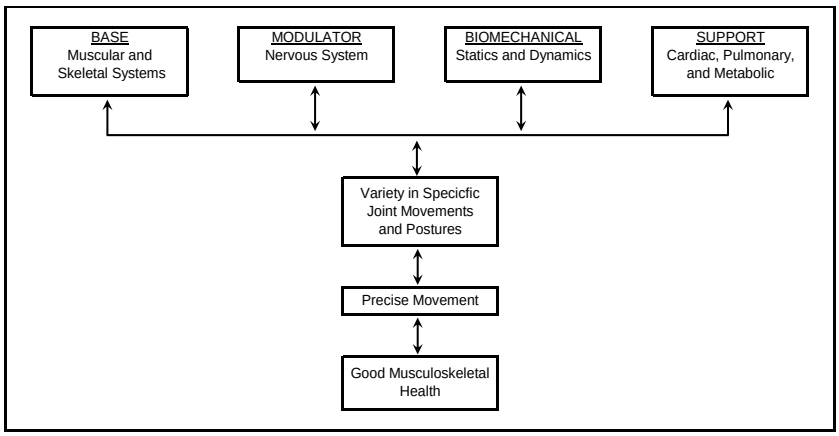
Multi SkillZ - FITNESS

Biological systems as foundation for a justified approach

A. Introduction

In the next 4 DrillZ we take a deeper look into the development factors of Multi SkillZ: Fitness, Skills, Function & Speed. These factors immediately depend on and are constrained by biological systems, namely: the MODULATOR, SUPPORT and BASE system as defined by Sahrman (2002). → *see DrillZ #5: Long term athlete development.*

Figure 1: Kinesiological model as presented by Sahrman



(after Sahrman 2002: 10)

This classification can be used as a handhold for designing the training process. The biological maturity is used as the basis for delineating the load capacity through the growth process. The core principle of a justified training approach suggested in Multi SkillZ is:
only a developed/matured system can be stressed, and therefore trained, at the fullest.

The role that each of the biological systems has in the training of the development factors receives brief attention in DrillZ #8 - #11.

B. Overview of the development factors and their sub-factors

Fitness		Skills				Function				Speed			
Games	Training	Orientation	Eye-hand & Eye-foot	Moving & Jumping	Rhythm & Dissociation	Balance	Mobility & Stability	Techniques	Kinetic Energy	Reaction	Agility	Running & Moving	Speed Coordination

C. Development factor Fitness

Fitness

Focus is on improving the physical readiness. Drills are designed to stimulate the physical ability and physical capacity through play and training. The physical activity of all participants is emphasized within the set-up.

For practical reasons we subdivide 'Fitness' into:

1. Games
2. Training

'Fitness' is mainly dependent on the SUPPORT-system (= metabolic, pulmonary and cardiovascular system).

FITNESS and the development of the SUPPORT element

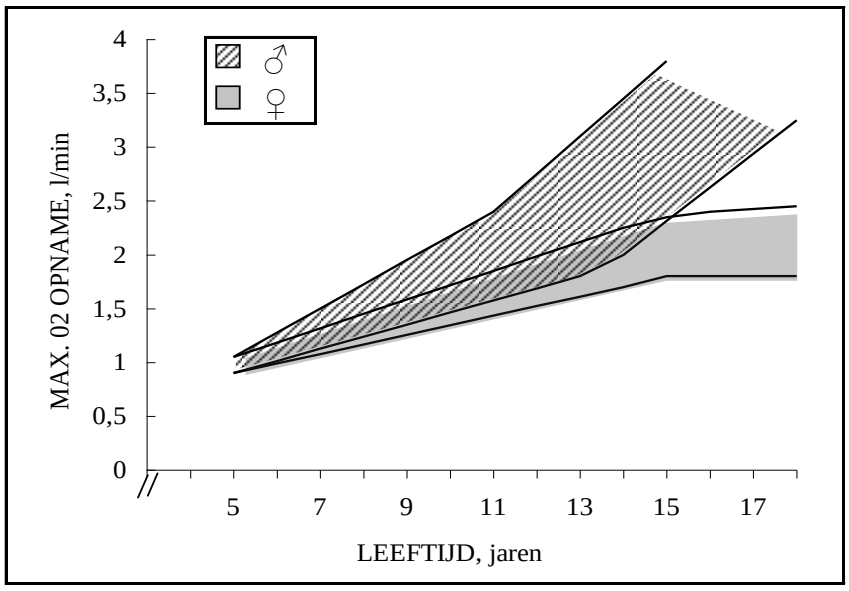
For Sahrmann (2002) the SUPPORT element includes the metabolic, cardiovascular and pulmonary function. The evolution of these systems through the growth and development of children is discussed briefly on the basis of the findings of Bar-Or (1983).

A. The metabolic response in children during physical exertion

1. Aerobic abilities

Absolute aerobic power (VO2max) is strongly related to lean body mass. This explains largely the difference between boys and girls during development (*see Figure 2*). Besides the fact that the ability of the body is dependent on dimensions, the metabolic maturity of a child plays also an important role. On this basis it could be concluded that the maximum power is less developed in adolescents than in adults.

Figure 2: *The maximum aerobic power and age. The absolute values for the maximum oxygen uptake in girls (n = 1730) and boys (n = 2180).*

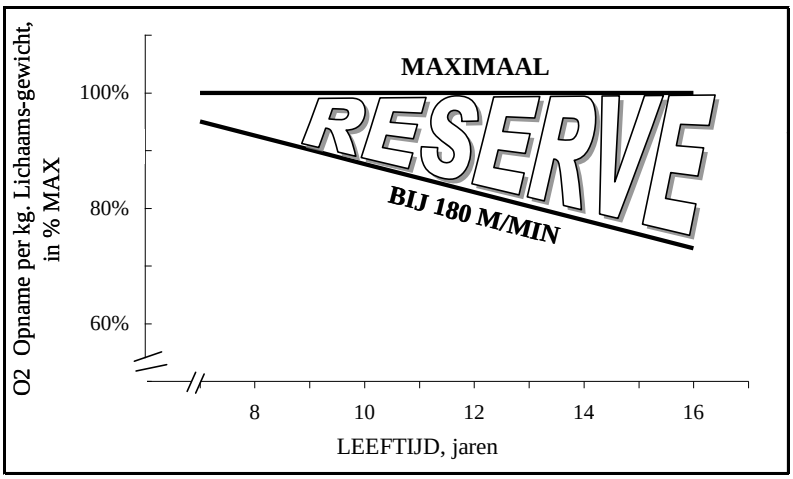


(after Bar-Or 1983: 4)

In order to compare the maximum aerobic power of individuals, the values for this quality should be expressed relative (per kilogram of body weight). During submaximal walking or hiking efforts, children have a *higher relative O2 (metabolic) cost* compared to adults. This is, in addition to a difference in a higher resting metabolic rate, mainly due to the lesser movement efficiency.

Based on the difference between the maximum O2 uptake and O2 uptake during a certain effort, which is expressed as the 'metabolic reserve " (*Figure 3*), children are disadvantaged. The reserve increases with increasing age and explains why they are less able than adults and adolescents have to perform over long distances.

Figure 3: *The aerobic reserve and age. The maximum O2 uptake and O2 uptake during exercise on the treadmill at 180 m/min at 134 boys & girls between 7 and 16 yrs old.*



(after Bar-Or 1983: 10)

This *limited movement economy and metabolic reserve*, with higher O2 emergency consequence, makes children ***less "aerobic machines" than can be expected*** from the high maximal oxygen uptake.

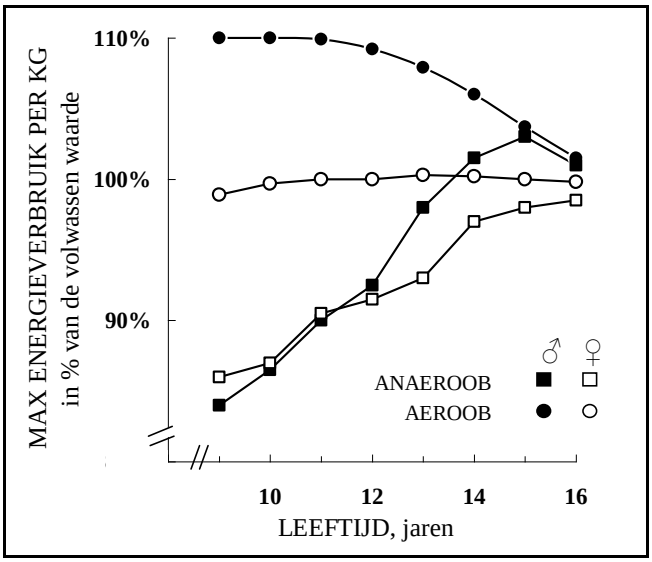
2. Anaerobic lactic abilities

This is largely due to a *qualitative deficiency in their muscle function*. The glycolytic capacity (concentration of muscle glycogen at rest and the degree of anaerobic use) in children is much lower, allowing them to be severely limited in the performance of highly intensive efforts of 10 to 60 seconds. Further, glycolysis in children is limited by a *lower enzymatic activity*. This slight glycolytic capacity is seen, for example, in the lower lactate concentrations found.

Figure 4 gives an overview of the development of the aerobic and anaerobic abilities. The figure shows that boys, and girls in a very limited extent, supply *their energy more than adults via aerobic processes*. Children have in comparison adults a higher oxidative enzyme capacity (Poortman & Dorchy 1998).

In addition, the oxygen deficit at the beginning of an effort remains smaller in children than in young adults. This may explain why children compared to adolescents and adults recover more quickly from an effort and thus may be ready to take up new movement tasks faster.

Figure 4 : *The development of the aerobic and anaerobic abilities. The maximum O2 uptake and maximum performance at the Margaria step-running test for 9 to 16 year old boys and girls. The mean values are represented as percentages where the reference of 100% is the performance found in 18-year-olds.*



(after Bar-Or 1983: 12)

Both the absolute and relative values show that children are much **less capable to perform anaerobic lactic activities** (capacity and capability) to adolescents and adults.

3. Anaerobic a-lactic abilities

Finally, in Table 1 the substrates in stock in prepubertal boys are compared to those of adults. The intramuscular glycogen concentration at rest in children is much smaller than those of adults. Only the amount of ATP is independent of age. Children have the **same metabolic substrates for maximum efforts that last less than 10 seconds** long.

Tabel 1 : *The availability of the metabolic substrates and their use in the muscles in prepubertal boys.*

SUBSTRAAT	Waarden in rust		Gebruik tijdens inspanningen
	Spierconcentraties in nmol/kg nat gewicht	Vergelijking met oudere individuen	
ATP	3,5 - 5 nmol/kg	Geen verandering met leeftijd	Zoals bij volwassenen
CP	12 - 22 nmol/kg	Lager bij kinderen	Hetzelfde of minder als bij volwassenen
GLYCOGEEN	45 - 75 nmol/kg	Lager bij kinderen	Veel minder dan bij volwassenen

(after Bar-Or 1983: 13)

B. The cardiovascular response in children during physical exertion

Children typically exhibit a remarkably lower stroke volume than adults during any activity. This is only partially compensated by a higher heart rate, giving children finally have a **lower cardiac output** for each metabolic intensity level. Boys show at all exercise intensities a higher stroke volume than girls.

Submaximal heart rate decreases with increasing age. The maximum heart rate values decrease, regardless of gender, fitness level or environmental factors, until a full maturity status was reached. In accordance with the "metabolic reserve", **a smaller "cardiac reserve"** is found in children based the differences between the maximum and the submaximal heart rate values.

Girls show a higher stroke rate of 10 to 20 more beats per minute at all intensities and at all ages. The heart rate after exercise slows down more rapidly in boys than in girls, which shows the **difference in the regulator mechanisms between girls and boys**.

C. The pulmonary response in children during physical exertion

In absolute terms, the ventilation is growing with increasing age. The '**ventilatory reserve**' also appears again to be **smaller** among young people.

Compared to adults, children have a *higher respiratory rate* and *shallow breathing* during maximal and submaximal efforts. This *inefficient ventilation* is associated with *an increased need of oxygen* for respiration. This may to some extent explain their **higher metabolic demands during submaximal efforts**.

CONCLUSION

In summary, it can be said that the **power and the capacity of the support element** in children, because of the differences in dimensions, and physiological response to adults, **remains limited**.

In addition, a **less optimal movement efficiency** affects the performance capacity negatively.

However, children have a **greater capacity for regeneration**, which enables them to quickly resume an effort.