Sports specific athletes' cardiorespiratory system responsiveness for short, middle and long distance running events

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Introduction
Regular repetition of uniform character of endurance sports training provides an increase of both specific metabolic capacities and responsiveness optimization of cardiorespiratory system (CRS). The specific metabolic capacities usually related to aerobic potential realization during loads of different power and specific of athletes' aerobic-anaerobic energy potential utilization for sports event (Morton, Hodson 1996). There are quite contradictory data about differences in fast kinetics and sensitivity of CRS responses in athletes of different specialization (Miyamura 1997; Mishchenko, Monogarov 1995). The aim of the studies was to determine the differences in fast kinetics of O2 uptake, CO2 elimination, lung ventilation and heart rate as well as sensitivity of CRS responses to hypercapnia in sprinters, middle and long distance runners.

Methods
Three groups of runners (19-24 years) which have been training for 5-8 years in 100m running (n=17; body mass 77.6±1.1 kg), 800m running (n=15; 75.1±1.2 kg) and 5000m running (n=16; 70.6±0.9 kg) were examined. The next exercise tests have been performed on treadmill: incremental (10-14 min), submaximal power at 53.5 (49.1-56.3) % VO2 max (5 min) and at power VO2 max (5 min). Peak responses and fast kinetics (half-period - T50, monoexponential, breath by breath method, transition from 6 km.hour⁻¹) were determined. Capillary blood lactate was measured after incremental load. Ventilatory sensitivity to hypercapnia was determined by re-breathing method under standard resting conditions.

Results
The studies have demonstrated that at incremental load the peak of lung ventilation (VE) were higher in long distance runners as compared to sprinters (2.22±0.10 and 1.57±0.12 l.min⁻¹.kg⁻¹; p<0.05). Blood lactate after the above load was higher in sprinters as compared to long distance runners (11.9±0.76 and 8.10±0.91 mmol.l⁻¹, respectively). Besides, sprinters have been also characterized by higher peak value of VCO2/VO2 during recovery period (1.45±0.12 and 1.18±0.08, respectively; p<0.05). Fast kinetics VO2, VE at submaximal load were higher in sprinters as compared to long distance runners. For instance, T50 VO2 has constituted 25.5±1.8 and 28.9±2.1 s, whereas T50 VE - 38.6±2.9 and 45.9±3.3 s, respectively; p<0.05). Just the opposite has been observed at power of VO2 max - the fast kinetics was the lowest in the group of sprinters and the highest - in long and middle distance runners. For instance, T50 VO2 has constituted 29.8±3.0 s in sprinters and 24.4±2.9 s - in long distance runners (p<0.05). The above value has been the lowest in middle distance runners (22.8±2.5 s). In middle distance runners individual differences in T50 VE and VCO2 have been related to VE sensitivity to hypercapnia (r=-0.67 and -0.65, respectively; p<0.05). Runners of different specialization have differed in sensitivity of CRS responses to CO2. The ΔVE/ΔPACO2 value was reliably higher in sprinters as compared to long and middle distance runners. According to lung ventilation level at PACO2 = 50 mm Hg reliable differences have been observed between long and middle distance runners. HR response to hypercapnia was also higher in sprinters vs. long distance runners. Analysis of all runners has shown that peak of gas exchange ratio (VCO2/VO2) after progressively increased load was related to VE sensitivity to CO2 (r = 0.59; p < 0.05).

Discussion/Conclusion
The data indicate relationship between differences in sensitivity to CO2 in sprinters, middle and long distance runners and differences in fast kinetics of CRS response in athletes as well as degree of anaerobic metabolism involvement and VCO2 kinetics. The latter was related to metabolic acidosis ventilatory compensation. Its expressiveness provides the most distinction of long and middle distance runners as well as sprinters. We have observed dependence of fast kinetics VO2, VCO2 and CRS peak responses in sprinters and long distance runners upon the load intensity. Under submaximal power sprinters have demonstrated higher response kinetics as compared to long distance runners. For power at VO2 max higher response kinetics has been noted in long and short distance runners.

References