THE NECESSITY OF RELATIVE ESTIMATION OF MOTOR FITNESS

by

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The level of person's motor fitness may be evaluated in two ways: either in "absolute" terms – through tests results, without considering the individual predispositions or in "relative" terms whereby the scoring depends on the basic predispositions (results of arm and shoulder strength tests per unit of body mass or lean body mass). The first of these tests is used in high-performance sports, while school grades and other evaluations where the motor skill is treated as manifestation of motor fitness should be based on relative approach. This view is closely linked with the changing opinion as to the aims and objectives of physical education. The opinion evolved from the concept of body shaping, body up-bringing right to the programme of body-care upbringing (Osiński 1996). Parallel to that view was the process of school assessment and scoring of motor skills in school children. Several tests for relative evaluation were designed to serve that purpose (review by Żak, 1991a). The method of indirect measurement became immensely popular when the concept of physical training was abandoned and then replaced with the "physical education and upbringing". Apart from current aims, the latter involves prospective aims as well. In view of thus specified goals, the only reasonable solution is that only those tests should be used at schools which motivate the students to make further effort to improve their fitness.

The current views concerning the physical education at schools are of great interest to researches from the field of biology, natural science or social science; as well as those engaged in relative assessment of motor fitness- teachers, doctors, health centres, education institutes and parents. The main point here is developing such groups of tests that would take into account the physical conditions and the level of advancement of individual motor predispositions, would be simple to perform and assess and would allow for most objective diagnosis of individual efforts. Besides, the requirement of test adequacy should be met. Close relations between the motor skill components and the level of somatic conditions during the period of rapid individual development have to be emphasised.

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The research work on how the basic morphological parameters (body height and mass, muscle mass, fat mass) impact on the person's motor performance how the level of somatic development influences motor fitness of an individual is well documented in Polish literature on the subject (Przewęda 1985; Haleczko 1989; Raczek 1989; Żak 1991a). This problem was also thoroughly investigated abroad, for example by the International Committee on Physical Tests Standardisation and the European Committee for Sport. Most research work was focused on establishing the relations between the basic somatic traits and separate motor fitness components. The main shortcoming was that those relations were established and interpreted using the linear regression models, while the linear relations are rarely found in nature. Most often we encounter some optimal parameters, usually nearing the mean values. This might be the consequence of the stabilising selection (Szarski, 1976), most commonly found in natural conditions, whereby the preference is given to individuals in whom most features are present in average degree; i.e. the individuals most typical for the given species.

Most recent research (Osiński, 1988, Żak 1991a, 1994) seems to confirm this view. Only the results of static (absolute) strength tests yield a linear relation to the body size. Most relations are multi-directional; even in such an extent that we are not able to establish the 'standard values' within the real and feasible limits taking into account three features only: body height and mass, and the amount of fat. That means that each relation should be considered separately; optimal fat content, body height and body mass may be in different relation to the results of speed ability tests. These relations may be still different in endurance or co-ordination tests (Osiński, 1988).

The reliability of curve relationships, described with the third or second order polynomials is further questioned by relatively low determining factors (apart from body mass and its components and the static muscle strength). The observed relations are curve- shaped mainly at the boundaries of their variability intervals.

Taking into account all the factors that determine the motor fitness in humans (including non-morphological factors as well), it seems that holistic approach to human motor abilities is more reasonable than the traditional, phenomenological one. Its rationale can be found not only in bio-mechanical conditions of the motor system, but also in greater levels of individual advancement and biological maturity. That is borne out by the variations of correlation coefficients and the curve profiles for different age groups (Żak, 1991a).

As the relations between the somatic traits and the motor test performance (mainly energetic) grow weaker after the puberty period, it may seem that the level of individual development — most strongly manifested during the adolescence period — gradually loses its importance, giving way to genetic and environmental conditions (mainly related to the person's physical activity (Żak, 1991a).

Precise measurements and evaluation of motor performance must take into account both the level of somatic predispositions and the performance itself. It is relatively easy to determine the level of motor fitness in the category of external efficiency (test results); while it is nearly impossible and impracticable to consider all the predispositions, because of their number and type. Therefore, it is recommended to search for most representative features, such that they would jointly and adequately determine the level of individual development.

One of the techniques applied to remove the influence of the individual development level is assuming the body height to be its measure. That approach was used in the works by Trześniowski (1981), Siniarska (1984), Malina (1984), Szopa and Żak (1986), Szopa and Sakowicz (1987). These works present the comparison between the population or group members as to their motor fitness levels, at the same time the influence of body mass was eliminated; thus only the methodological approach would be different. Osiński (1988), Haleczko (1989) and Wątroba (1990) went still further and developed the regression lines to compute the expected results of motor fitness tests for the accepted somatic parameters. We have to bear in mind, however, that these methods are not very precise and thus obtained results should be treated as an approximation only. It is mainly because we disregard the fact that the level of somatic parameters is the consequence not only of the development level, but the genetic conditions specific for the given feature, too.

So far the attempts to determine the influence of individual development level (expressed as the morphological age calculated from three components: number of calendar years, body height and lean body mass) were made only in the works of Żak (1986, 1991a, 1994). That was a more comprehensive and adequate assessment than through individual somatic components, which can be used as fairly correct measure of biological age.

The morphological age may vastly differ between individuals in all age categories during the period of progressive development (table 1 and 2). Its variability in

Table 1. Numbers of individuals in categories of morphological and calendar age — boys

	morphological														
calendar age	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
7	16	57	16												89
8	3	71	127	48	12										261
9		9	58	109	34	9	1								220
10			10	57	108	45	9								229
11				11	91	95	50	7							254
12					8	75	76	37	10	2					208
13						23	60	85	53	6					227
14						1	10	53	90	44	11	5			214
15								7	55	91	50	27	17		247
16									9	65	66	55	42		237
17										20	54	76	98		248
18										3	45	59	64	57	228
19											12	35	77	76	200
	19	137	211	225	253	248	206	189	217	231	238	257	298	133	2862

Table 2. Numbers of individuals in categories of morphological and calendar age — girls

calendar age \ morphological age	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
7	20	54	22	1											97
8	4	77	92	54	7										234
9		11	68	109	50	4									242
10			6	58	119	37	6	1	1						228
11				14	70	94	52	5	2	1					238
12					4	70	100	30	21	3	5				233
13					1	9	59	86	29	37	19				240
14							9	56	49	39	24	16			193
15								19	54	46	68	47			234
16								3	35	52	77	79			246
17								1	21	58	58	44	82		264
18									1	34	36	45	94		210
19															149
	24	142	188	236	251	214	226	201	213	270	287	231	176		2659

the same age groups (in terms of calendar years) may in extreme cases be 7 years. Let us use a more illustrative example: among 14-years old we can find some children whose morphological age ranges from 11 to 17.

It seems that morphological age is a major determinant of motor fitness level (of energetic source) and agility both in girls and boys (Fig 1, 2). That is probably due to considerable variability of somatic traits during the stage of progressive development. When this differentiation is treated as subsequent stages of morphological maturity, we can consider the kinetics of motor performance changes (the same as in the category of calendar years); which varies in certain fractions identified with regards to the development level (Żak, 1991a). We have to emphasise that the share of the somatic factor in their differentiation is not uniform and is manifested more in boys than in girls. Most considerable influence can be found in the results of static strength tests, speed abilities tests, endurance in running and agility — though in a smallest extent. The morphological factor becomes more pronounced in the period of adolescence — as the result of largest variability of somatic traits during that stage. That seems understandable and does not call for any extra explanation — it is however worth remembering for practical reasons. The kinetics of changes of analysed motor effects defined in morphological age categories vastly resembles the pattern of motor performance variability determined on the basis of chronological age for the whole population. Quotient ratios of intergroup variance to the overall variance are greater in all age categories when the morphological factors are considered rather than the number of calendar years. The arithmetic means for given years summarised for one category would yield similar values (Żak 1991a). That decidedly proves that the development level is predominant for shaping the motor fitness in children and young men, especially during adolescence. Therefore, this factor

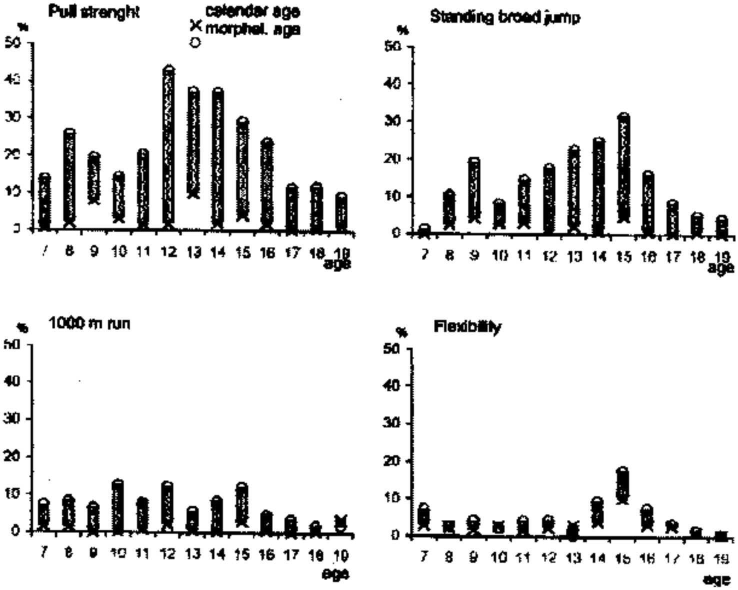

Fig. 1. Percentage participation of morphological and calendar age in differentiation of motor fitness in 7–19 years-old boys (Żak 1994)

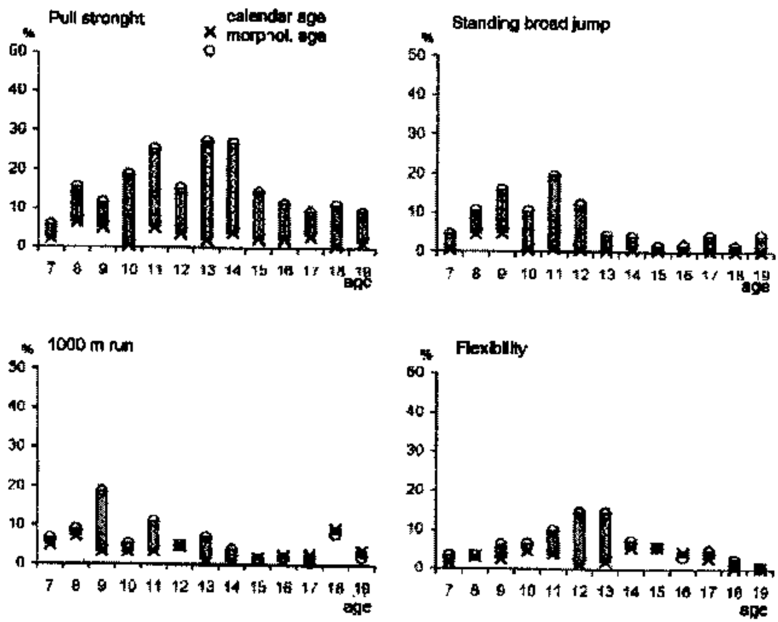

Fig. 2. Percentage participation of morphological and calendar age in differentiation of motor fitness in 7–19 years-old girls (Żak 1994)

must be considered, especially in school education practice, through using the relative techniques of motor fitness evaluation and (as far as possible) the physical activities should be arranged such that they should be run in groups which are homogeneous in terms of somatic development, not the calendar age. We realise that such arrangements might be difficult in school work organisation, yet we emphasise this necessity. That is mainly so during the progressive development, including the period of adolescence which is specially dynamic and proceeds differently in individuals. The rate of individual development in those getting mature earlier is much faster and more intensive than in those who reach their maturity later.

Among the four methods for determining the developmental age (bone age, teeth, sex development, body growth), the most objective and adequate is the method of bone age assessment. However, because of legal conditions and organisational requirements this method cannot be widely applied. The simplest, most adequate and reliable method is therefore determining the morphological age, commonly used in school and sport training practice as well as in research work. It is a correct approach since somatic and motor development proceed in the same direction during adolescence; while the development of the structure – as it was mentioned earlier- is ahead of functional development. Besides, thus calculated morphological age combines the genetic factors (the influence of genes controlling body height) and developmental factors (dynamics of changes) – which is the best way to express the motor fitness in relative terms, since it is determined by these two types of factors.

In the light of facts presented here, **the critical approach to uniform scoring for age groups in motor fitness tests seems fully justified**. This is a very important problem, since the motor fitness scoring is usually done in categories of calendar years. In spite of its serious shortcoming this method is still persistently used in many countries while designing modern test batteries (ICSPFT, Eurofit and others).

The theory of human motority allows to distinguish at least two types of standards. The first is based on arithmetic means and allows to determine the position of a child against the population — it means comparing a person with his or her contemporaries (population — related standard, or the statistic representation of the population). The major shortcoming of such standards is that individual development processes are neglected (such as the time of reaching adolescence). Thus comparing yearly measurements of motor performance to standards which do not account for individual variations seems useless, from the point of view of school practice. An individual reaching the subsequent stages of maturity later may in the earlier periods give poorer motor test performance than the mean for the whole population while in the later period he may well make up for this delay. On the other hand, while **referring to health-related fitness we must not agree with the assumption that the mean value should be the standard** (as in the case of health conditions or moral criteria). The **desired values** (the best which can be achieved) should be the standards here — so called **target standards**. We have to bear in mind, however, that though in theory such standard may seem perfect, yet for practical purposes they are infeasible in certain degree since such standards would involve achieving the best results thus removing the individual differences, which is quite impossible (for genetic reasons as well as others). It seems one should look for half-way solutions, introducing for example some population — related standards yet based on tests results from homogenous groups of individuals (having the level of development). When we check the morphological age of participants before the yearly motor fitness tests, then the scoring would be "free" from the bias of genetically determined rate of individual development (somatic predisposition), though it is only a simplified picture. This hypothesis is borne out by works of Milicerowa (1968), Wolański (1983), Przewęda (1985), and others, who treated the level of motor performance as the combination of somatic and functional development. We have to bear in mind, however, that both the growth rate and the final body size, and in turn also trainability, are genetically programmed. The tables prepared by Żak (1991b), taking into account the morphological age of tested individuals in their ontogenesis are also based on arithmetic means, yet the existing differences between the results are in large extent 'free' from the influence of somatic development levels.

Unfortunately, in spite of numerous arguments for returning to relative methods of scoring, already used in the past (Mydlarski, 1934), still the scoring scales are developed which are based on calendar years only (such as Chromiński's test used in Polish schools or Eurofit). These tests are in opposition to biological rules and the desired school practices, as they give preference to young people with better physical predispositions thus discriminating the average individuals or those with poorer morphological parameters.

Such approach produces very serious and negative effects. Recent research works (Żak 1994) reveal that, according to teachers, students with "delayed" development have little confidence in themselves and experience the feelings of loneliness. Unlike them, tall students or those reaching maturity earlier attempt to subordinate others and are more aggressive, particularly boys. Shorter students or those reaching maturity later display more features indicating their being not adapted to society. More biologically developed students will more quickly adapt to new situations, thanks to better physical conditions.

These facts and opinions agree well with the results presented by other authors. Hurlock (1985) made an observation that more physically active , hence more agile, children can better concentrate, are tougher, have better psychological strength, are more confident while less agile children often entertain the feeling of helplessness. Other research works indicate there is a close connection between children's physical activity and social acceptance and adaptation (Porębska 1982; Hurlock 1985). Feelings of inferiority, jealousy, aggression towards adults, rejection, dependence, shyness, boredom are commonly identified as consequences of lower motor fitness in children. We have to admit that social and psychological consequences of these feelings may be even more dangerous than the physical ones. They may warp the children's psychology and continue long after the backwardness has been made up for. Further research should focus on so called psychological age, about which little is known and social maturity — an aspect hardly ever mentioned in any theoretical considerations relating to human fitness.

Summing up, let us once again emphasise the main points. First of all, while evaluating the students' motor performance we have to remember the basic biological laws, whereby the structure, maturity and functions are inseparable. Secondly, the relation between the biological advancement level and motor fitness should be treated as having its roots in nature; therefore this factor should be always considered, especially in physical education at schools, by using relative techniques of motor fitness scoring. The latest choice of activities in designing a test was made Szopa (1988, 1989); while the tests was adapted to account for the categories of morphological age by Żak (1991a). The measure of its efficiency is evaluation of its basic function – producing a system of stimuli positively motivating individuals (students) to systematic exercise, which is indispensable for their development. Positive motivation is necessary for individuals to obtain their optimal motor fitness levels.

Thirdly, we have to draw our attention to the fact that according to our system of values, fitness is considered in biological and health related categories, as well as cultural and social ones. These two aspects are combined by manifested physical activity. The psychological factors have to remembered, too. Each movement ought to be considered as the manifestation of human psycho-motor activity.

As far as psychological and social aspects are concerned, extensive physical activity allows to develop attitudes necessary in adult life; such as emotional balance, psychic strength, resistance to stress, psychological adaptability to changing conditions. Besides, it promotes responsibility, self-discipline, persistence in pursuing the aims, and helps to acquire social norms and to internalise the cultural values (Strzyżewski, 1990).

Social merits of physical activity are that the body is a value in itself. By building prestige and authority and promoting acceptance the individual finds his place in the society. Those values are also the consequence of factors which bring certain benefits, though rarely seen. Fitness is a vital element of our personality, a distinguishing factor, bespeaking of our culture and lifestyle. Fitness can vastly enrich human life, providing new opportunities for pleasure or active recreation. It facilities interpersonal contacts, offers new ways of spending time, helps young men to find themselves in a group.

In the light of these facts, more intense and effective stimulation while working with students whose development is delayed (no matter whether it should be the consequence of genetic conditions or growth dynamics) is of primary importance as the element of health care and the means of providing for correct and multi-directional development, involving biological, psychological and social aspects. The organisational and methodological implications will not be further discussed in the present study, as these belong to the theory of physical education, a branch of pedagogic science. We have to emphasise, however, that these objectives are impossible to pursue without objective evaluation.

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