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Physical Activity as Medicine

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Introduction

Asthma, the largest cause of school absenteeism; an accelerating rate of young athletes impacted by mTBI (concussion); and children in large numbers dropping out of sports; these are the factors that inspire my research teams. We believe that Strategically designed programs related to sport, physical activity and physical education are akin to medicine; that is developmentally and age appropriate physical activity can contribute substantially to functional health and wellbeing. However, obstacles remain: These include obesity, chronic lung disease, head injury, and persistent sex differences in some sports-related skills. We have sought to address these issues by studying children in natural environments and by applying sophisticated designs and new technology. What follows is a series of synopses that characterize our work to-date.

The Research Program

Our first study challenges notions that children with asthma are at risk when it comes to vigorous aerobic activity. We used repeated measures and hierarchical linear modeling to compare aerobic performances by children with asthma and their non-asthmatic peers [1]. We found that although children with asthma began the test at a lower level of aerobic performance, they eventually reached the same performance level as their non-asthmatic peers:

Asthma and Aerobic Performance in Middle School Children

Background/purpose

Physical educators and allied health professionals are in the midst of a nationwide effort to increase youth fitness. Among several parameters central to physical fitness, none stands out more than aerobic capacity. And because aerobic capacity represents the functional limits of the O_2 delivery chain, its status is a key indicator of cardiovascular health. The centerpiece of most school based physical fitness programs is effective assessment. Field based graded exercise tests such as the Progressive Aerobic Cardiovascular Endurance Run (PACER) provide valid and reliable measures of children's aerobic performance. However, questions arise as to the appropriateness of such tools for children with health impairments such as asthma. The purpose of this study was to examine aerobic performance by children grades 4-8 with and without asthma.

Method

The design of this study was multi-cohort, sequential. Five cohorts of children (i.e., grades 4-8) were tested three times (September, January, May) on the PACER during the 2007-2008 school year, with follow up tests the succeeding year in September and December. Among 826 participants were 103 children with managed asthma [2].

Analysis/results

Hierarchical Linear Modeling (HLM) was applied to analyze the data. HLM models individual variation in growth (i.e., change) and permits hypothesis testing of possible growth correlates. Essentially a regression equation was computed for each child's baseline (intercept) and change over time (slope). Several key findings emerged: As anticipated, children with asthma performed nearly 3 fewer laps at intercept then their peers without asthma (γ = -2.74, t (804) = - 2.783, p=.006). Results for slope were reversed [3]. Among children without asthma, PACER scores increased .19 laps/month or a gain of 2.3 laps (γ = .193, t (805) =4.217, p<.001). However, children with asthma increased their PACER scores by .424 laps/month (γ = .424, t (805) =2.272, p=. 023). In addition, PACER scores for all participants were negatively associated with BMI (p<. 001) and positively associated with after school sports participation (p<.001).

Conclusion

Notwithstanding lower scores at baseline (intercept), children with asthma increased their performance on the PACER at a rate more than double that of their peers without asthma. By

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month 14, performances of both groups were about equal [4]. It was tentatively concluded that the PACER is an appropriate tool with which to examine aerobic performance by children with managed asthma. It also appears that the PACER may have value as an instructional as well as an assessment tool.

Our next study used Optogait, a relatively new technology to assess gait patterns in elite college soccer players [5]. Participants completed eight trials of the Optogait test battery. As reported by Engelson, (in press) OptoGait is a floor based photocell system that measures body movements and body mechanics. The Optogait system consists of a laptop, two two-meter modules, and two cameras. In the present study, modules were set up six feet apart. Each module is equipped with LEDs to sense when the foot leaves and enters the system. Cameras were set up at the front and side of each participant to record non-timed occurrences.

Monitoring Treatment and Recovery of Post Concussion Athletes

Background

The accelerating prevalence of sports-related mild traumatic brain injury (mTBI) has become a national health concern. According to Center for Disease Control (CDC) statistics, mTBI accounts for nearly nine percent of injuries in nine key high school sports [6]. An important component of any mTBI treatment plan is the decision to return the athlete to competition. The purpose of this pilot study was to examine the efficacy of the Optogait System, a new technology, to monitor recovery of athletes with mTBI. This study represents an initial step in this process by determining validity coefficients among Optogait, the Balance Evaluation Scoring System (BESS), and the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) [7]. Both BESS and ImPACT are accepted for use in recognition and diagnosis of mTBI.

Method

Participants were 20 college women varsity soccer players. Participants completed eight trials of the Optogait test battery. OptoGait is a modular system that measures body movements and body mechanics. In this study, Optogait was applied to assess each participant's gait as she marched in place, including conditions of sensory deprivation. Special goggles were used to impair vision, while earplugs and noise reduction earmuffs were used to restrict hearing. The Optogait system consists of a laptop, two one-meter modules, and two cameras [8]. The modules were set up six meters apart, each equipped with LEDs to sense when the foot leaves and enters the system. Cameras were set up at the front and side of each participant to record non-timed occurrences. Participants also completed six trials of the Balance Evaluation Scoring System (BESS) (double legged stance on solid and foam surfaces, non-dominant leg stance on solid and foam surfaces, and tandem stance on solid and foam surfaces). Finally, participants completed the ImPACT test. ImPACT is a neurocognitive test battery that assesses verbal memory, visual memory, reaction time, and visual processing speed. Sequence of all testing was randomized [9]. Medical histories were recorded for each participant. The design was correlational. It was hypothesized that meaningful correlations would exist among the three test batteries. Results--Several patterns emerged: First, correlations for the eight Optogait subtests were related to the Balance Double-Leg Foam Test (BESS). Correlations ranged in magnitude from r=0.43 (p=.049) to r= 0.58 (p=.006). Second, over one quarter of the correlations between Optogait standard deviation measures and the Balance Tandem Hard Surface Test (BESS) were significant at the p<.05 level. These ranged from r=0.48 (p=.029) to r=.89 (p<.001). Finally, a very specific pattern was observed between the Optogait Marching Eyes Open Hearing Impaired scales and ImPact Visual Memory scale, with six of eight correlations significant at the p<.05 level. These correlations ranged from r=.48 (p=.029) to r=.51 (p=.017).

Conclusion

It was concluded that meaningful correlations existed among the tests and that further large-scale study is warranted [10]. These investigations should employ larger samples and include athletes from a variety of sports such as football, ice hockey, and basketball. Given the high prevalence of injuries associated with frequent falls, another avenue of investigation might be Optogait performance by the elderly.

The last study I will present examines development of two important object control skills. Throwing and striking are important as they are used in several games and sports. Without adequate fundamental movement skill development, children will be limited in terms of opportunities to participate in games and sports. In this study, we gave careful consideration to potential sex differences.

Development of Throwing and Striking with Special References to Gender Differences

Purpose

Object control skills (OCS) provide the means for children to be physically active. In fact, success in OCS in childhood is predictive of performance in adolescence. However, gender equality in some OCS remains elusive. Particularly troublesome is the basic throwing pattern and by extension the striking pattern; both of which rely on forceful, rapid rotation of pelvis, trunk and shoulders. Some scholars argue that gender differences in throwing and striking are rooted in human evolution. The purpose of this study was to examine development of throwing and striking at the fundamental movement level. Methods: The design was multi-cohort sequential: Two hundred eighty boys and girls grades k-8 (ages 4-15) were tested up to three times per year per year for five years on the Test of Gross Motor Development (TGMD-2). Children in grades 5-8 (year one) were tested progressively fewer times [11]. Hierarchical linear modeling (HLM) was applied to analyze individual growth curves. Results: As anticipated, significant (p<.001) age-related gains were found for throwing and striking. In terms of gender differences, boys performed better at intercept and slope for throwing (p<.05) and striking (p<.05).

Conclusion

These results reinforce theories that girls may be disadvantaged in achieving proficiency in these skills. Interventions designed to enhance development of throwing and striking should be in place long before grade four when most PE curricula transition to games and sports.

Conclusion

Our findings, of course, are tentative and further work is required to address key questions such as, can instruction be designed to eliminate gender differences in object control skills? Can Optogait technology be used to determine the safest time for an athlete to return to competition? How does obesity interact with asthma to impact aerobic capacity?

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