SENSITIVE PERIODS IN PHYSICAL DEVELOPMENT

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Awareness of age ranges sensitivity for the development of certain physical performance factors assists in obtaining best training results. In the following text the authors present the results of a study to establish the most suitable periods for the development of strength, power and speed capacities for boys and girls in the 10 to 18 yrs. age range. The article is a slightly abbreviated version of the original published by the Institute of Coaching, University of Tartu, Estonia, 1994. Re-printed with permission from Modern Athlete and Coach.

THE PROBLEM

Coaches and Physical education teachers are well aware of the fact that students will not develop all physical characteristics and capacities in the same way, as the development is determined by genetic factors. The process of passing on genetic information takes place at its best in certain external conditions. When certain genetic information is missing, the expected capacity fails to develop even if optimal external conditions are provided. The possibilities to develop performance capacities are therefore limited by the genotype of an individual.

It has been shown that genetics can be exploited only when an optimal correlation exists with morphological and functional characteristics and environmental conditions at certain age periods. The influence of environmental factors (training) is not the same at different stages of the development of the organism. External factors that do not correspond to the capacities of the organism do not allow the use of the available reserves of the organism at different developmental stages. Only a close correlation with external environment makes it possible to exploit heredity. Inadequate influence will restrict the development, whereas excessive loads can exhaust genetic possibilities.

Understanding the above outlined factors suggests that it is possible to establish “critical sensitive” periods in physical development. Environmental factors have an optimal influence on development at certain periods. At other periods the influence can be neutral or even negative. Being aware of the critical periods and the optimal training effect allows us to guide the developmental procedures.

Numerous researchers have shown that several morphological characteristics are generally determined. Although morphological development undergoes important changes during different ages, it is more or less following a stable pattern and therefore allows making forecasts at all ages.

There are optimal periods of growth for the development and fixation of movement functions. Missing these periods can lead to slow or bad formulation of these functions, requiring more time for often unsatisfactory results. For this reason the development of one or another activity should take place during a favorable age.

Sensitive periods are essential in the determination of the specializing age, morphological readiness, optimal training loads etc. Research has shown that the best effect in the development of performance capacities according to the selected aim is achieved when the natural growth is at its peak. The development of the desired physical capacities during the phase of the most intensive growth leads to a significant increase in these capacities.

However, there is a danger that the full potential of the organism is not fully realized when early specialization and intensive training loads take place during the sensitive period. It is therefore necessary to be aware of the anatomical and physiological characteristics of the organism, as well as the duration and nature of sensitive periods in order to avoid health problems and negative influences.

Proceeding from the considerations outlined above, the authors conducted a study to establish the sensitive periods of physical development of school children of both sexes. The age range for boys was 11 to 18 yrs., for girls 10 to 17 yrs. The numbers involved in each age group are shown in table 1.

AGE	10	11	12	13	14	15	16	17	18
Boys	–	317	344	365	350	341	286	230	197
Girls	144	198	170	142	122	123	99	83	–

TABLE 1: Distribution of the tested subjects according to age groups.

The following tests were applied to evaluate the main physical performance capacities:

- Maximal strength — dynamometric back muscles strength
- Explosive strength — standing long jump, vertical jump, medicine ball put in sitting position (2kg)
- Speed — 30m sprint.

STATIC STRENGTH

The sensitive periods for physical development were established according to the annual improvement rates. Table 2 shows the percentage improvements in static strength (back dynamometrics). As can be seen, the sensitive period for the development of static strength occurs in the 13 to 16 yrs. age range for boys with the largest increase (23.4%) taking place between 14 to 15 yrs. The most sensitive period for girls was in 11 to 13 yrs. age range in 39.7% of the total improvement.

AGE	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18
Boys	–	4.0	7.6	17.5	23.4	19.9	14.7	12.9
Girls	11.8	20.5	19.2	9.5	12.6	9.5	16.7	–

TABLE 2: Annual percentage increases in the back strength of the tested subjects (% of the total increase)

POWER

Tables 3, 4 and 5 show the annual increases of power (standing long jump, vertical jump and putting the medicine ball). As can be seen from tables 3 and 4, the most sensitive development of leg power for boys took place in the large 12 to 17 yrs. age range, with the best results recorded between 13 and 16 yrs. In the girls the most sensitive period occurred from 10 to 12 yrs. During these two years (10 to 11 and 11 to 12) the standing long jump showed an improvement of 81.8%, the vertical jump 77.2% of the total achieved during seven years.

AGE	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18
Boys	–	6.8	14.0	18.8	18.9	16.7	13.0	11.8
Girls	28.5	53.4	2.3	8.7	4.2	2.3	0.6	–

TABLE 3: Annual percentage increases in the standing long jump of the tested subjects (% of the total increase)

AGE	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18
Boys	–	4.9	14.0	13.0	18.5	21.2	15.5	12.3
Girls	40.5	36.7	7.6	2.5	2.5	7.6	2.5	–

TABLE 4: Annual percentage increases in the vertical jump of the tested subjects (% of the total increase)

According to table 5 the most sensitive period for arm power development for boys was in the age between 13 and 17 yrs., while the girls recorded their best results in the 10 to 13 age range.

AGE	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18
Boys	–	8.1	11.9	17.9	18.5	16.6	16.5	10.5
Girls	19.3	20.5	26.0	9.7	7.3	15.0	12.0	–

TABLE 5: Annual percentage increases in the medicine ball put of the tested subjects (% of the total increase)

SPEED

The sensitive periods for the development of running speed are shown in table 6. As can be seen, this period for boys falls within the range of 12 to 17 years, while girls achieve best results during the early ages of 10 to 13 yrs. when development virtually stops.

AGE	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18
Boys	–	0	20.0	20.0	20.0	20.0	20.0	0
Girls	50.0	25.0	25.0	0	0	0	0	0

TABLE 6: Annual percentage increases in the running speed (m/s) of the tested subjects (% of the total increase)

CONCLUSION

1. Our study indicates that the sensitive periods to develop various physical performance capacities are concentrated in the 12 to 17 yrs. age range for boys and 10 to 13 yrs. age range for girls (table 7).

2. Emphasized attention should be given to the development of physical capacities during the sensitive age ranges because training during these periods leads to maximal improvement.

3. Awareness of the sensitive periods enables to plan the training of students according to their age and sex differences and secures an optimal development of physical performance capacities for future specialization.

CAPACITY	STATIC STRENGTH	POWER		RUNNING SPEED
		LEGS	ARMS	
Boys	13-16	13-17	13-17	12-17
Girls	11-13	10-12	10-13	10-13

TABLE 7: Summary of the sensitive development periods.