

---

North American Society for Pediatric Exercise Medicine

Presents

2008 Biennial Meeting  
15<sup>th</sup> NASPEM Scientific Meeting

*NASPEM 2008*  
*Crowne Plaza Colorado Springs*  
*Colorado, USA*

September 17<sup>TH</sup> – 20<sup>TH</sup>, 2008



## A Comparison of Cycle and Treadmill Exercise Testing in Children

M.R. Johnson & P. Hopkins-Price

Southern Illinois University School of Medicine, Springfield, IL

**BACKGROUND:** Children may undergo exercise testing for multiple reasons. Exercise testing measures multiple physiologic parameters when the body is under stress and can be performed by cycle or treadmill protocols. A higher oxygen consumption ( $VO_2$ ) has been noted by treadmill protocols. The oxygen uptake efficiency slope (OUES) and slope of ventilation to carbon dioxide ( $VE/VCO_2$ ) are newer parameters of cardiopulmonary response. Differences in OUES and  $VE/VCO_2$  slope have not been compared in regards to method of testing.

**METHODS:** Clinical exercise tests performed by graded treadmill (Treadmill group) were compared with those performed by cycle ergometer (Cycle controls) from a previous study carried out at a separate institution. Exercise testing of persons with cystic fibrosis (Cycle CF) was evaluated during the same study. Age, weight, height, body mass index, sex, pulmonary function, maximal heart rate,  $VO_{2max}$ ,  $VE_{max}$ , end tidal carbon dioxide (ET- $CO_2$ ), OUES and  $VE/VCO_2$  slope were compared by unpaired student's T-test among the three groups. Pearson product moment correlations compared  $VO_{2max}$ , OUES and  $VE/VCO_2$  slope in all three study groups.

**RESULTS:** The Treadmill group and Cycle controls had similar age, height, weight, BMI and baseline pulmonary function. The Cycle CF group had lower height, weight and BMI but similar age and pulmonary function to the other two groups.  $VO_{2max}$ , and  $VE_{max}$  were significantly higher in Treadmill group than cycle controls. OUES was higher in the Treadmill group than cycle controls ( $p=0.07$ ). Correlation between  $VO_{2max}$  and OUES was 0.89 in treadmill group, 0.96 in cycle controls and 0.93 in cycle CF.

**DISCUSSION:** This study suggests OUES and  $VO_{2max}$ , are highly correlated in healthy controls whether obtained by cycle or treadmill protocols. Variation in the level of correlation between  $VE/VCO_2$  slope and  $VO_{2max}$  existed in the three study populations.  $VE/VCO_2$  slope correlated highest with end tidal carbon dioxide at maximal exercise and this may confound the use of the  $VE/VCO_2$  slope in healthy populations. No clear advantage to testing by treadmill or cycle ergometry was determined in this study and testing can be determined based on institutional preference.

## **Gender Influence on OMNI Scale RPE during Resistance Exercise in Children: Biological and Pictorial Effect**

M. Gallagher Jr., R.J. Robertson, D.J. Aaron, & F.L. Goss

Center for Exercise and Health-Fitness Research, University of Pittsburgh, Pittsburgh, PA

**Background:** The potential effect of gender on ratings of perceived exertion (RPE) derived from the Children's OMNI-Resistance Exercise Scale (OMNI-RES) can involve both biological and pictorial factors. Biological gender effects are chromosomally determined. Pictorial effects pertain to the gender of the child depicted in each OMNI-RES pictorial descriptor. Pictorial effects may reflect psychosocial suggestion. Research examining biological and pictorial effects of gender on RPE using the OMNI Perceived Exertion Scale is limited. Robertson et al. (2005) reported an absence of gender-specific pictorial suggestion on RPE (OMNI-Step Scale) in children performing stepping exercise. However, the effect of gender-specific pictorial suggestion on RPE (OMNI-RES) has not been examined in children performing resistance exercise. In addition, the potential effect of children's biological gender on RPE during resistance exercise has been examined in only one previous investigation.

**Methods:** Fifty female and fifty male children (10-14 yrs) performed bicep curl (BC) and knee extension (KE) exercises. Three counterbalanced, 10 repetition sets (30%, 50%, 70% 1-RM) were performed for both exercises. RPE was obtained for active muscles using the Children's OMNI-RES. One scale format employed female pictorial descriptors and one format employed male pictorial descriptors. Therefore, four biological-pictorial pairings were examined i.e. male gender/male pictorial (MM), male gender/female pictorial (MF), female gender/female pictorial (FF), female gender/male pictorial (FM).

**Results:** RPE ranged across sets from 3.4 to 8.3 during BC and 5.0 to 8.9 during KE for females and males. ANOVA indicated no significant differences ( $p > 0.05$ ) between biological-pictorial pairings for BC (MM=6.1, MF=6.4, FF=5.9, FM=5.8) or for KE (MM=7.2, MF=7.2, FF=7.4, FM=7.1). Additionally, there was no significant difference ( $p > 0.05$ ) in RPE between female and male children for BC (F=5.8, M=6.3) or for KE (F=7.2, M=7.2).

**Discussion:** The findings demonstrate that 1) the female and male descriptors of the OMNI-RES did not produce gender-specific pictorial suggestions that systematically influence children's RPE during resistance exercise; and 2) RPE determined with the OMNI-RES did not differ between 10-14 year old female and male children when measured at relative resistance intensities ranging from 30% to 70% 1-RM for upper and lower body exercise.

## Concurrent Validation of the Children's OMNI Hurt Scale during Treadmill Exercise

C. M. Ledezma, L. Haile, R.J. Mays, M. Gallagher, Jr., F.L. Goss, R.J. Robertson, & S. Arslanian

<sup>1</sup>Center for Exercise and Health-Fitness Research, University of Pittsburgh, and <sup>2</sup>Children's Hospital of Pittsburgh, Pittsburgh, PA, USA

**BACKGROUND:** The Children's OMNI Hurt Scale was developed to assess pain intensity during exercise. Children commonly use the word "hurt" to describe their pain experience. As such, the verbal descriptors for the OMNI Scale use hurt as the key word. Concurrent and construct validity of the Adult OMNI Pain Scale have been established using cycling exercise for young women (Bolgar et al., 2007) and men (Ledezma et al., 2008). Similar validity evidence has not been determined for the Children's OMNI Hurt Scale specifically formatted to measure exercise induced muscle hurt in children. Therefore, the purpose of this investigation was to examine concurrent validity of the Children's OMNI Hurt Scale for use with boys and girls performing aerobic exercise.

**METHODS:** Seventeen boys (mean age:  $12.5 \pm 2.7$  yrs; mean  $VO_{2max}$ :  $40.9 \pm 8.4$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) and twenty girls (mean age:  $12.3 \pm 2.5$  yrs; mean  $VO_{2max}$ :  $36.6 \pm 7.2$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) participated in this investigation. Concurrent validity was established by correlating ratings of leg muscle hurt (RMH-Legs; OMNI Hurt Scale) with criterion variables of oxygen uptake ( $VO_2$ ), relative oxygen uptake (% $VO_{2max}$ ), ventilation ( $V_E$ ), and heart rate (HR) measured during a load incremented maximal treadmill exercise test.

**RESULTS:** No significant gender differences were found between ranges of physiological criterion variables ( $p > 0.09$ ). Response ranges for boys and girls were: OMNI Hurt = 0 to 10,  $VO_2 = 9.60$  to  $51.9$  ml·kg<sup>-1</sup>·min<sup>-1</sup>, % $VO_{2max} = 32.3$  to  $100$ ,  $V_E = 12.48$  to  $94.71$  L·min<sup>-1</sup>, and HR =  $111$  to  $212$  b·min<sup>-1</sup>. Regression analyses indicated that RMH-Legs distributed as a positive function ( $p < 0.05$ ) of all physiological criterion variables:

* $p < 0.05$	$VO_2$ ( ml·kg <sup>-1</sup> ·min <sup>-1</sup> )	% $VO_{2max}$	$V_E$ (L·min <sup>-1</sup> )	HR (b·min <sup>-1</sup> )
OMNI Hurt	0.684*	0.739*	0.648*	0.602*

Correlations for the Children's OMNI Hurt Scale: Concurrent Validation

**DISCUSSION:** Results demonstrate concurrent validity of the Children's OMNI Hurt Scale to measure leg muscle hurt during treadmill exercise in boys and girls. It is proposed that the OMNI Hurt Scale can be used in conjunction with the OMNI RPE Scale to concurrently measure muscle hurt and exertion experienced by children performing aerobic exercise.

## Myocardial Functional Responses to Progressive Exercise In Athletic Adolescent Males

T. Rowland<sup>1</sup>, M. Garrard<sup>2</sup>, S. Marwood<sup>2</sup>, M. Guerra Balić<sup>3</sup>, D. Roche<sup>2</sup>, & V. Unnithan<sup>2</sup>

Baystate Medical Center, Springfield MA<sup>1</sup>, Liverpool Hope University, Liverpool, United Kingdom,<sup>2</sup> Universitat Ramon Llull, Barcelona, Spain<sup>3</sup>

**Background:** The extent that enhancement of ventricular function contributes to the elevated levels of aerobic fitness in trained athletes is unclear. This study examined cardiovascular responses to progressive upright cycle exercise in 12 trained adolescent male soccer players (age 14.6±0.8 years) with assessment of ventricular inotropic and relaxation properties by Doppler echocardiographic techniques. Findings were compared to those of a group of 10 untrained youth matched for weight, height, and sexual development.

**Methods:** Subjects pedaled at 60 rpm to exhaustion with 3-minute stages of 35 W load increments with standard measures of gas exchange variables. Cardiac dimensions at rest were measured by M-mode echocardiography. Stroke volume was estimated by Doppler interrogation of aortic flow velocity. Systolic function was examined by peak aortic flow velocity and ejection flow rate at peak exercise. Diastolic transmitral pressure gradient was assessed by pulse-wave peak E-wave flow velocity, left ventricular relaxation properties by tissue Doppler interrogation (E' velocity, adjusted for ventricular size), and ventricular filling pressure by the E:E' ratio.

**Results:** Resting left ventricular end-diastolic dimension, adjusted for body size, was greater in the athletes (39.8±2.4 versus 37.4±1.8 mm BSA<sup>-0.5</sup>). Peak VO<sub>2</sub> values for the athletes (A) and controls (NA) were 57.4±4.8 and 44.4±6.6 ml kg<sup>-1</sup> min<sup>-1</sup>, respectively (P<0.05). Maximal cardiac index and stroke index were greater in the athletes (11.10±1.52 versus 9.02±2.05 L min<sup>-1</sup> m<sup>-2</sup>; 59±8 versus 46±2 ml m<sup>-2</sup>). A and NA demonstrated similar mean peak aortic velocity (231±20 and 207±45 cm s<sup>-1</sup>, respectively) and ejection rate (13.3±1.0 and 12.5±2.8 ml s<sup>-1</sup> cm<sup>-2</sup>, respectively). No significant differences between groups were observed in E, E', or E:E' at rest or during exercise:

	E (cm s <sup>-1</sup> )		Adj. E' (cm s <sup>-1</sup> mm <sup>-1</sup> )		E:adj.E'	
	Rest	Max	Rest	Max	Rest	Max
A	72±10	155±17	2.6±0.5	5.9±1.3	28.3±6.6	26.5±4.0
NA	72±9	149±23	2.5±0.5	5.8±1.1	29.5±7.5	26.2±5.6

**Discussion:** This study in adolescent males revealed typical cardiovascular features which distinguish trained athletes from nonathletes: greater maximal aerobic power, cardiac output, stroke volume, and left ventricular diastolic dimension. However, Doppler echocardiographic evaluation failed to reveal any group differences in myocardial functional responses to progressive exercise. These findings imply that the greater aerobic fitness of athletes reflects an expansion of the cardiovascular system without contribution of enhanced contractile or diastolic myocardial function.

## Young Children's Physical Activity and Bone Development: Is Anything Getting Banked

K.F. Janz, E.M. Letuchy, T.L. Burns, J.M. Eichenberger Gilmore, J.C. Torner, M.C. Willing, & S.M. Levy

University of Iowa, Iowa City, IA, USA.

**Background:** Bone responds to physical activity (PA) by increasing mass and improving geometry. The extent of the response during childhood is of importance for attainment of peak skeletal mass. Whether skeletal benefits of everyday PA during childhood are sustained or are due only to acute effects is unclear. This study examined the sustained effect of PA on bone mineral content (whole body, spine, and hip BMC, g) and bone geometry (femoral narrow neck section modulus, mm<sup>3</sup>) after controlling for height, weight, maturity, and concurrent (acute) PA.

**Methods:** Subjects were 333 children (185 girls, 148 boys) participating in the longitudinal Iowa Bone Development Study. At age 5, 8, and 11 yr, BMC and geometry were estimated using DXA and hip structure analysis. PA was measured using accelerometry (daily min above 3,000 counts). At age 11, somatic maturity (yr from peak height velocity) was estimated. A gender-specific repeated measures analysis of variance model was fitted to predict bone outcomes as a function of age, height, weight, maturity, concurrent PA (age 8 or 11), and age 5 PA. General linear models were used to examine the differences in bone outcomes at 8 and 11 yr between the least active age 5 children (n=84, 25 boys and 59 girls) and most active age 5 children (n=84, 47 boys and 37 girls).

**Results:** Repeated measures analysis showed that age 5 PA was strongly associated with age 8 and 11 bone outcomes ( $p<0.001$ ). General linear models analysis indicated that boys who were most active at age 5 had 7 - 16% more BMC and better geometry at ages 8 and 11 when compared to the least active age 5 boys ( $p<0.05$ ). Girls who were most active at age 5 had 7-12% more BMC at ages 8 and 11, and better geometry at age 11 when compared to the least active age 5 girls ( $p<0.05$ ).

**Discussion:** These data suggest that benefits gained from everyday physical activity when young (age 5) are sustained throughout childhood. If these benefits persist, it is likely that adolescent peak skeletal mass would be improved.

## **The effect of 12 months gymnastics participation on bone mass accrual in 4 to 7 year olds**

M. C. Erlandson & A. D. G. Baxter-Jones

College of Kinesiology, University of Saskatchewan, Saskatoon, SK, Canada

**Background:** Exercise during childhood and adolescence increase bone mass and possibly contributes to the prevention of osteoporosis in later life. Studies of adolescent gymnasts have consistently shown they have greater bone mass than age matched controls. However, the question remains as to what age these bone mass differences appear. The purpose of this study was to assess the effect of gymnastics participation on bone mass development from 4 years of age. **Methods:** Gymnasts (n=85, age=5.8±1.3 yrs) and controls (n=75, age=5.9±1.1 yrs) were assessed at baseline and at 12 months. At 12 months 31 gymnasts were no longer participating. At each measurement occasion height, weight, whole body (WB), total hip (TH) and lumbar spine (LS) bone mineral content (BMC), assessed by dual-energy X-ray absorptiometry (DXA), were recorded. Physical activity, physical inactivity and dietary intake were recorded via self-report questionnaires. Data were analyzed using ANOVA and repeated measures analysis of covariance (ANCOVA; covariates, age, changes in height and weight).

**Results:** There were no significant differences between gymnasts and controls with regard to any measures at baseline ( $p>0.05$ ). At 12 months the BMC values for WB, TH and LS were  $753.5 \pm 109.5$ ,  $9.2 \pm 2.3$  and  $16.8 \pm 3.2$  g for gymnasts;  $810.9 \pm 141.5$ ,  $9.8 \pm 2.4$  and  $18.2 \pm 3.2$  g for gymnast drop outs and  $760.1 \pm 109.9$ ,  $9.2 \pm 2.2$  and  $17.1 \pm 2.7$  g for controls ( $p>0.05$ ). Repeated measures ANCOVA indicated BMC increased with age ( $p<0.05$ ) but no group differences were found ( $p>0.05$ ). **Discussion:** No differences were found in bone mass at study entry (age range 4 to 6 years). Over a 12 month period bone accrual occurred at the same rate in all groups. No differences were found between the groups in bone parameters after 12 months of gymnastics participation. To address the question as to when, or if, changes in bone mass accrual observed in adolescent gymnasts will occur in this cohort further follow-up measures are required.

**Funding Support:** CIHR (MOP 57671) and University of Saskatchewan

---

**Bone strength in male child and adolescent competitive gymnasts: Quantitative ultrasound of the radius and tibia**

S. Braid <sup>1,2,3</sup>, M. Moore <sup>1</sup>, M. Yao <sup>1</sup>, P. Klentrou <sup>1</sup>, P. Sullivan <sup>1</sup>, & B. Falk<sup>1</sup>

<sup>1</sup>Faculty of Applied Health Sciences, Brock University, St. Catharines, ON <sup>2</sup>Department of Orthopaedics, University of British Columbia; <sup>3</sup>Centre for Hip Health and Musculoskeletal Research, Vancouver Coastal Health Research Institute Vancouver, BC;

**Background:** Previous studies have noted that the pubertal years present a window of opportunity to build bone and that weight-bearing activity yields the greatest osteotropic response. Gymnastics presents high-impacts for the upper and lower extremities, but its effect on bone has been mostly examined in females.

**Purpose:** To compare radial and tibial speed of sound (SOS, m/s) in competitive male child (pre-pubertal, 10-12yrs) and adolescent (late-pubertal, 14-16yrs) gymnasts (PG and LG) and age-matched, non-athletic controls (PC and LC), as assessed by quantitative ultrasound (QUS, Sunlight Omnisence™).

**Methods:** In total, 107 males were assessed: 59 children (11.2±0.6yrs; 34PC, 25PG) and 48 adolescents (15.3±0.7yrs; 31LC, 17LG). Athletes trained for >3yrs, training 15.5±5.6 and 17.1±4.3hrs/wk for PG and LG, respectively. Nutrition was determined using 24-hour recall interview. Salivary testosterone (sT) was analyzed by RIA.

**Results:** In each age group, gymnasts were shorter, lighter and had lower body fat (children: 137.5±7.2 vs. 154.7±6.8cm; 34.4±4.7 vs. 40.1±8.3kg; 12.7±3.2 vs. 19.9±8.6%, for PG and PC, respectively; adolescents: 162.4±8.9 vs. 172.9±8.9cm; 53.6±8.4 vs. 64.1±13.3kg; 10.8±3.8 v 17.5±9.8%, for LG and LC, respectively,  $p<0.05$ ). Radial SOS was higher in gymnasts in both age groups (children: 3834±84 and 3721±88m/s for PG and PC, respectively; adolescents: 3852±100 and 3760±94m/s for LG and LC, respectively,  $p<0.05$ ). Similar differences were observed in tibial SOS (children: 3726±77 and 3622±84m/s for PG and PC, respectively; adolescents: 3783±103 and 3720±104m/s for LG and LC, respectively,  $p<0.05$ ). A similar pattern was observed in the dominant and non-dominant limbs. No significant age-sports group interaction was noted. There were no differences in total caloric, calcium or vitamin D intake and no differences in sT or pubertal stage between gymnasts and control within each age group.

**Summary:** Male gymnasts, whose nutritional intake and maturational stage are similar to those of age-matched controls, exhibit greater bone strength, as reflected by QUS, in both the upper and lower extremities. Higher bone SOS was observed despite the gymnasts' lower body size. The results suggest that gymnastics training during youth results in increased bone strength in males, as previously reported in females.

**Bone properties, physical activity and nutrition in overweight pre- and late-pubertal girls**

M. Yao, P. Klentrou, I.A. Ludwa, L. Corbett, & B. Falk

Brock University, Ontario, Canada

**Background:** In females, adiposity provides a protective effect for bone during adulthood. However, during childhood, increased body fat may be associated with low bone strength. The purpose of this study was to compare bone strength, as reflected by speed of sound (SOS), of pre-pubertal and late-pubertal overweight and obese girls with normal-weight age-matched controls.

**Methods:** Data of 67 girls include pre-pubertal normal-weight (PPn; BF $\leq$ 25%; n=20), pre-pubertal overweight and obese (PPo; BF $\geq$ 28%; n=14), late-pubertal normal-weight (LPn, BF $\leq$ 25%; n=14) and late-pubertal overweight and obese (LPo; BF $\geq$ 28%; n=19) groups. Using quantitative ultrasound (Sunlight Omnisense™), bone SOS was measured at the distal radius and mid-tibia. Habitual physical activity was measured for one week using accelerometry and energy intake was assessed by a 24-hour recall.

**Results:** Younger girls had significantly lower radial SOS (3766 $\pm$ 95 versus 3984 $\pm$ 80 m/s for PPn and LPn, respectively), and tibial SOS (3695 $\pm$ 101 versus 3891 $\pm$ 70 m/s for PPn and LPn, respectively) than late-pubertal girls. Additionally, tibial SOS was lower in the overweight groups (3622 $\pm$ 72 and 3752 $\pm$ 115 m/s for PPo and LPo, respectively), compared with the above values for the normal-weight controls. Calcium and vitamin D intake was significantly lower in obese compared with normal-weight girls in both age groups, with no differences between age groups. The average daily calcium intake for all groups (769–1152mg) was below the recommended values for their age (1300mg as per FAO/WHO 2002), but was not significantly related to bone SOS. No differences were observed in habitual physical activity between the adiposity groups, although mean intensity in PP was higher than in LP (508 $\pm$ 136 and 430 $\pm$ 159 counts/min for PPn and PPo, respectively, versus 321 $\pm$ 145 and 305 $\pm$ 110 counts/min for LPn and LPo, respectively). Calcium and vitamin D intake and physical activity were not significant covariates of SOS. Partial correlation analysis, controlling for age, revealed that tibial SOS was negatively correlated ( $r=-0.59$ ,  $p<0.01$ ) with percent body fat. **Discussion:** These results suggest a negative effect of adiposity on tibial SOS among girls. More research is required to elucidate the effects of adiposity, physical activity and nutrition on bone properties in the different stages of growth.

## Long-Term Exercise Performance Following Surgical Repair for Sinus Venosus Atrial Septal Defect

A.C. Glatz, M.G. McBride, R.E. Tanel, M.S. Cohen, J.W. Gaynor, & S.M. Paridon

Divisions of Cardiology and Cardiovascular Surgery, The Children's Hospital of Philadelphia and University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania.

**Background:** Sinus venosus atrial septal defect (SVASD) has been successfully repaired with low risk for many years. Long-term outcome is good with many patients discharged from follow-up, but long-term post-operative exercise performance has not been comprehensively described.

**Methods:** We performed a cross-sectional non-invasive exercise evaluation of patients  $\geq 6$  y of age who had surgical repair of SVASD between January 1987 and September 2004. Subjects performed maximal cycle ergometry. Metabolic and ventilatory data were collected on a breath-by-breath basis using a metabolic cart. Primary outcome variables maximal  $\text{VO}_2$  ( $\text{MVO}_2$ ), ventilatory anaerobic threshold (AT), and physical working capacity (PWC) are reported as % predicted values. Subject-related variables assessed for association with outcome variables included peak heart rate, anatomic subtype, age at surgery, time from surgery, and type of surgical procedure. Analyses were performed using univariate linear regression.

**Results:** 28 subjects (ages= $16\pm 8.3$  yrs, 15 male) were successfully recruited and completed testing with metabolic data available. Subjects were evaluated  $10\pm 4.8$  y (range 3.3-20.4 y) after their operative repair. Mean age at surgical repair was  $6.4\pm 8.2$  y (range 1.3-45.7 y). Anatomic subtype was superior vena cava-type in 23 pts and inferior vena cava-type in 6. 24 subjects had patch repair; 5 had a Warden procedure.  $\text{MVO}_2$  and AT were mildly below normal values ( $87\pm 15\%$  and  $87\pm 19\%$ ). PWC ( $92\pm 22\%$ ) was normal. Chronotropy was impaired in 10 subjects (36%) but was not associated with  $\text{MVO}_2$  ( $p=0.29$ ). However, chronotropic impairment was significantly associated with longer time from surgery ( $p < .01$ ). No other perioperative or subject-related variables were associated with measures of exercise performance.

**Conclusions:** These findings demonstrate that exercise performance is mildly diminished, but falls within normative values during long term follow-up after SVASD repair. Chronotropic impairment is present in a large portion of patients, but does not have an impact on performance in childhood. Chronotropic impairment is significantly associated with time from surgery. These results suggest that routine clinical follow-up including exercise testing may be useful for ongoing rhythm surveillance.

## Exercise Capacity Before and After Pulmonary Valve Replacement for Severe Pulmonary Regurgitation

M. Schamberger, E. Ebenroth, T. Johnson, & R. Hurwitz

Riley Hospital for Children, Indiana University- School of Medicine, Indianapolis, IN

**Background:** Ventricular dysfunction in the face of severe pulmonary regurgitation following tetralogy of Fallot repair has been previously described. Timing of pulmonary valve replacement (PVR) in this population is a difficult dilemma. The purpose of this study was to evaluate exercise capacity before and after PVR for severe pulmonary regurgitation. We hypothesized that exercise capacity would significantly improve after PVR.

**Methods:** Twenty-three patients, ages 11 to 47 years old (mean  $23 \pm 10$  yrs), after repair of tetralogy of Fallot with severe pulmonary regurgitation demonstrated on echocardiography who were scheduled for PVR were enrolled in the study. Metabolic treadmill exercise stress testing was performed before PVR surgery in all patients. Age and gender matched normal control patients were selected from our exercise database. Exercise stress testing was repeated in 19 patients an average of 1.2 years after surgery.

**Results:** Treadmill exercise time was significantly diminished in the pulmonary regurgitation patients ( $10.2 \pm 3.3$  minutes) compared to the control group ( $15.2 \pm 3.0$  minutes) prior to surgery ( $p < 0.001$ ). Peak oxygen consumption was also significantly diminished in the pulmonary regurgitation group compared to controls ( $26.8 \pm 9.2$  ml/kg/min vs.  $42.0 \pm 10.1$  ml/kg/min;  $p < 0.001$ ). Echocardiography demonstrated moderate to severely dilated right ventricles in all patients. Left ventricular ejection fraction ranged from 0.46 to 0.77 with an average of  $0.60 \pm 0.1$ . Repeat exercise testing after surgery demonstrated no significant difference in exercise time ( $10.2 \pm 3.3$  minutes vs.  $10.6 \pm 2.6$  minutes;  $p = 0.36$ ) or in peak oxygen consumption ( $26.8 \pm 9.2$  ml/kg/min vs.  $27.0 \pm 7.8$  ml/kg/min;  $p = 0.36$ ) from baseline.

**Discussion:** Exercise capacity is significantly diminished in the face of severe pulmonary regurgitation and dilated right ventricle. Surprisingly, pulmonary valve replacement does not improve exercise capacity 1.2 years after surgery. Perhaps earlier intervention when exercise capacity has not yet been significantly affected would allow better preservation of exercise capacity. Serial exercise stress testing in patients with severe pulmonary regurgitation following tetralogy of Fallot repair should be considered to identify deteriorating exercise capacity which may assist in the decision making for PVR.

## **A Pilot Study to Optimize the Wingate Anaerobic Test for Clinical and Research Use in Juvenile Idiopathic Arthritis (JIA)**

J. Obeid, C.J.R. Blimkie, M.J. Larché, & B.W. Timmons

Departments of Kinesiology and Pediatrics, McMaster University, Hamilton, Ontario, Canada.

**Background:** Juvenile idiopathic arthritis (JIA) is a common chronic disease affecting about 1 in 2,000 Canadian children. Much of the disability associated with the condition occurs as a result of atrophy and weakness of muscles. Exercise capacity and muscle power have previously been studied using a 30-sec all-out cycling test against a standardized braking force (the Wingate test). While this standardized braking force is suitable for healthy children, it may be inaccurate for children with a chronic disease as has been demonstrated for patients with a neuromuscular disease. Thus, the aims of this pilot study were to identify the optimal braking force for the Wingate test in a cohort of children with JIA, and to compare the power generated using this approach with the traditional standardized approach.

**Methods:** Children with JIA between the ages of 8 and 18 were recruited from the Pediatric Rheumatology clinics at the McMaster Children's Hospital. Testing occurred over two sessions. The first session involved determination of the optimal braking force through multiple 15-sec maximal effort force-velocity tests against varying braking forces. The second session required participants to perform two randomized Wingate tests (optimal and standardized braking forces).

**Results:** Preliminary results based on four participants (2 boys; mean  $\pm$  SD; age,  $14.5 \pm 2.6$  y, body mass,  $53.3 \pm 15.3$  kg, height,  $1.6 \pm 0.2$  m, and % body fat,  $15.7 \pm 2.4$ ) revealed that the standardized test underestimated relative peak power by 12% when compared with the optimized test ( $13.0 \pm 0.9$  vs.  $11.3 \pm 1.1$  Watts/kg). No difference between the standardized and optimized tests was observed for mean power ( $6.4 \pm 1.2$  Watts/kg). Although peak power values were within a normal range for all participants, mean power was  $\sim 2$  standard deviations below normal values for healthy children.

**Discussion:** These preliminary results suggest that optimization of the Wingate test in patients with JIA may only be beneficial for identifying their true peak power. Our findings confirm deficits in mean muscle power, which is likely a consequence of the disease process.

## **Uncertainty, Safety and Exercise Capacity: Parent Questions about Physically Activer Play for Their Children with Complex Congenital Heart Defects**

P. E. Longmuir, J. L. Russell, M. Corey, & B. W. McCrindle  
Hospital of Sick Children, Toronto, Canada

**Background:** Children with complex heart defects lead very sedentary lives, compromising their heart health, peer play, and quality of life. Previous research suggests parental feelings of uncertainty about activity were commonplace. The purpose of this study was to examine parental questions about activity participation, and their relationship to the child's activity level.

**Methods:** Parents of 64 children (25 female), 6 to 11 years, were recruited through a randomized trial examining physical activity intervention efficacy. Parents were asked "If you could ask your cardiologist or another expert for more information about physical activity and your child, what would you ask?". Qualitative research software (NVivo) was used to code question content using a grounded theory-informed approach. An unpaired t-test compared daily activity for children from families with and without questions. Daily activity was total minutes of moderate-to-vigorous activity over one week, measured by accelerometer.

**Results:** Twenty-six (41%) parents stated question(s) that they would like to ask. Questions about exercise capacity, safety and uncertainty about activity were particularly prominent, occurring 2.5 to 3 times more frequently than other topics. Parents most frequently asked how much activity the child could or should do, types of activity considered safe, and how the child would respond to activity. Questions about activity benefits and enjoyment, or how to increase or encourage activity were much less common. Child gender and age did not influence whether parents asked questions. Children from families with questions had significantly lower ( $p=.048$ ) activity levels than those from families who did not ask questions (312 and 376 minutes/week, respectively).

**Discussion:** This study confirms that parental uncertainty and questions about activity safety are related to more sedentary lifestyles among children with complex heart defects. That questions about exercise capacity, safety and appropriateness are much more frequent than questions about encouraging or increasing activity suggests that interventions focused on having children perform exercises or activities may be premature. Until parents are confident about how much and what type of activity is appropriate, they are unlikely to strongly encourage their children to comply with such programs or to become more active in unsupervised settings.

**Funding Support** The project is supported by the Heart and Stroke Foundation of Ontario and the Cardiovascular Clinical Research Unit of the Hospital for Sick Children. Patricia Longmuir's work is supported by a Doctoral Research Award from the Canadian Institutes of Health Research

## Enjoyment of Physical Education over Time: Results from a large prospective cohort study of children

J. Cairney<sup>1,2,3,4</sup>, J. Hay<sup>4</sup>, S. Veldhuizen<sup>3,4</sup>, & B. Faught<sup>4</sup>

<sup>1</sup>Department of Family Medicine, McMaster University <sup>2</sup>Department of Psychiatry and Behavioural Neuroscience, McMaster University, <sup>3</sup>Health Systems Research and Consulting Unit, Centre for Addiction and Mental Health; <sup>4</sup>Department of Community Health Sciences, Brock University

**Background:** School-based physical education programs (PE) are often touted as an effective setting for positively affecting health and physical activity (PA) behaviours in children. In Canada, PE class is the only legislated program specifically mandated to provide PA opportunities for children. While these programs have the potential to improve participation in PA, success in that enterprise is contingent on providing children with positive experiences. We have remarkably little data on children's perceptions of PE class, especially enjoyment of PE, whether these perceptions differ for boys and girls, how they change as children age, and what factors might be associated with positive or negative perceptions over time.

**Methods:** We assessed a large cohort of children (n=2363), all of whom were in grade four at baseline, twice yearly (fall and spring) beginning in Spring of 2005 and ending in the Spring of 2007. We administered questionnaires on enjoyment of PE and the Harter Competence Scales during regular school hours in the classroom. We used mixed effects modelling to examine the role that gender and perceived athletic competence play in the reported enjoyment over time.

**Results:** In the sample as a whole, enjoyment of PE increased marginally. Enjoyment was slightly lower among girls overall, and there was a strong time by gender interaction ( $t=5.52$ ,  $df=8052$ ,  $p<0.001$ ), with enjoyment increasing among boys but decreasing among girls. Adding perceived physical competence (PPC) as a potential mediator resulted in a substantial three-way interaction between time, gender, and PPC ( $t=3.44$ ,  $df=8033$ ,  $p<0.001$ ). Results indicate a decline in enjoyment among girls with low PPC and steady or slightly increasing enjoyment among all other students.

**Discussion:** If we assume enjoyment to be an important predictor of engagement and participation in PE, then the success of PE programs in promoting physical activity in girls is called into question by these data. Our results show that perceived lack of physical competence is associated with declining enjoyment of PE among girls. Although other factors are likely to play a role in decreased PA among girls in this age group, PE programs are modifiable, and these findings suggest areas for potential alteration.

## **Effect of Enhancing School-Based Physical Activity Opportunities on Students' Health Related Fitness**

D. Sutton, J. M. Pivarnik, A. Murphy, M. J. Stacks, J. L. Knous, & A. K. Hunsinger  
Michigan State University, 3 IM Sports Circle, East Lansing, Michigan, USA.

**Background:** Previous research has shown mixed results when innovative physical activity/education programs have been implemented in schools. Many of these previous studies have focused on specific grade levels, rather than using a district wide approach. The East Lansing School District (ELSD) was awarded a three year Carol M. White Physical Education Program (PEP) grant by the US Department of Education. The main goals of the program were two fold: 1) provide enhanced school-based physical activities to all grade levels in the district and, 2) improve district-wide performance on standardized health related fitness tests.

**Methods:** PEP grant activities were implemented in all buildings within the ELSD. Funding was used to create new opportunities for students to be physically active, purchase new equipment, and provide professional development. One way we assessed program success was by evaluating change in students' health related fitness after one year of program intervention. Fitness assessments were performed over two years (n=1,146 in 2006; n=1,492 in 2007), using Polar's TriFIT 700 and field measures, on children enrolled in grades 5 through 12. Measurements on body fatness, flexibility, muscular strength, and blood pressure were obtained from the TriFIT 700. Body mass index (BMI) was calculated from anthropometric measurements. Aerobic fitness was evaluated using a 20-meter shuttle run and muscular endurance was estimated from timed sit-up measures.

**Results:** Students showed improvements (analyzed by group/grade level) in flexibility, muscular strength, muscular endurance, and aerobic fitness in all grade levels tested. There were no changes in body fatness or BMI.

**Discussion:** Findings indicate that the addition of physical activity programs and equipment had a positive effect on the fitness levels of students (grades 5-12) in a single school district. Further individual level analysis is needed to determine which (and to what degree) students took advantage of the enhanced physical activity opportunities, and how the program affected their awareness and appreciation for physical activity.

## How do kids spend their time after school?

D. Willms & M. Tremblay

<sup>1</sup>Canadian Research Institute for Social Policy, University of New Brunswick, Fredericton, New Brunswick, Canada; <sup>2</sup>Healthy Active Living and Obesity Research Group, Children's Hospital of Eastern Ontario Research Institute, Ottawa, Ontario, Canada

**Background:** Childhood obesity has increased rapidly in developed countries around the world. Physical activity is believed to be an important protective factor while excessive sedentary behaviour is a risk factor. Monitoring and surveillance efforts to help understand these behaviours have traditionally relied on recall questionnaires. Most questionnaires employ methods that are not time limited. For example, respondents may provide the number of hours per day they spend watching television, using computers, participating in sport and physical activity, reading, etc. and the total may (and often does) far exceed the number of hours in the day even if not all true activities are captured. One method to correct this is to apply a proportional adjustment by constraining the total activities to a reasonable time.

**Methods:** To gain insight into what children and youth do in the 7 hour after school period (e.g. 3:30-10:30) this study examined survey responses to the 2007-08 Tell Them From Me (TTFM) survey (N = 44,773). The TTFM survey collected data from participants in grades 5-12 in schools across Canada. The TTFM asked respondents to report the average daily time spent after school on homework, reading for fun, physical activity, television, computer/video games, part-time work, and volunteering. The answers were standardized to a 7-hour after-school day.

**Results:** Overall, more after-school time is spent on computer/video game use (1.52 hrs), physical activity (1.44 hrs) and television viewing (1.34 hrs) while less is spent on volunteering (.33 hrs) and reading (.65 hrs). Girls spend more time on homework, reading, part-time work and volunteering while boys spend more time on physical activity and screen time. As grade increases, reading for fun decreases, physical activity decreases, television viewing decreases, and computer/video game and work time increases.

**Conclusions:** Standardizing survey time-use data to a reasonable after-school period provides an alternate means of assessing discretionary behaviours in children and youth. The confounding of physical activity and screen time with grade and gender suggests the relative importance of physical activity and screen time to obesity and related health outcomes will be difficult to disentangle.

## Change in Physical Activity Induced by a Simulated After-School Program

J. Bland, K. Pfeiffer, T. Prout, & R. Pate

East Lansing, Michigan and Columbia, South Carolina

**Background:** As the proportion of overweight children and adolescents in the United States increases, researchers/practitioners are gaining interest in providing after-school opportunities for children to be physically active. Limited data exist regarding the amount of physical activity (PA) children/adolescents obtain during these programs. The purposes of this study were to compare the amount of PA attained in a simulated after-school program versus a usual week and to determine if total daily PA was different in the week of program attendance compared to a usual week.

**Methods:** Participants were elementary school children (N=22;  $9.4 \pm 1.2$  years, 86% female, 86% African American, BMI =  $22.5 \pm 6.8$ ) who wore an Actical accelerometer for two weeks. The first week consisted of usual activities; during the second week children participated in an after-school program including two days of sedentary behavior and three days of moderate-to-vigorous PA (MVPA). Previously developed count cutpoints were used to categorize PA intensity levels (sedentary, light, moderate, and vigorous PA). MVPA days were matched to randomly selected usual days. Paired t-tests assessed differences in PA during after-school hours (3-5 pm) and total day between the usual week and after-school program week.

**Results:** During after-school hours, children spent approximately 24 less minutes in sedentary activities [ $t(21)=10.7$ ,  $p<0.001$ ], 5 minutes less in light PA [ $t(21)=3.1$ ,  $p<0.01$ ], 24 minutes more in moderate activity [ $t(21)=11.2$ ,  $p<0.001$ ], and 4.5 minutes more in vigorous PA [ $t(21)=8.2$ ,  $p<0.001$ ] during the after-school program week than the usual week. For total day PA, children spent approximately 2 *minutes/hr* more in moderate PA [ $t(16)=6.2$ ,  $p<0.001$ ] and 0.3 *minutes/hr* more in vigorous PA [ $t(16)=4.9$ ,  $p<0.001$ ] during the after-school program week than the usual week. Children wore monitors for approximately 13 hours/day; thus, total day PA increased by about 26 minutes of moderate and 4 minutes of vigorous PA during the after-school week.

**Discussion:** Children were more active from 3-5 pm on MVPA days in the after-school program than during a usual week. It is likely that the program was the reason for increased PA, indicating that after-school programs are a promising source of PA and should be further investigated.

## An Exploratory Investigation into the Effect of Added Weight on Dynamic Balance

V.B. Unnithan<sup>1</sup>, R.C. Aimes<sup>1</sup>, M.J. Lake<sup>2</sup>, G.J. Barton<sup>2</sup> & J. Vanrenterghem<sup>2</sup>

<sup>1</sup>Sport Department, Liverpool Hope University, Liverpool, UK <sup>2</sup>Research Institute for Sport and Exercise Sciences, Liverpool John Moores University, Liverpool, UK.

**Background:** The aim of the study was to explore the effect added weight has on dynamic balance in children. This pilot work used a new technology called the CAREN platform (Motek, Amsterdam) to assess medial-lateral stability in a child.

**Methods:** One subject (age: 12 years, stature: 164 cm, body mass: 53 kg) performed the following balance trials on the CAREN platform: Romberg tandem (RT), normal stance (NS) and standing on dominant leg (SDL). The platform was programmed so that the participant experienced various random perturbations in the medial-lateral direction. Dynamic balance could then be analysed by focusing on the movement of the centre of mass during the trials. Testing was performed with (AW) and without (NW) wearing a weighted vest. The 6kg load increased the subject's BMI to a value reflective of an obese child.

**Results:** Differences were observed between the added weight (AW) and normal weight (NW) trials. There was a greater displacement of centre of mass (COM) from the original location in the AW trials compared to the NW trials: (NW(RT):  $25 \pm 1.41$  cm vs. AW(RT):  $28 \pm 14.14$  cm), (NW(NS):  $4.5 \pm 0.7$  cm vs. AW(NS):  $16.5 \pm 8.26$  cm) and (NW(SDL):  $13 \pm 2.65$  cm vs. AW(SDL):  $15.17 \pm 7.49$  cm). Also, the time at which COM moved from the origin of stability occurred more frequently in the AW(NS) and AW(SDL) trials compared to the NW trials: (NW(RT): 12.5 s vs. AW(RT): 15 s), (NW(NS): 17.5 s vs. AW(NS): 15 s) and (NW(SDL): 15 s vs. AW(SDL): 8.7 s). Following loss of balance, the frequency of oscillations in the COM were greater for the NW trials of RT and NS compared to the AW trials: (NW(RT):  $0.66 \pm 0.36$  Hz vs. AW(RT):  $0.52 \pm 0.24$ Hz), (NW(NS):  $0.89 \pm 0.2$ Hz vs. AW(NS):  $0.61 \pm 0.42$ Hz) and (NW(SDL):  $0.48 \pm 0.2$ Hz vs. AW(SDL):  $0.6$ Hz  $\pm 0.27$ Hz).

**Discussion:** The results indicated that added weight does have a negative impact upon dynamic balance. Future research involving this system has the potential to develop our understanding of dynamic posturography beyond anything that is currently known.

## The Influence of Physical Activity Behaviours on the Relationship between Motor Proficiency and Body Composition in Children

J. MacInnis, J. Liu, B. Faught, J. Cairney, and J. Hay

<sup>1</sup> Brock University, <sup>2</sup> McMaster University, Ontario, Canada

**Background:** There is an emerging awareness that children with poor motor abilities are at particular risk for overweight. This study examined children with low motor proficiency to determine the influence of various aspects of physical activity on body composition.

**Methods:** Participants were 1287 (646 males, 641 females) Grade 6 students in the Physical Health Activity Study Team (PHAST) project. Height, weight, and motor proficiency (Bruininks-Oseretsky Test of Motor Performance - BOTMP) were assessed and physical activity behaviours evaluated with a multifaceted approach. Children reported school-based physical activity, community sports, free time play, and sedentary activities using the Participation Questionnaire, and leisure time exercise (Godin-Shephard Leisure Time Exercise Questionnaire - GS). Children were classified as case (CG,  $\leq 10\%$  on BOTMP), or non-case (NC). Overweight was defined by BMI: boys  $\geq 20.6$ -21.2 and  $<25.1$ -26.0; girls:  $\geq 20.7$ -21.7 and  $<25.4$ -26.7, and obesity as: boys:  $\geq 25.1$ -26.0; girls:  $\geq 25.4$ -26.7.

**Results:** Seventy-four children (7.8%) were identified as cases. Analyses of variance uncovered that the CG reported significantly lower participation in school sports teams and lower GS results with a trend to lower participation in all active pursuits. They also reported a significantly higher duration of television watching and book reading. There were no significant differences between motor proficiency groups by gender, age, community sports, or free-time activity. Multivariate ordinal logistic regression analysis showed that the case group was 10.9 times more likely to be overweight/obese than their peers. No single aspect of physical activity accounted for a significant proportion of the variance in this odds ratio.

**Discussion:** These findings confirm that children with low motor proficiency are at significant risk of developing overweight. It is evident that these children have generally attenuated activity levels and heightened levels of sedentary pursuits. School-based activities appear particularly limited and are the one area where children have near autonomy in their decision to pursue active opportunities. This suggests that schools should consider the needs of those children with low motor proficiency when developing programs to promote physical activity.

## Inter-relationships among physical activity, body fat, and motor performance in 6 to 8-year-old Danish children

K.M. Morrison, J.C. Eisenmann, L.B. Andersen, K. Froberg, & K.A. Pfeiffer

<sup>1</sup> Michigan State University; Department of Kinesiology; East Lansing, MI <sup>2</sup> Michigan State University; Department of Pediatrics and Human Development; East Lansing, MI <sup>3</sup> University of South Denmark; Institute of Sports Science & Clinical Biomechanics; Odense, Denmark <sup>4</sup> Norwegian University of Sport and Physical education; Department of Sports Medicine; Oslo, Norway

**Background:** Although several studies have examined the univariate relationships among physical activity (PA), body fat, and motor performance in children, few have explored the potential interactions among these variables. The purpose of this study was to determine the inter-relationships among PA, body fat, and motor performance and the combined influence of body fat and PA on motor performance in 6- to 8-year-old Danish children.

**Methods:** PA, body fat, and motor performance were measured in 508 Danish children (268 boys, 240 girls, mean age 6.7 years) during baseline data collection of the Copenhagen School-Child Intervention Study. PA was assessed over four days (2 weekdays, 2 weekend days) with the Actigraph accelerometer. Body fat was assessed by skinfolds and percent fat was calculated using the Slaughter equation. The Körperkoordinationstest für Kinder (KTK) was used to assess motor performance. Correlations were used to examine the associations among PA, body fat, and motor performance. Motor performance was compared across four groups, which were created by cross tabulation of body fatness and PA using median split. The groups were High PA/Low fat, Low PA/Low fat, High PA/High fat, Low PA/High fat.

**Results:** PA was not associated with body fat ( $r = -.07$ , males;  $r = .02$ , females), but was significantly associated with motor performance ( $r = .20$ , males;  $r = .13$ , females,  $p < .05$ ). The strongest relationships existed between body fat and motor performance, and remained even after controlling for the level of PA ( $r = -.37$ , males;  $r = -.26$ , females,  $p < .001$ ). High PA/Low fat had a higher mean motor performance score compared to Low PA/High fat, and within the High fat groups motor performance was higher in the High PA versus Low PA group.

**Discussion:** The complex interrelationships among variables assessed in this study indicate that motor performance may be influenced by body fat, but the association varies by PA level.

## Assessment of Fitness by BMI Classification in School-Aged Youth

A.J. Aubrey<sup>1</sup>, C.J. Dondzila<sup>1</sup>, D.P. Coe<sup>1</sup>, C.L. Blair<sup>2</sup>, T.H. Peterson<sup>3</sup>

<sup>1</sup>Grand Valley State University, Allendale, MI, USA <sup>2</sup>Kent Intermediate School District, Grand Rapids, MI USA <sup>3</sup>Spectrum Healthier Communities and Helen DeVos Children's Hospital, Grand Rapids, MI USA

**Background** Obesity is a growing epidemic among children in the U.S. Contributing to this trend is reduced funding for physical education and after-school programming. The resultant decrease in fitness increases the propensity for children to develop risk factors for cardiovascular disease into adulthood. The purpose of this study is to determine the effect of level of adiposity on fitness in school-aged youth.

**Methods** Subjects were 1,115 youth (3<sup>rd</sup>, 6<sup>th</sup>, and 9<sup>th</sup> graders). BMI was calculated from height and weight and the Centers for Disease Control and Prevention Body Mass Index (BMI) cut points for age and sex were used to classify youth as underweight ( $\leq 10^{\text{th}}$  percentile), normal weight, overweight ( $\geq 85^{\text{th}}$  percentile) and obese ( $\geq 95^{\text{th}}$  percentile). Fitness was assessed using the FITNESSGRAM test battery: cardiorespiratory endurance (PACER), muscular strength and endurance (curl-ups and pushups), and flexibility (Back saver sit-and-reach). Differences in fitness variables for each BMI group were analyzed using a one-way ANOVA.

**Results** Youth in the obese group scored significantly lower than the underweight, normal weight, and overweight groups in pushups, curl-ups, and PACER ( $P < 0.001$ ). The overweight group scored significantly higher than the obese group and lower than the normal weight group in PACER and pushups ( $P < 0.001$ ). There was no significant difference in flexibility among any of the groups.

BMI Groups	Underweight (N=113)	Normal weight (N=654)	Overweight (N=171)	Obese (N=177)
Push-Ups	12.2 ± 6.9	12.3 ± 8.0	10.1 ± 6.8 <sup>†</sup>	6.9 ± 4.5 <sup>*</sup>
Curl-Ups	27.1 ± 20.1	29.5 ± 20.5	27.8 ± 20.1	18.9 ± 14.6 <sup>*</sup>
Sit and Reach	24.2 ± 2.4	24.8 ± 2.8	24.9 ± 3.1	24.9 ± 2.7
Pacer	28.9 ± 16.8	30.7 ± 17.8	23.0 ± 15.4 <sup>†</sup>	16.5 ± 14.0 <sup>*</sup>

<sup>\*</sup>Significantly less than the underweight, normal, and overweight groups ( $P < 0.01$ )

<sup>†</sup> Significantly greater than the obese group and less than the normal weight group ( $P < 0.01$ )

**Discussion** FITNESSGRAM scores were significantly lower in youth classified as overweight and obese. Increased levels of adiposity translate into lower levels of fitness. These results indicate that a greater effort should be made promote healthy, physically active behaviors in youth in order to possibly decrease adiposity and improve fitness levels.

## Examining Predictors of Physical Activity among Inner-city African American Children

J. Hay<sup>1</sup>, A. Raman<sup>2</sup>, M.D. Fitch<sup>2</sup> & S.E. Fleming<sup>2</sup>

<sup>1</sup>Brock University, St. Catharines ON; <sup>2</sup>University of California, Berkeley CA.

**Background:** This investigation examined predictors of physical activity among a cohort of inner-city African-American children at elevated risk for insulin resistance in Oakland CA. These children were part of the 'Taking Action Together' program, an ongoing USDA funded community intervention trial in conjunction with the YMCA of the East Bay.

**Methods:** All subjects were evaluated for physical activity habits, BMI, waist/hip ratio, VO<sub>2</sub> (20m shuttle run), pubertal stage (blood hormone assessment), self-assessed physical activity capabilities, knowledge of physical activity, family physical activity habits, and generalized self-efficacy toward physical activity (CSAPPA – Children' Self-perceptions of Adequacy in and Predilection for Physical Activity) during June of 2007.

**Results:** 115 (51 boys, 64 girls,) of 146 children (mean age 10.7 (SD=1.1) had full results. These children had a mean BMI of 28.3 (boys 27.6, girls 28.9). Analyses of Variance revealed no significant gender differences in age, VO<sub>2</sub>, BMI, hip to waist ratio, or knowledge of physical activity; marginally insignificant gender differences (boys higher) for physical activity habits (p=.06) and family activity habits (.08), and self-efficacy (0.10); and significant (p<.001) gender differences in pubertal status (girls more mature) and perceived physical capability (boys higher). Regression modeling was used to predict physical activity habits entering each of the above variables. Self-efficacy alone produced an R<sup>2</sup> of .247, increasing to .324 when physical activity capability was added. None of the other variables had a significant effect on the equation, adding all six only increasing the R<sup>2</sup> to .346. The depressed self-efficacy of these children (boys 59.5, girls 56.2) is significantly lower than that typically seen in their age group and similar to that seen among other pediatric populations with attenuated activity levels associated with chronic illness or disorder.

**Discussion:** These results strongly suggest that a significant predictor to and barrier for physical activity among these children is their low generalized self-efficacy toward physical activity and their concomitant belief that they have a motoric disadvantage. As their low levels of activity are a major contributing factor to their overweight and risk for insulin resistance these findings suggest that intervention programs designed to promote physical activity must address issues of self-efficacy in the target population.

## Relationship between circulating adiponectin levels and physical activity in youth

R.G. McMurray, A.N. Jessup, & JS. Harrell  
University of North Carolina, Chapel Hill, NC

**Background:** Adiponectin (ADPN) is produced by adipocytes and is believed to be protective against the development of atherosclerosis. Circulating ADPN is usually lower in overweight or obese youth compared to normal weight youth. Physical activity (PA) can also reduce the risk of developing atherosclerosis, independent of weight loss. However, the concurrent exploration of ADPN, obesity and habitual physical activity levels has not transpired in children; hence, this study examined these associations.

**Methods:** Serum ADPN levels were measured after an overnight fast in 1215, 7-18 yr old youth (603 girls & 612 boys; 712 Caucasians & 503 African Americans). Height (m), body mass (kg) and skinfolds were also measured and BMI computed ( $\text{kg}/\text{m}^2$ ). Habitual levels of total (TPA) and vigorous (VPA) physical activity levels and pubertal development were obtained from questionnaires. The sample was divided into normal ( $n=711$ ) and overweight ( $n=504$ ) groups based on the 85<sup>th</sup> BMI percentile.

**Results:** Reported habitual TPA and VPA were similar for both weight groups ( $p>0.52$ ). ADPN levels were lower in overweight vs. normal weight youth:  $10.6\pm 6.2$  vs.  $14.4\pm 7.0$   $\mu\text{g}/\text{mL}$  ( $p=0.0001$ ). Simple correlations between body fat and ADPN were not significant for the normal weight group ( $r = 0.021$ ) but were for the overweight group ( $r = -0.125$ , respectively). Correlations between ADPN and TPA or VPA scores were significant for the normal weight group ( $r = 0.137$  &  $r = 0.095$ , respectively), but not the overweight group. Multiple regression analyses, adjusting for pubertal stage, sex, and weight group, found that the Total PA score was positively associated with ADPN ( $p<0.05$ ), but VPA was not ( $p=0.114$ ).

**Discussion:** In normal weight youth increased habitual PA levels are related to increased ADPN and thus, may contribute to reducing the risk of developing atherosclerosis in normal weight youth. However, in overweight youth the relationship between body fat and ADPN exceeds the influence of habitual PA levels; thus, the importance of weight control in children.

## Adiponectin and Cardiovascular Fitness in Black and White Youth

A.N. Jessup, R.G. McMurray, & J.S. Harrell  
University of North Carolina, Chapel Hill, NC

**Background:** Adiponectin (ADPN) is secreted by adipocytes and appears to have anti-inflammatory actions that are protective against type 2 diabetes (T2D) and cardiovascular disease (CVD). ADPN levels are lower in those who are overweight, and decreased ADPN levels are associated with greater risk for CVD and T2D. Although aerobic power has positive effects on CVD and T2D risk factors in youth, little research has been done to examine the relationship between fitness levels and ADPN. This study examined the relationship between ADPN and aerobic power ( $VO_2\text{max}$ ) in a large sample of youth.

**Methods:** Fasting serum levels of ADPN were measured from 1215 youth, aged 7-18 years (603 girls & 612 boys; 503 Black & 712 White).  $VO_2\text{max}$  was estimated from cycle ergometry, and expressed as ml/min, ml/kg body mass/min, and ml/kg fat-free mass (FFM)/min in order to account for adiposity. Gender, race and pubertal stage were obtained from questionnaires.

**Results:** All 3  $VO_2\text{max}$  units differed by gender ( $p < .01$ ), with higher levels in males; there was no difference by race ( $p \geq .06$ ). ADPN did not differ by gender ( $p = 0.053$ ), but levels were lower in Black subjects than in White subjects ( $p < .0001$ ). ADPN was correlated with  $VO_2\text{max}$ , when expressed as ml/min ( $r = -0.21$ ,  $p < .0001$ ) and ml/kg body mass/min ( $r = 0.10$ ,  $p < .001$ ), but not when expressed in ml/kg<sub>FFM</sub>/min ( $p = 0.47$ ). The relationships between ADPN and  $VO_2\text{max}$  expressed as ml/min (inverse) and ml/kg body mass/min (positive) remained significant in a regression model that included gender, race and pubertal stage ( $p < .01$ ).

**Discussion:** ADPN is not associated with  $VO_2\text{max}$  when accounting for fat free mass, suggesting that the relationship between ADPN and aerobic power is more dependent on the amount of fat mass than muscle mass. When taking total body mass into account, results imply that greater aerobic power relative to overall size is associated with higher ADPN levels, reinforcing the metabolic and cardio-protective role of aerobic fitness.

## The Influence of a Positive Family History for Non-Insulin Dependent Diabetes Mellitus on Ventilatory Threshold in Adolescent Boys

A.D. Mahon, L.E. Hanna, L.M. Guth, & K.A. Craft

Human Performance Laboratory, Ball State University, Muncie, IN

**Background:** Impaired oxidative metabolism in skeletal muscle in individuals with non-insulin dependent diabetes mellitus (NIDDM) may be a consequence of the disease. Moreover, this impairment may become apparent prior to the onset of disease. Ventilatory threshold (VT) is a submaximal exercise response that is influenced by muscle metabolism, thus it may serve as an indirect indicator of an alteration in muscle metabolic activity.

**Methods:** This study examined VT in adolescent boys with (POS,  $n = 6$ ;  $14.6 \pm 1.0$  yrs) and without (CON;  $n = 8$ ;  $14.0 \pm 0.5$  yrs) a positive family history for NIDDM. Subjects with a positive history for NIDDM had one first-degree or at least two second-degree relatives with NIDDM. Each subject performed a graded exercise test on a cycle ergometer for the determination of VT and peak oxygen uptake (peak  $\text{VO}_2$ ). Data were analyzed using independent t-tests with  $P < 0.05$ .

**Results:**  $\text{VO}_2$ , respiratory exchange ratio (RER), and heart rate (HR) at peak exercise were  $47.6 \pm 2.5$  ml/kg/min ( $2.52 \pm 0.33$  L/min),  $1.15 \pm 0.05$ , and  $197 \pm 7$  bpm, respectively in POS. In CON peak  $\text{VO}_2$ , RER, and HR were  $47.4 \pm 6.0$  ml/kg/min ( $2.72 \pm 0.36$  L/min),  $1.18 \pm 0.06$ , and  $197 \pm 10$  bpm, respectively. Differences between groups were not statistically significant for any of these variables. The  $\text{VO}_2$  at VT was  $28.8 \pm 4.1$  ml/kg/min ( $1.50 \pm 0.11$  L/min) in POS and  $29.0 \pm 4.8$  ml/kg/min ( $1.66 \pm 0.31$  L/min) ( $P > 0.05$ ). When expressed relative to peak  $\text{VO}_2$ , VT was  $60.2 \pm 6.6$  % and  $60.7 \pm 4.9$  % in POS and CON, respectively ( $P > 0.05$ ). HR at VT also was similar ( $P > 0.05$ ) in POS ( $156 \pm 15$  bpm) and CON ( $151 \pm 11$  bpm).

**Discussion:** These results suggest that the early onset of an impairment in muscle oxidative capacity in boys with a positive family history for NIDDM is either not apparent or that VT is not sensitive enough to make this assessment.

## The Metabolic Response to Rest and Acute Exercise in Adolescent Boys with Non-Insulin-Dependent Diabetes Mellitus (NIDDM) Relatives

L.E. Hanna, L.M. Guth, K.A. Craft & A.D. Mahon

Human Performance Laboratory, Ball State University, Muncie IN

**BACKGROUND:** NIDDM patients have altered fuel use, characterized by increased lipid oxidation. This may be caused by increased lipid availability, decreased glycogen stores and/or a depressed muscle oxidative capacity. These abnormalities are seen in NIDDM offspring, suggesting alterations in muscle metabolism occur prior to NIDDM onset.

**METHODS:** Twelve males ( $15.9 \pm 0.8$  yrs), six with a positive family history for NIDDM (POS) and six controls (CON) participated. Subjects with a positive history for NIDDM had one first-degree or at least two second-degree relatives with NIDDM. Peak oxygen consumption ( $VO_{2peak}$ ), ventilatory threshold (VT) and body composition were measured. On another day, subjects arrived fasted for the experimental trial. Measurements were made during 6 minute stages at rest and during exercise at 80, 100 and 120% of VT. Oxygen consumption ( $VO_2$ ) and respiratory exchange ratio (RER) were measured during each phase to calculate fuel use. Graded exercise test responses and anthropometric data were analyzed using independent t-tests. Fuel use responses were analyzed using a 2-way (group x intensity) ANOVA.

**RESULTS:** There were no significant differences between groups with respect to anthropometric data,  $VO_{2peak}$  (CON  $48.0 \pm 3.4$  versus POS  $47.7 \pm 2.5$  ml/kg/min), or VT (CON  $29.6 \pm 1.4$  versus POS  $28.8 \pm 4.1$  ml/kg/min), although there was a tendency ( $P = 0.08$ ) for fat free mass (FFM) to be greater in CON. Interactions involving fuel use were not apparent. There was a tendency ( $P = 0.10$ ) for a group difference with respect to a higher percentage of carbohydrate use in CON than in POS ( $73.9 \pm 23.5\%$  vs.  $61.5 \pm 27.3\%$ ) and a lower percentage of fat use in CON compared to POS ( $26.1 \pm 23.5$  vs.  $38.5 \pm 27.3\%$ ). There were no differences between groups for carbohydrate or fat oxidation rates relative to FFM.

**DISCUSSION:** Trends towards greater fat and lesser carbohydrate contribution to energy expenditure in POS group suggests metabolic abnormalities associated with NIDDM may be present in this group. The lack of differences in fuel oxidation rates may be attributed to subjects being young, fit and lean; these characteristics may lessen the development of fuel abnormalities.

## **Association between maternal obesity and offspring fatness and blood pressure: Role of physical activity**

M.A. Sarzynski<sup>1</sup>, J.C. Eisenmann<sup>1</sup>, J. Tucker<sup>2</sup>, K. Laurson<sup>2</sup>, & K.A. Heelan<sup>3</sup>

<sup>1</sup>Michigan State University, East Lansing, MI; <sup>2</sup>Iowa State University, Ames, IA; <sup>3</sup>University of Nebraska-Kearney, Kearney, NE.

**Background:** There is an emerging interest on the role of the intra-uterine environment on offspring physiology, including obesity and cardiovascular disease risk factors. However, to our knowledge no study exists that examines how offspring physical activity (PA) may affect the relationship between maternal obesity and offspring fatness and blood pressure (BP).

**Methods:** 144 maternal-child pairs (n = 74 boys and 70 girls, mean age = 7.3 yrs) were included in the analysis. Maternal pre-pregnancy BMI was determined by self-report. Offspring characteristics included resting systolic and diastolic BP, body fatness by DXA, and moderate-to-vigorous physical activity (MVPA) using the Actigraph accelerometer. ANCOVA was used to determine differences in offspring fatness and BP by pre-pregnancy BMI and offspring MVPA groups independently and by cross-tabulation (e.g., pre-pregnancy normal weight and child meets MVPA guideline, etc.).

**Results:** Children whose mothers were overweight or obese pre-pregnancy (Pre-preg OB) were significantly larger and fatter (29% v. 26%, respectively) than children from mothers with a normal pre-pregnancy BMI (Pre-preg NORM). Pre-preg OB children also had higher BP than Pre-preg NORM children (e.g., MAP, 84 v. 81 mmHg, respectively). BP values were not different across maternal Pre-preg BMI/MVPA groups. Percent fat was significantly different across Pre-preg BMI/MVPA groups. Pre-preg OB children that did not meet the daily recommended value of MVPA (<60 min/day) were the fattest (32%). Pre-preg OB children that attained ≥60 min of MVPA/day had a mean percent body fat (26%) that was similar to Pre-preg NORM children of either MVPA group (≥60 min = 24% and <60 min = 26%).

**Discussion:** Maternal pre-pregnancy BMI influences fatness and BP in children with overweight mothers posing the greatest risk to their children. Although PA may not influence BP values, attaining the recommended amount of daily PA may positively influence fatness and attenuate the negative effects of high maternal pre-pregnancy BMI.

**Funding Support:** This work was supported by the American Heart Association (##0665500Z).

## The relationship between changes in physical activity, weight status and insulin resistance in youth

K. S. Ondrak, R. G. McMurray & J.S. Harrell

University of North Carolina at Chapel Hill, NC, USA

**BACKGROUND:** Numerous studies have shown that habitual physical activity (PA) declines as children enter adolescence. However, the relationships between this decline and changes in weight status and insulin resistance (IR) have not been previously examined. Thus, this study investigated the relationship between natural changes in PA, weight status and IR over a two year period. **METHODS:** A total of 120 youth were followed for two years (ages 9.8 y to 11.6 y). The youth were divided into four groups: normal weight (>5<sup>th</sup> to <85<sup>th</sup> BMI percentile) at baseline and at follow-up (NN), normal weight at baseline and overweight ( $\geq 85^{\text{th}}$  percentile) at follow-up (NO), overweight at both time points (OO), and overweight who became normal weight (ON). PA levels were obtained from a self-report questionnaire and IR was determined from fasting blood samples using the homeostatic model assessment.

**RESULTS:** PA levels declined similarly in all groups (-34% on average,  $p > 0.05$ ) over the two years and the percent change in PA was related to change in BMI percentile ( $r = 0.27$ ,  $p < 0.05$ ). Percent change in IR was greater in the NO group (+50%), compared to all others (NN = +2%, OO = -1%, ON = -8%,  $p < 0.05$ ); but the percent change in PA was not related to percent change IR ( $p > 0.05$ ). Changes in BMI percentile and IR were related ( $r = 0.26$ ,  $p < 0.05$ ). In the regression model for percent change in IR, change in BMI percentile accounted for 10% of the variance, while percent change in PA did not enter into the model.

**DISCUSSION:** The results suggest that natural changes in IR are more strongly related to changes in weight status than changes in habitual levels of PA as children become adolescents. This is likely attributable to the common drop in PA seen in the majority of adolescents. However, it is possible that increases in PA, over habitual levels, may attenuate the large rise in IR seen in participants who moved from normal to overweight status. Thus, early interventions are needed to avoid unnecessary weight gain and rises in IR.

## **Relationship between fat mass development (8-26 years) and young adult risk for metabolic syndrome**

L. B. Sherar, R. A. Faulkner, & A.D.G. Baxter-Jones  
University of Saskatchewan, Saskatchewan, Canada

**Background:** Previous research suggests that excess weight during adolescence may be predictive of adverse cardiovascular health in adulthood. However, the relationship between fat mass (FM) development, from adolescence into young adulthood, and subsequent risk for metabolic syndrome (MetS) has yet to be ascertained. The purpose of this study was to determine if FM development (8-26 yrs) differed between young adults classified as high and low risk for MetS.

**Methods:** The sample were 21 males and 27 females from the Saskatchewan Pediatric Bone Mineral Accrual Study (1991-2007) who were assessed from childhood to young adulthood (median of 11 visits per individual; min. 7, max. 12) and had a measure of MetS risk at young adulthood ( $26.2 \pm 2.2$  yrs). Height was measured biannually. Total body FM was assessed annually by dual x-ray absorptiometry. Physical Activity was evaluated two to three times annually using the PAQ-C/A. Years from peak height velocity were used as a biological maturity age indicator. A continuous MetS score was derived by taking the average value of the standardized measures (z scores) for: waist circumference, systolic blood pressure (BP), diastolic BP, fasting plasma glucose; fasting plasma insulin, inverted fasting high-density lipoprotein cholesterol (C)/total C; and fasting triglyceride levels. Individuals were ranked based on MetS score; those in the lowest half were classified as 'low risk' and the remainder as 'high risk'. Data were analyzed using random effects models. Models were built in a stepwise procedure with predictor variables added one at a time, using the log likelihood ratio statistic to determine if one model was a significant improvement over the previous one.

**Results:** Using NCEP ATP III guidelines, 2 men and 2 women (8.8% of the sample) were classified as having the MetS. The final model indicated that once the independent effects of maturity (years from PHV), gender and physical activity (1 low; 5 high) were controlled the high risk group had significantly greater FM development ( $1.83 \pm 1.1$  g) at all ages.

**Discussion:** Young adults at higher risk for MetS have greater body fat as early as 8 years of age, which lends support to early intervention.

**Funding Support:** CIHR (MOP 57671), SHRF and University of Saskatchewan

## Metabolic risk profile in 24 day old mice selectively bred for high wheel-running activity

J.C. Eisenmann, T.H. Meek, & T. Garland, Jr

Michigan State University, East Lansing, MI, USA, University of California-Riverside, Riverside, CA, USA

**Background:** Genetics is known to play an important role in several complex human diseases, such as obesity, cardiovascular disease, type II diabetes, and the metabolic syndrome, which are now emerging in childhood. In addition, physical activity has been shown to be an important factor in reducing the risk of the metabolic syndrome. In this study, we examine the metabolic risk profile of postnatal mice that were bred for high voluntary wheel running compared to controls.

**Methods:** Blood cholesterol and lipoprotein levels and blood glucose were measured in 77 male offspring from selected lines and 76 male mice from control lines at 24 days of age (3 days post-weaning).

**Results:** Total cholesterol and glucose were similar between control and select mice. The differences in LDL-C, TC:HDL-C, and LDL:HDL were either significant ( $p < 0.05$ ) or showed a trend for significance ( $p < 0.08$ ).

Table 1. Values are mean (SD)

	TC	HDL	LDL	TG	TC:HDL	LDL:HDL	GLU
Control	124 (18)	62 (20)	44 (30)	104 (46)	2.44 (1.7)	1.06 (1.6)	80 (14)
Select	127 (19)	66 (17)	35 (28)	116 (45)	2.06 (1.5)	0.68 (0.8)	82 (11)

**Discussion:** The atherogenic-lipid profile may be slightly ameliorated in postnatal mice bred for high wheel-running activity. Continued study in this postnatal animal model will provide an in-depth longitudinal investigation of the metabolic syndrome taking into account genetics, physical activity, and diet.

**Funding Support:** This work was supported by a National Science Foundation grant (TG) and a seed grant from Michigan State University (JE).

## Muscle Force and Muscle Activation in Girls and Women During Isometric Elbow Flexion and Extension

L. Brunton, D. Gabriel, R. Dotan, C. Usselman, P. Klentrou, B. Falk  
Faculty of Applied Health Sciences, Brock University, St Catharines, Ontario, CANADA

**Background:** Previous studies have demonstrated that in boys, lower muscle strength is likely due to their lower muscle size and muscle activation. In girls, the contribution of muscle size to age-differences in muscle strength is unclear, and there are no data on the role of muscle activation. This study aimed to compare maximal force, rate of force development, and muscle activation of pre-pubertal girls vs. young women in isometric elbow flexion and extension.

**Methods:** Ten girls ( $9.1 \pm 1.4$  years) and 15 women ( $21.5 \pm 0.6$  years) performed fast, isometric maximal voluntary elbow flexions and extensions on the Biodex System 3 dynamometer. Surface-EMG was used to monitor biceps and triceps muscle activation, using 10mm bi-polar electrodes. Averaged traces of torque and EMG were used to calculate maximal torque (T), rate of force development (dFdt), EMG amplitude, electro-mechanical delay (EMD), and rate of muscle activation (Qpk - rate of EMG rise during peak dFdt). Muscle cross-sectional area (CSA) was assessed using ultrasound.

**Results:** Flexion T was significantly lower in the girls than in women ( $16.0 \pm 7.0$  vs.  $39.5 \pm 8.0$  N·m, respectively), but not when normalized to CSA ( $7.79 \pm 2.49$  vs.  $8.24 \pm 1.65$  N·m·cm<sup>-2</sup>, respectively). Relative to agonist EMG activity, T was significantly lower in girls ( $794 \pm 493$  vs.  $1962 \pm 1128$  N·m·mV<sup>-1</sup>, respectively). Absolute dFdt was also lower in girls ( $98.2 \pm 58.3$  vs.  $263.5 \pm 84.6$  N·m·s<sup>-1</sup>, respectively), but when normalized to T, no group differences were observed in dFdt ( $7.23 \pm 1.91$  vs.  $7.42 \pm 2.16$  N·m·s<sup>-1</sup>/N·m, respectively). Normalized for Qpk, dFdt was lower in the girls ( $195 \pm 125$  vs.  $568 \pm 441$  N·m·s<sup>-1</sup>/mV·s, respectively). Agonist EMD was significantly longer in girls ( $68 \pm 22$  vs.  $54 \pm 23$  ms, respectively). No group differences were observed in co-contraction, as indicated by the agonist/antagonist EMG-amplitude ratio. The same pattern was observed in elbow extension.

**Conclusions:** The findings suggest that girls are similar to women in their size-normalized isometric strength and rate of force development, despite lower apparent muscle activation and longer electro-mechanical delay. It is possible that functional differences will be manifested in dynamic contractions.

---

## **Longitudinal analysis of the benefit of physical activity on fatness during childhood: Iowa Bone Development Study**

S. Kwon, K.F. Janz, E.M. Letuchy, T.L. Burns, J.M. Eichenberger Gilmore, J.C. Torner, M.C. Willing, S.M. Levy  
University of Iowa, IA, USA.

**Background:** Lack of physical activity (PA) is widely assumed to be one of causes of increased obesity in children. Although extensive cross-sectional studies have been done to examine the association between PA and fatness in children, only a few studies have examined longitudinal data. In general, these studies have used less accurate measures such as PA questionnaires or body mass index. The purpose of this study was to examine whether or not the benefit of early childhood PA on fatness is sustained throughout childhood.

**Methods:** Subjects included 333 children (44.4% girls) participated in the longitudinal Iowa Bone Development Study. At age 5, 8, and 11 yr, daily PA and body fat mass were measured using accelerometry and DXA, respectively. At age 11, somatic maturity was estimated. Mixed linear model for correlated data was used to examine the predictability of PA at age 5 on fat mass at age 8 and 11 after adjusted for height, weight, age, maturity, and concurrent PA. Least-square means were compared to examine differences in later fat mass between the highest and the lowest quartiles of PA at age 5 (adjusted for height, weight, age, maturity, and concurrent PA).

**Results:** PA at age 5 was a significant predictor of fat mass at age 8 and 11 for both boys and girls ( $p < 0.05$ ). However in girls, PA at age 5 proved to be statistically insignificant when adjusted for fat mass at age 5. In comparison of the highest and the lowest quartiles of PA at age 5, the boys in the highest quartile of PA at age 5 were more likely to have a lower fat mass at age 8, but not at age 11 than the boys in the lowest. The girls in the highest quartile of PA at age 5 were more likely to have a lower fat mass at age 11, but not at age 8 than the girls in the lowest.

**Discussion:** These data suggest that the benefit of early childhood PA on fatness may persist throughout childhood.

---

## Is there a relationship between lean tissue mass accrual and bone strength in adolescence?

S. A. Jackowski, S. Kontulainen, J. Farthing, R. Faulkner, A. Baxter-Jones  
College of Kinesiology, University of Saskatchewan, Saskatoon, Canada

**Background:** The objective of this study was to examine the timing of the age of peak lean tissue mass accrual (peak lean tissue velocity, PLTV) as it relates to the age of peak cross sectional velocity (PCSAV) and section modulus velocity (PZV) during adolescence. We hypothesized that the age of PLTV would precede the age of PCSAV and PZV in both males and females.

**Methods:** 41 males and 42 females aged 8-18 years were selected from the Saskatchewan Pediatric Bone Mineral Accrual Study (1991-2005). Participants' total body lean tissue mass was assessed annually for 6 consecutive years using DXA. Narrow neck, intertrochanteric and femoral shaft cross sectional areas and section modulus, measures of bone strength, were determined annually using the hip structural analysis (HSA) program. Participants were aligned by maturational age (years from peak height velocity). Lean tissue mass, CSA, and Z were converted into whole year velocities and the maturational age of peak tissue velocities was determined using a cubic spline curve fitting procedure. A 2x3 factorial ANOVA with repeated measures was used to test for differences between age of PLTV and both, the age of PCSAV and PZV between males and females.

**Results:** There was no sex difference in the ages at which tissue peaks occurred when aligned by maturational age. There were significant differences between the age of PLTV ( $0.246 \pm 0.4712$ ) and both PCSAV and PZV at the narrow neck ( $0.435 \pm 0.749$  and  $0.572 \pm 0.845$ ,  $p=0.001$ ) and femoral shaft ( $0.402 \pm 0.950$  and  $0.528 \pm 1.125$ ,  $p=0.03$ ), where the age of PLTV preceded both PCSAV. There were no significant differences at the intertrochanteric site ( $p=0.814$ ).

**Conclusions:** These findings support the hypothesis that the age of PLTV precedes the age of PCSA and PZV at the proximal femur and provides further evidence supporting the muscle-bone relationship suggesting that lean tissue mass accrual influences bone strength. Since physical activity influences lean tissue accrual this provides further evidence for the importance of physical activity on bone health during adolescence.

---

## Comparing indirect and direct measures for assessing physical activity in the pediatric population: A systematic review

KB. Adamo<sup>1,2</sup>, S. A. Prince<sup>3</sup>, A. C. Tricco<sup>3</sup>, M. Tremblay<sup>1,4</sup>, S. Connor-Gorber<sup>3,4</sup>

<sup>1</sup>Healthy Active Living and Obesity Research Group, Children's Hospital of Eastern Ontario Research Institute, <sup>2</sup>Faculty of Health Science, School of Human Kinetics, University of Ottawa, <sup>3</sup>Population Health PhD Program, University of Ottawa, <sup>4</sup>Physical Health Measures Division, Statistics Canada, Ottawa, Ontario, Canada

**Background:** Accurate assessment of physical activity (PA) in children and adolescents is required to establish the prevalence of youths meeting PA recommendations, monitor changes over time, assess the effectiveness of interventions designed to increase activity levels, and inform public health policies. This paper examines the extent of agreement between indirect (subjectively measured; e.g. questionnaire, recall) and direct (objectively measured; e.g. accelerometry, heart rate monitoring (HRM), doubly labeled water (DLW) assessments of PA in pediatric populations ( $\leq 19$  years of age) through a systematic review of the literature.

**Methods:** Literature was primarily identified through searching electronic databases (e.g., MEDLINE, EMBASE), relevant organizations and governmental department websites, and conference proceedings' abstracts until April 2007. Studies were included if they collected both indirect and direct measures of PA in pediatric populations and were reported in English. The quality of included studies was appraised using a modified Downs and Black tool.

**Results:** A total of 83 studies were included; 24 describing comparable data and 59 including a correlation analysis. The majority of correlations reported between indirect and direct measures were low-to-moderate but ranged from -0.56 to 0.89. Overall, 72% of the indirect measures overestimated the directly measured values with differences ranging from -95% to 13,025%. Combined gender data, as well as male- and female- only data comparing indirect measures to accelerometry, HRM or direct observation all reported that the indirect measure overestimated PA. A similar trend was observed in the combined male and female data that compared indirect measures with DLW; however, the opposite trend was observed in the male- and female-only data with the indirect measures having slightly underestimated PA.

**Discussion:** The substantial discrepancies and moderate correlations highlighted in this systematic review between the common indirect methods of assessing PA in pediatric populations and other more robust direct measures is of concern, especially when trying to establish relationships with health outcomes.

---

---

## **An Examination of Low Generalized Self-efficacy as a Barrier to Activity in Children with Asthma in the United Kingdom**

M. Kamel<sup>1</sup>, C. White<sup>1</sup>, C. Glazebrook<sup>1</sup>, C. Macdonald<sup>1</sup>, J. Hay<sup>2</sup>

<sup>1</sup>University of Nottingham, UK, <sup>2</sup>Brock University St. Catharines, ON, Canada

**Background:** Children with asthma report low levels of physical activity and have high rates of obesity. Exercise self-efficacy has been identified as an important determinant of future physical activity in children and this study aims to explore the reliability of a measure of exercise self-efficacy in a UK sample and to explore the hypothesis that low exercise self-efficacy may contribute to inactivity in children with asthma.

**Method:** In this cross-sectional survey, 89 children ages 9-11 years old recruited from 3 Nottingham schools, completed the Children's Self Perceptions of Adequacy in and Predilection for Physical Activity (CSAPPA) scale. This measure assesses three dimensions of self efficacy: perceived adequacy, predilection for activity, and enjoyment of physical education class. Participants also completed the Physical Activity Questionnaire which assesses frequency of physical and sedentary activities in the previous 24 hours.

**Results:** The CSAPPA sub-scales had good internal consistency with Cronbach's alphas >0.7. Boys had higher total exercise self efficacy scores ( $p=0.046$ ) and predilection for activity scores ( $p=0.03$ ). Higher total CSAPPA scores were correlated with increased physical activity ( $r=0.49$ ,  $p<0.001$ ), with adequacy scores having the strongest association with activity ( $r=0.41$ ,  $p<0.001$ ). Exercise self-efficacy was unrelated to sedentary activity. As predicted, children with asthma ( $n=10$ ) reported lower levels of physical activity ( $p=0.049$ ). Boys with asthma ( $n=7$ ) had lower levels of self-efficacy compared to other boys in the sample and this difference was most marked for CSAPPA adequacy scores (means 19.7 vs 23.2;  $p=0.015$ ).

**Discussion:** This evidence suggests that a significant barrier to the full participation in physical activity of young boys with asthma is their lack of perceived efficacy in their capacity to be active in spite of their willingness to be active. Programs designed to promote activity in this population should consider this when developing interventions. The CSAPPA proved a reliable and valid measure for the assessment of exercise self-efficacy and would be a useful outcome measure for such programs.

---

---

## **Predisposing, Reinforcing, and Enabling Factors Associated with Physical Activity and Sedentary Behavior in Adolescent Males and Females**

P. Wenthe<sup>1,4</sup>, K. F. Janz<sup>1,2</sup>, and S. M. Levy<sup>2,3</sup>

<sup>1</sup>Department of Health and Sports Studies, <sup>2</sup>Department of Epidemiology, <sup>3</sup>Department of Preventive and Community Dentistry at the University of Iowa, <sup>4</sup>Department of Occupational Therapy at St Ambrose University

**Background:** More information is needed on factors that promote physical activity in adolescents because despite the evidence of the health benefits of physical activity and the health risks posed by inactivity, adolescents do not engage in the amount or type of physical activity needed to experience these benefits. Welk developed the Youth Physical Activity Promotion Model (YPAP) to address this need. The purpose of this study was to investigate the relationship between the predisposing, reinforcing, and enabling factors found in the YPAP Model and the physical activity and sedentary behavior of adolescent males and females.

**Methods:** The Physical Activity Questionnaire for Adolescents (PAQ-A) and an activity monitor (Actigraph 7164) were used to obtain measures of physical activity in 205 adolescents. This included measures of total physical activity, moderate-vigorous physical activity (MVPA), bouts of MVPA, vigorous physical activity (VPA), sedentary activity, and physical activity performed on the week-end, during the school day, after school, and during the evening hours.

The YPAP factors examined by a questionnaire developed for this study included self-efficacy to overcome barriers; enjoyment of physical activity; family support and peer support of physical activity; perceived school climate; and neighborhood safety and access to physical activity. Objective measures of access and safety to perform physical activity in the home and neighborhood were employed.

**Results:** Gender differences were noted in the associations between the YPAP factors and physical activity. Family support emerged as the most significant and consistent factor associated with the physical activity of both males and females. The relationship between adolescent physical activity behavior and the YPAP factors was the most informative when the time of the physical activity was examined. Many significant associations were noted between after school physical activity and the YPAP factors while very few associations were noted with activity during the school day.

**Discussion:** These findings suggest family support is important in the physical activity behavior of male and female adolescents; gender differences should be considered in the promotion of physical activity; and the factors associated with adolescent physical activity vary with the time of day or context of the physical activity.

---

---

## **ParticipACTION: Mass Media Campaign Promoting Physical Activity**

M. Tremblay

Healthy Active Living and Obesity Research Group, Children's Hospital of Eastern Ontario Research Institute, Ottawa, Ontario, Canada

**Background:** ParticipACTION was launched in 1971 as a leading catalyst and provider of information to positively influence personal behaviour, and social supports, to encourage healthy, active living for all Canadians. It was an internationally renowned social marketing and communications organization committed to the promotion of physical activity and fitness in Canada. Because of funding cuts, ParticipACTION ceased operations in 2001. After six years of absence support arose for the resurrection and revitalization of ParticipACTION. The "new generation" ParticipACTION was formally announced in February 2007. The new generation ParticipACTION aspires to engage all Canadians in improving their health and the healthy nature of the communities in which they live, study, work and play, through physical activity and sport participation communications; encouraging and supporting the coordinated actions of many partner organizations; and contributing to community capacity building.

**Methods:** Utilizing content input from experts and creative talents of communication and advertising consultants, the first mass media campaign of the revitalized ParticipACTION was officially launched in October 2007. The first campaign focused on children and youth by targeting a series of television advertisements to parents.

**Results:** Humorous, negative framed television segments were created linking physical inactivity to an accelerated aging message. Television advertisements ran on several national networks from October 2007 to September 2009 in both English and French. Strategic partnerships in the media sector were leveraged to increase the campaign exposure well beyond the investment. Early evaluations suggest the campaigns resonate with the target audience.

**Conclusions:** A Canadian social marketing icon is back and the promotion of physical activity for children and youth is a priority. ParticipACTION is committed to developing communication materials that will promote healthy active living for Canadian children and youth. The inaugural campaign of the "new generation" ParticipACTION was successful.

---

---

## Gender-specific response of pulmonary artery pressure to acute high altitude exposure in families with and without HAPE-susceptible parents

C. Wick<sup>1</sup>, B. Soltermann<sup>1</sup>, B. Kaufmann<sup>2</sup>, A. Bernheim<sup>2</sup>, R. Handschin<sup>3</sup>, A. Hoffmann<sup>2</sup>, H.P. Brunner-La Rocca<sup>2</sup>, S. Kriemler<sup>1</sup>

<sup>1</sup>Exercise and Health Sciences, University of Basel and <sup>2</sup>Cardiology, University Hospital Basel, Switzerland

**Background:** A high pulmonary artery pressure (PAP) response to hypoxia is a risk factor for the development of high altitude pulmonary edema (HAPE), a potentially life-threatening disease. We have recently shown that mostly male prepubertal children develop more severe pulmonary hypertension than their fathers when acutely exposed to high altitude. This might make them more susceptible to HAPE. In addition, this raise in PAP was related between fathers and their children. We therefore performed a study to test whether the PAP response to high altitude is related within families 1. with a parent who had suffered from HAPE in the past (fam<sub>HAPE</sub>) and 2. within families without HAPE history (fam<sub>NO</sub>).

**Methods:** Eleven fam<sub>HAPE</sub> (21 parents 40-61 y, 23 children aged 10-16 y) and 10 fam<sub>NO</sub> (8 fathers and 2 mother with a history of HAPE, 8 parents without history, 14 children aged 10-16 y) participated in the study. Systolic PAP was measured echocardiographically by estimating pressure gradients of tricuspid regurgitation (dpTR) four to six hours after fast ascent (within 2 hours) to 3450m.

**Results:** None of the subjects developed HAPE. In HAPE-susceptible parents, dpTR was significantly higher compared to non-HAPE parents (41±12 vs. 30±5 mmHg, p<0.01), but children from fam<sub>HAPE</sub> and fam<sub>NO</sub> did not differ (32±7 vs. 34±7 mmHg). However, when gender separated analyses were done, females behaved like the whole group, while boys from HAPE-susceptible fathers showed dpTR that were not different to their father's (36±8 vs. 44±9), while PAPs of boys and men from fam<sub>NO</sub> remained significantly lower (30±6 and 32±6 vs. 44±9, both p<0.01).

**Discussion:** These preliminary data suggest that the hereditary precondition of HAPE-susceptibility, i.e. an increased PAP response to acute hypoxia may be gender specific.

---

---

## Short-term endurance training in young girls: peak oxygen uptake, plasma volume expansion and cardiac function

RJ Winsley<sup>1</sup>, N Armstrong<sup>1</sup>, J Blackwell<sup>1</sup>, AR Middlebrooke<sup>1</sup>, AC Roberts<sup>1</sup>, T Rowland<sup>2</sup>, K Stoedefalke<sup>3</sup>

<sup>1</sup>Children's Health and Exercise Research Centre, School of Sport & Health Sciences, University of Exeter, UK. <sup>2</sup>Baystate Medical Centre, Springfield, Massachusetts, USA. <sup>3</sup>Colby Sawyer College, New Hampshire, USA

**Background:** Endurance training in adults elicits a significant expansion in plasma volume (PV) after just 10-days, with a resultant increase in cardiac output and peak oxygen uptake (peak  $\dot{V}O_2$ ). As children show little or no change in peak  $\dot{V}O_2$  with training, whether the PV expansion response is also diminished is unclear. The purpose of this study was to investigate whether short-term endurance training would induce PV expansion in young girls and if it was associated with changes in heart dimensions, maximum cardiac output and peak  $\dot{V}O_2$ .

**Methods:** Ten girls (9.8±0.4y) participated in the study. Measures were collected at baseline, after a 2-week control period and finally after 2-weeks of endurance training (6 sessions, >80% maximum heart rate for >20 mins). Descriptive anthropometric measures were collected and heart dimensions assessed using M-Mode echocardiography. A venous blood sample was taken to determine albumin, globulin and total protein concentrations. Plasma volume change (%) was calculated from haemoglobin concentration and haematocrit. Participants performed an incremental exercise test to exhaustion on an electronically braked cycle ergometer. Oxygen uptake was measured continuously throughout the test, concurrently with cardiac output and stroke volume measurement using thoracic bioimpedance. Change scores were analysed using paired samples t-test and Pearson correlation analyses to determine significant associations.

**Results:** There was no significant ( $p>0.05$ ) change in body mass, stature or body fat percentage during the study. Plasma volume change was not significantly different between the control ( $\Delta 6\pm 8\%$ ) and training ( $\Delta -4\pm 5\%$ ) periods.

Blood albumin, globulin and total protein concentrations also remained constant ( $p>0.05$ ). Peak  $\dot{V}O_2$  did not increase ( $42\pm 9$  (baseline),  $39\pm 7$  (pre-training) and  $41\pm 8$  (post-training) mL.kg<sup>-1</sup>.min<sup>-1</sup>,  $p>0.05$ ), with left ventricular end diastolic and systolic diameters and maximum cardiac index unaffected ( $p>0.05$ ). There was no significant correlation between training period  $\Delta PV$  with  $\Delta$ peak  $\dot{V}O_2$ ,  $\Delta$ heart dimensions or  $\Delta$ maximum cardiac output.

**Discussion:** These data suggest that young girls do not exhibit a significant increase in PV with short-term endurance training. No change in peak  $\dot{V}O_2$  was also observed. These findings may help in understanding why young children show a blunted training response in aerobic fitness compared to adults.

---

## RPE during Prolonged Cycling with and without Carbohydrate Intake in Pre-adolescent and Adolescent Girls

B.W. Timmons, B. Wilk, and O. Bar-Or

Children's Exercise and Nutrition Centre, McMaster University, Hamilton, Ontario, Canada

**Background:** Ratings of perceived exertion (RPE) provide the perceptual interpretation of physiological cues. Compared to adult men, young boys experience a faster rate of increase in RPE during prolonged cycling with no effect of carbohydrate intake. To examine these outcomes in females, we measured RPE in pre-adolescent and adolescent girls during exercise with and without CHO intake.

**Methods:** Thirteen 12-yr-old girls (YG; mean  $\pm$  SD; body mass,  $45.9 \pm 7.8$  kg, height,  $1.57 \pm 0.07$  m, % body fat,  $18.1 \pm 6.7$  %,  $VO_{2max}$ ,  $41 \pm 5$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) and 11 14-yr-old girls (OG; mean  $\pm$  SD; body mass,  $58.4 \pm 4.8$  kg, height,  $1.63 \pm 0.05$  m, % body fat,  $22.9 \pm 5.2$  %,  $VO_{2max}$ ,  $40 \pm 5$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) cycled for 60 min (2  $\times$  30 min with 5-min rest) at  $\sim$ 70%  $VO_{2max}$  on 2 occasions in thermoneutral conditions. Subjects drank 4 ml/kg body mass of a 6% CHO-electrolyte beverage or flavored water (FW) in a double blind, counterbalanced fashion before and during exercise. Whole body RPE (Borg's 6-20 scale) and heart rate (HR) were recorded every 5 min.

**Results:** Average exercise HR for both groups tended ( $P = 0.055$ ) to be higher during CHO compared to FW. HR during the final 30 min of exercise was lower ( $p < 0.001$ ) in YG ( $166 \pm 17$ ) than in OG ( $174 \pm 11$ ). RPE increased during exercise, but was not different between groups or trials reaching  $18 \pm 2$ . The ratio of RPE to HR was not influenced by CHO intake but was higher ( $p = 0.003$ ) in YG ( $\sim$ 11.0) than in OG ( $\sim$ 10.0) during the last 30 min of exercise.

**Discussion:** Even though cardiovascular strain was slightly lower in the younger girls during the final 30 min of exercise, they perceived the task to be harder. These results confirm earlier findings in males that young age is associated with a higher sense of effort when exercise is prolonged.

---

## Is the RDA for Protein Adequate in Young Endurance Athletes?

B.W. Timmons and M.A. Tarnopolsky

Department of Pediatrics, McMaster University, Hamilton, Ontario, Canada.

**Background:** Optimal nutrition for children should allow physically active individuals to meet the energy demands of exercise while supporting healthy growth and development. Given the clear lack of evidence to inform the protein requirements of active children, we sought to determine whether the current recommended dietary allowance (RDA) is adequate for young endurance athletes.

**Methods:** Six endurance-trained children (4 boys and 2 girls, mean  $\pm$  SD: age,  $11.5 \pm 1.0$  y and  $VO_{2max}$ ,  $56 \pm 6$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) recorded their habitual dietary intake for 4 days. As a baseline, each child completed a 24-h urine sample for determination of nitrogen balance (NB) and exercised in the laboratory for 90 min at 65% of their previously determined  $VO_{2max}$ . An individualized diet was then prescribed that maintained habitual caloric intake, but set protein intake to the RDA –  $0.95$  g·kg<sup>-1</sup>·day<sup>-1</sup>, and followed for 7 consecutive days while the children maintained their normal activity routines. Following this adaptation phase, each child continued with their prescribed diet and started a 6-day balance phase with consecutive 24-h urine collections. On Day 1, they exercised for 90 min at 65%  $VO_{2max}$ . On Day 2, they exercised for 60 min at 50%  $VO_{2max}$ . Day 3 was a rest day. This 3-day sequence was then repeated (i.e., Days 4, 5, and 6) with either a 6% sport drink or flavored water consumed during exercise. On Days 1, 3, 4, and 6 of the 6-day balance phase, whole body protein turnover was estimated using <sup>15</sup>N-glycine stable isotope methods.

**Results:** NB at baseline was  $8.1 \pm 4.2$  g·kg<sup>-1</sup>·day<sup>-1</sup>. During the 6-day balance phase NB was lowered to  $1.1 \pm 0.8$  g·kg<sup>-1</sup>·day<sup>-1</sup> ( $p = 0.01$ ), with no effect of the sport drink consumed during exercise ( $p = 0.83$ ). Protein balance calculated using <sup>15</sup>N-glycine was  $0.38 \pm 0.13$  g·kg<sup>-1</sup>·day<sup>-1</sup> over the 6-day balance phase, with no effect of the sport drink ( $p = 0.34$ ).

**Discussion:** Despite reflecting a reduced protein intake of ~50% from habitual, the current RDA resulted in a positive NB and protein balance in these young endurance athletes. Whether the RDA reflects the optimal protein intake for active children deserves further investigation.

## Prediction of children's VO<sub>2</sub>max using OMNI Scale RPE from a load-incremented treadmill test

L. Haile<sup>1</sup>, C. M. Ledezma<sup>1</sup>, R. J. Mays<sup>1</sup>, M. Gallagher<sup>1</sup>, Jr., F. L. Goss<sup>1</sup>, R. Robertson<sup>1</sup>, S. A. Arslanian<sup>2</sup>

<sup>1</sup>Center for Exercise and Health-Fitness Research, University of Pittsburgh, and <sup>2</sup>Children's Hospital of Pittsburgh, Pittsburgh, PA, USA

**Background:** The prediction of maximal oxygen consumption (VO<sub>2max</sub>) from submaximal exercise tests using the relation between heart rate (HR) and VO<sub>2</sub> is commonly employed in the health-fitness setting. Ratings of perceived exertion (RPE) have been used to predict VO<sub>2max</sub> in adult subjects who performed submaximal cycle and field running assessments using the Borg (6-20) Scale, and submaximal cycle ergometer tests using the pictorial OMNI (0-10) Scale. This investigation developed statistical models to predict children's VO<sub>2max</sub> using OMNI Scale RPE measured during submaximal stages of a load-incremented treadmill test in children.

**Methods:** Thirty male (n = 13) and female (n = 17) children (mean ± SD: age = 12.7 ± 2.6 yr; height = 157.3 ± 15.2 cm; weight = 61.4 ± 24.3 kg; VO<sub>2max</sub> = 39.11 ml·kg<sup>-1</sup>·min<sup>-1</sup>) performed a Bruce treadmill protocol terminating at maximal intensity. VO<sub>2</sub>, HR, RPE-Overall body (O), RPE-Legs (L), and RPE-Chest/Breathing (C) were recorded at the end of each test stage. Multiple linear regression was used to develop separate VO<sub>2max</sub> prediction models using HR and RPE-O, L, and C as predictor variables determined from 3 submaximal exercise stages.

**Results:** The correlation coefficients and F values for the prediction models are shown in Table 1. Significant correlations were observed for the models derived from RPE-O and HR, accounting for 27.5 and 28.0 % of the explained variance, respectively.

**Discussion:** Statistical models based on the relation between RPE and VO<sub>2</sub> can provide an easily administered and accurate method to predict maximal aerobic power in young children. The prediction power of the perceptual model was similar to that of the HR model. This investigation concludes that VO<sub>2max</sub> can be predicted from submaximal RPE-O in young boys and girls performing treadmill exercise. Future research should develop gender specific prediction models and explore the application of these models in special populations, i.e. obesity, diabetes, and cystic fibrosis.

RPE-O			RPE-L			RPE-C			HR		
r	R <sup>2</sup>	F	r	R <sup>2</sup>	F	r	R <sup>2</sup>	F	r	R <sup>2</sup>	F
.524*	.275	3.283*	.336	.113	1.104	.392	.154	1.576	.530*	.280	4.156*

---

## **Aerobic fitness, Physical Activity and Renin-Angiotensin System Activity (RAS) in Adolescents Born Prematurely with Very Low Birth Weight (VLBW)**

P.A. Nixon, L.K. Washburn, J. Aye, S. O'Malley, M. O'Shea  
Wake Forest University, Winston-Salem, North Carolina

**Background:** Infants born prematurely with VLBW have increased risk for developing hypertension later in life. The increased risk may be due in part to programming effects of early life exposures on the developing systems (such as the RAS) or lower levels of physical activity and aerobic fitness. The purpose of this study was to examine the effects of physical activity and fitness on measures of RAS and blood pressure in adolescents born prematurely with VLBW.

**Methods:** Forty-four 14-year-old adolescents (17 male, 24 Caucasian, 20 African-American) performed a maximal exercise test on a cycle ergometer to determine aerobic fitness (VO<sub>2</sub>peak). Physical activity was assessed using Kriska's Modifiable Activity Questionnaire, and average total hours per wk (Tot-hrs/wk) and hours per week spent in vigorous (>6 METs) activity (Vig-hrs/wk) for the past year were calculated. Plasma and urinary Angiotensin II (AngII) and 1-7 (Ang1-7) were determined via radioimmunoassay. Resting blood pressure (BP) was measured in triplicate three separate occasions using a mercury sphygmomanometer.

**Results:** Fifty-five % of participants had a VO<sub>2</sub>pk < 80% predicted, and 70% reported less than 2 hours per week of Vig activity (13 reported none). Plasma AngII was inversely correlated with VO<sub>2</sub>peak ( $r=-0.44$ ), but not Vig-hrs/wk. VO<sub>2</sub>peak was inversely correlated with SBP ( $r=-0.31$ ) but not DBP. Plasma Ang1-7 was positively correlated with resting DBP ( $r=0.35$ ), and plasma AngII was correlated with SBP ( $r=0.36$ ).

**Discussion:** These results indicate that aerobic fitness and Ang II are inversely associated. Lack of association of Ang II with physical activity may be due the limited participation by these adolescents. Correlations of BP with pAngII and pAng1-7 provide evidence of both vasoconstrictive and vasodilatory effects, respectively. Further research is warranted to determine if improvements in fitness may reduce RAS and ultimately blood pressure in this at-risk population.

## Assessment of Body Composition in Paediatric Patients with Cystic Fibrosis

J.Schneiderman-Walker<sup>1</sup>, L. Heale<sup>1</sup>, D.L.Wilkes<sup>1</sup>, F. Ratjen<sup>1</sup>, A.L. Coates<sup>1</sup>, G.D. Wells<sup>1,2</sup>

<sup>1</sup>Division of Respiratory Medicine, The Hospital for Sick Children, Toronto, Canada <sup>2</sup>Physiology and Experimental Medicine, The Hospital for Sick Children, Toronto, Canada, and Department of Anaesthesiology, The Toronto General Hospital and University of Toronto, Toronto, Canada

**Background:** Cystic fibrosis (CF) leads to pathological changes in organs that express the cystic fibrosis transmembrane conductance regulator (CFTR), including secretory cells of the digestive tract and the pancreas. Maintaining nutritional sufficiency is challenging for CF patients and is important for their clinical management. The objective of this study was to test the accuracy of four methods of skinfold measurements for determining body composition of paediatric patients with CF, using dual-energy x-ray absorptiometry (DEXA) as a gold standard comparison.

**Methods:** In 55 CF patients (30 F) (age 13.2 yrs  $\pm$ 2.4; FEV<sub>1</sub> 88.9 %pred  $\pm$ 12.9) skinfolds (bicep, tricep, subscapular and suprailiac) and DEXA information were collected. Percent fat (%fat) was calculated via four methods (Slaughter, Durnin, 2-site Durenberg and 4-site Durenberg) and lean body mass (LBM) was determined. The relationship of each of these methods to DEXA was evaluated by ICC and Bland and Altman analyses (BA). A subset of 20 patients (n=19, 10 F) were also evaluated for body composition via magnetic resonance imaging (MRI).

**Results:** The ICCs of 0.92 (%fat) and 0.99 (LBM) for Slaughter were the highest of the four methods. The BA plots revealed that the %fat results were evenly distributed along the range of values for the Slaughter method, with the least bias (bias -0.7, C.I.'s +/- 6.9). With the other three methods, the %fat values were over and under estimated, at the upper and lower ends of the range respectively. Body composition estimates obtained from cross sectional MRI of the thigh demonstrated high correlation with DEXA results ( $r=0.98$ ). MRI %fat results were higher than DEXA by approximately 5% at the low end and 10% at the high end. This was likely due to regional differences in fat deposition. **Discussion:** Body composition may be an important prognostic indicator of clinical outcome in children and adults with CF. While techniques such as MRI and DEXA are highly accurate, the use of skinfold measurements is more cost-effective, non-invasive and feasible, thereby facilitating the tracking of longitudinal changes in CF clinics. We conclude that the Slaughter skinfold method may be used for body composition assessment of paediatric CF patients.

---

## Association of parent reported and measured indices of physical activity and motor skill performance in preschool children

K. Pfeiffer<sup>1</sup>, K. McIver<sup>2</sup>, J. Bland<sup>1</sup>, M. Dowda<sup>2</sup>, J. O'Neill<sup>2</sup>, H. Williams<sup>2</sup>, and R. Pate<sup>2</sup>

<sup>1</sup>Michigan State University, East Lansing, MI and <sup>2</sup>University of South Carolina, Columbia, SC

**Background:** Assessment of physical activity (PA) and its correlates (e.g., motor skill performance) in preschool children is challenging due to inability to reliably query children and limitations of proxy reports (e.g., parents do not observe the school day). The purpose of this study was to examine the relationships between parent-reported PA and accelerometer PA and parent perception of athletic competence and assessed motor skill performance (MSP) in preschool children.

**Methods:** Participants were preschoolers (N=225; age =  $4.2 \pm 0.6$ , 52% female, 50% African American, BMI =  $16.3 \pm 2.3$ ) who wore an Actigraph accelerometer during waking hours for 8-10 days and one weekend. Previously developed count cutpoints were used to categorize PA intensity levels (moderate-to-vigorous- MVPA; vigorous- VPA; total- light plus MVPA). MSP was assessed using a protocol based on the Test of Gross Motor Development (TGMD-2). Process characteristics from six locomotor and six object control activities provided separate scores, which were summed to provide a total motor skill score. Parent-reported PA was assessed using two questions; parent perception of athletic competence was assessed by one question (test-retest reliability  $R=0.81$ ). Pearson correlations were used to assess relationships, followed by linear mixed model regression analysis. Separate analyses were performed for the total sample, by sex, and by race with the three intensities of accelerometer PA and three MSP variables as dependent variables. Analyses controlled for age and BMI (in addition to sex and race for total sample).

**Results:** Relationships between parent-reported PA and accelerometer PA ranged from  $r=0.24-0.29$  ( $p<0.001$ ) for the overall sample,  $r=0.33-0.36$  ( $p<0.001$ ) for males, and  $0.23-0.31$  ( $p\leq 0.05$ ) for African American children; all significant relationships occurred with MVPA and VPA. Correlations for parent perception of competence and MSP ranged from  $r=0.17-0.25$  ( $p\leq 0.05$ ). Results of regression analysis showed that relationships remained significant after controlling for age and BMI (and sex and race for total sample).

**Discussion:** Parent perception of PA and athletic competence showed low but significant correlations with accelerometer PA and measured motor skill scores. Longitudinal analyses are necessary to determine if causality exists in these relationships and if actual skills and behaviors drive parent perceptions or vice versa.

---

---

## Safety of maximal exercise testing in children with pulmonary hypertension

G. Smith, J. Reyes, J. Russell, T. Humpl  
Heart Center, Hospital for Sick Children, Toronto, Canada

**Introduction:** Maximal cardiopulmonary exercise testing is widely regarded as a valuable means to quantify functional capacity in patients with cardiovascular disease. Although several studies have examined exercise testing in adult pulmonary hypertension patients, information regarding pediatric patients is limited, possibly related to safety concerns during exercise. The purpose of this study was to examine the safety of maximal cardiopulmonary exercise testing in pediatric pulmonary hypertension patients.

**Methods:** Exercise and echocardiography data was obtained retrospectively from pulmonary hypertension patients referred for exercise testing at the Hospital for Sick Children between 01/2001 and 09/2007. Patients with a six minute walk distance <300m were excluded from maximal cardiopulmonary testing, which was conducted using a cycle ergometer or treadmill until volitional fatigue. Test results were grouped according to: ischemic ECG changes, presence of arrhythmia, and oxygen saturation at peak exercise, and graded as “mild”, “moderate” or “severe”.

**Results:** Data was gathered from 32 patients (5 idiopathic, 27 secondary) aged 12.5 years (range 6.9 to 18.8) who participated in 66 maximal cardiopulmonary tests with a resting echocardiography RVsp of 79.5 mmHg (33 to 126). Peak VO<sub>2</sub> was 23.2 ml/kg/min (11.4 to 38), with a decrease in SaO<sub>2</sub> to 85% (47 to 100) at peak exercise. Thirty six (55%) patients were on standard pulmonary hypertension therapy at time of testing. There was a frequency of 27% for mild and 2% for moderate arrhythmia. Notable ST depression was graded as mild (13%), moderate (1%), and severe (2%) in all tests. Twenty five (38%) patients had a decrease in O<sub>2</sub> saturations to <85% or a 10% absolute decrease from baseline. There were no significant events as syncope, chest pain, or dizziness. Tests were stopped for fatigue (53%), leg fatigue (23%) dyspnea (21%) or miscellaneous reasons (3%).

**Conclusion:** The results of this study suggest that maximal cardiopulmonary testing can be performed safely in pediatric pulmonary hypertension patients. Although the number of patients in this study was limited, the data suggests that the absence of significant patient symptoms, low incidence of arrhythmia, and no significant ST depression make this a safe choice for measuring functional capacity in this patient population.

---

---

## Sample Entropy Assessment of Short Term Training on Heart Rate Variability

M.T. Nelson<sup>1</sup>, G.R. Biltz<sup>1</sup>, R.J. Winsley<sup>2</sup>, A.C. Roberts<sup>2</sup>, N. Armstrong<sup>2</sup>, K. Stodefalke<sup>2</sup>, D.R. Dengel<sup>1</sup>

<sup>1</sup>University of Minnesota, Minneapolis, MN; <sup>2</sup>University of Exeter, Exeter, UK

**Background:** Heart rate variability (HRV) assessment in children typically uses time domain or frequency domain analysis. Sample entropy (SampEn) is a nonlinear method for assessing the regularity of a data series and has been used to assess neonatal HRV. We hypothesize that SampEn score for HRV will demonstrate the effects of training.

**Methods:** Ten female children ( $9.8 \pm 0.4$  years) completed the 3 stage training study. All measurements were collected at baseline, after a 2 week control period and then after 2 weeks of training. Six exercise sessions were completed for >20 minutes at > 80% of maximum HR. Peak  $VO_2$  tests were completed on an electronically braked cycle ergometer using a continuous protocol with 10W/minute increases until voluntary exhaustion. Serial heart rate (HR) data was collected using a Polar Vantage telemetry system (Polar Electro, Finland) after 10 minutes of quiet relaxation and before each peak  $VO_2$  testing. Breathing was paced at 12 breaths per minute throughout 10 minutes of HR recording. All 30 HR collections were edited to remove the initial 2 minutes before the next 5 minutes of data was analyzed for SampEn score using Kubios software (Beta version 2, University of Kupio, Finland). SampEn was calculated using  $m = 2$  and  $r = 0.2$  SD of N.

**Results:** Peak  $VO_2$  was not significantly improved with the short term training program (pre  $38.9 \pm 7.3$  ml/kg/min vs. post  $40.5 \pm 8.3$  ml/kg/min;  $p=0.29$ ). Similarly, group SampEn score was not significantly changed (pre  $1.45 \pm 0.22$  vs. post  $1.48 \pm 0.26$ ;  $p=0.72$ ). Four of six subjects who increased peak  $VO_2$  with training also increased HRV SampEn score. All four subjects who decreased peak  $VO_2$  with training also decreased HRV SampEn score.

**Discussion:** In this study, the change in HRV SampEn score did reflect the direction of peak  $VO_2$  change with training. A stronger training stimulus and a larger sample size will be needed to further test our hypothesis.

---

## Age Related Gait Variability in Children: A Preliminary Analysis by Sample Entropy Method

S.A. Novotny<sup>1</sup>, G. Biltz<sup>1</sup>, R.J. Wetzsteon<sup>2</sup>, G. Witten<sup>3</sup>, K.J. Swanson<sup>1</sup>, K.A. Pickett<sup>1</sup>, M.A. Petit<sup>1</sup>  
<sup>1</sup> University of Minnesota School of Kinesiology, Minneapolis, MN <sup>2</sup> Department of Pediatrics, Children's Hospital of Philadelphia, Philadelphia, PA <sup>3</sup> PeregrineQuant, Cape Town, S.A.

**Background:** Previous studies suggest that children have decreasing stride time variability with increasing age. The temporal organization of pediatric gait has been assessed by spectral analysis, autocorrelation and detrended fluctuation analysis. Sample entropy, a nonlinear variability analysis technique, measures the inherent regularity of a data sequence. Sample entropy, SampEn, is easily calculated and can be applied to as few as 100 data points. We hypothesize that SampEn assessment of pediatric gait data will demonstrate decreasing stride time variability with increasing age.

**Methods:** Fourteen children (8 males, 6 females) aged  $11.4 \pm 1.4$  years volunteered to participate in the study. All participants completed a 5 minute warm-up on the treadmill prior to testing. Gait data were collected while walking on a treadmill at a self-determined pace for one minute. Participants had a minimum of 100 strides for time series analysis. For data collection, Pedar pressure measuring insoles (Novel Inc., St. Paul, MN) were inserted into participants shoes to determine the onset of each step. The duration between successive ipsilateral heel strike (stride time) was calculated after importing the raw data into MATLAB, where the first and last two gait cycles were removed from the data set. Stride time variability was analyzed using MATLAB code based on the SampEn method described previously by Richman and Moorman (2000). Sample Entropy ( $m, r, N$ ) is the negative natural logarithm of the conditional probability that a dataset of length  $N$ , having repeated itself for  $m$  points within tolerance  $r$ , will also repeat itself for  $m+1$  points. SampEn was calculated with  $m=2$  and  $r=0.2 \times \text{standard deviation of } N$ .

**Results:** The SampEn score for each child's gait data was plotted against their age in years. The distribution of the resulting scatter plot was assessed by linear regression: ( $y=-0.064x+1.837$ ). The negative slope of the regression line is consistent with our hypothesis. However, the  $R^2=(0.25)$  suggests only a moderate correlation.

**Discussion:** SampEn is an alternative way to characterize stride time variability in children using relatively few data points and could extend the potential applications of gait variability analysis. A larger sample size and broader age range are needed to further test this hypothesis

---

---

## Acute mountain sickness at 3450m of altitude is not different between children and adults

B. Soltermann<sup>1</sup>, C. Wick<sup>1</sup>, H.P. Brunner-La Rocca<sup>2</sup>, S. Kriemler<sup>1</sup>

<sup>1</sup>Exercise and Health Sciences, University of Basel and <sup>2</sup>Cardiology, University Hospital Basel, Switzerland

**Background:** Acute mountain sickness (AMS) is an altitude related complication of altitude exposure and includes a symptom complex comparable to an “alcohol hangover”. There is little information about the prevalence of AMS in children and adolescents despite the fact that more and more children visit high altitude resorts for recreational reasons. Furthermore, it is not clear, whether a child adapted version of an AMS questionnaire would reveal different results. We therefore measured AMS in two related generations upon fast ascent to 3450m.

**Methods:** Thirty six children and adolescents (13±2 y) and their parents (n=39, 48 ±6 y) participated. They ascended within 2 hours to 3540m of altitude and stayed there overnight. AMS was measured 8h after ascent, and on the following morning by 1. the adult Lake Louise Score (LLS), 2. the Sampson environmental questionnaire (ESQ), 3. a published child version of the LLS (LLAASS), and 4. an adapted version of the LLAASS. A score of >4 was defined as AMS.

**Results:** The prevalence of AMS on day1 was 18-23% for children and adolescents and 33-41% for adults depending on the questionnaire used. On day2 the prevalence was 8-14% and 24-30% for children and adults, respectively. The cumulative incidence was 27-38% and 33-54% for children and adults, respectively. There were no significant differences in prevalence and cumulative incidence between children and adults, between day1 and day2, nor among the different questionnaires used. None of the subjects had to be evacuated and symptoms responded well to symptomatic treatment.

**Conclusion:** The prevalence of AMS at 3450m of children and adolescents is relatively low, self limiting, and comparable to adults, irrespective of questionnaire used.

---

## Maturity-Related Differences in Physical Activity Among 10-to-12-Year-Old Girls

C.J. Drenowatz<sup>1</sup>, J.C. Eisenmann<sup>1,2</sup>, K.A. Pfeiffer<sup>1</sup>, E.E. Wickel<sup>3</sup>

<sup>1</sup> Department of Kinesiology, Michigan State University, East Lansing, MI. <sup>2</sup> Department of Pediatrics and Human Development, Michigan State University, East Lansing, MI. <sup>3</sup> Athletic Training/Exercise and Sports Science Program, University of Tulsa, Tulsa, OK

**Background:** Several studies have shown a substantial age-related decline in physical activity during adolescence, particularly in girls. The reasons for this decline are often explained by psycho-social factors, thus ignoring the biological basis for physical activity. Therefore, the purpose of this study is to examine the influence of biological maturity status on physical activity.

**Methods:** Participants included 268 girls 9.5 to 11.5 years of age. Chronological age, standing height, sitting height, and body mass were measured and used to calculate the maturity offset, a non-invasive method for determining years from peak-height-velocity. Biological maturity groups (Early, n=33; Average, n=183; Late, n=52) were created according to estimated age at peak-height-velocity (estAPHV) based on the sample mean. Habitual physical activity was determined with a pedometer (Yamax Digiwalker SW-200) over a 7-day period. Differences in steps/day across maturity groups were examined by ANCOVA controlling separately for leg length and body mass.

**Results:** Girls were  $10.3 \pm 0.5$  years of age,  $142 \pm 7$  cm tall, and weighed  $38 \pm 10$  kg. The estAPHV was  $11.7 \pm 0.5$  years and the mean pedometer steps/day was  $10\,822 \pm 2639$ . As expected, body size varied with maturity status (e.g., early > average > late). Significant maturity-group differences were found with early maturing girls showing lower activity levels ( $9706 \pm 2880$  steps/day) compared to average or late maturers (approx. 11 000 steps/day) ( $p < 0.05$ ). These differences remained after controlling for leg length; however, when controlling for body mass the differences were no longer significant.

**Discussion:** The results suggest that biological maturity status influences physical activity levels in girls between 10-12 years of age. These differences cannot be explained by leg length. However, body mass (and perhaps fat) explains this relationship. Further research is needed to establish the complex inter-relationships between adiposity, biological maturation, and energy expenditure during the time of puberty.

---

---

## **Activity and barriers to physical activity in adolescent girls based on chronological and biological ages**

L. B. Sherar, N.C. Gyurcsik, M.L. Humbert, A.D.G. Baxter-Jones  
College of Kinesiology, University of Saskatchewan, Saskatoon, SK, Canada

**Background:** The marked decline in physical activity (PA) during adolescence is well documented. However, minimal research has examined whether the decline in PA among adolescent girls is associated with chronological age (CA) or biological age (BA). The aim of this study is to describe the PA levels and perceived barriers to PA of adolescent girls grouped by CA (i.e., school grade) and BA (i.e., early or late maturing) within grades.

**Methods:** 221 girls (aged 8-16 years; grades 4-10) wore an Actical accelerometer for seven days and then completed a semi-structured, open ended questionnaire on perceived barriers to PA over a 7-day period. Predicted age at peak height velocity and recalled age at menarche were used to assess maturity among the elementary and high school girls, respectively. BA and CA group differences in PA were assessed using a MANCOVA and independent sample t-test, and barriers to PA using chi squared statistics.

**Results:** Daily minutes spent in moderate to vigorous PA decreased by 40% between grades 4 to 10. Within grade groupings, no differences in PA were found between early and late maturing girls ( $p>0.05$ ). Grades 4-6 participants cited more interpersonal (i.e., social) barriers. Grades 9-10 participants cited more institutional barriers to PA, primarily revolving around the institution of school. No differences were found in types of barriers reported between early and late maturing girls.

**Discussion:** Since PA and types of perceived barriers to PA were dependent on CA, future research should work to identify the most salient (i.e., frequent and limiting) barriers to PA by CA in youth. Once reliably identified, multi-pronged intervention strategies to help youth cope with their salient barriers must be tested for effectiveness.

**Funding Support:** NASPEM, SHRF and CPHR.

---

---

## Effect of maturation status on the validity of body mass index in middle school youth

D.P. Coe<sup>1</sup>, J.J. Ode<sup>2</sup>, K.A. Pfeiffer<sup>3</sup>, J.M. Pivarnik<sup>3</sup>

<sup>1</sup>Grand Valley State University, Allendale, MI, USA, <sup>2</sup>Saginaw Valley State University, Saginaw, MI USA, <sup>3</sup>Michigan State University, East Lansing, MI USA

**Background** During maturation, youth experience physiological changes that influence both growth and body composition. As a result, a child's timing and tempo of maturation may influence the utility of the body mass index (BMI) for categorizing youth as overfat. The purpose of this study is to determine the effect of maturation status on the validity of BMI as a measure of adiposity in middle school youth.

**Methods** Subjects were 567 middle school youth (age=11.9±0.9 years). BMI was calculated from height and weight and percent fat was determined using triceps and calf skinfold assessments (Slaughter et al.). The Centers for Disease Control and Prevention (CDC) BMI cut points for age and sex were used to define overweight (≥85<sup>th</sup> percentile). Cut points determined by Williams et al. were used to define overfatness in girls (30%) and boys (25%). Maturity status was determined using the maturity offset equations (Mirwald et al.) and youth were categorized as pre-peak height velocity (PHV; >1 year pre-PHV), at PHV (±1 year from PHV), or post-PHV (>1 year post-PHV). Using percent fat as the criterion measure, BMI sensitivity and specificity were calculated by maturity status for the total group and by sex.

**Results** As a group, sensitivity increased from 81% for pre-PHV to 93% and 92% for PHV and post-PHV, respectively. Specificity decreased slightly from 88% for pre-PHV to 82% and 83% for PHV and post-PHV, respectively. There were no differences in sensitivity or specificity among maturation groups in girls. However, in boys, sensitivity was lower in the pre-PHV group (79%) compared to the PHV and post-PHV groups (100%) and specificity was higher in the pre-PHV group (97%) compared to the PHV and post-PHV groups (84%).

**Discussion** Overfat youth in the PHV or post-PHV groups were more accurately categorized as overweight compared to the pre-PHV group, and the effect is more clearly seen in boys compared to girls. It appears that maturation influences the accuracy of BMI as a predictor of percent fat in boys.

---

---

## Waist-to-Height Ratio and Body Mass Index as Indicators of Cardiovascular Risk in Youth

D. Keefer<sup>1</sup>, J. Caputo<sup>2</sup>, W. Tseh<sup>3</sup>

<sup>1</sup>Millersville University, Millersville, PA, <sup>2</sup>Middle Tennessee State University, Murfreesboro, TN,

<sup>3</sup>University of North Carolina Wilmington, Wilmington, NC

**BACKGROUND:** Previous research has shown that both waist-to-height ratio (WHTR) and body mass index (BMI) display a significant association with total serum cholesterol in older adolescents. However, these relationships were not found to be significant in younger adolescents and children. In an attempt to resolve these equivocal findings, the primary objective of this study was to determine the association between systolic blood pressure (SBP) and both WHTR and BMI in a large sample of boys and girls.

**METHODS:** Data from children and adolescents (N = 1848; males = 964; females = 884; age range = 9 to 17 years) who were part of the 2003-2004 National Health and Nutrition Examination Survey (NHANES) were analyzed. Participants were stratified into three age groups (G1 = 9- to 11-year-olds; G2 = 12- to 14-year-olds; G3 = 15- to 17-year-olds). Chi-square analyses (2 x 2) were used to compare risk levels of BMI (< and > 85th percentile) and WHTR (< and > 0.50) to SBP (< and > 90th percentile) for the entire cohort and specified age groups.

**RESULTS:** There were significant relationships between BMI and SBP values for the entire cohort ( $\chi^2 = 14.54$ ,  $p = .0001$ ) as well as the G2 ( $\chi^2 = 8.27$ ,  $p = .004$ ) and G3 ( $\chi^2 = 5.88$ ,  $p = .0153$ ) sub-samples. A significant association between WHTR and SBP was also noted for the entire sample ( $\chi^2 = 18.79$ ,  $p < .0001$ ) and G2 ( $\chi^2 = 14.42$ ,  $p = .0001$ ) and G3 ( $\chi^2 = 5.97$ ,  $p = .0146$ ) age groups. In contrast, no significant relationships between SBP and WHTR or BMI, respectively, were present for the G1 age group.

**DISCUSSION:** In concurrence with previous research, a significant association was observed between SBP and both BMI and WHTR in the entire NHANES cohort of male and female youth. Interestingly, the youngest group of participants was the only sub-sample that did not display a notable link between SBP and WHTR or BMI, respectively. Viewed in concert, these results suggest that early screening tools for cardiovascular disease risk may be more effective in older children and adolescents.

## Risk of Overweight (ROW) and Overweight (OW) in Mexico City and California Hispanic School Youth.

SR Siegel<sup>1</sup>, ME Peña Reyes<sup>2</sup>, and RM Malina<sup>3</sup>

<sup>1</sup>CSU- San Bernardino, San Bernardino, CA, <sup>2</sup>Escuela Nacional de Antropología e Historia, México, DF, Mexico, and <sup>3</sup>Tarleton State University, Stephenville, TX

**Background:** Childhood obesity is a global concern. Prevalence of ROW and OW has been increasing in the US since the 1960s. ROW and OW tend to be higher in Hispanics than in non-Hispanic whites in the US. As many California Hispanics (CA) are of Mexican decent, a broad look at ROW and OW in CA Hispanic and Mexico City (MC) youth is of interest. The purpose of this study was to ascertain the prevalence of ROW and OW youth 9-18 years in MC (519 males, 552 females) and CA (294,501 males, 285,154 females) based on body mass index (BMI; kg/m<sup>2</sup>). Subjects in the CA sample self-identified as Hispanic.

**Methods:** Height and weight for the MC data set were collected in 1998; BMI was calculated. BMIs from the Fitnessgram reported to CA Dept. of Education (2006) constitute the CA sample. Percentages for ROW and OW were determined from CDC BMI cut-offs based on sex and age specific percentiles (CDC, 2002). The two samples were also classified into the Fitnessgram Healthy Fitness Zone (HFZ) using BMI.

**Results:** Prevalence of ROW and OW are shown in Table 1. In MC, 71 - 89% of males and females were in the HFZ; prevalence was higher in older males and younger females. In CA, HFZ was 52-71% and varied by age and sex. CA females BMI < males in both age groups ( $p < 0.001$ ). The MC BMI did not differ by sex. While the sample sizes are unequal, a t-test indicated that CA BMI > MC BMI for age and sex ( $p < 0.001$ ).

**Discussion:** Regardless of the cutoffs used to indicate health status via BMI, the MC sample appears healthier. The differences between samples may reflect sample size, cohort, population differences, and the secular change in BMI in youth over the last 10 years.

**Table 1.** Prevalence of ROW and OW in MC and CA Hispanic youth by CDC BMI cut-offs

	ROW (%)	OW (%)	ROW (%)	OW (%)
Age (yrs)	Males		Females	
<b>MC</b>				
9-13	18.4	20.5	18.2	11.2
14-18	15.4	7.4	14.4	3.6
<b>CA</b>				
9-13	26.5	29.9	27.0	22.4
14-18	23.2	25.7	24.9	17.1

---

## **Alternate ways of expressing Cardiovascular Disease Risk factors in Mid-Michigan Children**

W. Saltarelli, K. Saltarelli, J. Berry, J. Kriener, P. Visich, W. Leonard  
Human Performance Laboratory, Central Michigan University, Mt. Pleasant, MI.

**Background:** Autopsy data on children has revealed coronary and aortic intimal blood vessel changes suggestive of atherosclerosis. These changes have been linked to the expression of 3 or more cardiovascular disease risk factors (CVDRF). Presently, various cutoff points are used to express each risk factor level for major CVDRF's. However, few studies have attempted to describe the degree of risk attributed to each risk factor or to combine risk from multiple factors in children. Because much confusion exists in the literature by using different cut-points to describe the CVD risk of children, the purpose of this study was to develop a CVDRF inventory that is based on the most recent autopsy and blood vessel imaging evidence to more completely describe CVD risk in children.

**Methods:** After a search of the literature, a 21-point inventory was developed which included all major CVDRF's. Each of the following risk factors was assigned a risk score (0-3) based on either the degree of intimal damage from autopsy studies, imaging studies or accepted normative values. The risk factors included smoking behavior and exposure to secondhand smoke, blood pressure, blood glucose, non-HDL cholesterol, body composition (BMI), family history of CVD, and physical inactivity.

**Results:** When applying this scale to the Cardiovascular Health Intervention Program (CHIP) data including 2132 Mid-Michigan 6<sup>th</sup> grade children we found the average score was  $4.4 \pm 2.2$ . More alarming we found that only 4% of the children had a score of 0 meaning they had no CVD risk factors while 4% had scores  $\geq 9$ .

**Discussion:** These numbers in themselves have minimal value at this time, however they maybe a basis for further study when evaluated in relation to imaging and blood flow studies especially for evaluating intervention programs. In addition this scoring system maybe more sensitive than traditional cut point systems at describing children's risk and could be used as a tool to help motivate children to improve their risk factor profiles.

---

## Body Image Perception and Dissatisfaction among Overweight Children and Adolescents in Relation to Age, % Body Fat, and Caregiver Perceptions

S. Kelley, B. Wilk, and B.W. Timmons

Children's Exercise and Nutrition Centre, McMaster University, Hamilton, Ontario, Canada

**Background:** Clinical management of childhood obesity is a critical issue. Since many co-morbidities of childhood obesity relate to various emotional and behavioral problems and an overall reduction in quality of life, it is necessary to consider how these issues impact clinical success. We report on the perception of current body image and dissatisfaction in overweight youth and how these perceptions are related to age, % body fat (BF), and caregiver's perceptions.

**Methods:** A pictorial (7 figure – gender specific) scale reflecting a range of body images from lean to overweight was presented in a standardized and blinded manner to 108 youth (ages 5-18) and a caregiver at one of their initial visits to a weight management program. Each child was asked to select a figure, best reflecting their current body image (C) and one that they would like their body image to be. The caregiver was asked the same question regarding their perceptions about the child. Answers were scored with the difference between current and desired body image taken as the level of body image dissatisfaction (D). Percent BF was assessed using BIA. Spearman correlations were calculated to describe the associations.

**Results:** Eighty-four % of the participants (45 boys, 46 girls) were at or above the 95<sup>th</sup> %ile of weight for age. Significant correlations were found between C and %BF ( $r = 0.51$ ,  $p < 0.0001$ ) and age ( $r = 0.49$ ,  $p < 0.0001$ ) and between D and %BF ( $r = -0.32$ ,  $p = 0.0008$ ). D was not correlated with age. Caregiver's rating of the child's C and the child's rating of their C was correlated in the boys ( $n = 54$ ,  $r = 0.45$ ,  $p = 0.0007$ ), but not in the girls ( $n=54$ ,  $r = 0.23$ ,  $p = 0.10$ ). There was no correlation between caregiver's D and the child's D ( $r = 0.10$ ,  $p = 0.28$ ).

**Discussion:** Body image dissatisfaction in overweight youth may be a useful and age-independent predictor of success in a weight management program. How the caregiver's perceptions of body image influence the child's clinical success deserves further investigation.

---

## Prevalence of Healthy Behaviors among Michigan High School Students

M. E. Holmes, P. Bauer, J. L. Knous, J. J. Ode, J. M. Pivarnik  
Michigan State University, East Lansing, MI USA

**Background:** Little is known about the proportion of high school students who participate in healthy lifestyle behaviors based on current age appropriate recommendations. Our purposes were to 1) examine the prevalence of healthy diet and physical activity related lifestyle behaviors in high school students and 2) examine the distribution of students' body mass index (BMI) and prevalence of overweight based on their specific healthy lifestyle profiles (HLP).

**Methods:** Students (N=2111; 50% boys) at two mid-Michigan high schools completed a survey addressing nutrition and physical activity behaviors in Fall, 2004. Height and weight were self-reported and used to calculate BMI. Students were categorized into a HLP group by determining how many of the following five healthy behaviors were met: consuming the recommended servings of milk, fruits and vegetables, and soda pop, participating in physical activity and limiting sedentary pursuits. Prevalence and 95% confidence intervals were calculated to determine the proportion of students participating in each behavior. ANCOVA testing examined differences in BMI among HLP controlling for grade and gender. Chi-square analysis examined differences in proportion of overweight among HLP groups.

**Results:** Participation in individual healthy behaviors ranged between 9.2% (fruit-vegetable recommendation) to 78.9% (soda pop recommendation). Approximately 2% of the total sample met the recommendations for all five behaviors, with notably more boys meeting all recommendations. There were no differences in BMI among the HLP groups among boys. Girls who participated in only one healthy behavior had significantly greater BMIs than girls who participated in two, three, and four healthy behaviors (26.0 vs. 22.0, 22.1, and 21.7, respectively;  $p < 0.05$ ). The proportion classified as overweight did not differ by HLP groups ( $X^2=3.56$ ,  $p= 0.61$ ;  $df= 1,5$ ).

**Discussion:** Very few high school students, particularly girls, participate in all five healthy behaviors. The prevalence of consuming five fruits-vegetables per day is particularly low. Similarities in BMI among HLP groups suggest that participation in any number of healthy behaviors has only slight influence on BMI, thus other factors likely contribute to overweight and obesity in this age group

---

## Effects of a Family History of Non-Insulin-Dependent Diabetes Mellitus on Body Composition in Adolescents

L.M. Guth, L.E. Hanna, K.A. Craft, A.D. Mahon  
Human Performance Lab, Ball State University, Muncie, IN

**Background:** High android fat distribution is independently correlated to non-insulin-dependent diabetes mellitus (NIDDM) and metabolic abnormalities, such as increased fat oxidation and decreased glucose utilization during exercise. Fat distribution patterns are largely inherited, thus adolescents with a family history for NIDDM may exhibit increased android fat distribution patterns.

**Methods:** Body composition and regional fat distribution were measured by dual energy x-ray absorptiometry in 14 adolescent boys (aged 13 - 15 years) with either a positive family history of NIDDM (POS; N = 6) or no family history of NIDDM (CON; N = 8). POS was defined as having at least two second-degree relatives or one first-degree relative with NIDDM. Groups were matched for height, weight, BMI, and pubertal status. All data were analyzed by independent t-tests.

**Results:** There were no differences in whole-body fat percentage between POS ( $18.9 \pm 6.6\%$ ) and CON boys ( $18.2 \pm 10.1\%$ ). Additionally, no differences were observed in fat distribution patterns. In POS, android fat percentage was  $21.9 \pm 9.4\%$ , gynoid fat percentage was  $26.3 \pm 7.3\%$ , and the android/gynoid ratio was  $0.81 \pm 0.21$ . In CON these values were  $19.1 \pm 12.6\%$ ,  $24.8 \pm 11\%$ , and  $0.74 \pm 0.18$ , respectively. There were no significant differences between groups for any of these comparisons.

**Discussion:** There is no indication of altered body fat percentage or fat distribution in adolescents with a positive family history of NIDDM. This lack of alteration may be due to the age or fitness level of these subjects, as android fat distribution is typically lower in younger age groups as well as those who are physically active.

---

## Physical Activity Levels and the Metabolic Syndrome In Young Girls

K. D. DuBose, R.C. Hickner, P. Brophy, G.I Geyer, L. Westerkamp, J. Finkelstein, M. T. Mahar.  
East Carolina University, Greenville, NC

**Background:** This study investigated the relationship between physical activity levels and the metabolic syndrome (MetSyn) in young girls.

**Methods:** Twenty-eight prepubescent girls (mean age =  $9.2 \pm 1.3$  years) had a fasting blood sample drawn to measure HDL, glucose, and triglyceride concentrations. Waist circumference and blood pressure were also measured, and an ActiGraph accelerometer was worn for five days. Previously published cut-points were used to estimate the minutes of moderate, moderate-to-vigorous, and vigorous intensity physical activity from the ActiGraph. Meeting physical activity recommendations was defined as accumulating 60 min/day of moderate-to-vigorous intensity physical activity (MVPA). The MetSyn was defined as the presence of 2 or more of the following components: low HDL, high glucose and triglyceride levels, elevated waist circumference and systolic and/or diastolic blood pressure. Fisher's exact test was used to examine the differences between moderate, moderate-to-vigorous, and vigorous intensity physical activity and between MetSyn groups, and its related components. Logistic regression examined the relationship between physical activity levels and the MetSyn and its related components.

**Results:** Only 32% of the girls met current recommendations for MVPA. Thirty-nine percent had either none or one component of the MetSyn, 26% were classified as having the MetSyn, and only 4% had three or more MetSyn components. Other than a high waist circumference (50%) the most common components were high triglyceride (18%) and low HDL-cholesterol concentrations (18%). The percent of girls meeting physical activity recommendations was similar among those who had the MetSyn compared to girls who did not have the MetSyn ( $p > .05$ ). Likewise, the percent of girls having individual components of the MetSyn was similar between those who either did or did not meet MVPA recommendations. Meeting physical activity recommendations (i.e., MVPA) was not associated with the odds of having the MetSyn (OR=0.35, 95%CI: 0.04-3.55). Further, MVPA was not associated with individual components of the MetSyn ( $p > .05$ ); however, a trend was observed between MVPA and waist circumference (OR=0.17, 95%CI: 0.03-1.03;  $p=0.054$ ).

**Discussion:** As defined in this study, 26% of girls had the MetSyn. Meeting MVPA recommendations was not associated with the MetSyn or its related components.

---

## Incidence of non-functional overreaching in young athletes

N. Matos, C. Williams, R. Winsley

Children's Health and Exercise Research Centre, School of Sports & Health Sciences,  
University of Exeter, UK

**Background:** If the balance between training / non-training stressors and recovery is disproportionate, the athlete may be at risk of becoming overreached or overtrained (Kuipers and Keizer, 1988). Information concerning the incidence and symptoms of overreaching / overtraining in young athletes are scarce. The aim of this study was therefore to assess the incidence of self-reported non-functional overreaching (NFOR; Meeusen *et al.*, 2006), and its associated symptoms in national / international-level athletes (NIA) and sub-national level athletes (Sub-NA).

**Methods:** One hundred and eighty-seven athletes (60 girls, 127 boys) from a range of individual and team sports (mean age:  $14.4 \pm 1.8$  yrs) completed a 92-item questionnaire about training practices, experiences of NFOR, and psychosocial stress. Athletes were classified as being NFOR if they reported having experienced daily fatigue and a significant decrement in performance for more than 2-weeks during training. Data were analysed using Mann-Whitney non-parametric test. Statistical significance set at  $p < 0.05$ .

**Results:** For the analysis, 2 groups were formed: Sub-NA (N=136), and NIA (N=51). Both groups had similar years of involvement in the sport (4-6 years), but the Sub-NA trained fewer hours per day ( $>3\text{hr}\cdot\text{d}^{-1}$ ; 28% (NIA) vs. 18% (Sub-NA)), and less days per week compared with the NIA ( $5-6\text{d}\cdot\text{wk}^{-1}$  (NIA) vs.  $4-5\text{d}\cdot\text{wk}^{-1}$  (Sub-NA)). However, 22% and 36% of the Sub-NA and NIA respectively, were classified as NFOR.

**Discussion:** The symptoms reported by the NFOR athletes were similar for both the Sub-NA and NIA athletes; greater incidence of upper respiratory tract infections, frequent problems with sleep, loss of appetite, persistent feelings of fatigue, higher incidence of injuries, mood fluctuations during hard training and competition, lack of confidence when competing, feelings of apathy, and perception of failure to meet parental expectations.