

Abstracts From the 31st Pediatric Exercise Physiology Meeting: Children-Exercise-Physical Activity & Sport Performance (September 2019, Umeå, Sweden)

The Effect of Menstrual Cycle and Oral Contraceptive Use on Responses to Resistance Training

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An improved muscle strength are of great importance in many sports, hence an increased understanding on how to generate optimal strength training programs in women without negative side effects that may lead to the female athlete triad are essential. Therefore the purpose of our research was to investigate effects of high frequency periodized menstrual/oral contraceptive (OC) cycle based leg resistance training in trained women and investigate potential negative effects on components in the female athlete triad. Fifty-nine women, with experience of resistance training and with regular menstrual/OC cycles were included in the analyses. The participants were randomly assigned a training program consisted of high frequency leg resistance training, periodized to the first two weeks (group 1) or the last two weeks (group 2) of each cycle, or to a control group performing regular training, during four consecutive menstrual/OC cycles. The main analysis was the pre-to-post change of squat and countermovement jump, isokinetic peak torque in hamstrings and quadriceps, sex and growth hormones, cortisol, total body fat mass, and bone mineral density in the spine. Further, we examined the participants' own experience of the training programs. We detected significant increase in squat and countermovement jump, and peak torque values in hamstrings for group 1, but not in group 2. In the control group, an increase in squat and countermovement jump, and peak torque (only left hamstring) was observed. There was also a significant increase in lean body mass of the legs in group 1 only. There were no evident differences in the training effects between women with or without oral contraceptive use. No significant negative impact on sex and growth hormones, cortisol, total body fat mass and bone mineral density in the spine, was detected in any of the groups. Moreover, the women in group 1 experienced their training program as positive. Our conclusions are that the high frequency periodized leg resistance training during the first two weeks of the menstrual cycle is more beneficial to optimize training than in the last two weeks. Resistance training during the first two weeks of the menstrual cycle even resulted in a larger gain of lean body mass than regular training. The high frequency periodized leg resistance training was not associated with exercise-related negative consequences on components in the female athlete triad. Moreover, the training was well accepted when performed during the first two weeks of each cycle.

Expert's Choice: Aerobic Exercise and Training During Youth

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Background: The paper, 'Cardiorespiratory fitness in childhood and adolescence affects future cardiovascular risk factors: A systematic review

of longitudinal studies' (Mintjens et al. *Sports Med.* 2018; 48:2577-2605) was selected for discussion. **Methods:** 7524 titles and abstracts were screened, 38 articles assessing 44,169 children and adolescents followed for a median of 6 years met the inclusion criteria and were used for further analysis. Directly determined peak $\dot{V}O_2$ was acknowledged as the gold standard test of cardiorespiratory fitness (CRF) but only 21 of the 38 papers analysed reported measured or estimated peak $\dot{V}O_2$ with 11 papers reporting directly determined peak $\dot{V}O_2$. Of 11 papers rated as 'high quality' four reported directly determined peak $\dot{V}O_2$ with two papers only reporting peak $\dot{V}O_2$ in ratio with either body mass (BM) or fat free mass (FFM). **Results:** In about half of included articles higher 'CRF' in youth was associated with indicators of fatness in later life. Relationships were, however, only present when peak $\dot{V}O_2$ was expressed in ratio with body mass. Similarly, a higher peak $\dot{V}O_2$ was associated with a lower total cholesterol:high density cholesterol ratio but only when peak $\dot{V}O_2$ was expressed in ratio with body mass. **Discussion:** Spurious relationships arise when ratio-scaled data are correlated with other health-related variables and no reviewed papers analyzed peak $\dot{V}O_2$ appropriately controlled for either BM or FFM. Moreover, the authors recognized that their findings could be 'hampered' by confounders such as adiposity. They noted that adiposity markedly impacts on performance in field tests purporting to measure CRF (e.g. 20mSRT/Pacer test) and confounds associations between CRF and cardiovascular risk factors. CRF should be precisely defined and rigorously assessed. A field test prediction does not provide a valid substitute for a directly determined peak $\dot{V}O_2$. Spurious relationships should be avoided by not using peak $\dot{V}O_2$ ratio-scaled with BM in statistical analyses with other health-related variables. In analyses of youth CRF the influence of sex-specific, concurrent changes on age and maturity-status driven morphological variables should be appropriately controlled for. Future studies in this field should explore relationships between youth CRF and current and future health with these messages in mind.

Aerobic Fitness Testing in Pediatrics; Looking Beyond Peak Oxygen Uptake

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For over 8 decades aerobic fitness tests with respiratory gas analysis have been used in children. Aerobic fitness is an important determinant of overall health. Higher aerobic fitness has been associated with many health benefits. Cardiopulmonary exercise testing includes the measurement of respiratory gas exchange and is the gold standard for determining aerobic fitness, as well as for examining the integrated physiological responses to exercise in paediatric medicine. As the physiological responses to exercise change during growth and development, appropriate paediatric reference values are essential for an adequate interpretation of the cardiopulmonary exercise test. In this workshop we discuss an interpretative approach that we use in our clinic for diagnostic, prognostic, and evaluative purposes. This

interpretation scheme allows us to interpret results from the gas-exchange data in a systematic order to support the physiological reasoning.

Development of Asthma in Young Skiers: What Can We Tell From Airway Immunological Responses to Exercise in Cold?

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The prevalence of asthma is high in winter endurance athletes with onset typically occurring during adolescence; later than classical asthma. It is well accepted that cold and dry air is involved in the pathogenesis, but nevertheless there remain gaps in current understanding of how cold air influences the immunological profile of the airways. This in part limits our ability to make recommendations about which environmental conditions are harmful to healthy athletes and at which temperatures training or racing should be modified or cancelled. Several studies have collectively demonstrated lymphocytic and neutrophilic inflammation in winter athletes with and without bronchial hyperresponsiveness (BHR), as well as a pro-inflammatory cytokine profile and damage-associated molecular patterns. Lymphocyte infiltration to bronchial tissues may increase during the winter competition season. Eosinophilic inflammation may distinguish between winter athletes with and without BHR. Single bouts of exercise in sub-zero temperatures increase biomarkers of airway damage such as serum Clara cell protein 16 to a greater extent than in warm, humid conditions. It remains to be investigated whether prolonged, steady-state or short, high-intensity exercise in sub-zero climates is more damaging to the airways. Moreover, the effect of protective devices such as heat-exchanger masks on airway immune responses warrants investigation.

Expert's Choice: Pediatric Pulmonary Medicine

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Postural tachycardia syndrome (POTS), is the chronic form of orthostatic intolerance associated with excessive upright tachycardia in the absence of hypotension. POTS occurs mostly in young females (>85%). Troubling symptoms are lightheadedness, fatigue, cognitive loss, and, increasingly, dyspnea now seen in approximately 50% of new patients. Hyperpneic hypocapnia with ventilatory pattern instability occurs in dyspneic patients. Preliminary studies support an increased hypoxic ventilatory response and sympathoexcitation consistent with sensitization of the carotid body peripheral chemoreflex. Hypocapnia alone produces tachycardia and reduces cerebral blood flow (CBF) provoking many POTS symptoms. Unlike voluntary hyperventilation, hyperpneic POTS is related to decreased central blood volume and cardiac output, increased systemic vascular resistance and BP, splanchnic blood pooling despite apparent splanchnic blood flow reduction, and a shift in the sigmoidal baroreflex relation that favors tachycardia even while supine. Carotid body sensitivity is highly plastic and can be rapidly conditioned by chronic intermittent hypoxia or by "stagnant hypoxia" - recurrent ischemia of the carotid body. Stagnant hypoxia can be produced by "initial orthostatic hypotension" (IOH) comprising a transient fall in BP and CBF on standing. IOH is abnormal in POTS with a paradoxical decrease in cerebral conductance indicating impaired cerebral autoregulation. We hypothesize that carotid body sensitization initiated by recurrent IOH results in hyperpneic hypocapnia driving tachycardia directly and indirectly by resetting arterial baroreflexes. Abnormalities in nitric oxide, angiotensin-II, and histamine are complicit. We will compare POTS patients aged 15 to 29 years with (N=40) and without (N=40) orthostatic hyperpnea, to healthy volunteers (N=40) with the following aims:

1. To test poikilopapnic (allowing CO₂ to vary) orthostatic cardiopulmonary responses determining how abnormal IOH drives upright hypocapnia in hyperpneic POTS compared with other groups. We also use 70° upright tilt to quantitate cerebral and splanchnic blood flow deficits using indocyanine green dye dilution methods. We will use the reference standard modified Oxford technique to measure the cardiovascular baroreflex.
2. To test for chemoreflex sensitization of ventilatory and sympathetic (by microneurography) responses when supine and upright (at 45°) and to assess interactions of chemoreflexes with Oxford measured cardiovascular and sympathetic baroreflexes. Comparisons of isocapnic hypoxia and isocapnic hyperoxia measure the carotid body chemoreflex and hyperoxic isocapnia and hyperoxic hypercapnia measure central chemoreflexes.
3. To explore candidate treatments aiming to reduce chemoreflex sensitivity and hyperpnea - angiotensin type 1 receptor blocker, dietary nitrate to donate NO, and H1 inhibition - repeating experiments of Aims 1 and 2.

The Effect of a Physical Activity Intervention on Bone Health in Childhood Cancer Survivors: A Randomized Controlled Trial (SURfit)

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Background: Childhood Cancer Survivors (CCS) have an enhanced risk of low bone mineral density (BMD). We aimed to assess the effect of a one-year exercise intervention on lower body bone parameters in a sample of adult CCS volunteers. **Methods:** SURfit included volunteers from a random sample from the Swiss CCS Registry. They were ≥16 yrs at study, aged <16 yrs at diagnosis, and ≥5 yrs in remission. We used minimization randomization to two groups. The intervention group was asked to perform an additional ≥2.5 h of intense physical activity/week, while controls performed exercise as usual. At baseline and after one year, we assessed total and trabecular volumetric BMD at the distal tibial epiphysis, and cortical volumetric BMD, total cortical cross-sectional area, and strain strength index at the tibial shaft by peripheral quantitative computed tomography. BMD of the lumbar spine, hip, and femoral neck were assessed by dual-energy X-ray absorptiometry. We estimated the intervention effect on lower body bone health parameters by multiple linear regression models adjusted for baseline bone parameters, gender, age, and cancer category (leukaemia/lymphoma; CNS tumors; bone tumors/soft tissue sarcomas; other diagnoses). **Results:** 151 survivors (43% females), 7.5 ± 4.8 yrs at diagnosis and 30.4 ± 8.5 yrs at baseline were included. 13 survivors from the intervention group and 6 controls dropped out. Intention-to-treat analyses revealed no significant differences in changes of bone parameters between groups in any measurement. However, in those starting at low trabecular BMD (z-score ≤ -1, n=13 (17%)), trabecular