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**LEVEL OF MOVEMENT COORDINATION IN PERSONS OF DIFFERENT AGE
WITH PARTICULAR FOCUS ON THE AGING PROCESS**

INTRODUCTION

The development of modern civilisation affects human beings in an adverse way. In spite of this people tend to live longer and longer. The world record in this respect is held by the Japanese, for whom the average length of life is 80 years for women and 76 years for men. The Poles, similarly to other nationalities, age at a rather quick pace. Between 2010 and 2020 the Polish population in the post-productive age will have reached 2 million (women over 60 years of age, men over 65 years of age), and in 2030 each fourth Pole shall be a pensioner. In the years 2000-2030 the number of people in the post-productive age will grow from 14% to 24%. The increasing number of elderly people would require greater expenditures on social welfare and health care. The magnitude of needs is already experienced in countries of Western Europe, whose societies have started to age earlier [16].

People want to live longer, and until older age they want to remain independent and be able to maintain an appropriate life quality. To meet their needs a number of studies have been aimed at lowering the morbidity rate, life prolongation and improvement of its quality. Among them of particular importance are studies related to increasing human motor activity. This activity was reduced in the period from 1864 to 1964 by 93% [21]. Man, despite the natural needs of human body, leads a generally sedentary lifestyle. The human body, on the other hand, was genetically programmed to lead an active lifestyle. Movement is a biological need of a human body. When Man was creating modern civilisation, he forgot about this fundamental principle. It is assumed that an increase in motor activity of older people could allow a decrease in the number of terminal diseases by 25-33% [3]. This estimated figure does not fully reflect the value of motor activity relevant to the

age or its influence on the psyche of an aging human. In addition, it also contains an underestimated evaluation of human motor activity for health and life, which was already mentioned in the past by such ancient philosophers as Aristotle, who said that, "Nothing can ruin a human as much as long-lasting movement idleness". This famous expression is also known by its abbreviation: "Movement is life". Despite numerous appeals of the World Health Organisation to propagate motor activity, modern man tends to disrespect such advice, as often he is not aware of the fact that, "Movement can replace almost any medication, but all available medications cannot replace movement" [15].

Much too frequently one tends to forget that movement stimulates not only physical and motor development, but also functional and mental development. A human being develops through movement and thanks to movement. Some argue [2] that with age a human should undertake an intensified psychomotor activity. This conforms to the principle popular among Ancient Greeks: "We do not stop exercising because we age, but we age because we stop exercising".

MOTOR ACTIVITY AND THE AGING PROCESS
IN LITERATURE

There are many theories that attempt to clarify aging-related processes, but the majority of them are mere hypotheses, and not scientific evidence [4]. Up to now little material has been collected in respect to the relation between motor activity and the aging process. As a result of performing simple, daily, household chores, women over 70 are now stronger and had better endurance and functional fitness [18]. An improvement of muscle strength was found even in 90-year-old and

older persons [6, 25]. As a result of four-month endurance training for 55- to 70-year-old women and men, shorter reaction time and improvement in respect to elementary cognitive processes was observed [5]. A twelve-week agility training in 65- to 88-year-old women and men led to improvement in the scope of motor activity in six joints by 22% on average [13].

In a six-month experiment conducted on seven persons aged 78, G. Kirchner and K. Stober [10] ascertained a significant increase in the level of ability to maintain balance. The classes carried out in this group took 60 minutes a week, of which only 20 minutes were dedicated to improvement of balance. Some studies show the effect of movement activity at an older age on improvement of the ability of maintaining balance and preventing falls. The improvement was from 10% to 31%, and it turned out that particularly effective was the Tai Chi Quan programme [12]. Injuries caused by falls are the main indirect cause of mortality in older people [26]. Of particular value are studies conducted by S. Starischka et al. [19] on 1322 subjects of both sexes aged from 40 to 94 years. Both women and men who practice sport displayed a much quicker movement reaction and a higher level of the ability of maintaining balance than their inactive peers.

This short list of publications indicates an exceptionally favourable impact of movement exercises on diverse motor abilities, and in particular on the reaction speed and ability to maintain balance. Unfortunately, it does not contain results of observations related to the impact of directed exercises or sets of exercises on a larger number of particular motor coordination abilities, and especially those of a global nature. In an endeavour to decrease this deficit the study was directed at seeking connections between the level of movement coordination and age. Assuming that motor coordination reflects the effectiveness of the central nervous system, an attempt was undertaken at finding another concept for this subject. The aims of the study were:

- to determine the level of motor coordination, its changeability and conditions depending on age, particularly in older persons;
- to seek relations between the type of motor activity, including the practiced sport, and the level of motor coordination;
- to seek sports for persons of each age;
- to establish a relationship between motor activity and education system.

METHODS

The studies were conducted on a total of 6592 female and male individuals aged 7 to 75 years. The studied subjects also included highly advanced athletes of 10 sport disciplines. Based on a large number of tests the level of various motor abilities was evaluated: global movement coordination [23], jumping ability, speed of reaction, spatial orientation and maintaining balance [7]. The studies were cross-sectional and continuous. In the latter the pedagogical experiments were carried out, which lasted from 2 to 7 years.

LEVEL OF MOVEMENT COORDINATION AND ITS CHANGES WITH AGE

The results of studies were compared to the synthetic diagram of development of psychomotor abilities in particular stages of human life, developed on the basis of available literature.

Results of numerous studies indicate that with age the level of movement coordination decreases; this also concerns its particular components [7, 22, 24]. Much more information can be found in continuous studies. From this viewpoint, long-term studies of P. Hirtz [7] deserve special attention. Of particular value were those directed at developing the ability of maintaining dynamic balance, which were conducted on a very numerous group of people (n=2647). They indicated the occurrence of the most dynamic development of this ability in boys and girls between 7 and 11, i.e. in the sensitive period. After the age of 19, the level of this ability was lowered both in men and women. In experimental groups subjected to systematic training, no such trend was observed; and on the contrary, a visible increase took place in their case. Lower results related to the ability to maintain balance after the age of 18 in persons of both sexes were also recorded by E. Schielke [17]. A decrease until the age of 22-23 was also observed with reference to the speed of movement reaction to optical and acoustic signals in persons of both sexes.

More interesting were the results of studies conducted by P. Hirtz (1989) on 600 individuals aged 7 and 70 years, related to simple movement reaction and spatial orientation. In respect to those two abilities, their level was lower after the age of 21 or 22. It was relatively moderate, but quite systematic. As compared to the results obtained by this numerous group of individuals (n=600), of particular interest are individual results of two former athletes who continued systematic training. The results of one of them, a 55-year-old subject, in respect to spatial orientation were at the level of mean arithmetic values for men aged 20 to 24 years,

and that of simple reaction even higher than the results for 20-year-olds. The results of a 75-year-old former athlete were at the level of mean arithmetic values for 35-year-olds in spatial orientation, and in reference to the reaction speed close to the levels for 55-year-olds.

Studies of P. Hirtz [9] related to the ability of movement differentiation of men and women and men within the age bracket of 20 to 75 years indicated the highest decrease in the results of persons of both sexes between 55 and 75 years of age, while between the age of 25 and 55 it was relatively moderate. Also particularly interesting was a six-week experiment related to the ability to maintain dynamic balance (walking over an overturned bench) conducted on 50- to 70-year-olds by R. Westphal [27]. In this experiment special exercises were applied for 15-20 minutes, which were directed at developing the balance ability. An essential increase in indices of the applied tests was obtained in the group of 60-70-year olds.

The review of literature mainly took into consideration studies related to particular coordination abilities. The topic of interest was whether a similar tendency in results also occurs in relation to a complex of such abilities contained in such tests as global movement coordination [23] or jumping ability [22], which necessitate simultaneous mastery of a few of those abilities. As for the jumping ability, its high level requires simultaneous manifestation of motor physical abilities (speed and strength) and numerous coordination abilities. An increase in the jumping ability level was recorded up to the age of 18 in females, and up to 21 in males. Afterwards, a more pronounced reduction in results was recorded for male subjects.

The high level of global motor coordination is recorded in persons manifesting simultaneously various motor abilities, first of all, those related to physical abilities and in particular to coordination abilities. Tests conducted on a numerous group of advanced hockey players indicated a relatively small degree of impact of the global movement coordination on the athletes' age. A relatively moderate progress of the curve for mean arithmetic results indicates insignificant 'fluctuations' in the level of global movement coordination at different ages. They were rather similar, particular in hockey players within the age bracket of 13 to 32 years. This seems to indicate that in persons who practice sport in a systematic way an increase in the level of movement coordination (within defined limits) and its maintaining over many years is possible. This allows stabilisation of the sport technique in technically complex sports, as well as achievement of good results and occupying top positions in sport for many years.

THE PRACTICED SPORT AND THE LEVEL OF MOVEMENT COORDINATION

Results of our own extensive studies based on the application of the test of global movement coordination [23] indicated the highest level of movement coordination in persons who practice figure ice skating. A comparison of results obtained in cross sectional studies of a large number of pupils from schools in Warsaw, Gdańsk and figure ice skaters, showed in the latter group a higher coordination level than in both groups of children who were not practicing sport. The perceived differentiation was fundamental. A comparison was made for results obtained in groups of different sizes, because in Poland there is not a large enough group of 10-year-old athletes to match the group of individuals who do not practice sport. In subsequent studies, both cross-sectional and continuous, an attempt was made to find a response whether also in subjects from other age groups the prevalence of figure ice skaters over those who were not practicing any sport was just as great as the one for the 10-year-olds. The results of consequent studies confirmed the trend observed earlier, i.e. a much higher level of global movement coordination in figure ice skaters, as well as an increase in this differentiation with age.

The development of movement coordination through appropriately selected exercises enables the achievement of its high level, which significantly exceeds the recorded prevalence of almost 100% of figure ice skaters over persons who do not practice sport. It should be noted that 8-12-year-old ice skaters constituted a selected group in which, through numerous new and varied exercises, coordination was being developed in the most susceptible period of their ontogenesis. Yet, this does not mean that figure ice skating exercises may help obtain a high level of coordination by anyone. However, independently of the level of inborn movement coordination it can be developed at various ages and to various degrees thanks to applying appropriately selected exercises, among which a special place is occupied by figure ice skating exercises. For this reason this discipline is recommended as an indispensable element of motor education of a child [20], sport training of athletes independently of their specialisation, as well as an important component of maintaining health and high psychomotor fitness until old age [14]. According to some authors this is a sport for life.

ICE SKATING – A UNIVERSAL SPORT FOR PEOPLE AT ALL AGES

Ice skating, especially its more complex form – figure ice skating, is characterised by exceptionally numerous qualities. It requires nearly all coordination abilities from the exercising person, and in particular those abilities that are indispensable to an individual in everyday life: differentiation of movements and their rhythmisation, maintaining balance, spatial orientation and reaction speed. Ice skating is not complex and enables the exercising person to regulate the load, as well as to graduate the complexity of exercises depending on current health condition, frame of mind and psychomotor condition. Many years ago American magazine *Skating* ran a special column for older people under a meaningful title: “One is never too old”. The example of world famous writer Lew Tolstoy is symptomatic, as he learnt to ride a bicycle and skate when he was 65 [11]. The legendary multiple European, world and Olympic figure ice-skating champion, S. Henie started her unique career at the age of 11, and completed it as a solo performer in her own variety show when she was 57 years old.

Until recently sport classes with older people have been a relatively rare phenomenon. For much too long we believed in the old Arab saying: “He who teaches an old man – writes on water, and he who teaches a young man – writes (carves) words on stone”. A great enthusiast of ice skating, and also a coach, S. Glazer, organised in 1958 a figure ice skating club section for veterans in Moscow for people older than 45. Many of them were unable to ice skate. After five years a jubilee was celebrated, and an album was issued entitled: *Sport of eternal youth* (1963), in which 22 persons described their health state and the way that the sport training affected their body and psyche. The titles of those reminiscences appear to be especially meaningful: “*I feel young*”, “*Cure to all illnesses*”, “*It’s never too late*”, “*I have a whole life ahead of me*”, “*We forget about our age*”, “*I have not been sick even once*”, “*Golden age*”, “*Return to youth*”, “*Ice skates made many of us happy*”, “*Rebirth*”. During the *Holiday on Ice* show organised by this club section, solo performers of the sailor dance included also the 79-year-old P. Belajev.

The above examples concerned older people who practiced recreational ice skating containing some sport elements. However, a worldwide sensation was aroused by the special performances of multiple European, world and Olympic champions Bielousova and O. Protopopov, skating as a pair. They introduced various dance and sport types, their own style and a new way of interpreting the movement-related content of music into figure ice skating, and turned each of their performances

into a mini-theatrical performance. Their every movement, even the smallest gesture, appealed to the spectators in a meaningful way, arousing their emotions. They were characterised by a high level of aesthetics of movement and beautiful body lines. They ended their brilliant amateur career by asking permission to stay in Switzerland. Afterwards they became multiple world champions in professional ice skating, and for many years they were participating in shows in different countries. They developed over 40 programmes, mainly accompanied by classical music.

There would have been nothing exceptional in the biography of former champions, if not for their age. On the occasion of her 70th birthday, Ludmila and 74-year-old Oleg gave a performance of their unusual motor ability enthusiastically welcome in St. Petersburg. Their performances were just as welcome in the United States and in many other countries. They continue to score excellent results and display a great level of technical mastery, despite their advanced age, with unbelievable accuracy, numerous complex elements (such as jumps to pirouettes, pirouettes with a great number of rotations – from 18 to 36), including also three “spirals of life and death” developed by them. The only change in their programmes concerns the number of complex multi-rotation jumps, which decreases with age, but without which it is also possible to achieve spectators’ admiration by applying the principle: “minimum movements – maximum expression”. This has not, however, been the world record yet. The famous ballet soloist M. Plisiecka gave a dance performance at the age of 80, which also included technical elements performed on tip toe.

The presented data from recreational figure ice skating, as well as sport in general, confirms the exceptional adaptive capabilities of the human body, as well as the fact that ancient Greek philosophers were quite right when they said: “We do not stop exercising because we age, but we age because we stop exercising”.

MOVEMENT AND THE EDUCATION SYSTEM

The importance of movement and its role in human life has undergone various changes throughout centuries. Different nations have solved the issue of motor activity in different ways. A fascinating trend in this respect may be observed in people of various ages in the Far East (Japan, China, Korea). In those countries movement has been always associated with a philosophy – not necessarily a profound one – which values and justifies it. Before each exercise a close and a far aim is determined, and in such a way development perspectives are outlined. They are strictly related to the concept of internal self-improvement from early childhood until late

age. And consequently, achieving a high level of fitness in respect to self-control of movements of one's own body and its internal manifestations such as ability to control emotions, rationally controlled breathing, appropriate concentration, movement economics and movement smoothness. All this becomes directed at full harmony of form and content, i.e. its internal and external image. Furthermore, the emphasis is placed on the internal dimension (external dimension in European culture). Consequently this becomes a process of self-improvement of the nervous system efficiency, and on the whole, of the functioning of an individual in harmony with himself and with the surrounding environment. Consequently, the performed movement is accompanied by harmony, which is the objective of the exercises. Could it be the reason for the record longevity of the Japanese?

On the contrary, in European culture it seems that the aim of physical activity is a conscious violation of that harmony. This leads a human being towards competitiveness and aggression, and consequently to unnecessary stress and an increasing number of mental illnesses. Copying certain cultural elements from motor education of the inhabitants of the Far East and redirecting oneself onto a different concept of self-improvement process through movement may enrich European culture and improve the health of Europeans.

DISCUSSION

The development of modern civilisation and the accompanying sedentary life style adversely affect the human body. One seems to forget about one's genetic programme, which imposes the need of considerable motor activity. Despite that people live longer. Results of some studies indicate a close relationship between one's motor activity, health and life span. Some ancient philosophers appealed to undertaking intensified motor activity as a source of health and wellbeing. An increasing number of studies indicate a decline in human psychomotor fitness with age. Some of them indicate the possibility of impeding or decreasing the rate of this process using a directed motor activity, even one that is moderately intense. Of particular importance here are results of studies directed at changes in the level of motor coordination abilities that take place with age, which determine the correct functioning of a human in everyday life. Among them the leading position is occupied by the speed of movement reaction and ability of keeping one's balance. Results of studies conducted on subjects at various age indicate that there is a possibility of maintaining a relative high level, as well as its increase over a relatively short time through application of directed training. One of particularly

effective means is ice or roller skating, which demands from Man various co-ordination abilities, and especially those indispensable in everyday life. Their exceptionally beneficial influence results from the great number and variety of technical elements that require maintaining balance. Movement activity acquired in childhood allows achieving a high level of various motor abilities in mid-life, which assures high comfort in occupational work and life until old age. This is proven not only by results of tests and models observed among the Far East residents, but also by examples of long-lasting careers of leading world champions. On the basis of numerous studies conducted by different authors, as well as on our own studies, we have managed to determine the variability of the level of movement coordination depending on age. It shows that systematic and intensified movement activity enables maintaining its relatively high level, and even improving it at different ages. However, with age this scope tends to decrease.

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