furthermore causes a loss of control over emotional reactions.

Zuckerman (1994) determined the sensation seeking need to be a "motivation for seeking different, new, complex and intense sensations and experiences, as well as the willingness to take physical, social, legal, or financial risk if necessary to achieve them". He also stated that a person, who had an urgent sensation need, underestimated risk or was willing to take it as the price for the reward of a new experience. Sensation seekers, however, only rarely take unnecessary risk, but rather try to minimise it. Zuckerman (1994) thus defined a person with high sensation need to be open to new experiences, active, impulsive, in need of excitement and stimulating experiences, and expressing positive feelings as well as anger.

Zuckerman (1994) also defined risk as an estimation of certain behaviour to turn out negatively. Sensation need grows according to the novelty of a situation and risk assessment up to a point of optimal excitement. At that point, tendencies for withdrawal and advancement are the strongest. It represents sensation seeking and anxiety at the same time. When the estimated risk is too high, anxiety and a withdrawal tendency prevail. Dahlbäck (1990) developed a theory of conflict with which he tried to explain human risk taking. According to his theory, impulsive risk should not trigger a conflict, while non impulsive decision making triggers a conflict between possibilities and their potential negative impact. A decision of an athlete is therefore the product of his/her anxieties, stick to it iveness, and an inclination to develop feelings of guilt. According to Dahlbäck (1990) athletes who are taking the highest risk are those who are capable of keeping their eye on the ball, are not anxious to lose control over a situation and don't develop feelings of guilt. Levenson (1990) studied sensation need in different types of persons. Persons in the first group were denominated "heroes", as they took risk in a pro social manner (e.g. policemen, firemen, etc). The second group consisted of drug addicts, who take risk in an anti social manner. In the third group there were mountain climbers, who take risk in an adventurous manner.

Distinctive and very poorly studied are female mountain climbers. They have been present in Slovenian mountain climbing since the beginning of modern mountain climbing. There have never been many of them. At the beginning there were only a few individual excellent climbers who had to constantly prove themselves against their male colleagues. The number of female mountain climbers has increased lately. However, the proportion that can be observed in other sports has never been reached. Burnik, Jug and Tušak (2002) found that Slovenian female mountain climbers were more enduring, indisposed, disturbed, had more difficulties with establishment of social contacts, a low tolerance for frustration, general psychosomatic disturbances, low self confidence, that they are more self critical and have stronger feelings of loneliness and inferiority in comparison with their male colleagues.

Studies of sensation seeking in male and female high risk sports athletes are few, Campbell, Tyrrell and Zingaro (1993) studied sensation seeking in white water kayakers and included both male and female athletes. They found that both male and female athletes scored higher than the average population in the risk subscale, but reported no differences between both genders. Some research shows that disinhibition is higher in male high risk sports athletes than in females in such sports according to Hartman and Rawson (1992, in Zuckerman, 1994) – this was confirmed also in the sample of non-athletes.

Cronin (1991) conducted research thanks to which he found that alpinists score higher in sensation seeking in total when compared to the general population and lower than the general population in the disinhibition subscale – the interesting part of his research was that he included both male and female alpinists and considered them to be a homogenous sample, meaning that there are no differences between them. Chirivella and Martinez (1994) did the same when attempting to distinguish between high risk sports and medium risk sports – the sample of high risk sports consisted of both male and female athletes. The same procedure was undertaken also by Wagner and Houlihan (1994) and Jack and Ronan (1998). All these authors considered male and female high risk sports athletes to be equal in risk – taking (which is understood by using them as a homogenous sample), although they offer no statistical data to support this claim.

Within the framework of our study, we attempted to offer more data and shed more light onto the question of the sensation seeking needs of our female and male mountain climbers – our aim was to determine and compare the sensation seeking needs of our female and male mountain climbers. No studies that would investigate this problem have been carried out in Slovenia before now. This is mostly due to the small number of women mountain climbers in Slovenia as well as in the world.

METHOD

Participants

A group of 33 Slovenian male and female mountain climbers aged between 22 and 30 years were studied (M = 24.93 years; SD = 2.11 years). There were 15 male and 18 female mountain climbers. All of them were members of Slovenian climbing clubs, the difference in age between both groups was not significant.

Instruments

Sensation seeking scale (**SSS – IV**) – Zuckerman (1994): The questionnaire consists of 72 pairs of statements. Each time, the subject has to choose the one that best represents him or her, the factors being as follows (Lamovec, 1988):

The general factor marks the desire for an exciting life, full of adventure, a tendency to want to experience everything possible, and it is also demonstrated as an interest in unusual and exciting sports, for unplanned travelling and experiencing extraordinary sensations with the use of drugs, hypnosis, etc. It also includes the desire to associate with unpredictable, dynamic and emotionally expressive people.

The factor of adventure and risk taking encompasses the desire for participating in unusual physical activities, such as sky gliding, sky diving, diving, alpinism, car racing and the like.

The experience seeking factor refers to seeking out unusual sensual or mental experiences and to the unconventionality of one's lifestyle. It is marked by the need to wear extraordinary clothes, to shock others, by having an interest in extraordinary places and people, using drugs, and so on.

The disinhibition factor includes seeking pleasure, mainly sexual pleasure. It is marked by the desire to engage in wild parties, attended by happy and attractive people that give in to uninhibited sensuality, often under the influence of alcohol.

The factor of boredom susceptibilitiy includes the rejection of repetitive events, routine, rejection of always the same people and places, of predictable and boring people. It is connected with the tendency to change work places every once in a while, to buy and try new products, to test new and unknown dishes and so forth.

The Slovene translation was published in the work of Lamovec (1988). There is no data for Slovene samples, but the authors of the test report α reliability coefficients between 0.68 and 0.84 for risk taking, experience and disinhibition factors and 0.62 and 0.66 for males on boredom susceptibility and 0.38 and 0.56 for females. The test-retest method rendered a high coefficient 0.89 after three weeks and 0.75 after 6 to 8 months (Zuckerman, 1994).

Procedure

The application of the questionaires was carried out on a number of separate groups from January 2006 till March 2007. The results for all groups were collected anonymously, that is, the ethical code of the Slovene Association of psychologists was respected. The T-test was used to establish differences between both groups.

RESULTS AND DISCUSSION

TABLE 1
Differences between male and female alpinists in sensation seeking

Factor	Group	M	SD	t	p (t)
GENERAL	Males Females	9.33 9.39	2.77 2.77	–0.06	0.96
TAS	Males Females	6.27 6.06	1.75 2.15	0.31	0.76
ES	Males Females	7.40 6.83	2.87 1.86	0.68	0.50
Dis	Males Females	6.40 7.94	2.44 2.64	–1.73	0.09
BS	Males Females	9.13 9.56	2.03 2.71	–0.50	0.62

Legend:
GENERAL – general factor of sensation seeking,
TAS – thrill and adventure seeking factor,
ES – experience seeking factor,
Dis – disinhibition factor,
BS – boredom susceptibility factor,
MIN – minimum,
MAX – maximum,
M – mean,
SD – standard deviation,
t – t value,
p (t) – significance of t–test.

Our results, as displayed in TABLE 1, show, that there are no differences between male and female mountain climbers, there is only one tendency toward

statistical significance, which is shown in the factor of disinhibition. This finding, although it might be surprising, since studies indicate that risk taking and sensation seeking is higher in males than in females (Zuckerman, 1994; Dahlbäck, 1990; Levenson, 1990), can be well understood when we take into consideration studies comparing male and female athletes in non risk sports. These show that there are fewer differences between male and female athletes than there are between male and female non athletes (Tušak & Tušak, 2001; Erjavec, 2002).

It could be said that females in sport show a greater amount of male attributes or traits, such as aggression, lower neuroticism, dominance, emotional stability and the like, the fact of which often leads them into conflicts with the traditional society, where females are expected to be good looking, submissive, and to take care of the house and children (Cox, 1994). Studies in comparing male and female athletes have been done in the area of personality traits. Burnik, Jug and Tušak (2002) even compared the personality of male and female alpinists, some comparing anxiety (Swain & Jones, 1991), while the area of sensation seeking in sports has been somewhat left out. Worth mentioning is the research done by Hartman and Rawson (1992, in Zuckerman, 1994), who found disinhibition to be higher in male high risk sports athletes, a result which has been partially confirmed also in our study with a tendency toward statistical significance.

We could thus say that there are some indications that female high risk sports athletes engage less often in pleasure seeking, especially sexual pleasure. They seem to engage in wild parties less frequently, surrender to uninhibited sensuality less frequently and give into alcohol and drugs less often than male high risk sports athletes.

Other studies on sensation seeking in high risk sports, which included male and female athletes, made no distinction between both genders (Campbell, Tyrrell, & Zingaro, 1993; Cronin, 1991; Chirivella & Martinez, 1994; Wagner & Houlihan, 1994; Jack & Ronan, 1998). All these authors considered male and female high risk sports athletes to be equal in risk taking by treating them as a homogenous sample, but offer no statistical data to support this claim. Our study supports their findings – there actually seem to be no differences between male and female athletes in high risk sports when it comes to sensation seeking. This could be well explained by the type of activity they engage in. Both male and female alpinists (if we focus especially on the sport our participants engage in) face the same task. They both go up the same mountain, they both have to look out for avalanches, scrutinize conditions hard and well and both genders face the same consequences, when things go wrong. We could say that the task before them could be successfully accomplished only when sensation seeking needs are high enough for the athletes to accept the situation of possible danger, which even stimulates them further. The same could be said for all other high risk sports. It seems that males and females in these sports really have equally high sensation seeking needs. The filter assumed by Breivik (1999) works in the gender sense as well. Only people with sufficiently high sensation seeking needs will engage in high risk sports, however, the filter has to be higher and more powerful in females, since the general level of sensation seeking in this gender is lower than in males.

We can conclude by stating that there are no differences in male and female high risk sports athletes and that they actually can be considered as homogenous samples when studying this group of sports.

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VYHLEDÁVÁNÍ PROŽITKU U SLOVINSKÝCH HOROLEZKYŇ A HOROLEZCŮ

Naše pojednání se zaměřuje na odlišnosti ve vyhledávání prožitku („sensation seeking“) u sportovkyň a sportovců, kteří se věnují vysoce rizikovým sportům. Existuje několik studií (Cox, 1994; Tušak & Tušak, 2001; Erjavec, 2002), jež udávají, že sportovkyně a sportovci si jsou podobnější než ženy a muži v obecné populaci, tj. sportovkyně vykazují více „tradičně mužských“ charakteristik. Tyto studie se zaměřují zejména na osobnost, úzkost a agresi; těmito otázkami jsme se chtěli zabývat v oblasti vyhledávání prožitku. Vyhledávání prožitku bylo v oblasti vysoce rizikových sportů dobře prozkoumáno – u mužů byly zaznamenány vyšší potřeby vyhledávání prožitku, ale rozdíly mezi pohlavími v oblasti vysoce rizikových sportů doposud nebyly dobře probádány. Našeho výzkumu se zúčastnilo 33 horolezců, z toho 15 mužů a 18 žen a nepřihlíželo se k věkovým rozdílům. Použili jsme Zuckermanův dotazník Sensation seeking scale IV, jenž zkoumá vyhledávání prožitku za pomoci 5 faktorů, jimiž jsou všeobecný faktor; faktory podstoupení rizika; faktor hledání zkušenosti; faktor odtlumení (disinhibice) a faktor vnímavosti nudy. Mezi horolezkyněmi a horolezci nebyly nalezeny rozdíly s výjimkou tendence ke statistické významnosti u faktoru odtlumení, jenž je v souladu s některými předchozími výzkumy. Náš závěr je ten, že horolezkyně a horolezci ve Slovinsku jsou si rovni v potřebách vyhledávání prožitku a lze je považovat za homogenní vzorek.

Klíčová slova: horolezectví, vyhledávání prožitku, vysoce rizikové sporty, rozdíly mezi pohlavími.

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COMPARISON OF GAME CHARACTERISTICS OF MALE AND FEMALE TENNIS PLAYERS AT ROLAND GARROS 2005

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The game characteristics of elite male and female tennis players at the French Open 2005 (Roland Garros) have been analyzed based on a large number of sets, a total of 894 in the category of men and 592 sets in the category of women. In addition, a comparison of game characteristics in an individual set between winners and losers has been made. It was ascertained that there are statistically characteristic differences in most variables between the winners and loser in the category of men as well as in the category of women. In the category of men, there are statistically characteristic differences in all variables except in the break point conversions. In women however, there are statistically characteristic differences in all variables except in the number of won aces.

Based on these findings it can be concluded that statistically characteristic differences in the majority of variables, which define game characteristics, indicate that there are certain measurable indicators of tennis statistics, which distinguish winners from losers.

Keywords: Tennis, tennis statistics, successfulness in tennis.

INTRODUCTION

Direct or competitive successfulness is indicated in the competitive effectiveness of tennis players. The utmost indicator of how competitively effective the players are, is their ranking on national, European or world ranking lists. The ranking depends on the number of tournaments played and on the result achieved (ranking) at individual tournaments. In addition to ranking on the ranking lists, a good indicator of competitive effectiveness is the statistical data on each individual tennis match.

Using the statistical data, we can better define the successful performance of individual strokes in the match (serve, return), excellent and poor characteristics of an individual's game, the way of playing (aggressive, defensive) and some other factors that contribute to a successful tennis game. With the statistical analysis of game characteristics, we can establish the reasons for winning or losing a game.

An effective serve, an aggressive and reliable game across the entire court, a low number of unforced errors, and the ability to complete a high number of victories are now the key to achieving good results. Contemporary tennis game development trends are to shorten the point played and the match in general. The players therefore score more points also with the first or second stroke after the serve or return. The success of a serve is therefore a very important factor in a tennis game.

The return is a stroke that lately became of equal importance as the serve. It is true that players less often score victories though, but in spite of this, successfulness and scoring points after a return represent significant statistical data, which ultimately affect successfulness in tennis.

The percentage of points won on the first and second serve is likewise one of the indicators demonstrating the effectiveness of the player's serve related to playing across the entire court.

A break opportunity in a tennis game signifies an opportunity to take the opponent's serve or an opportunity to win the game served by the opponent. Taking advantage of a break is a certain advantage for the player in winning the set, particularly on fast pace surfaces where such opportunities are less frequent.

Tennis game aggressiveness is, in addition to fast pace and accuracy of serve, characterized by a more aggressive style of playing at the baseline and in an "all court" game. Such a way of playing is indicated primarily by scoring more victories as well as by net approaches and consequently putting more pressure on the opponent. There are certain moments in the game when players choose or have to choose more or less risky tactical decisions. In this case, the ratio between the number of winners and the number of unforced errors is also important.

There are different methods that can be used to analyze a tennis game. Tennis coaches use special statistical

forms or computer programs for palmtops and personal computers.

In the selected problem area, a couple of similar research projects were carried out. Planinšek (1994) used the tennis expert system to analyse playing and time characteristics in tennis on different surfaces (clay, hard court). Two tennis matches were analyzed and several differences in time characteristics were found. We should mention the research done by Ferjan (2001), who analyzed the final matches at the US Open and at the Australian Open in 2000 and 2001. He established that the winner of the US Open was more successful in the percentage of points won after the first and the second serve; the winner had less double faults and won more victeories and total points. The loser was, however, more successful in the first serve. At the Australian Open, the winner was more successful in the percentage of points won after the first serve, had less double faults and won more total points, while the loser was more successful in the percentage of points won after the second serve and in the number of victories. Pintarič (2002) analyzed the final matches at the French Open in 2001 and 2002. He established that the winners in both finals scored a higher percentage of first serves and at the same time also a higher percentage of points won after the first and the second serve than the losers. Zlatoper (2002) analyzed the final matches of the French Open (Roland Garros), Wimbledon and the US Open in 2001. He established that the winner of the US Open was more successful in the percentage of first serves, the percentage in points won after the first and the second serve. The winner also won more victories and total points. The loser had fewer double faults and won more aces. At the Wimbledon tournament, the winner was more successful in the percentage of points won after the first and the second serve, the winner won more aces and winners, and had the same number of total points won as the loser. The loser was, however, more successful in the first serve and had fewer double faults. When analyzing the French Open, he established that the winner was more successful in the percentage of first serves and the percentage of points won after the first and the second serve, the winner also won more aces, had fewer double faults and won more total points. The loser was more successful in the number of victories.

AIMS OF THE STUDY

Aims of the study were to ascertain the following:

1. Is there a difference between winners and losers in the percentage of first serves in the category of men and women?
2. Is there a difference in the reliability of playing between winners and losers in the category of men and women?
3. Is there a difference between winners and losers in the percentage of points won after the first and the second serve in the category of men and women?
4. Is there a difference in the aggressiveness of play between winners and losers in the category of men and women?
5. Is there a difference in the percentage of receiving points won afterwards and in the percentage of break point conversions between winners and losers in the category of men and women?
6. Is there a difference in the total points won between winners and losers in the category of men and women?

METHODS

The sample of participants

We have analyzed the game characteristics of male and female tennis players who played in the main draw of the 2005 Roland Garros. Data for 128 male and 128 female tennis players has been collected from the tournament's official web sites. We have analyzed the total of 894 sets in the category of men and 592 sets in the category of women.

The sample of variables

The sample of variables used for the game characteristics analysis was as follows: percentage of first serves (S1P); number of aces (ACES); number of double faults (DF); number of unforced errors (UE); winning percentage on first serve (W1S); winning percentage on second serve (W2S); number of winners (WIN); percentage of receiving points won (RPW); percentage of break point conversions (BPC); percentage of points won in net approaches (NA) and total points won (TPW).

Data processing methods

We have calculated the parameters of descriptive statistics for the collected data. For all variables, a normal distribution was tested using the Kolmogorov-Smirnov test. A non parametric method (chi-square test) was applied to ascertain statistically characteristic differences between winners and losers in both the male and female category.

RESULTS AND DISCUSSION

The results and discussion are presented separately for male and female players (winners and losers).

Male tennis players

Descriptive statistics (min., max., mean, standard deviation, normal distribution test – Kolmogorov-Smirnov) were calculated separately for winners and losers

for male players (TABLE 1). The table shows that some players achieved a 100% success rate in certain variables (W1S, W2S) and that some male players (winners) absolutely no unforced errors (UE) were made.

We have established that in the majority of variables, the distribution was non normal, therefore a non parametric method (chi-square test) was used to ascertain statistically characteristic differences between winners and losers in the male category. We have established that in all variables except for BPC (Break Point Conversions), there is a statistically characteristic difference between the two groups.

Number of aces (ACES)

The analysis of the number of aces shows a statistically characteristic difference between winners and losers. Namely, winners of the matches won a higher number of aces as compared to losers. From the descriptive statistical results presented in TABLE 1, it is evident that players on average won less than two aces per set. According to this we can conclude that because of the tactics and a slower pace surface, the effect of the first serve is not such as the effect of the faster pace surfaces. Recently, Zlatoper (2002) established that the winners of the 2001 French Open and Wimbledon won a higher number of aces than the losers. The winner of the 2001 US Open, which is played on a fast pace surface, however hit less aces than the loser. The latter fact is interesting, but winners as a rule win a higher number of aces. It should be mentioned here that aces are an effective and attractive way of winning points, but are very rare on clay courts. So it all depends on the court surface and on the players in a match.

Percentage of break point conversions (BPC)

The analysis of the percentage of break point conversions *did not* show statistically characteristic differences between winners and losers. It is worth mentioning that

TABLE 1
Descriptive statistics and chi-square for male tennis players (winners and losers)

Variable	Group	n	Min.	Max.	Mean	Std. deviation	Kolmogorov–Smirnov	Sig.	χ-square value	Sig.
ACES	1	446	0	7	1.43	1.388	0.816	0.518	–3.862	0
	2	448	0	7	1.33	1.513	0.834	0.49		
BPC	1	446	0	100	52.65	29.951	4.728	0	–1.935	0.053
	2	448	0	100	33.78	36.897	5.077	0		
DF	1	446	0	5	0.93	1.033	5.247	0	–4.332	0
	2	448	0	7	1.29	1.252	4.789	0		
NA	1	446	0	100	65.44	22.142	1.839	0.002	–9.156	0
	2	448	0	100	56.12	23.722	1.526	0.019		
RPW	1	446	5	86	43.51	12.258	1.332	0.058	–10.529	0
	2	448	0	79	30.12	12.629	1.175	0.127		
S1P	1	446	25	94	60.29	11.154	1.583	0.013	–11.239	0
	2	448	26	86	57.46	10.367	0.912	0.377		
TPW	1	446	7	59	32.95	7.704	2.145	0	–4.16	0
	2	448	5	59	27.28	10.196	1.92	0.001		
UE	1	446	0	35	11.59	6.033	1.053	0.217	–15.1	0
	2	448	2	43	15.14	5.971	1.099	0.178		
W1S	1	446	11	100	71.58	13.586	2.734	0	–8.785	0
	2	448	8	100	61.75	14.342	5.498	0		
W2S	1	446	0	100	53.34	17.683	1.636	0.009	–6.146	0
	2	448	0	86	39.28	16.528	1.53	0.019		
WIN	1	446	1	27	10.6	4.518	2.099	0	–9.529	0
	2	448	0	26	9.38	4.591	1.439	0		

Legend:
1– winners,
2– losers,
ACES – number of Aces,
BPC – Break Point Conversions,
DF – Double Faults,
NA – Net Approachs,
RPW – Receiving Points Won,
S1P – 1st Serve %,
TPW – Total Points Won,
UE – Unforced Errors,
W1S – Winning % on 1st Serve,
W2S – Winning % on 2nd Serve,
WIN – Winners (Including Serve).

the results approached statistically characteristic differences ($p = 0.053$) because winners took the advantage of more break point conversion opportunities as compared to losers. Inevitably there are more factors that influence such outcomes: the return quality and the quality of the game in all playing situations at the baseline, at the net, and in defending situations. It is additionally possible that winners have higher capability of controlling their psychological pressures in stressful situations.

Number of double faults (DF)

The analysis of the number of double faults showed a statistically characteristic difference between winners and losers. Winners of matches made fewer double faults than losers. It is observed in TABLE 1 that players on average made fewer double faults per set, which indicates a high accuracy of serving. Ferjan (2001) established that the winners of the US Open 2000 and Australian Open 2001 made fewer double faults than the losers. Similar findings were established by Zlatoper (2002) in analyzing the final match at French Open 2001. In the analysis of the US Open and Wimbledon 2001, he established that the losers made fewer double faults in the matches. Zlatoper (2002) concluded that a higher number of double faults could possibly be the result of taking more risk in serving.

Percentage of points won in net approaches (NA)

The analysis of the percentage of points won in net approaches showed statistically characteristic differences between winners and losers. Winners won more points in net approaches. We can again establish that on clay courts, it is the aggressive game that leads to success in a tennis game. Despite the fact that, these days, the so called aggressive baseliners prevail among tennis players, playing at the net is, on the other hand, obviously significant, too. It is evident that winners are capable of improving the aggressive baseline game by adding a net approach transition and a score at the net in situations that allow them to do so.

Percentage of receiving points won (RPW)

The analysis of the percentage of receiving points won showed statistically characteristic differences between winners and losers. Winners had a higher percentage of receiving points won. The quality of a serve makes it hard for the receiver to win a point. This is also evident from the results in TABLE 1. The receivers on average won less than 40% of the points. This is an additional characteristic that distinguishes winners from losers. Winners are capable of playing more reliably, in a more controlled way and more aggressively, and this enables them to continue the game more easily.

Percentage of first serves (S1P)

The analysis of the percentage of first serves showed a statistically characteristic difference between winners and losers. There was a higher percentage of first serves in winners than in the losers of matches. The results, however, do not precisely show whether the winners serve faster and more accurately than the losers. The fact is that the percentage of first serves impact the final match outcome. On clay courts, players more often serve the first serve with more rotation in order to prevent opponents from taking the initiative after the second serve. In their analyses, Ferjan (2001) and Zlatoper (2002) established that the losers of the US Open 2000 and Wimbledon 2001 were more successful in the percentage of the first serves. Based on the fact that these two tournaments were held on surfaces that are faster than clay, these conclusions are rather surprising. However, the results should not be generalized.

Total points won (TPW)

The analysis of the total points won showed statistically characteristic differences between winners and losers. Winners won more total points in a match than losers. The results are of no surprise as they indicate that winners are capable of high performance playing for the entire match and are capable of successfully solving various playing situations. Previously, Ferjan (2001) and Zlatoper (2002) established that winners of the matches won more total points.

Number of unforced errors (UE)

The analysis of unforced errors showed statistically characteristic differences between winners and losers. Winners made fewer unforced errors than losers. The number of unforced errors is one of the significant indicators of being successful in a tennis game. The game of tennis has lately become extremely fast, dynamic and aggressive; nonetheless, players are capable of playing with a remarkably low number of unforced errors. On clay courts a number of variations are taking place: the speed of the ball, rotation, height and depth, and the angles at which the players perform their strokes. A higher number of ball exchanges over the net, moreover, requires excellent physical condition.

Winning percentage on first serve (W1S)

The analysis of the winning percentage on the first serve showed statistically characteristic differences between winners and losers. There was a higher percentage of points won after the first serve in winners. It can be established that on clay courts and other surfaces alike, a higher percentage of winning on the first serve positively affects the success in a match. We can con-

clude that when the winners serve, they are more frequently capable of taking the initiative and controlling the course of the game. In their research projects of individual final matches, Ferjan (2001), Pintarič (2002) and Zlatoper (2002) established that the winners of the US Open 2000, Australian Open 2001, French Open 2001 and 2002, Wimbledon and US Open 2001 achieved a higher percentage of points won on the first serve, which additionally confirms the previously mentioned results.

Winning percentage on second serve (W2S)

The analysis of the winning percentage on the second serve showed statistically characteristic differences between winners and losers. There were a higher percentage of points won after the second serve in winners. On clay courts players more often use a spin serve, which increases the reliability of the serve and at the same time, increases the height and the bounce of the ball. In this way they prevent the opponents from taking the initiative in a game. Additionally, the quality of a return should be observed, as it can enable the other player to annul the advantage of the player serving. Pintarič (2002) and Zlatoper (2002) came to the same conclusions. The winners of the final matches at the French Open and US Open won a higher percentage of points on the second serve. Ferjan (2001) analyzed the Australian Open, yet established just the opposite. In the final match of the 2001 Australian Open, the loser won a higher percentage of points on the second serve than the winner.

Number of winners (WIN)

The analysis of the number of winners showed statistically characteristic differences between winners and losers. Namely, winners in the male category achieved more victories than losses. TABLE 1 presents the fact that players, on average, achieved 10.6 wins per set. It can be concluded that an aggressive game and taking the initiative in a game are current factors that influence successfulness in tennis. Ferjan (2001) and Zlatoper (2002) established that the winners of the Australian and French Open in 2001 achieved fewer victories than losers. Here we should consider though, that we are looking a few years back and that the analysis covered just one single tennis match.

Female players

Descriptive statistics (min, max, mean, standard deviation, normal distribution test – Kolmogorov-Smirnov) were calculated for female players (TABLE 2).

We have established that, in the majority of variables, the distribution was non normal, therefore a non parametric method (chi-square test) was used to ascertain statistically characteristic differences between winners and losers in the female category. We have established that, in all variables except for ACES (number of aces) there is a statistically characteristic difference between the two groups of female tennis players. The table shows that some female players achieved a 100% success rate in certain variables (W1S, W2S) and that some male players (winners) made absolutely no unforced errors (UE).

Number of aces (ACES)

The analysis of the number of aces *did not* show a statistically characteristic difference between winners and losers. Winners of the matches won a higher number of aces but the difference was not statistically characteristic. From the descriptive statistical results presented in TABLE 2, it is evident that female winners on average won less than one ace per set, which is less as compared to male players (TABLE 1). According to this we can conclude that because of the tactics and a slower paced surface, the effect of the first serve is not such as found in male players. It should be mentioned at this point that aces are an effective and attractive way of winning points also in the female category, but are very rare on clay courts. Based on these results we can establish that the number of aces does not impact success in the match in the female category.

Percentage of break point conversions (BPC)

The analysis of the percentage of break point conversions showed statistically characteristic differences between female winners and losers. Winners had a higher percentage of won break points than losers. In our opinion, there are inevitably more factors that influence such outcomes – the return quality and the quality of the game in all playing situations at the baseline, at the net, and in defending situations. It is additionally possible that winners are better capable of controlling their psychological pressures in stressful situations.

Number of double faults (DF)

The analysis of the number of double faults showed a statistically characteristic difference between female winners and losers. Winners of matches made fewer double faults than losers, which indicates a high reliability of the second serve. From the descriptive statistics results presented in TABLE 1 and 2, it is evident that female players made more double faults as compared to male players.

Percentage of points won in net approaches (NA)

The analysis of the percentage of points won in net approaches showed statistically characteristic differences between female winners and losers. Winners had

TABLE 2
Descriptive statistics and chi-square for female tennis players (winners and losers)

Variable	Group	n	Min.	Max.	Mean	Std. deviation	Kolmogorov-Smirnov	Sig.	χ-square value	Sig.
ACES	1	296	0	6	0.97	1.189	0.744	0.637	–0.57	0.569
	2	296	0	4	0.45	0.78	0.906	0.384		
BPC	1	296	0	100	58.6	25.57	4.338	0	–6.027	0
	2	296	0	100	38.18	33.322	6.969	0		
DF	1	296	0	10	1.78	1.567	3.223	0	–2.947	0.003
	2	296	0	8	2.11	1.523	2.928	0		
NA	1	296	0	100	63.84	27.776	1.064	0.208	–2.924	0.003
	2	296	0	100	55.97	31	1.355	0.051		
RPW	1	296	8	92	47.3	12.365	0.813	0.524	–11.682	0
	2	296	0	68	32.29	12.881	1.088	0.188		
S1P	1	296	30	92	58.9	11.231	1.168	0.131	–8.764	0
	2	296	30	93	59.36	11.435	1.247	0.089		
TPW	1	296	14	56	33.64	7.369	1.308	0.065	–9.159	0
	2	296	2	53	26.89	9.978	2.07	0		
UE	1	296	0	37	14.45	6.994	1.124	0.16	–13.009	0
	2	296	2	41	15.96	6.23	1.006	0.264		
W1S	1	296	25	100	67.84	13.201	2.115	0	–8.069	0
	2	296	0	95	52.81	15.39	3.065	0		
W2S	1	296	0	100	44.63	16.002	2.064	0	–3.483	0
	2	296	0	100	33.44	14.887	1.685	0.007		
WIN	1	296	0	24	10.54	4.395	1.698	0	–8.73	0
	2	296	0	20	7.26	4.028	1.026	0.243		

Legend:
1 – winners,
2 – losers,
ACES – number of aces,
BPC – Break Point Conversions,
DF – Double Faults,
NA – Net Approaches,
RPW – Receiving Points Won,
S1P – 1st Serve %,
TPW – Total Points Won,
UE – Unforced Errors,
W1S – Winning % on 1st Serve,
W2S – Winning % on 2nd Serve,
WIN – Winners (Including Serve).

a higher percentage of points won at the net. We can conclude that winners are capable of improving their aggressive baseline game by adding a net approach transition and a score at the net in situations that allow them to do so. This undoubtedly indicates that winners have the capability to play more diversely than losers and that they can score points in more ways also in the female category. From the descriptive statistics results presented in TABLE 1 and 2, it is seen that female players have a similar percentage of points won in net approaches.

Percentage of receiving points won (RPW)

The analysis of the percentage of receiving points won showed statistically characteristic differences between female winners and losers. Winners had a higher percentage of receiving points won. We can assume that the reasons for these differences are indicated by the quality of the return and the game following the return as was also found in the male category. In addition, from the descriptive statistics results presented in TABLE 1 and 2, it is seen that female players have a lower percentage of receiving points won as compared to male players.

Percentage of first serves (S1P)

The analysis of the percentage of first serves shows a statistically characteristic difference between female winners and losers. Surprisingly, there was a higher percentage of first serves in losers than in winners, which was not found in the male category TABLE 1. We can establish that in female tennis players, the percentage of first serves does not impact success in the match.

Total points won (TPW)

The analysis of the total number of points won showed statistically characteristic differences between female winners and losers. Winners won more total points in a match than losers. Just as for men, it can likewise be concluded that winners among women are

capable of high performance playing for the entire match and are capable of successfully solving various playing situations.

Number of unforced errors (UE)

The analysis of unforced errors showed statistically characteristic differences between female winners and losers. Winners made less unforced errors than losers. Also in women, the number of unforced errors is one of the significant indicators of being successful in a tennis game. The winners were capable of playing more aggressively (number of won victories) and had a lower number of unforced errors. Based on the clay court game characteristics, we can establish that, particularly in women, such results were to be expected.

Winning percentage on first serve (W1S)

The analysis of the winning percentage on the first serve showed statistically characteristic differences between female winners and losers. There was a higher percentage of points won after the first serve in winners. Just as for men, it can likewise be established for women, that on a clay court, a higher percentage of winning on the first serve influences the outcome of a match.

Winning percentage on second serve (W2S)

The analysis of the winning percentage on the second serve showed statistically characteristic differences between female winners and losers. There was a higher percentage of points won after the second serve in winners. It can be established that winners are more frequently capable of winning a point on or after the second serve. From the descriptive statistical results presented in TABLE 1 and 2, it is seen that female winners won a lower percentage on the second serve as compared to male winning players.

Number of winners (WIN)

The analysis of the number of winners showed statistically characteristic differences between female winners and losers. Winners achieved more wins than losers. Also in women's matches, an aggressive game and taking the initiative in a game are factors that influence successfulness in tennis.

CONCLUSION

Based on the results the following was ascertained:

1. There is a difference in the reliability of playing between winners and losers in the category of men and women. Namely, winners in both categories made fewer double faults and unforced errors and reached a higher percentage of first serves.
2. Winners are more aggressive in both categories. Winners reached more aces, and approaches to the net.
3. There is a difference between winners and losers in the percentage of points won after the first and the second serve in the category of men and women. Namely winners in both categories reached a higher percentage of points.
4. There is a difference in the percentage of receiving points won after the serve and break point conversions between winners and losers in the category of men and women.
5. Winners are capable of high performance playing for the entire match and are capable of successfully solving various playing situations.

Based on findings presented in these research results, it can be concluded that there are statistically characteristic differences in the majority of variables, which define game characteristics. Therefore, it can be concluded, there are certain measurable indicators of tennis statistics, which distinguish winners from losers in both the male and female category.

It is worth mentioning that these results show the situation on a clay surface, therefore a similar analysis should be explored on both a grass and on a hard court surface.

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SROVNÁNÍ HERNÍCH CHARAKTERISTIK TENISTŮ A TENISTEK NA ROLAND GARROS 2005
(Souhrn anglického textu)

Herní charakteristiky elitních tenistů a tenistek na French Open 2005 (Roland Garros) byly analyzovány na rozsáhlém základě 894 setů v kategorii mužů a 592 setů v kategorii žen. Navíc se srovnávaly herní charakteristiky jednotlivého setu mezi vítězi a poraženými. Bylo potvrzeno, že u většiny proměnných existují statisticky významné rozdíly mezi vítězi a poraženými, a to jak v kategorii mužů, tak i žen. V kategorii mužů jsou statisticky významné rozdíly u všech proměnných, s výjimkou využití brejkbolu. U žen byly shledány statisticky významné rozdíly u všech proměnných s výjimkou počtu vyhraných es.

Na základě těchto zjištění lze učinit závěr, že statisticky významné rozdíly u většiny proměnných určujících herní charakteristiky naznačují existenci určitých měřitelných ukazatelů ve statistice tenisu, kterými se odlišují vítězové od poražených.

Klíčová slova: tenis, statistika tenisu, úspěšnost v tenisu.

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LANDING ERRORS IN MEN'S FLOOR EXERCISE

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In our research we focused on the reasons for the magnitude of landing errors in floor exercise in men's artistic gymnastics. Our goal is to determine the parameters of the landing characteristics which have an influence on the magnitude of landing mistakes. We analyzed flips which were performed by all gymnasts (n = 97) competing in the qualification rounds of the European Championships in the year 2004 in Ljubljana. We defined the variables according to the theoretical model for the evaluation of flip landings in floor exercises. The results show that a soft landing is most effective, incomplete twists are the reason for large errors, landing after performing flips without twists is optimal with the feet together (unless the gymnast's abilities of his/her left and right leg are different) and the arms' positions at the time of the touch down should be upward.

Keywords: Gymnastics, floor exercise, landings, errors.

INTRODUCTION

Landing in modern gymnastics is one of the most important factors which determine the final rank of gymnasts at competitions. There are landings involved with every event using gymnastic apparatus. Most gymnasts perform in floor exercises where the competition routine performed is made up of several acrobatic elements. Each acrobatic jump element includes a take off phase, a flight phase and a landing.

The goal of the landing is to absorb the body's energy (kinetic energy being zero) produced at the take off phase. According to the conservation of mechanical energy, kinetic energy will be the same at take off and at landing if no external forces are applied to the body in the flight phase. This rule affects acrobatic elements, such as, for example, flips.

Each gymnast has to asses the amount and direction of energy in the flight phase and anticipate the amount and direction of energy at landing. The direction of kinetic energy at contact can be oriented towards or to the side of the energy from the flight phase. If the kinetic energy at landing is oriented towards the energy of the flight phase than the total sum of energies is equal to the difference between them and oriented in the direction of the greater one. If the direction of energies is the same than the total amount is equal to the sum of both energies. Therefore it is necessary for the stick landing to develop such initial conditions that the impulse of the ground reaction force would be oriented towards the energy of the flight phase and equal to its amount. These are characteristics of landings that occur after an independent acrobatic element or at the end of an acrobatic series. The ability of a gymnast to control a reaction force during the landing is limited by muscular coordination, the ability of an individual to predict the magnitude of loading, and the ability to overcome the load created at the time of contact with the surface (McNitt-Gray, Costa, Mathiyakom, & Requejo, 2001). If the body is not capable of efficiently controlling the loading at the time of landing, acute or overuse injuries can occur.

An additional problem is represented by the rule that feet should be together at landings (FIG, 2006). One of the most important factors affecting stability is the magnitude of the base support. The base of support is an area bounded by the outermost regions of the body in contact with the supporting surface. In the feet together stance, the base of support is small and this fact aggravates the gymnast's stability. Another factor that affects stability is the angle between the line of action of a body's weight and the boundaries of the base of support. When the line of action of a body's weight moves outside the base of support, stability is disrupted.

If the gymnast keeps his/her feet together at landing than he/she can increase his/her stability by horizontally positioning the center of gravity near the edge of the base of support of the oncoming external force and vertically positioning the center of gravity as low as possible.

Before the gymnast makes an (un)necessary step at landing he/she can perform modification movements. Research has shown that the distribution of momentum among segments at the flight phase and contact influenc-

es stability during interaction with the landing surface (McNitt-Gray, Hester, Mathiyakom, & Munkasy, 2001; Requejo, McNitt-Gray, & Flashner, 2002). Modifications in shoulder torque during the flight phase enables the gymnast to reach kinematic characteristics which are consistent with successful landings. After such a contact, the gymnast can circle the arms in the same or in the opposite direction to the direction of movement or lower his/her center of gravity. Modifications with hands help to preserve and transfer angular quantity (Prassas & Gianikellis, 2002). When the center of gravity is lowered, a time interval is enhanced, in which the interaction of the impulse of the ground reaction force with his/her muscles can be actively lowered.

Results from some research projects show a rather low success rate of landings at competitions (McNitt-Gray, Requejo, Costa, & Mathiyakom, 2001; Prassas & Gianikellis, 2002). At the Olympic games in 1996 in Atlanta McNitt-Gray et al. (1998) investigated landings from a high bar and from the parallel bars. Competitors performed twenty landings. Only one was performed without a mistake. Eight were over and eleven under rotated.

When performing acrobatic elements, mistakes can occur in every phase of the element. These phases are interdependent. Mistakes that occur in later phases can be in correlation with earlier phases. Therefore it is important to know types of landing mistakes in order to find the reasons for their occurrence.

In our research we will try to describe landing mistakes and find out what is the influence of the chosen variables on the magnitude of error. The subject of this research is: landings in floor exercise. The problem is to find out the reasons for the mistakes made.

MATERIAL AND METHODS

In our research we analyzed landings of flips performed after an independent flip or at the end of an acrobatic series of flips (n = 241). The analyzed flips were performed by all gymnasts (n = 97) who were competing in the qualification founds of the European Championships in 2004 in Ljubljana.

We defined variables according to a theoretical model for the evaluation of flip landings in floor exercise (Marinšek & Čuk, 2007). From the mentioned model we chose the following variables that describe landing:

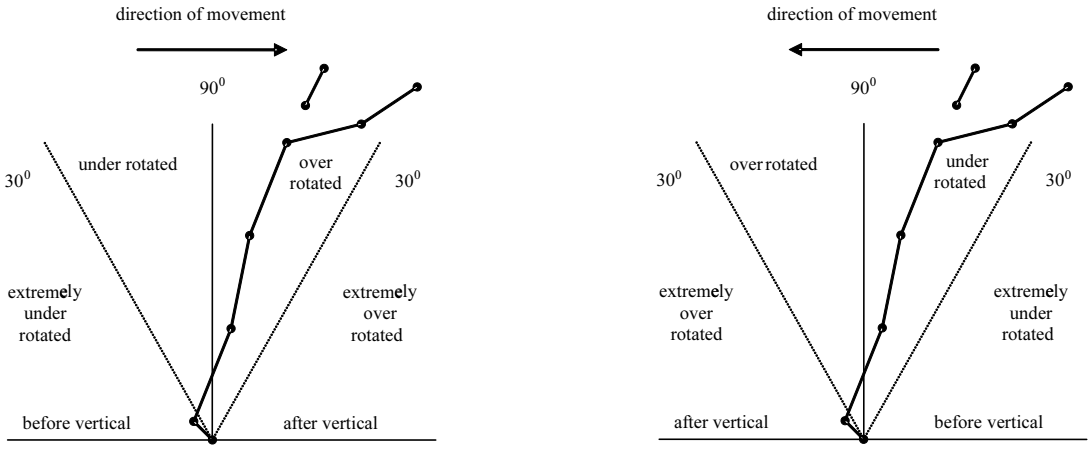
1. Style of landing:
   - on the feet,
   - in support*,
   - in a roll.

* We excluded from the research all somersaults performed with the support of both hands as our goal is to analyze the landings of flips that end up on the feet.

2. Angle of the body at contact (Fig. 1 and Fig. 2):
   - landings on feet (angle between the floor, heels and shoulders),
   - landings in a roll (angle between the floor, wrist and heels),
     - more than 31° after the vertical (very over rotated),
     - from the vertical to 30° (over rotated),
     - from 30° to the vertical (under rotated),
     - more than 31° before the vertical (very under rotated).

3. Base of support:
   - feet together,
   - ≤ shoulder width,

Fig. 1
Angles of the body at contact for landings on the feet



- > shoulder width,
- support with the hands.

4. Amortization:
   - stiff landing,
   - soft landing,
   - deep landing.

5. Inexactness of landing:
   - complete twists,
   - incomplete twists.

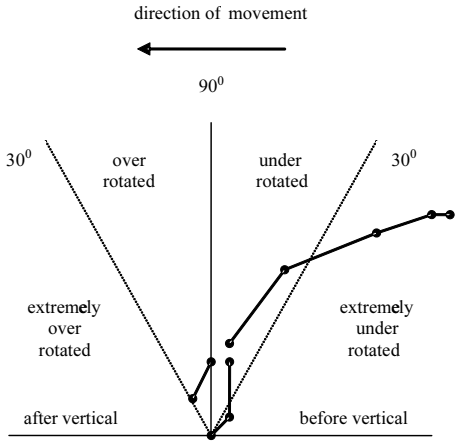
6. Hands position at contact:
   - forward,
   - outward,
   - upward,
   - downward,
   - backward.

7. Movement direction after landing:
   - no movement*,
   - forward,
   - backward,
   - to the side.

* We excluded from the research all flips performed which ended in a motionless landing as our goal is to analyze landings with mistakes.

For all variables we computed frequencies and their percentage in comparison to the magnitude of landing mistakes (crosstabs). With the Chi-square test, we determined differences between the chosen variables and flips with landing mistakes.

Fig. 2
Angles of the body at contact for the landings in a roll



RESULTS

Between the magnitude of error and the style of landing there are significant differences (TABLE 1). Landing in a roll has fewer errors from the code of points perspective. Flips landing on the feet have all errors related to a fall or a large error. The percentage of the occurrence of errors is relative to the same percentage as the number of landings on the feet (90.0%) and into a roll (10.0%).

TABLE 1
Distribution of the magnitude of error and the base of support

STYLE OF LANDING	Magnitude of error							Sum
	Small		Medium		Large		Fall	
	Step	Hop	Step	Hop	Touch	Support		
On feet	**48**	**83**	**54**	**20**		**4**	**8**	**217**
% within style of landing	22.1%	38.2%	24.9%	9.2%		1.8%	3.7%	100.00%
% within magnitude of error	78.7%	92.2%	96.4%	100.0%		100.0%	80.0%	90.00%
In roll	**13**	**7**	**2**				**2**	**24**
% within style of landing	54.2%	29.2%	8.3%				8.3%	100.00%
% within magnitude of error	21.3%	7.8%	3.6%				20.0 %	10.00%
Sum	**61**	**90**	**56**	**20**		**4**	**10**	**241**
% within style of landing	25.3%	37.3%	23.2%	8.3%		1.7%	4.1%	100.00%

Chi-square test between magnitude of error and style of landing		
Value	**Degrees of freedom**	**Significance**
7.936	3	0.047

TABLE 2
Distribution of the magnitude of error and the base of support

BASE OF SUPPORT	Magnitude of error							Sum
	Small		Medium		Large		Fall	
	Step	Hop	Step	Hop	Touch	Support		
Feet together	**7**	**19**	**6**	**5**				**37**
% within base of support	18.9%	51.4%	16.2%	13.5%				100.00%
% within magnitude of error	11.5%	21.1%	10.7%	25.0%				17.10%
≤ shoulder width	**32**	**58**	**42**	**13**		**3**	**3**	**151**
% within base of support	21.2%	38.4%	27.8%	8.6%		2.0%	2.0%	100.00%
% within magnitude of error	52.5%	64.4%	75.0%	65.0%		75.0%	37.5%	69.60 %
> shoulder width	**9**	**6**	**6**	**2**		**1**	**1**	**25**
% within base of support	36.0%	24.0%	24.0%	8.0%		4.0%	4.0%	100.00%
% within magnitude of error	14.8%	6.7%	10.7%	10.0%		25.0%	12.5%	11.50%
support with hands							**4**	**4**
% within base of support							100.0%	100.00%
% within magnitude of error							50.0%	1.80 %
Sum	**61**	**90**	**56**	**20**		**4**	**8**	**217**
% within base of support	25.3%	37.3%	23.2%	8.3%		1.7%	3.7%	100.00%

Chi-square test between magnitude of error and base of support		
Value	**Degrees of freedom**	**Significance**
109.479	9	0.000

The base of support at landing and the magnitude of error show significant differences (TABLE 2). A bigger base of support means a larger margin of error (also according to the code of points). Most of the landings ended in a standing position with the legs apart up to the hip width (69.6%), much fewer ended in standing with the feet together (17.1%) and standing with the feet apart by more than the hips' width (11.5%) and the smallest number of landings ended using the support of the arms (1.8%).

Between the magnitude of error and the type of amortization there are significant differences (TABLE 3). The largest number of errors occurred during soft landings (58.9%), followed by stiff landings (37.3%) and deep landings (3.7%). Large errors and falls mostly occur in the case of deep landings (11.1% and 22.2%) and stiff landings (2.2% and 5.6%), and a lesser number in the case of a soft landing (0.7% and 2.1%).

TABLE 3
Distribution of the magnitude of error and amortization

AMORTIZATION	Magnitude of error							Sum
	Small		Medium		Large		Fall	
	Step	Hop	Step	Hop	Touch	Support		
Stiff landing	**16**	**31**	**22**	**14**		**2**	**5**	**90**
% within amortization	17.8%	34.4%	24.4%	15.6%		2.2%	5.6%	100.00%
% within magnitude of error	26.2%	34.4%	39.3%	70.0%		50.0%	50.0%	37.30%
Soft landing	**45**	**57**	**30**	**6**		**1**	**3**	**142**
% within amortization	31.7%	40.1%	21.1%	4.2%		0.7%	2.1%	100.00%
% within magnitude of error	73.8%	63.3%	53.6%	30.0%		25.0%	30.0%	58.90%
Deep landing		**2**	**4**			**1**	**2**	**9**
% within amortization		22.2%	44.4%			11.1%	22.2%	100.00%
% within magnitude of error		2.2%	7.1%			25.0%	20.0%	3.70%
Sum	**61**	**90**	**56**	**20**		**4**	**10**	**241**
% within amortization	25.3%	37.3%	23.2%	8.3%		1.7%	4.1%	100.00%

Chi-square test between magnitude of error and amortization		
Value	**Degrees of freedom**	**Significance**
24.792	6	0.000

TABLE 4
Distribution of the magnitude of error and the inexactness of landing

INEXACTNESS OF LANDING	Magnitude of error							Sum
	Small		Medium		Large		Fall	
	Step	Hop	Step	Hop	Touch	Support		
Without turn	**18**	**26**	**21**	**4**			**7**	**76**
% within inexactness of landing	23.7%	34.2%	27.6%	5.3%			9.2%	100.00%
% within magnitude of error	29.5%	28.9%	37.5%				70. %	31.10%
Complete twists	**39**	**52**	**25**	**15**		**3**	**1**	**135**
% within inexactness of landing	28.9%	38.5%	18.5%	11.1%		2.2%	0.7%	100.00%
% within magnitude of error	63.9%	57.8%	44.6%	75.0%		75.0%	10.0%	56.00%
Incomplete twists	**4**	**12**	**10**	**1**		**1**	**2**	**30**
% within inexactness of landing	13.3%	40.0%	33.3%	3.3%		3.3%	6.7%	100.00%
% within magnitude of error	6.6%	13.3%	17.9%	5.0%		25.0%	20.0%	12.30%
Sum	**61**	**90**	**56**	**20**		**4**	**10**	**241**
% within inexactness of landing	25.3%	37.3%	23.2%	8.3%		1.7%	4.1%	100.00%

Chi-square test between magnitude of error and inexactness of landing		
Value	**Degrees of freedom**	**Significance**
12.583	6	0.050

Between the magnitude of error and the inexactness of landing there are significant differences (TABLE 4). The highest frequency of errors is among flips with completed twists (56.0%), followed by flips without twists (31.1%) and flips with incomplete twists (12.3%), which have the highest number of medium errors (36.6%), large errors (3.3%) and falls (6.7%), while flips with completed twists have the largest number of small errors (67.4%).

TABLE 5
Distribution of the magnitude of error and the hands' position at contact

HANDS POSITION AT CONTACT	Magnitude of error							Sum
	Small		Medium		Large		Fall	
	Step	Hop	Step	Hop	Touch	Support		
Forward position	**6**	**23**	**10**	**1**		**2**	**3**	**45**
% within hands position	13.3%	51.1%	22.2%	2.2%		4.4%	6.7%	100.00%
% within magnitude of error	9.8%	25.6%	17.9%	5.0%		50.0%	30.0%	18.40%
Outward position	**37**	**47**	**29**	**14**			**1**	**128**
% within hands position	28.9%	36.7%	22.7%	10.9%			.8%	100.00%
% within magnitude of error	60.7%	52.2%	51.8%	70.0%			10.0%	53.10%
Upward position	**12**	**7**	**3**			**1**	**1**	**24**
% within hands position	50.0 %	29.2%	12.5%			4.2%	4.2%	100.00%
% within magnitude of error	19.7 %	7.8%	5.4%			25.0%	10.0%	9.80%
Downward position	**6**	**11**	**14**	**5**		**1**	**4**	**41**
% within hands position	14.6%	26.8%	34.1%	12.2%		2.4%	9.8%	100.00%
% within magnitude of error	9.8%	12.2%	25.0%	25.0%		25.0%	40.0%	17.00%
Backward position		**2**					**1**	**3**
% within hands position		66.7%					33.3%	100.00%
% within magnitude of error		2.2%					10.0%	1.20%
Sum	**61**	**90**	**56**	**20**		**4**	**10**	**241**
% within hands position	25.3%	37.3%	23.2%	8.3%		1.7%	4.1%	100.00%

Chi-square test between magnitude of error and hands position at contact		
Value	**Degrees of freedom**	**Significance**
30.423	12	0.002

TABLE 6
Distribution of the magnitude of error and the direction of movement after landing

DIRECTION OF MOVEMENT	Magnitude of error							Sum
	Small		Medium		Large		Fall	
	Step	Hop	Step	Hop	Touch	Support		
Forward	**36**	**61**	**30**	**16**		**3**	**1**	**147**
% within direction of movement	24.5%	41.5%	20.4%	10.9%		2.0%	0.7%	100.00%
% within magnitude of error	59.0%	67.8%	53.6%	80.0%		75.0%	10.0%	61.00%
Backward	**8**	**18**	**17**	**3**		**1**	**8**	**55**
% within direction of movement	14.5%	32.7%	30.9%	5.5%		1.8%	14.5%	100.00%
% within magnitude of error	13.1%	20.0%	30.4%	15.0%		25.0%	80.0%	22.50%
Aside	**17**	**11**	**9**	**1**			**1**	**39**
% within direction of movement	43.6%	28.2%	23.1%	2.6%			2.6%	100.00%
% within magnitude of error	27.9%	12.2%	16.1%	5.0%			10.0%	16.00%
Sum	**61**	**90**	**56**	**20**		**4**	**10**	**241**
% within direction of movement	25.3%	37.3%	23.2%	8.3%		1.7%	4.1%	100.00%

Chi-square test between magnitude of error and direction of movement		
Value	**Degrees of freedom**	**Significance**
23.306	6	0.001

Between the magnitude of error and the hands position at contact there are significant differences (TABLE 5). Gymnasts have mostly had their arms in an outward position (53.1%), ratherthan in a forward position (18.4%), a downward position (17.0%), an upward position (9.8%) or a backward position (1.2%). The highest number of small (55.6%) and medium range (56.6%) errors occurred with the "outward arms" position. The highest number of large errors (50.0%) occurred with the use of the forward arms position and the largest amount of falls occurred with arms in the downward position.

Between the magnitude of error and the direction of movement after landing, there are significant differences (TABLE 6). After landing, gymnasts mostly continued with their movement in the direction of the flip (61.0%), in much fewer cases in a direction counter to the flip (22.5%) and in a sideways direction (16.0%). The highest frequency of small (64.2%), middle range (60.5%) and large (75.0%) errors were performed in the case of movement in the same direction as the flip, the highest number of falls occurred in the case of movement in a direction counter to that of the flip (80.0%). Among small errors, the short hop (67.8%), and among medium errors, the overly large step (53.6%), prevailed.

TABLE 7
Chi-square test between the magnitude of error and other variables

Chi-square test between magnitude of error and other variables			
	Value	**Degrees of freedom**	**Significance**
Angle of the body at contact for landings on feet	20.826	15	0.142
Angle of the body at contact for landings in roll	1.346	3	0.718

Differences between the angle of the body at contact for landings on the feet and for landings in a roll were not significant (TABLE 7).

CONCLUSION

In men's artistic gymnastics, we differentiate three types of landing: in a standing position, into a roll out and into a front lying position. A perfect landing into a stand still position is the most difficult, while the other two types are easier.

To land in a stand still position, gymnasts use different positions of the feet. Mostly they perform standing with their legs apart up to hip width, but this type of landing was not very successful. A higher area of the base of support (standing with the legs apart, both left and right up to hip width) will be effective in the equilibrium sense only when some other factors (the biomechanical characteristics of the element and quality of motor control) will be fulfilled. Stability of body in both a forward and a backward direction (flips without twists) is not better if the feet are apart, as the stability angle does not rise as well, so to land with the legs apart has no biomechanical reason. Such landings with the feet apart (with a raised base of support) are successful in landing after a sideways flip and in flips with twists as the stability angle in a left/right direction is raised.

Results show that a soft landing is the most effective, while stiff landings and deep landings are reasons for more severe errors. Even when a gymnast performs a soft landing, he/she should be aware not to lower the knee angle so much as a moment of inertia in the direction of the flip can be too small and raises an angular

velocity which causes an overly fast movement in the rotation direction.

Incomplete twists are reasons for large errors. Incomplete twists are technical errors which are directly related to airborne time and to the characteristics of take off. Landing with an incomplete twist is a very difficult task as the position of the gymnast is always different (the amount and sort of error is random). Only technically close to perfect elements should be included in the exercise.

Before gymnasts perform unnecessary hops or steps during the landing, they can also do some other correction movements – swinging their arms into the direction or into the opposite direction of the movement. The smallest number of errors was done while the gymnast had an upwards arms position at the moment of a touch down done with the feet. The highest number of errors were noticed when using the downward arms position. The upward arms position is the best (as an initial position) as the arms can swing forward, backward, or outward in accordance with the landing characteristics.

In conclusion we should emphasise again what is the opposite of the usual coaches' stereotypes:

- landing after flips without twists is optimal with the feet together (unless the gymnasts' abilities to use the left and right leg are different),
- the arms' position at touch down should be upward.

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CHYBY V DOSKOCÍCH V PROSTNÝCH MUŽŮ

(Souhrn anglického textu)

Ve výzkumu jsme se zaměřili na příčiny chyb v doskoku v prostných v mužské sportovní gymnastice. Naším cílem je stanovit parametry charakteristik doskoku, které ovlivňují závažnost chyby v dopadu. Analyzovali jsme přemety provedené všemi gymnasty (n = 97) soutěžícími na kvalifikační soutěži Mistrovství Evropy 2004 v Lublani. Podle teoretického modelu pro hodnocení doskoků při přemetech v prostných jsme stanovili proměnné. Výsledky ukazují, že nejúčinnější je měkký doskok, zatímco neúplné obraty způsobují závažné chyby. Doskok po přemetu bez obratu je optimální s nohama u sebe (pokud se gymnastovy schopnosti levé a pravé nohy neliší) a se vzpaženýma rukama.

Klíčová slova: gymnastika, prostná, doskok, chyby.

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THE STATE OF MIND OF LESS PHYSICALLY ACTIVE AND REGULARLY PHYSICALLY ACTIVE WOMEN IN THE SECOND TRIMESTER OF THEIR PREGNANCIES

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The moment a woman finds out that she is pregnant, her life changes in many aspects as she starts to adjust to the baby growing in her body. Her wish is to feel well, to safely reach the due date and give birth to a healthy child. We conducted a survey among 163 pregnant women at the end of the second trimester of their pregnancies and this article presents the relationship between their sport activity and their state of mind during pregnancy. Two groups of pregnant women, namely those who were regularly physically active (RPA) and those with a low level of being physically active (LPA) were compared and the relationship between their level of sport activity and their state of mind was established. The first part of the inventory focused on sport activity, namely – the frequency, forms and types of their sport activities. The RPA group consisted of 69 pregnant women who regularly engage in organised sport activities at sport centres or are physically active 3 to 4 times a week in an unorganised way. Activities which lasted for 30 minutes or more were considered. The LPA group consisted of 94 pregnant women who were physically active only occasionally or were physically inactive. The second part of the inventory investigating pregnant women's state of mind included 45 items which probed into their state of mind; for each item the study subjects defined their psychological state of mind on a five degree scale (never, rarely, sometimes, often, nearly always). Of all items, 20 had a prevalence of a positive state of mind and 25 a prevalence of a negative state of mind. In both groups, the state of mind of the women was analysed and relationships were established between regular sport activity and a low level of sport activity and the state of mind of the women in the second trimester, which is the time when pregnant women are most frequently and most easily physically active. By using a factor analysis we proved that, in the RPA, the first factor to be eliminated is the one associated with positive emotions, explaining 23.51 percent of the variance of the total 34.91 percent of the explained variance. Hence, the RPA pregnant women defined their state of mind as being mostly positive, with the following emotions: relaxed, satisfied, agreeable, not pessimistic, attractive, proud and happy. In the LPA group, the first eliminated factor was the one associated with negative emotions, explaining 19.45 percent of the variance of the total 34.68 percent of the explained variance. This group of pregnant women defined their state of mind mostly as negative, with the following recurring emotions: melancholic, tense, irritable, depressed and nervous. The findings show that regular sport activity benefits the psychological state of mind and the mental health of pregnant women.

Keywords: Emotions, organised, unorganised physical activity, inventory investigating the state of mind.

INTRODUCTION

An active lifestyle during pregnancy with a sufficient amount of physical activity and a healthy diet benefits a pregnant woman's body and her child's health and also facilitates childbirth and helps her regain her fitness. Continuous exercising during pregnancy improves the progress of labour contractions and the delivery of the child (Clapp, 1991; Clapp, Sleamaker, & Wesley, 1987; Grisso, Main, & Chiu, 1992; Kramer, 2002). The positive impact of moderate sport activity on foetal growth has been proven (Campbell & Mottola, 2001; Hatch, Shu, & McLean, 1993; Spinillo, Baltaro, & Capuzzo, 1996). Exercising helps pregnant women overcome some of the problems associated with pregnancy such as constipation, fatigue, morning sickness, frequent urination, sleepiness and lower abdominal pain. According to many studies and related recommendations (Brown, 2002; Bung, 1999; Lochmuller & Friese, 2004), sport activity is beneficial for relaxation and one's psychological state of mind, it improves the cardiovascular system, helps maintain one's body weight and prevents back and joint pain. Exercising of the pelvic floor muscles during pregnancy helps to strengthen and reinforce the muscles, while it also shortens the second stage of labour because a woman thus prepared is, during labour, aware

of the functioning of her muscles and can relax them in due time. She can actively participate in the labour and thereby make it shorter and easier (Gamberger, Videmšek, & Karpljuk, 2005). The effects of regular sport activity include an improvement in overall physical and psychological fitness, thus preserving one's capacity to work and building a sense of security and enabling those concerned to take pleasure in movement. This supports a positive attitude towards one's pregnancy, has a positive influence on one's psychological state of mind, cheerfulness and good mood and also helps prevent depression and maintain one's mental balance (Klun, 1992).

Previous studies (Pivarnik, Ayres, & Mauer, 1993; Wolfe, Preston, & Burggraf, 1999) have shown that, from the early second trimester, moderate to medium intensive aerobic exercise is beneficial, with the heart rate not exceeding 140 beats per minute; it should be performed three to four times a week and last 25–60 minutes. This volume of exercise causes aerobic power to be reduced by a minimum amount, whereas body weight increases more slowly owing to the prompt consumption of fats (Clapp & Capeless, 1991; Clapp & Little, 1995). The recommended aerobic activities include walking, running, aerobics, cycling on a exercise bicycle, hiking and swimming (Davis, Mottola, MacKinnon, & Wolfe, 2003). In addition to aerobic exercise in the open air, pregnant women may also relax by practicing a kind of exercing called "pilates". Pilates is a form of exercise which improves the psychological state of mind of pregnant women and helps increase their self confidence while continuously adapting to their changing body (King & Green, 2002; Selby, 2002).

In the second trimester of pregnancy, from week 14 to week 27, most pregnant women feel well, they are full of life and energy, and their appearance shows it. In this trimester most pregnant women do not suffer from morning sickness or general fatigue like at the beginning. Generally, they are physically stronger and can move energetically despite the pregnancy. This is perhaps the most enjoyable time of pregnancy; women are physically aware of their pregnancy and the child is not big enough to hinder them or change their way of moving or their posture (Charlish, 1997).

Pregnancy, along with motherhood, involves a fusion of instinctive desires and needs of the highest degree of the ego's potential. It is a source of the kind of satisfaction which can be derived from having a child, raising it and being its parent; however, it also presents us with many drawbacks. The integration process unavoidably awakens the woman's past, brings back old conflicts and triggers the question of her identity. Pregnancy is, on the one hand, a progressive and, on the other, a regressive process. The maturity of the woman and her steadiness determine the strength and intensity with which the progressive process prevails over the regressive. Therefore, during the period of pregnancy and labour, new formations emerge in the somatic, psychological and social domains, requiring a comprehensive bio-psycho-social approach (Rojšek, 1990).

The psychological aspect of the considerations of pregnancy is based on the premises that this is a unique period in life when two persons are joined together in one body. Therefore, it is important how a pregnant woman deals with this dilemma of "joining" (Raphael-Leff, 1991). The author puts particular emphasis on conditions related to conception, the experience of two people in one body, a change in physical appearance, doubts about maternal abilities, the capacity of the foetus to mature, and some experiences of emotional instability. Kapor-Stanulović (1985) stated that pregnancy is a critical phase leading to a new level of the integration and development of a personality. Pregnancy in itself constitutes a source of psychological stress (Velikonja, 1998). In difficult circumstances and with emotionally vulnerable women these pressures become even stronger. During pregnancy and at childbirth, women often experience mixed and labile emotional reactions and conditions and not just sheer satisfaction, as is often believed. About 50 percent of pregnant women in any normal population suffer from insomnia, anxiety, anxiousness and depression (Velikonja, 1998). Each woman experiences pregnancy in a unique way and her attitude towards it is strongly influenced by the environment she lives in. The pregnant woman's state of mind is strongly affected by her social environment and having a solid relationship and communication with her partner. Problems are less thorny if they can be discussed with someone (Horvat-Kuhar, 1995). The organic phenomenon of pregnancy is imbued with psychological material and each physiological phase of the pregnancy is characterised by specific psychological aspects.

In the second trimester, a pregnant woman eventually succeeds in striking the right balance by creating a distance between herself and her unborn child and between her mother and herself as a child (Raphael-Leff, 1991). At the end of this period, most pregnant women are happy, some of them have never before taken so much delight in everything they do, and most of them enjoy moving around. Women find themselves attractive because of their beautiful appearance and their positive state of mind that shows on their faces. Of course, this is only true if a pregnant woman is healthy and the expectation of the baby is a source of joy.

Given that this is an interesting and topical subject, our study aimed at analysing the state of mind of physically active and inactive pregnant women and to find out whether there is a relationship between regular sport activity and their state of mind in the second trimester of pregnancy during which women are most frequently and

easily active. We wanted to establish differences in the structure of factors and/or in their contents which are in the background and explain the factors in both groups. These contents are explained by emotions which define the pregnant woman's psychological state of mind. We aimed to relate the eliminated factors to sport activity and establish in what way the contents of these factors differ. The purpose of the article was to prove that, in the RPA group, the first eliminated factor is the one associated with positive emotions, which indicates a positive psychological state of mind of the pregnant women in this group, whereas in the LPA group, the first eliminated factor is the one associated with negative emotions, which indicates that negative states of mind occur more frequently. We thus wanted to confirm our hypothesis that regular sport activity benefits pregnant women's psychological state of mind and mental health.

METHODS

Participants

The sample included 163 pregnant women at the end of their second trimester. The subjects were divided into regularly physically active and less physically active groups. The regular physically active group consisted of 69 pregnant women who regularly engaged in organised sport activities at sport centres or were physically active 3 to 4 times a week in an unorganised way, with individual activity lasting 30 minutes or more. The lowly physically active group consisted of 94 pregnant women who were physically active only occasionally or physically inactive. The average age of the sample was 29.6 years. The active and inactive groups did not differ substantially in terms of age, place of residence and marital status. A minor difference between the two groups was established in terms of education; the physically active had a higher level of education; however, the difference was not statistically significant. Data were gathered from November 2005 to November 2006.

Instruments

The items of the inventory focused on sport activity, namely the frequency, forms and types of sport activities. The inventory investigating sport activity was compiled on the basis of the "Health related behavioural style" inventory (Zaletel-Kragelj, Fras, & Maučec-Zakotnik, 2004) and, within its framework, the measurement characteristics were verified; it is available from the authors. The inventory also included 45 items concerning the notion of state of mind; the subjects assessed each individual emotion on a scale from 1 to 5 and thus expressed their positively or negatively inclined psychological state of mind. All emotions were graded from 1 – "never" to 5 – "nearly always" and the subjects chose between them according to how they experienced themselves over the last few days. For example, the emotion "disappointed" was assessed as 1 – never disappointed, 2 – rarely disappointed, 3 – sometimes disappointed, 4 – often disappointed and 5 – nearly always disappointed. Of all items, 20 had a prevalence of a positive state of mind and 25 a prevalence of a negative state of mind. Based on the sum total of grades of the occurrence of positive and negative emotions, the average values of expressed negative and negative emotions were calculated. The inventory concerning their psychological state of mind was compiled by the clinical psychologist Vislava Globevnik Velikonja and its measurement characteristics were verified.

Procedure

The data were processed with the SPSS statistical software package. Besides the basic statistics of variables, the dimension of the matrix of variables was reduced using an analysis of the main components, i.e. factor analysis. The varimax rotation procedure was applied. All hypotheses were verified at a 5 percent statistical risk level ($p = 0.05$). The entire study was approved by the Slovenian Medical Ethics Committee and the Professional and Business Committee of the Department of Obstetrics and Gynaecology of the University Medical Centre in Ljubljana.

RESULTS

The analysis of the parameters of sport activity showed that the majority of the inventoried subjects in the second trimester of pregnancy engaged in unorganised types of sport activity, i.e. 93.9 percent. The types of activities which pregnant women chose the most often included walking or walking in nature with 87.9 percent, followed by swimming with 17.2 percent, running with 14.1 percent, active walking with 12.1 percent and morning gymnastics with 5.5 percent. Women engaging in organised activities accounted for 14.1 percent and they regularly practiced pilates, aerobics for pregnant women and pregnancy exercises in the framework of prenatal classes. Based on an analysis of the frequency of sport activity, the subjects were divided into two groups: RPA – regularly physically active (active 3–4 times a week for 30 minutes or more) encompassing 69 pregnant women (42.3 percent) and LPA – less physically active, encompassing 94 pregnant women (57.7 percent).

The analysis of the assessment of emotions, graded on a scale from 1 to 5 based on how the subjects experienced themselves over the last few days, is presented in TABLE 1 where the average values for both groups

are shown: for all emotions; for the 20 items of positive emotions and for the 25 items of negative emotions.

TABLE 1
Descriptive statistics

		N	Mean	Std. deviation	Std. error mean
All emotions	**Inactive**	94	3.74	0.46	0.05
	Active	69	3.89	0.42	0.05
Positive emotions	**Inactive**	94	3.76	0.51	0.05
	Active	69	3.96	0.49	0.06
Negative emotions	**Inactive**	94	3.71	0.51	0.05
	Active	69	3.82	0.46	0.06

Active pregnant women recorded higher average values for positive emotions, namely 3.96, compared to the inactive ones for whom the respective figure was 3.76. Higher averages were also reported for negative emotions of the active subjects, namely 3.82, compared to the inactive ones for whom the respective figure was 3.71. The difference between the average values is greater in the area of positive emotions. In spite of the differences in the average values of emotions, the difference between the RPA and the LPA groups in terms of the expressed positive or negative emotions was not statistically significant.

The state of mind of pregnant women regularly engaging in sport

TABLE 2 shows that 12 factors have a lambda higher than 1. For the purpose of explaining the areas of sport activity and state of mind, the two strongest factors were extracted explaining 34.91 percent of the total variance. The first one accounted for 23.51 percent and the second for 11.40 percent. Other factors explain a considerably

TABLE 3
Rotated factor matrix(a)

	Factor 1	Factor 2
Relaxed	0.78	
Satisfied	0.76	–0.30
Agreeable	0.73	
Pessimistic	–0.72	0.31
Attractive	0.71	
Proud	0.70	
Happy	0.69	–0.28
Accepted	0.68	
Joyful	0.68	–0.29
Loved	0.67	–0.30
Tense	–0.66	
Lively	0.65	–0.25
Curious	0.63	
Poised	0.63	–0.23
Neat	0.60	0.22
Feminine	0.57	
Understood	0.55	
Depressed	–0.54	0.34
Guilt ridden	–0.49	0.25
Kind	0.49	
Melancholic	–0.49	0.45
Worried	–0.45	
Nervous	–0.45	0.42
Indecisive	–0.42	0.31
Active	0.40	
Energetic	0.38	–0.33
Disappointed	–0.37	0.26
Maternal	0.33	
Sleepless	–0.28	
Unworthy	–0.27	0.25
Clumsy	–0.25	0.24
Effete	–0.23	
Over burdened		
Sensitive		0.76
Hot tempered		0.75
Vulnerable		0.70
Irritable	–0.23	0.69
Absent-minded		0.54
Whining		0.52
Apathetic	–0.33	0.49
Sick and tired	–0.36	0.43
Impatient	–0.30	0.38
Self critical		0.30
Weary		0.24
Lacking appetite		

TABLE 2
Total variance explained

Factor	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	13.23	29.41	29.41	12.68	28.17	28.17	10.58	23.51	23.51
2	3.60	8.01	37.41	3.03	6.74	34.91	5.13	11.40	34.91
3	2.92	6.49	43.91						
4	2.39	5.30	49.21						
5	1.81	4.03	53.24						
6	1.78	3.96	57.20						
7	1.58	3.52	60.72						
8	1.41	3.13	63.85						
9	1.39	3.08	66.92						
10	1.28	2.85	69.78						
11	1.14	2.54	72.31						
12	1.02	2.28	74.59						

smaller share of the variance and a proper explanation of their contents would require a consideration of other areas of personality structures.

TABLE 3 shows the structure of the two extracted factors explaining the psychological state of mind of the active pregnant women.

For the active study subjects, the first extracted factor was the one associated with positive emotions. This group of pregnant women defined their state of mind with the following items – relaxed, satisfied, agreeable, not pessimistic, attractive, proud, happy, accepted, joyful, loved, not tense, lively, curious and poised. The state of mind of pregnant women is defined as positive by the first, stronger factors. The first most important factor explaining 23.51 percent of the variance is defined by positive emotions in terms of contents. This shows that sport activity in the second trimester has a beneficial effect on a pregnant woman's state of mind. The other factor was associated with the following emotions – hot-tempered, vulnerable, sensitive, absent minded and whining. Occasional periods of mixed emotions are expected and perfectly normal, even for healthy active women.

The state of mind of pregnant women not engaging in sport

Eleven factors have a lambda higher than 1 (TABLE 4); however, for the same reason as above, two factors were extracted, explaining 34.68 percent of the total variance. The first one accounted for 19.45 percent and the second for 15.24 percent of the total variance.

TABLE 5 shows the structure of the two extracted factors explaining the psychological state of mind of the inactive pregnant women.

For those pregnant women who do not engage in any sport, the first, stronger factor that was extracted and which explains 19.45 percent of the variance was associated with negative emotions. This group of subjects defined their state of mind with the following items – melancholic, tense, irritable, depressed, nerv-

TABLE 5
Rotated factor matrix(a)

	Factor 1	Factor 2
Melancholic	0.74	–0.27
Tense	0.73	
Irritable	0.71	
Depressed	0.70	–0.34
Nervous	0.69	
Pessimistic	0.66	–0.32
Sensitive	0.64	
Poised	–0.63	
Sick and tired	0.61	–0.26
Worried	0.57	
Vulnerable	0.56	
Hot tempered	0.56	
Apathetic	0.54	–0.27
Impatient	0.54	
Satisfied	–0.51	0.50
Whining	0.49	–0.32
Guilt ridden	0.45	–0.30
Indecisive	0.44	
Sleepless	0.44	
Absent minded	0.43	
Unworthy	0.41	
Disappointed	0.41	
Weary	0.40	
Clumsy	0.35	
Effete	0.35	
Self critical	0.30	0.28
Lacking appetite	0.28	
Over burdened	0.25	
Joyful	–0.32	0.71
Agreeable		0.71
Proud		0.71
Kind	–0.26	0.65
Happy	–0.28	0.62
Lively	–0.25	0.62
Attractive		0.58
Relaxed	–0.39	0.58
Neat		0.57
Feminine		0.57
Understood		0.50
Energetic	–0.29	0.49
Loved	–0.25	0.49
Curious		0.48
Maternal		0.47
Accepted	–0.26	0.46
Active		0.44

TABLE 4
Total variance explained

Factor	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	12.50	27.79	27.79	11.92	26.49	26.49	8.75	19.45	19.45
2	4.31	9.57	37.36	3.69	8.19	34.68	6.86	15.24	34.68
3	2.39	5.31	42.67						
4	2.20	4.89	47.56						
5	1.79	3.97	51.54						
6	1.69	3.76	55.30						
7	1.54	3.43	58.73						
8	1.37	3.05	61.78						
9	1.31	2.92	64.70						
10	1.21	2.69	67.39						
11	1.10	2.45	69.84						

ous, pessimistic, sensitive, restless, sick and tired, worried and vulnerable. During pregnancy mixed emotional reactions are frequent and those pregnant women who were unable to dedicate some time to themselves, to sport and relaxation, expressed negative emotions and were bad humoured more frequently. The results show that sport activity during pregnancy is an important element of relaxation. The other, weaker factor, explaining 15.24 percent of the variance, was associated with the following positive emotions – joyful, agreeable, proud, kind, happy, lively, attractive and relaxed. The state of mind of the inactive pregnant women is thus defined as negative and inclined to melancholy, according to the first, stronger factor. These women experience periods of positive emotions less often than the active pregnant women.

DISCUSSION

Of all the subjects in the study sample, 42.3 percent were regularly active and 57.7 percent were inactive in terms of sport activity. In the active group, the contents of the first factor are associated with positive emotions. The study subjects explained their state of mind with the following emotions – relaxed, satisfied, agreeable, not pessimistic, attractive, proud and happy. The findings confirm that regular sport activity benefits the psychological state of mind of pregnant women. The results corroborate the findings of many earlier studies (Brown, 2002; Bung, 1999; Klun, 1992; Lochmuller & Friese, 2004) which demonstrate that sport activity relaxes pregnant women, benefits their psychological state of mind, boosts their positive attitude to pregnancy and mental stability as well as guards them against depression.

The contents of the second factor of physically active pregnant women are associated with mixed emotions which are completely normal in healthy pregnant women. During pregnancy and at childbirth, women often experience mixed and labile emotional reactions and conditions and not just sheer satisfaction as is often believed. Healthy, active pregnant women experience the following emotions from time to time – sensitive, hot-tempered, vulnerable, absent minded and whining. However, as was expected, the active women are more positively oriented.

With the inactive pregnant women, the contents of the stronger factor are associated with the following emotions – melancholic, tense, irritable, depressed, nervous, pessimistic, sensitive and restless. The findings show that about 50 percent of pregnant women in a normal population suffer from insomnia, anxiety, anxiousness and depression (Velikonja, 1998). Our findings show that inactive pregnant women are more inclined to a negative mood and more often experience the associated negative emotions. On the other hand, it is common knowledge that at the end of the second trimester most pregnant women are happy and satisfied. Women find themselves attractive because of their beautiful appearance and are glad about the visibility of what is causing their feelings and influencing their state of mind (Raphael-Leff, 1991). It is therefore understandable that, even according to the second, weaker factor, the inactive pregnant women also define their psychological state of mind positively.

In addition to the above, regular sport activity during pregnancy causes aerobic power to be reduced by a minimum amount and body weight increases more slowly owing to the prompt consumption of fats (Carpenter, Sady, & Sady, 1990; Clapp, 1991; Clapp & Little, 1995). In view of the fact that research (Abraham, Taylor, & Conti, 2001) reports that weight gain and a changed physical appearance correlate with postnatal depression, sport activity can play a major preventive role here. It enables the slower and more controlled gaining of weight and thus the maintaining of a positive self image and frame of mind. After childbirth, women who were active during their pregnancy more quickly regain the fitness and body weight they had before their pregnancy.

Pregnancy is a period of great changes and having to adapt to the new conditions can arouse different feelings in a pregnant woman. The way a woman experiences herself and her state of mind not only affects her but also her child. The child also takes part in the psychosomatics of its mother whose emotional states are transferred to the child through blood excitation. All impact on the mother also impact her foetus. The normal, daily programme of the mother is transferred to the child (Milaković, 1986). The state of mind in pregnancy not only affects the mother but also her unborn child. Therefore, it is very important that a pregnant woman has good knowledge of these mechanisms and uses them to relax. An important role is also played by moderate sport activity, which is also confirmed by our results. The physically active pregnant women expressed mainly positive emotions, were more relaxed and felt better. Their high psychological state of mind also positively affected the baby and its development.

There are many factors that coinduce the relaxed state of mind of a pregnant woman and help her avoid the whirl of negative emotions. The findings of our study corroborate the results of previous studies, namely that sport activity is one of the main factors. The analysis of our study sample revealed that only a good 40 percent of pregnant women engaged in a sport activity in the volume attributed to the RPA group. The factor analysis showed that these pregnant women mainly expressed positive emotions and a better psychological state of

mind. The results show that during pregnancy nearly 60 percent of women engaged in a sport insufficiently and, according to our findings, expressed negative emotions and feelings more often and were in a poorer state of mind. In view of the above, we believe that women should be advised about the advantages of sport activity and its positive effects already before they become pregnant. With this article we wish to recommend that all young women who are planning their pregnancy assume a healthy lifestyle with sufficient physical activity and relaxation already at the time they start considering having a child. The provision of information and encouragement of women to adopt this lifestyle so as to make their pregnancy easier and more pleasant should be arranged on the broadest possible scale.

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DUŠEVNÍ STAV MÁLO A PRAVIDELNĚ TĚLESNĚ AKTIVNÍCH ŽEN VE DRUHÉM TRIMESTRU TĚHOTENSTVÍ

V okamžiku, kdy žena zjistí, že je těhotná, se její život v mnoha ohledech změní, protože se začne přizpůsobovat dítěti ve svém těle. Přeje si dobře se cítit, v bezpečí dosáhnout stanoveného termínu a porodit zdravé dítě. Průzkum jsme prováděli u 163 těhotných žen na konci druhého trimestru těhotenství. Článek představuje vztah mezi sportovní aktivitou a duševním stavem během těhotenství. Srovnávali jsme dvě skupiny žen – ženy s pravidelnou tělesnou aktivitou (PTA) a ženy s nízkou úrovní tělesné aktivity (NTA) – a zkoumali vztah mezi tělesnou aktivitou a duševním stavem. První část výzkumu se zaměřovala na tělesnou aktivitu, a to zvláště na její četnost, formu a typ. Skupina PTA sestávala z 69 těhotných žen, které se pravidelně věnují organizovaným sportovním aktivitám ve sportovních střediscích nebo které jsou tělesně aktivní neorganizovaně třikrát až čtyřikrát za týden. V potaz jsme brali aktivity trvající 30 a více minut. Skupina NTA sestávala z 94 těhotných žen, které se tělesným aktivitám věnují pouze příležitostně nebo které nejsou tělesně aktivní. Druhá část výzkumu týkajícího se duševního stavu těhotných žen obsahovala 45 položek, které se týkaly jejich duševního stavu. U každé položky ženy určovaly svůj duševní stav na pětistupňové škále (nikdy, málo, občas, často, skoro pořád). Z celkového počtu mělo 20 položek prevalenci pozitivního duševního stavu a 25 prevalenci negativního duševního stavu. U obou skupin jsme analyzovali duševní stav a vztahy mezi pravidelnou sportovní aktivitou a nízkou sportovní aktivitou a duševním stavem v druhém trimestru, kdy jsou těhotné ženy nejčastěji a nejsnáze tělesně aktivní. Pomocí faktorové analýzy jsme prokázali, že u skupiny PTA je prvním eliminovaným faktorem faktor spojený s pozitivními emocemi, což vysvětluje 23,51 % variance z celkových 34,91 % vysvětlené variance. Těhotné ženy skupiny PTA tedy svůj stav definovaly většinou jako pozitivní, s následujícími emocemi: uvolněný, spokojený, příjemný, nepesimistický, přitažlivý, hrdý a šťastný. U skupiny NTA byl prvním eliminovaným faktorem faktor spojený s negativními emocemi, což vysvětluje 19,45 % variance z celkových 34,68 % vysvětlené variance. Tato skupina těhotných žen definovala svůj stav většinou jako negativní, s následujícími opakujícími se emocemi: melancholický, napjatý, vznětlivý, depresivní a nervózní. Zjištěná fakta ukazují, že pravidelná sportovní aktivita prospívá duševnímu stavu a duševnímu zdraví těhotných žen.

Klíčová slova: emoce, organizovaná, neorganizovaná tělesná aktivita, soupis zkoumající duševní stav.

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LEVEL OF SELECTED FITNESS ABILITIES OF PUPILS AT PRACTICAL ELEMENTARY SCHOOLS IN RELATION TO THE AETIOLOGY OF THEIR INTELLECTUAL DISABILITY

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The objective of the study was to determine the level of the selected fitness abilities of 153 pupils (aged 10.62 ± 0.56 years) at practical elementary schools in Prague in relation to the aetiology of their intellectual disability. A unifittest battery (6–60) was used to assess the level of motor performance with regard to fitness abilities. Clear differences were found between pupils with polygenetically determined lower intellectual abilities in combination with an unstimulating upbringing or neglect, who achieved the best results, and pupils with multiple disabilities, who recorded the lowest motor performance.

Keywords: Intellectual disability, aetiology of intellectual disability, practical elementary schools, fitness abilities.

INTRODUCTION

Practical elementary schools (former special schools) are primarily designed to educate children with mild mental retardation (IQ 69–50). In recent years in particular we have encountered pupils here whose reasoning abilities fall into the intellectual below average band, or possibly even the intellectual average band, who for some reason, did not make progress at ordinary elementary schools. At these schools there may be individuals with mental and nervous disorders, with specific learning defects, slight brain dysfunctions, autistic features, mutism, behavioural defects, and sometimes a combination of defects (epilepsy, sensory defects, endocrinological defects, speech defects, motor defects etc.); a considerable number come from an unstimulating socio-cultural environment. Children come to these schools from different environments – directly from the family, from a special kindergarten, from an ordinary kindergarten, or from an elementary school. There are almost 20% more boys than girls in these schools (Dolejší, 1987). The principal differences in the work of practical elementary schools and ordinary elementary schools are the differentiated content, methods and forms of teaching and instruction, the modified working environment, the lower number of pupils in classes enabling individual treatment, the slower pace of work and greater attention paid to exercising and consolidating the acquired knowledge, skills and habits.

Our contemporary civilisation increasingly needs individuals whose excellence enables them to keep pace with the perfection of technology and, seeing that the future work process of those leaving these schools focuses mainly on manual work, a good standard of motor performance is a precondition of their successfully finding work.

In view of the considerable heterogeneity of pupils in terms of their mental development, age and sex, motor abilities, emotional factors, motivation, concomitant defects, socio-cultural background etc., teaching physical education (which is, incidentally, often undervalued) to one class can be highly demanding for a special needs teacher. We therefore regard it as essential in the teaching process to make allowance for an internal differentiation process that would lead to a more effective management of the teaching unit and would also enable individualisation according to pupils' special needs and capabilities. Besides the aetiology of intellectual disability, we see the fundamental criterion in the degree of intellectual disability, on the basis of which pupils would be split into relatively homogeneous groups with approximately the same motor ability, which would make it possible for the vast majority of them to achieve the set goals of the physical education programme.

PROBLEM

At present a relatively large quantity of results are available from empirical studies examining the differences in motor performance between children with mild mental retardation (MR) and intact children from the same age group. Those studies generally come from other countries, but in the Czech Republic relatively little attention has been paid to the assessment of the level of motor indicators for children with mild MR, or

more precisely, pupils at practical elementary schools, and the professional literature only presents general facts, not exact data.

There is very little data available on the relation between the aetiology or type of MR (regardless of the degree) and the motor performance of persons with MR, especially children. Studies of adolescents and adults are concerned with a comparison of the level of motor indicators primarily among individuals with Down's syndrome, non specific MR, MR caused by organic brain damage (Frey & Kronewirth, 1981; Klempert & Hagmeier, 1981; Schumacher, 1981; Kusano & Gohara, 1990; Henderson, Illingworth, & Allen, 1991; Schantz, 1994; Angelopoulou et al., 1999a, 1999b), and autism (Okuzumi, Haishi, & Kokobun, 1994; Kokobun & Koike, 1995; Kokobun et al., 1997). Válková and Thaiszová (1989) have also made a contribution to this issue in the Czech Republic.

One of the objectives of our relatively extensive study was therefore to determine the level of the selected fitness abilities of pupils of secondary school age at practical elementary schools in Prague, in relation to the aetiology or type of their intellectual disability.

METHOD

Subjects

The research sample consisted of 153 practical elementary school pupils (61 girls and 92 boys, aged 10.62 ± 0.56 years) of two identical birth years. This involved an exhaustive survey at those schools that offered suitable conditions for and agreed with the conducting of the research (a total of 17 out of a basic sample of 24).

Based on the data acquired from content analysis of pedagogical-psychological documentation, pupils were divided into three groups according to the aetiology or type of their intellectual disability:

- group 1: the reduction in intellectual abilities was owing to an unstimulating social environment or neglect in combination with polygenetically determined lower abilities (62 pupils – 43.5% girls and 56.5% boys),
- group 2: multiple disabilities – reduction in intellectual abilities combined with other deficits e.g. ADHD, specific learning difficulties, and epilepsy, which indicates damage to the central nervous system (44 pupils – 40.9% girls and 59.1% boys),
- group 3: a simple e.g. non specific, reduction in intellectual abilities (33 pupils – 42.4% girls and 57.6% boys).

The content analysis also revealed that the sample tested included 14 pupils of average intellectual ability who had been placed in the special education system for reasons unrelated to their intellect (e.g. lack of motivation or demotivation in school, health problems, anxiety, neuroticism etc.). We excluded them from the original sample, and did not place them in any of the three groups.

Because the fundamental criterion for the research's comparative objective was the standard of intellectual ability and not comparison with a certain norm, and because the groups were relatively balanced in terms of sex and age, we do not consider viewing the groups as a whole, i.e. irrespective of anamnestic medical history indicators, as too much of an error.

Instruments

In view of basic, predominantly fitness related motor abilities and based on the author's own previous experience of testing (Lejčarová & Tilinger, 2002), a unifit test battery (6–60) (Měkota et al., 1996) was used to assess the level of pupils' motor performance. For the age category under scrutiny this involved the following tests, which comprised relatively simple and technically undemanding motor tasks: the standing broad jump, repeated sit-ups, the 12 minute run, and the 4 × 10 m shuttle run.

Procedure

The following basic descriptive statistical characteristics were used to assess the standard and consistency of performances in individual motor tests: arithmetical mean (M), median (Me), and standard deviation (SD). The substantive significance of differences in average performances was assessed using Cohen's *d* index (effect size), in which differences between two groups are standardised using standard deviation. This index operates with conventional values, which make it easier to determine when a difference is large, or when the relative substantive significance of the difference in performance averages. If *d* is greater than 0.8 we rate the difference as large; if *d* ranges from 0.5 to 0.8, the difference is rated as medium; and we treat the substantive significance of a difference below the value of 0.2 as small (Kromrey et al., 2007). When judging substantive significance we worked on the sole basis of the mean of the scores of probands who had completed a given motor task.

Some pupils could not do all the motor tests owing to permanent health limitations (heart defects, asthma, epilepsy, diabetes) and were therefore not included in the final results in the particular disciplines.

RESULTS AND DISCUSSION

In the motor indicators monitored there was a substantively significant difference between groups 1 and

TABLE 1
Assessment of substantive significance of the difference in motor test results between individual groups of pupils differentiated according to the aetiology of intellectual disability

Motor test	1–2		1–3		2–3	
	Difference	d	Difference	d	Difference	d
Broad jump	large	**1.00**	small	0.34	medium	**0.64**
Sit ups	large	**0.95**	small	0.46	small	0.46
12 minute run	medium	**0.77**	small	0.06	large	**0.82**
Shuttle run	large	**0.91**	small	0.19	medium	**0.72**

2, with group 1 achieving better results, which is confirmed by the high values for Cohen's *d*. In contrast the scores for groups 1 and 3 did not differ significantly. We again find significant differences between groups 2 and 3 (with group 3 always achieving better results), with the exception of the results for the repeated sit-ups test (TABLE 1).

Overall, group 1 emerged as the most homogenous in the level of motor performance, while in group 2 there were substantial variations.

In the selected tests, group 1 achieved the highest scores, while group 2 had the lowest level of motor performance (TABLE 2).

Unfortunately we cannot compare the data collected with any studies of research subjects from the same age group and with a similar structure of intellectual disability where similar diagnostic instruments have been used to assess motor skills. We can find some support for our findings in the work of Frey and Kronewirth (1981), who after comparing the motor performance of girls aged 13–18 with MR in the 50 metre run, the standing long jump and throwing a ball, concluded that girls with cryptogenic disabilities (i.e. of uncertain origin), partially conditioned by their environment and partially hereditary, overall had higher motor performance than girls with MR due to organic brain damage. The authors put that finding in context, recording that the first group of girls did not mostly have any organic or other physical defects. Schumacher (1981) recorded similar results for the motor performance of 23 boys aged 11.5–18.5 with MR, i.e. the same categories as in the aforementioned study.

Assessing pupils' motor performance on the basis of their scores in specific tests does not reveal the internal and external factors that their performance depends on, and which are various among pupils due to individual differences. The causes of the level of motor performance recorded for pupils in the individual groups are as diverse as the causes of their disability, and are in part identical with them. As multiple factors usually operate here, shortcomings in pupils' motor performance can only rarely be unambiguously attributed to a single specific cause. We consider organic factors, which we cover in more detail below, to be the main negative factor in the lowest scores for motor performance tests in the group with multiple disabilities compared with the other two groups, while inadequate conditions in pupils' environments, specific psychological and emotional aspects and cognitive difficulties also have an influence.

TABLE 2
Basic statistical characteristics of scores in motor tests for individual groups of pupils, differentiated according to the aetiology of intellectual disability

Motor test	Group 1				Group 2				Group 3			
	n	M	SD	Me	n	M	SD	Me	n	M	SD	Me
Broad jump[1]	62	129.66	24.07	130.5*	44	102.95	29.47	101.5	33	120.97	26.63	120
Sit-ups[2]	62	26.23	9.81	28*	44	17.14	9.30	19.5	33	21.61	10.12	22
12-minute run[3]	55	1582.55	365.20	1480*	40	1325.75	299.28	1300	31	1564.52	279.86	1540*
Shuttle run[4]	56	13.64	1.44	13.4*	44	15.33	2.26	15.1*	33	13.93	1.64	13.9*

Legend:
* abnormal distribution of data,
[1] M, SD, Me are given in centimetres,
[2] M, SD, Me are given in number of cycles,
[3] M, SD, Me are given in metres,
[4] M, SD, Me are given in seconds.

In the following part of the discussion we look more closely at pupils' difficulties in performing certain tests and the factors that could affect their performances.

Performance in the standing broad jump is fundamentally influenced by the proband's body mass (negatively), which they have to overcome, and the manner in which, primarily, the take off and landing are executed. Conversely, an above average physical height has a positive effect on performance (Čelikovský, 1986). Seeing that no substantively significant difference was found between individual groups in somatic indicators, we do not attribute a relevant role in the different standard of performances to them. Two pupils had problems jumping with their legs together when performing this motor task. For that reason we had to take appropriate measures to ensure that these boys were able to spring with both legs simultaneously, otherwise their test score could not be counted in the overall assessment.

The length of the jump is influenced both by the explosive power of the legs and also by jumping skill, which increases with the probands' age and movement experience. The standing broad jump requires a high degree of neuromuscular coordination and development of the legs' submaximal muscle strength. As this motor task represents, according to Rarick (1973), a somewhat higher degree of neuro-motoric complexity, or sensomotoric difficulty, than, say, running (not specified in greater detail by the author), it is a reasonable assumption that children's performance in the jump will be at an even lower level than their running performance, which was confirmed by our research. The substantive differences between the groups' performances (from the point of view of the magnitude of index *d*) in the jump were almost without exception greater than the differences in their performances in the 4 × 10 metre shuttle run. This fact is also indirectly confirmed by Válková and Thaiszová (1989), who found that power/speed disciplines require simple skills, but, being based on short term maximum concentration, they were relatively very difficult for juvenile individuals from the Social Care Institute.

Although the reason for the poorer performances by children with mild MR in tests of strength abilities is not absolutely clear, it is fair to assume, in accordance with Rarick (1973), that this may be the consequence of either a quantitative or qualitative defect in muscle tissue, primarily related to their physically inactive lifestyle (whereby the difference in performance compared to the intact population in this case indirectly concerns mild MR, as this is the result of external factors), or the consequence of their insufficient ability or unwillingness to mobilise their neuromuscular system to expend the maximum exertion in strength tests, or possibly a combination of the two factors. Deficits in muscle tissue mainly concern low muscle tone, or muscular hypotonia, something that, for example, Schilling (1979), Heller et al. (1996) draw attention to in this population group. By contrast, Bös (1987) claims that the reduced performance in this test is more a question of the insufficient coordination of swing and movements in the legs rather than a low level of strength in the legs. Similar conclusions were reached by DiRocco, Clark and Phillips (1987), who addressed the qualitative aspects of performance in this test among 4–7 year old children with mild MR and children of the same age without disability. They found that, although the coordination formula of legs and arms was similar among both groups, the average distance jumped by children with mild MR was at the level of those aged 2–3 years younger than the performances achieved by intact children. The authors explain this discrepancy with reference to either a lack of optimal coordination between legs and arms, which is essential for this skill, or differences in control mechanisms (the control process).

The motivation of pupils in our sample was satisfactory. This was the only motor task of the set that the majority of them had never come across.

The repeated sit ups test is dependent on body mass that the proband has to overcome, height and technique (accelerating and decelerating movement). Seven pupils scored zero – this can be attributed to a high BMI in the case of two of them. We again attribute the pupils' poorer performances in this test to Rarick's aforementioned suppositions (1973). Besides the individual standard of their abdominal and iliopsoas muscles, the problem of some of the probands also lay in an insufficient ability to exert their maximum strength and low motivation and perseverance to complete the movement (Sugden & Keoch, 1990), which manifested itself in increasingly unpleasant feelings of fatigue from the accumulation of lactic acid in the applied muscles. In a small number of individuals, however, and particularly in boys, knowledge of their co-pupils' results and a great effort to be the best had a positive influence on the final number of cycles. Based on our own experience from our previous research among 14–15 year old special schoolchildren (Lejčarová & Tilinger, 2002) we have to say that in the younger age group we observed a degree of motivation and effort of will, especially in the endurance tests (repeated sit ups, 12 minute run), that was greater than among the older pupils.

"Running technique, weight and somatometric factors considerably influence the results of the 12 minute run" (Čelikovský, 1986, 76). A higher BMI has indeed proven to be a negative factor in performance in the running endurance test among children and adolescents with mild MR (Fernhall & Pitetti, 2000; Pitetti, Yarmer, & Fernhall, 2001). After this factor is discounted, however, the differences between individuals with mild MR and their intact peers were still considerable, however;

from this the authors of the cited studies deduce that higher BMI alone cannot explain the low standard of performance in this specific population category. The strength capability of the legs of children and adolescents with MR has been seen as an independent predictor of cardio-respiratory capability and endurance ability (Pitetti & Fernhall, 1997; Fernhall & Pitetti, 2000).

From the methodological point of view, ascertaining endurance abilities is very difficult, particularly among individuals with MR. We are aware that performing field tests of long term running endurance is a problem with individuals with reduced intellectual capacities and in this regard they should be regarded merely as indirect methods for measuring endurance ability. The principal difficulty is that individuals with intellectual disability are not capable of completing the run (Seidl, Reid, & Montgomery, 1987). That is attributed to a combination of factors, including a low level of cardio-respiratory capacity, the difficulty of choosing and maintaining a suitable running pace and a lack of motivation and perseverance to complete prolonged and monotonous activity[1] in the face of discomfort related to, for example, an inability to cope with an increasing breathing frequency and fatigue, exhaustion, and even pain (Watkinson & Koh, 1988; DePauw et al., 1990; Pizarro, 1990; Baumgartner & Horvat, 1991; Fernhall, 1993; Lavay, McCubbin, & Eichstaedt, 1995; McCubbin, Rintala, & Frey, 1997; Kozub et al., 1998). Another key factor in this regard is the complexity of the task, consisting in the abstract nature of the expended maximum effort over a particular length of time, in other words understanding the point of long distance running – if a specific task is not set, or the length of track is not marked out, then many pupils soon lose interest in the run and stop (Fait, 1972; Cressler, Lavay, & Giese, 1988). Another possible factor influencing performance in the long term running endurance test is mentioned by Fediuk (1990) and Sherill (1998) – poor running technique and economy, which is then reflected in, among other things, an earlier onset and greater level of fatigue in the probands.

The substantive difference in performances between the individual groups was overall the smallest of all the undertaken fitness tests. When performing the tests, some pupils did not just display a lack of will power – they also displayed shortcomings in the emotional sphere and were governed primarily by the kind of emotional impulses that they could not satisfactorily control. This behaviour was evidently a reaction to excessive strain. The results could also have been influenced by the children's limited, or in some cases non existent experience of endurance running, which is also confirmed by Jakubec (2005) among 8th and 9th grade special school pupils in the Czech Republic; he found that 34% of the 147 questioned pupils had never performed endurance running during school physical education classes.

The aforementioned methodological difficulties in testing the endurance abilities of individuals with intellectual disability give rise to a need to construct valid and reliable field tests to measure these abilities. According to DePauw et al. (1990), the 12 minute run test cannot be a suitable measure of the cardio-respiratory capacity of adolescents with mild MR because of cognitive and motivational shortcomings. The authors recommend other modified tests that provide a substantially greater overview of their ability to perform, such as walking at a constant speed. The endurance shuttle run over 20 metres was found to be a reliable and valid indicator of aerobic capacity for children and adolescents with mild MR (Fernhall et al., 2000). In addition, Sherrill (1998) stresses that valid measurements can be made with probands with mild MR but not with persons with profound MR.

The aforementioned factors may therefore limit pupils' efforts to display their maximum performance level, which means that the performance limits in endurance running among this population may often be conditioned by factors other than their level of cardio-respiratory capacity. In this regard, a lack of opportunities for pupils to participate in movement programmes and their hypoactive lifestyle also play a major role.

The latest studies of the aerobic capacity of children and adolescents with MR (Fernhall et al., 1996; Pitetti, Miller, & Fernhall, 2000) found that the reliability of physiological responses among individuals with MR and their intact peers is similar and, at the same time, high, which is testament to the very consistent effort and motivation in both sets of individuals. To a certain extent the results of these research studies cast doubt on the earlier supposition that weak motivation and comprehension of the task among persons with MR has a negative impact on their potential maximum performance. We should note, however, that practice is important when obtaining precise data in endurance capability tests – if the test is practised, the reliability of tests should not differ between mentally retarded and intact individuals.

At present it is still not clear whether aerobic capacity is influenced by the degree of MR, as was suggested in certain field research studies[2] (Londeree & Johnson, 1974; Eichstaedt et al., 1991; in Eichstaed & Lavay, 1992), or whether their lower standard stems from MR individuals' insufficient activity and motivation. It is therefore necessary to examine the possibility of a lower

[1] This problem proved particularly serious among children with minimal brain dysfunction accustomed to busy movement activity and also at the point when the intervals between individual pupils increased in mass testing.

[2] Conversely, Rarick, Widdop and Broadhead (1970), who used a 300 yard walk/run to test the aerobic capacity of children with mild MR, state that the relationship between endurance ability and cognitive performance document a merely insignificant correlation to the profundity of intellectual disability.

maximum heart performance among the mentally retarded using laboratory tests and thus to help clarify the complex relationships between the test scores and their limitation in terms of both the cardio-respiratory and, in particular, neuromuscular system. For example, Heller et al. (1996) registered just a slightly reduced cardio-respiratory function under strain among 10 boys, with IQs of 60–80, who were aged 11–15.

"In the majority of the scrutinised indicators, discrepancies were found between the absolute values of the functional parameters of a satisfactory level and reduced values relativised to body mass or active body mass or to body surface area" (Heller et al., 1996, 127).

It seems that increased somatic development in the probands was more advanced than the development of the organism's functions and capacity.

Similar results from the study by Bar-Or, Shephard and Allen, (1971), who examined the standard of endurance capabilities among 10–13 year old children with mild MR and intact children based on physiological parameters of maximum oxygen consumption and the value relativised to body mass, do not demonstrate significant differences between sets of individuals. The authors state that the high intensity of "all out" physiological tests often means they cannot be used among this population group because of motivation, concomitant disability (primarily cardiological, neurological, pulmonary or muscular) or the premature termination of the test by probands (in the cited research 21% of children with mild MR did not complete the test, compared to 7% of the intact children). These limitations then mean that the data used for comparative purposes do not represent the entire spectrum of the performance of the mentally retarded, rather just the results of a best performing sample.

During the 4 × 10 metre shuttle run, extra attention had to be paid to the choice of running track surface, suitable footwear and time recording with regard to measurement errors. From the psychological point of view, performing the test requires control of motor coordination and the mutability of nerve processes, i.e. the possibility of rapid alternation of excitation and attenuation. Motivation is another key factor. Performance is also affected by the anatomical construction of the body influencing the leverage that can be exerted by the limbs (Čelikovský, 1977). Besides running speed, the results of this test partly reflect strength and dexterity (adaptability and ability to change movement), as well as reaction time to the start signal that depends almost exclusively on the course of the involved nerve processes. Reaction time, which is considerably longer among children with reduced intellectual capacity than the intact population (Heller et al., 1996), constitutes just a very small part of the overall time, however, and has only a limited impact on the final score in the run.

Because practical elementary school pupils, or children with mild MR, have attention difficulties, we consider it important to mention the finding of Kostadinovová (1992) that there is a significant correlation between attention and shuttle running – a lower level of attention goes hand in hand with worse performance in this test, while a higher standard of attention does not play a role in the degree of success in this test.

When performing this motor test a considerable number of pupils had difficulties following the correct running track. In exceptional cases, a change of direction caused the pupils slight spatial orientation problems, consisting in a considerable deviation from the direction towards the marker in front of them, which was naturally reflected in the resulting time. Nor must we overlook the fact that although some were able to achieve quick acceleration, difficulties always arose when estimating speed before the marker, or with slowing down locomotive movement, which is partially linked to strength capabilities. It is also necessary to draw attention to the unsuitable running style of certain children, characterised by their placing their weight on the full sole and too slow, incorrect or non existent arm movement. Graunke and Schmidt (1983) also state that on short track runs, practical elementary school pupils often display, e.g. irregular, maladroit movement, lacking in power, with a non straight trajectory, arrhythmic arm movements and inflexible, clumsy "stamping" using the full sole.

In the case of this test in particular we would like to again stress the fact that many children attending practical elementary school come from a socially unstimulating environment with a low socio-economic standard, which is reflected, among other things, in their material means. Some pupils' poor quality footwear might to some extent influence performance in this test in particular. This is a merely speculative supposition, perhaps unwarranted or even banal, but we believe that we should not ignore any, even minor factors that could negatively influence these pupils' test performances. Unfortunately we were not able to ensure objective testing conditions in this regard.

Assessing pupils' motor performance on the basis of their scores in specific tests does not reveal the internal and external factors that their performance depends on, and which have a various valence among pupils due to individual differences. The causes of the level of motor performance recorded for pupils in the individual groups are as diverse as the causes of their disability, and are in part identical with them. As multiple factors usually operate here, shortcomings in pupils' motor performance can only rarely be unambiguously attributed to a single specific cause. We consider organic factors, which we cover in more detail below, to be the main negative factor in the lowest scores for motor performance tests in

the group with multiple disabilities compared with the other two groups, while inadequate conditions in pupils' environments, specific psychological and emotional aspects and cognitive difficulties also have an influence.

A large proportion of the deficiencies in motor performance among pupils with mild MR is associated with organic brain damage. In that context Schilling (1979) points out that we must anticipate the possibility of limited motor performance for any disability in childhood. Of course, according to the author it is also true that such disabilities only lead to serious and long term motor defects if an organic condition is discovered, or if other unsuitable conditions are involved.

Many shortcomings in the motor performance of some pupils at practical elementary schools can, with a high degree of probability, be attributed to the aforementioned minimal brain dysfunction. Among those children in gross motor skills there are typically developmental defects (motor infantilism), defects in the harmonising and coordination of movements, i.e. an inability to perform multiple movements simultaneously to produce a complex movement comprising individual movements, defects in rhythmic movement, defects in directed movements (performing many more movements than necessary) and defects in movement memory, which are primarily apparent in larger complex movements where the sequence of individual movements is defective and the overall performance therefore worse. In short the children appear clumsy (Třesohlavá, 1986; Černá et al., 1999). Their specific psychological features (perceptual, emotional and behavioural dysfunctions and dysfunction in concentration and attention) may also negatively influence their test scores, and also complicate motor learning. The approach adopted when testing those pupils' motor skills is derived from those factors: it is necessary to guide the children individually in a way that allows the true level of motor performance to be ascertained as accurately as possible, as their performance at any one time may be influenced by agitation, insufficient attention, a momentary fluctuation in performance, lack of motivation, overall mental instability, a decline in their interest in the task in question, fatigue, etc. For a clumsy, unfocused and unstable pupil, the testing may be unpleasant or too demanding, with the consequence that the pupil refuses to cooperate, runs away and focuses on something else. The pupil is easily fatigued and performing tasks to order within a specific time limit is a source of frustration.

Schilling (1979) states that the differences between children with organic brain damage and children with no brain damage are primarily apparent in dynamic physical coordination, simultaneous coordination, the coordination of fine motor performance, balancing and strength abilities and the rapidity of the movement of the hand and fingers. It is evident from this that organic brain damage is always accompanied by defects (a milder qualitative change in movement) or defects in coordination (a major, pathological change in the quality of movement). While coordination defects, which occur more frequently among pupils at practical elementary schools, may, according to Kiphard (1990), be caused by inadequate stimuli for movement in their environment, and by constitutional, biological and psychological factors, or due to delayed maturity and light brain dysfunction, for coordination dysfunction it is always necessary to anticipate pathological factors in the central nervous system. In both cases the dynamic, swing and strength movements of the body and limbs are limited. There is often a marked deficiency in strength abilities, especially "jumping" abilities, which is documented in our study by the high values for the *d* index, pointing to a considerable substantive difference in the scores for the standing broad jump between groups 2 and 1. According to the author, injury to the cerebral cortex is often responsible for that quantitative loss of strength and rapidity.

CONCLUSION

Our study at practical elementary schools in Prague confirmed the dependency between the level of selected fitness abilities and the aetiology of pupils' intellectual disabilities. That fact was unambiguously demonstrated by a comparison of the scores achieved by pupils with polygenetically-determined lower intellectual abilities combined with an unstimulating upbringing and pupils with multiple disabilities, who achieved the worst results in the tests. The scores achieved in motor tests by neglected pupils and pupils with simple, or rather non specific, intellectual disabilities did not differ significantly. We found substantively significant differences in all tests between pupils with multiple disabilities and pupils with simple intellectual disabilities (with the latter group always achieving better scores), with the exception of the repeated sit ups test.

The research results highlight the urgent need to devote adequate attention to the motorics of practical elementary schoolchildren. In particular, the motor shortcomings identified in children with multiple disabilities may be considered a barrier to their mobility training when instilling basic work and life habits, and consequently in social adaptation, or integration; there is no doubt, however, that they too have sufficient prerequisites for development of their motor abilities, within the context of their disability.

The low level of motor performance among these pupils is primarily apparent in their soon becoming fatigued during practical activities that are part of the curriculum for practical elementary schools, and during any later vocational training. It is necessary to be

aware of the importance of transferring fitness abilities to daily life, where they have a very broad application, and therefore should be adequately developed among this group of the population.

We cannot view the low standard of motor performance in the studied children merely from the viewpoint of the aetiology of intellectual disability; it should also be seen in terms of their personality and external conditions represented by, for example, the physical education process at practical elementary schools, the family, etc. The emphasis in educational work should therefore be placed not only on practical activity and assimilation of the practical skills necessary for involving these children in the ordinary life of society, on manual dexterity and work habits; emphasis should also be placed on the overall development of motorics in physical education. As a final point, we would like to point out that children's motor abilities are not the only precondition of movement activity in an occupation or sport; success in these areas is also conditional on prerequisites such as constitution, personality qualities and performance motivation.

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ÚROVEŇ VYBRANÝCH KONDIČNÍCH SCHOPNOSTÍ ŽÁKŮ ZÁKLADNÍCH ŠKOL PRAKTICKÝCH V ZÁVISLOSTI NA ETIOLOGII JEJICH INTELEKTOVÉHO POSTIŽENÍ

(Souhrn anglického textu)

Cílem realizované studie bylo zjistit úroveň vybraných kondičních schopností 153 žáků středního školního věku (10,62 ± 0,56 roků) na základních školách praktických v Praze s ohledem na etiologii jejich intelektového postižení. K posouzení úrovně motorické výkonnosti se zřetelem ke kondičním schopnostem byla použita testová baterie Unifittest (6–60). Zcela jednoznačné diference byly zjištěny mezi žáky s polygenně podmíněným nižším intelektovým nadáním v kombinaci s výchovnou nepodnětností, popř. zanedbaností, kteří dosáhli nejlepších výkonů, a žáky s multihandicapem, u nichž byly naopak zaznamenány nejnižší motorické výkony.

Klíčová slova: intelektové postižení, etiologie intelektového postižení, základní školy praktické, kondiční schopnosti.

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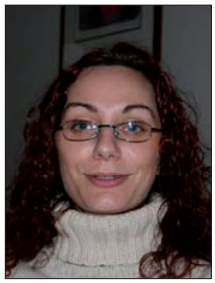

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THE EFFECT OF 8 WEEK PULMONARY REHABILITATION PROGRAMME ON CHEST MOBILITY AND MAXIMAL INSPIRATORY AND EXPIRATORY MOUTH PRESSURE IN PATIENTS WITH BRONCHIAL ASTHMA

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Bronchial asthma (AB) can lead not only to breathing disorders but also to musculoskeletal disorders. Breathing and musculoskeletal disorders can lead to health problems and decreased quality of life. These disorders may be also associated with psychosocial problems and could influence adult participation in various activities (physical activities and sports, activities of daily living – shopping, cleaning house, etc.). Breathlessness and cough are usually the most problematic symptoms of AB.

Comprehensive care is based on medical treatment and non pharmacological treatment. Chest physiotherapy is an important part of the non pharmacological treatment, but the optimal medical treatment is also necessary for successful rehabilitation.

The aim of this study was to find out if the pulmonary rehabilitation programme can influence the maximal inspiratory and expiratory mouth pressure and chest mobility of AB patients. The examined group consisted of 23 patients with AB. All AB patients had intermittent mild asthma and they were medically stable patients. All of them underwent an 8 week pulmonary rehabilitation programme (visits were twice a week, 30 minutes in length). The 8 week pulmonary rehabilitation programme was focused on breathing exercises (diaphragmatic breathing, activation of expiration, effective cough training, etc.) and on soft tissue techniques for releasing thoracic and shoulder muscles and fascias. Maximal inspiratory and expiratory mouth pressure and chest mobility were examined at the beginning and at the end of the 8 week pulmonary rehabilitation programme. Chest excursion measurements at the level of the fourth intercostal space and at the level of the tip of the xiphoid process were used for assessment of chest wall motion.

The results of this study showed improved chest mobility and increased values of maximal inspiratory and expiratory mouth pressure after the pulmonary rehabilitation programme. Such improvement can be very important for AB patients. An increase in chest mobility and maximal inspiratory and expiratory mouth pressure leads to easier breathing with less inspiratory effort and consequential physical fatigue. For that reason a pulmonary rehabilitation programme should be a part of comprehensive care for AB patients.

Keywords: Breathing disorders, musculoskeletal disorders, breathing exercises, soft tissue techniques.

INTRODUCTION

Bronchial asthma (AB) is an obstructive disease, which is one of the most common pulmonary diseases, affecting both children and adults. The main goal of comprehensive patient care is the minimization or elimination of symptoms. Comprehensive care involves not only using medicaments, but also non pharmacological treatment.

A chronic inflammatory process in the airway can result in wheezing, breathlessness and cough (Pryor & Prasad, 2002). Asthma can also affect chest wall motion. Upper chest breathing can be found in patients with AB and this type of breathing leads to biomechanical changes and musculoskeletal system dysfunction. Breathing function can be also influenced by muscles and fascia dysfunction such as muscle shortening, muscle weakness, fascial restriction and presence of trigger points (TPs) – for example TPs in diaphragm, serratus anterior muscle, pectoralis major et minor muscles (Chaitow, Bradley, & Gilbert, 2002; Simons, Travell, & Simons, 1999; Travel & Simons, 1982). All these musculoskeletal system dysfunctions could be the cause of respiratory insufficiency and could lead to chest, shoulder or arm pain.

For that reason pulmonary rehabilitation and chest physiotherapy is supposed to be a very important part of a comprehensive treatment and the rehabilitation programme can help to improve breathing and decrease the incidence of musculoskeletal system dysfunctions.

OBJECTIVES

This research views the effect of pulmonary rehabilitation on chest mobility and maximal inspiratory (MIP) and expiratory mouth pressure (MEP) in patients with AB.

MATERIALS AND METHODS

The examined group consisted of 23 medically stable outpatients with intermittent mild asthma (11 women, aged 27.6 ± 5.9 years, 12 men, aged 28.6 ± 4.5 years) who underwent an 8 week pulmonary rehabilitation. None of them had acute exacerbation of asthma during the rehabilitation programme. It was the first time for each of the patients to attend a pulmonary rehabilitation programme.

Rehabilitation programme

The 8 week rehabilitation programme involved two visits per week. Each visit was 30 minutes in length. During the rehabilitation programme, patients underwent an initial and a final examination (spirometric examination, chest mobility examination, examination of MIP and MEP), an interview with a physiotherapist, an introductory education lesson and 12 physiotherapeutic treatment visits.

Baseline interview

Patients had an interview with a physiotherapist. The interview concentrated on the time of asthma onset, on the symptoms of asthma (wheezing, breathlessness, cough, exercise induced asthma, restriction of activity of daily living, night breathing disorders, etc.), pharmacotherapy, smoking history, physical activity and work disability.

Education

Breathing disorders and breathing problems, the pathophysiology of bronchial asthma, the importance of breathing exercises and possibilities of treatment were discussed with the physiotherapist at an education lesson. The physiotherapist gave them materials about AB and materials describing exercises.

Physiotherapy

The physiotherapeutic treatment focused on breathing exercises (pursed lip breathing, diaphragmatic breathing, etc.), an active cycle of breathing techniques (control breathing, thoracic expansion exercises, forced expiratory technique), autogenic drainage, effective cough training and elimination of upper chest breathing. Furthermore, the physiotherapist used mobilization to improve joint play and soft tissue techniques to release muscles and fascias (trapezius muscle, levator scapulae muscles, pectoralis major and minor muscles, pectoral fascia, etc.). Patients learned about stretching muscles and the automobilization of joints (cervical and thoracic spine) and learned breathing exercises and techniques for expectoration.

Examination of chest mobility

We used chest excursion measurements to assess chest wall motion. Both chest circumferences – at maximal voluntary inspiration (INS_{max}) and at maximal voluntary expiration (EXP_{max}) – were measured in a standing position using a tape measure at the level of the fourth intercostal space and at the level of the tip of xiphoid process at the beginning and at the end of an 8 week rehabilitation programme. The difference between INS_{max} and EXP_{max} was defined as chest expansion at the level of the fourth intercostal space (IC) and at the level of the tip of xiphoid process (XP).

Examination of maximal inspiratory and expiratory mouth pressure

We used the measurements of MIP and MEP for the evaluation of respiratory muscle strength. MIP and MEP were measured with respiratory pressure meter MicroRPM at the beginning and at the end of the 8 week rehabilitation programme. The measurement was non invasive and this assessment of respiratory muscle strength is useful for monitoring patients with breathing disorders. This examination is well tolerated by patients and recommended by The American Thoracic Society and The European Respiratory Society (Green, Road, Sieck, & Similowski, 2002) as a test of respiratory muscle strength.

Statistical analysis

The initial and final results were statistically compared. Analysis of the data was done separately for men and women. We used a repeated measure analysis of variance (ANOVA).

RESULTS

Baseline interview

10 patients had asthma onset during their childhood (the existing average duration of AB was 16.3 ± 6.8 years) and 13 patients had adult asthma onset (the existing average duration of AB was 7.2 ± 5.1 years). All 23 patients experienced breathlessness during physical activities and during common illnesses, 4 of them had breathing difficulties during routine daily activities such as cleaning house, shopping, carrying bags, etc. 19 of them claimed that they had coughing problems during

common illnesses (cold, flu, bronchitis, etc.) including chest pain, and they were exhausted by coughing.

Of the participating patients, 20 were non smokers, 2 patients stopped smoking before the programme (one of them had been smoking 5 cigarettes daily for 6 months, the other had been smoking 8 cigarettes daily for 3 years) and 1 of them stopped smoking at the beginning of rehabilitation programme (he had been smoking 3 cigarettes daily for 10 years). Only one patient had to change employment because of asthma. All patients used their medicaments regularly (use of inhaled steroids, inhaled ß agonists, antihistamines, etc.).

After the rehabilitation programme patients felt better, they had fewer breathing disorders (breathlessness, chest pain, etc.) during physical activities and during activities of daily living.

Chest mobility – women

The average value of chest expansion at the level of the fourth intercostal space (IC) was 3.6 cm at the beginning of the treatment and 5.6 cm at the end of the treatment. The average value of chest expansion at the level of the tip of xiphoid process (XP) was 3.9 cm at the beginning of the treatment and 5.9 cm at the end. There were significant improvements of chest expansion at the level of the fourth intercostal space and at the level of the tip of xiphoid process at the end of the treatment (TABLE 1).

TABLE 1
Initial and final values of IC and XP – women

Chest mobility (cm) women	AB_{prae} n = 11		AB_{post} n = 11		
	M	SD	M	SD	p
IC	3.6	0.8	5.6**	1.2	0.00018
XP	3.9	0.7	5.9**	1.2	0.00075

Legend:
IC – examined value of chest expansion at the level of the fourth intercostal space,
XP – examined value of chest expansion at the level of the of the tip of the xiphoid process,
n – number of women,
M – mean,
SD – standard deviation,
p – significance level,
** $p < 0.01$ (ANOVA),
AB_{prae} – initial values,
AB_{post} – final values.

Chest mobility – men

The average value of chest expansion at the level of the fourth intercostal space (IC) was 3.6 cm at the beginning of the treatment and 5.1 cm at the end of the treatment. The average value of chest expansion at the level of the tip of xiphoid process (XP) was 3.8 cm at the beginning of the treatment and 5.9 cm at the end. There were significant improvements of chest expansion at the level of the fourth intercostal space and at the level of the tip of xiphoid process at the end of the treatment (TABLE 2).

TABLE 2
Initial and final values of IC and XP – men

Chest mobility (cm) men	AB_{prae} n = 12		AB_{post} n = 12		
	M	SD	M	SD	p
IC	3.6	1.1	5.1**	1.2	0.00055
XP	3.8	0.7	5.9**	1.2	0.00029

Legend:
IC – examined value of chest expansion at the level of the fourth intercostal space,
XP – examined value of chest expansion at the level of the of the tip of xiphoid process,
n – number of men,
M – mean,
SD – standard deviation,
p – significance level,
** $p < 0.01$ (ANOVA),
AB_{prae} – initial values,
AB_{post} – final values.

Maximal inspiratory and expiratory mouth pressure – women

The initial average value of MIP was 44.3 cmH_2O and the final average value of MIP was 67.2 cmH_2O. The initial average value of MEP was 66.3 cmH_2O and the final average value of MEP was 93.5 cmH_2O. There were significant improvements of MIP and MEP at the end of the treatment (TABLE 3, Fig. 1).

TABLE 3
Initial and final values of MIP and MEP – women

Mouth pressure (cmH_2O) women	AB_{prae} n = 11		AB_{post} n = 11		
	M	SD	M	SD	p
MIP	44.3	16.1	67.2**	15.2	0.00023
MEP	66.3	14.6	93.5**	13.4	0.00033

Legend:
MIP – maximal inspiratory mouth pressure,
MEP – maximal expiratory mouth pressure,
n – number of women,
M – mean,
SD – standard deviation,
p – significance level,
** $p < 0.01$ (ANOVA),
AB_{prae} – initial values,
AB_{post} – final values.

Fig. 1
Initial and final values of MIP and MEP – women

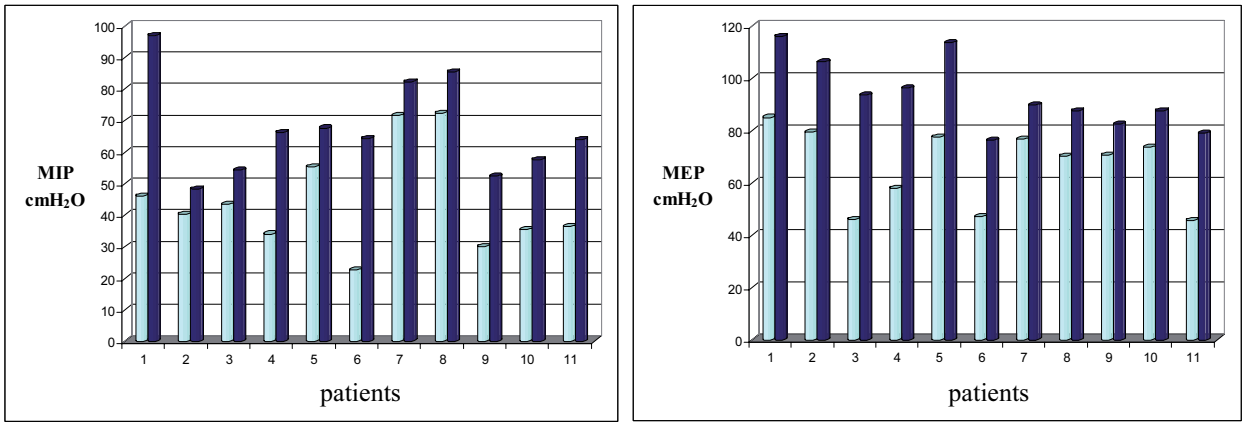
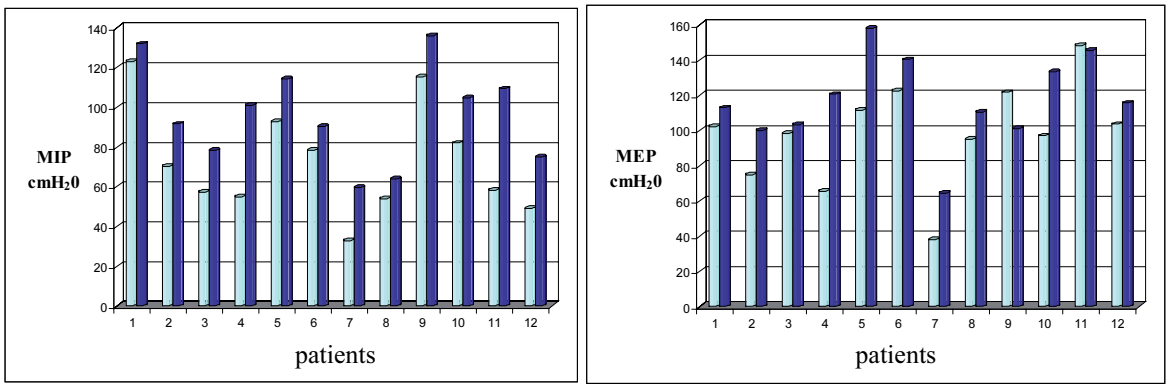


Fig. 2
Initial and final values of MIP and MEP – men



Maximal inspiratory and expiratory mouth pressure – men

The initial average value of MIP was 72.3 cmH_2O and the final average value of MIP was 96.3 cmH_2O. The initial average value of MEP was 98.2 cmH_2O and the final average value of MEP was 117.2 cmH_2O. There were significant improvements of MIP and MEP at the end of the treatment (TABLE 4, Fig. 2).

TABLE 4
Initial and final values of MIP and MEP – men

Mouth pressure (cmH_2O) men	AB_{prae} n = 12		AB_{post} n = 12		
	M	SD	M	SD	p
MIP	72.3	27.1	96.3**	24.6	0.00018
MEP	98.2	28.8	117.2**	24.9	0.00509

Legend:
MIP – maximal inspiratory mouth pressure,
MEP – maximal expiratory mouth pressure,
n – number of women,
M – mean,
SD – standard deviation,
p – significance level,
** $p < 0.01$ (ANOVA),
AB_{prae} – initial values,
AB_{post} – final values.

DISCUSSION

The results of this study show that AB patients had subnormal chest expansion at the level of the fourth intercostal space and at the level of the tip of xiphoid process at the beginning of the rehabilitation programme. We noticed a similar average value of chest expansion at both levels in women and men.

Initial lower chest expansion could influence breathing and could lead to an increased inspiratory effort and to breathing disorders. The improvement of chest mobility could have been caused by the combination of pharmacological treatment, mobilization and soft tissue techniques, breathing exercises and better timing

of inspiratory and expiratory muscles during breathing. Improvement of chest mobility at the end of the treatment could lead to easy breathing and a lower presence of breathing disorders. When we find decreased chest mobility, the treatment should be focused not only on mobilization of costovertebral joints, but also on the activation of respiratory muscles and better timing of the movement of these muscles.

Measurement of chest excursion with a tape measure is a very simple and quick method for the assessment of chest mobility and this measurement has high intertester and intratester reliability (Bockenhauer, Chen, Julliard, & Weedon, 2007; Lapier et al., 2000). For that reason, the measurement of chest excursion is useful in clinical practice for the determination of rehabilitation treatment and for choosing types of techniques and methods. We can use this examination for the assessment of rehabilitation treatment effect.

We require for the determination of MIP and MEP values the patient's maximal effort and that is why it is very important to explain the basis of the examination to the patient. The patient's cooperation is necessary. The assessment of measured values of MIP and MEP has been very difficult, because we have found a wide range of the predicted normal values of MIP and MEP, which were mentioned in the literature (Green, Road, Sieck, & Similowski, 2002; Harik-Khan, Wise, & Fozard, 1998; Neder, Andreon, Lerario, & Nery, 1999). We haven't found any predicted normal value for the Czech population nor any research about MIP and MEP being conducted in the Czech Republic.

At the end of the treatment we have noticed higher values of MIP and MEP. This increase of MIP and MEP values could have been caused by the combination of soft tissue techniques for releasing trigger points in respiratory muscles and respiratory muscle training (breathing exercises concentrated on the inspiratory and expiratory muscles and their coordination during breathing).

The values of MIP and MEP were lower in women than the values of MIP and MEP measured in men. The initial average MIP value of men was 30.2% higher than the initial average MIP value of women. The final average MIP value of men was 38.7% higher than the final average MIP value of women. The initial average MEP value of men was 32.6% higher than the initial average MEP value of women. The final average MEP value of men was 20.2% higher than the final average MEP value of women. These results correspond with results of research studies in literature. Harik-Khan, Wise and Fozard (1998) report that the average MIP values of the men are about 30% higher than those of women. Neder et al. (1999) and Terzano, Ceccarelli, Conti, Graziani, Ricci and Petroianni (2008) noticed in their research that values of MIP and MEP are dependent on gender and age (MIP and MEP values of men are higher than MIP and MEP values of women, MIP and MEP values decrease in people older than 70).

CONSLUSIONS

From the given results it can be concluded that a combination of special breathing and postural exercises and mobilization and soft tissue techniques has a positive effect on the chest mobility and respiratory muscle strength of AB patients. In our opinion, the pulmonary rehabilitation programme is useful for AB patients and this programme should start as soon as asthma is diagnosed because it can help to improve or maintain chest mobility and respiratory muscle strength. Furthermore, initial education can help asthma patients better cope with their disease. Better timing of the movement of respiratory muscles and increase of chest mobility can lead to lower inspiratory effort.

Unfortunately the number of examined AB patients hasn't been sufficient for the generalization of results, it is necessary to have larger group of AB patients for better assessment of the rehabilitation treatment effect. Furthermore, it is important to compare the measured MIP and MEP values of AB patients with those of healthy adults for the assessment and determination of whether the MIP and MEP values of AB patients are lower or higher than those of healthy adults.

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ÚČINEK OSMITÝDENNÍHO PLICNÍHO REHABILITAČNÍHO PROGRAMU NA HRUDNÍ MOBILITU A MAXIMÁLNÍ VDECHOVÝ A VÝDECHOVÝ ÚSTNÍ TLAK U PACIENTŮ S BRONCHIÁLNÍM ASTMATEM

(Souhrn anglického textu)

U nemocných s bronchiálním astmatem se mohou vyskytovat nejen poruchy dýchání, ale také muskuloskeletální poruchy. Poruchy dýchání a muskuloskeletální poruchy mohou vést k dalším zdravotním problémům a mohou tak snižovat kvalitu života. Tyto poruchy mohou být také spojeny s psychosociálními problémy a mohou mít vliv na omezení různých aktivit nemocných (pohybové aktivity, sportování, běžné denní aktivity – nakupování, uklízení atd.). Mezi nejvíce omezující symptomy u nemocných s bronchiálním astmatem patří ztížené dýchání a kašel.

Komprehensivní léčba je založena nejen na farmakoterapii, ale také na nemedikamentózní léčbě, jejíž důležitou součástí je respirační fyzioterapie. Pro účinek rehabilitační léčby je ale nutné správné nastavení farmakoterapie.

Cílem této studie bylo zjistit, zda program plicní rehabilitace ovlivní hodnoty maximálních nádechových a výdechových ústních tlaků a rozvíjení hrudníku u nemocných s bronchiálním astmatem. Výzkumný soubor byl tvořen 23 nemocnými s bronchiálním astmatem, kteří absolvovali osmitýdenní program plicní rehabilitace (30minutová terapie dvakrát týdně). Jednalo se o pacienty s intermitentním lehkým stádiem bronchiálního astmatu beze změn ve farmakoterapii. Program plicní rehabilitace byl zaměřen na dechová cvičení (aktivace bráničního dýchání, aktivace výdechu, nácvik efektivní expektorace atd.) a techniky měkkých tkání s cílem uvolnění svalů a fascií v oblasti hrudního koše a pletence ramenního. Na začátku a konci osmitýdenního programu plicní rehabilitace byly vyšetřeny maximální nádechové a výdechové ústní tlaky a rozvíjení hrudníku. Rozvíjení hrudníku bylo hodnoceno ve dvou úrovních – mezosternální a xiphosternální.

Po absolvování osmitýdenního programu plicní rehabilitace bylo zaznamenáno zlepšení rozvíjení hrudníku v obou úrovních a zvýšení hodnot maximálních nádechových a výdechových ústních tlaků. Zvýšení rozvíjení hrudníku a hodnot maximálních nádechových a výdechových ústních tlaků je velmi důležité pro nemocné s bronchiálním astmatem, neboť může vést ke snazšímu dýchání, menšímu nádechovému úsilí a menší únavě. Z tohoto důvodu by měla být respirační fyzioterapie součástí komprehensivní péče o nemocné s bronchiálním astmatem.

Klíčová slova: poruchy dýchání, muskuloskeletální poruchy, dechová cvičení, techniky měkkých tkání.

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