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Metabolic health and academic achievement in youth at risk for high school dropout in rural Mississippi: The role of classroom management

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ABSTRACT

Disparities in health and academic achievement affect large cross-sections of the same population subgroups. This study examined the relationship metabolic health and academic achievement in youth "at risk" for school dropout in rural Mississippi. Fifteen adolescents participated in a studio based learning educational summer camp and subsequent follow-up sessions during the regular school year that were aimed at developing knowledge of core curriculum subjects by developing design projects based on the camp STEM-related theme. These projects are characteristic of a pedagogical technique known as Studio Based Learning (SBL) and involve more movement than a traditional classroom setting. Participants' metabolic health was assessed via measurements of blood lipids and glucose, blood pressure, BMI and waist circumference, and examined individually and as a combined risk score. Academic achievement measurements were obtained from district standardized testing. Mean BMI for this sample was classified as overweight; however, other metabolic parameters (blood lipids and glucose, and resting blood pressure) were in normal ranges for this age group. Little association was found between metabolic health and academic achievement and in this sample for math of language ($r = -0.56$ and 0.20, respectively). Participants took part in notable amounts of moderate-to-vigorous physical activity during the SBL camp and very little in the traditional classroom setting (approximately 30 vs. 7 min/day, respectively). Actively engaging teaching strategies, such as SBL, may impart a meaningful impact on physical activity levels of school-aged children, which may have long term, positive health outcomes.

1. Introduction

Researchers acknowledge certain aspects of health as "educationally relevant" (Basch, 2011b), suggesting childhood obesity is linked with academic underachievement as well. Segments of the population who consistently are reported as having higher rates of obesity and lower levels of physical activity often comprise the same groups identified for greater educational disparities. For example, African American females and Mexican American males are the least physically active populations in youth, and also have a high percentage of school dropout (Basch, 2011c; Colquitt et al., 2011). Physical activity alone will not close the gaps in academic achievement and health disparities, but it does provide a means of directly targeting strategies to improve cognitive function (Best, 2010), while simultaneously benefiting multiple health-related parameters (Eisenmann, 2003).

Schools are ideal settings for targeted physical activity interventions in youth and often stem from physical education programs. A decline in physical activity opportunities within the school day can partially be attributed to schools' shift in focus from physical education to core curriculum due to the No Child Left Behind Act (NCLB) of 2001. Decreasing environmental cues contribute to the decline in physical activity over the lifespan. Given that the age-related decline in physical activity appears to be more severe among the same people who exhibit educational disparities (Basch, 2011c), it is critical to identify ways to increase physical activity opportunities in the everyday settings of this demographic.

Studio based learning (SBL) is a multidisciplinary approach in educational reform efforts that inherently incorporates physical activity into the learning process by a making and doing pedagogy. SBL is typically used in learning places centered on design and creation and has been shown to foster skills in higher-order thinking, knowledge transfer, professional literacy, collaboration, and motivation (Attoe and Mugerauer, 1991; Boyer and Mitgang, 1996; Schön, 1983). SBL time is spent in perpetual progression towards more technically accurate,

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artistically, and scientifically superior design proposals.

The purpose of this study was twofold: 1) investigate the relationship between metabolic health and academic achievement in a sample of youth who were identified as at risk for school dropout; and 2) examine the role a SBL environment may have on these variables.

2. Methods

2.1. Participants

Participants in this study are involved in a larger service project called Generation S-Studio School. Recruitment for this project is a multi-stepped process initiated each spring for over a decade. The process involves recruitment of students ranging from 5th through 12th grade from a single rural, high-poverty school district to maintain a 40-participant project total. Generally, new enrollees are middle school-aged. Principals and teachers select participants to refer, and then Generation S-Studio School staff make home visits to describe in full the experience to the referred students and their respective family members. Interested participants are then enrolled in the Generation S-Studio School program.

In a global sense, participants are defined by a myriad of characteristics known as "at-risk" for school drop out in the K-12 student performance literature. Empirical research data has shown high poverty, poor attendance, frequent behavior referrals, low academic grades, weak social connections at school, relative little extra-curricular involvement, low motivation as "at risk" characteristics (Freeman and Simonsen, 2015). For the present study, principals and teachers suggested possible participants based upon the presence of "at risk" qualities defined in the existing research literature. There were no participant exclusion criteria. Participants in the Generation S-Studio School project may choose to participate in the research portion of the work, but being a research participant is optional, provides no extra incentive, and does not provide for any difference in experience or treatment. This investigation examined the fifteen adolescents (4 females, 11 males) who participated in the 2013 Generation S-Studio School summer camp for which healthy snacks and transportation were provided. All participants provided assent and parental consent was obtained prior to collection of any data. This study was approved by the University Institutional Review Board.

2.2. Studio based learning environment

The Generation S-Studio School program is comprised of summer camp and academic year portions, and was created as an educational intervention strategy targeting kids at high risk for school dropout. Briefly, academic content is embedded in design problems presented to Generation S-Studio School participants to solve. The summer camp was structured as a two week day camp. During the academic year, participants took part in tutoring, various field trips and presentations, as well as assessment of relevant study variables.

Studio based instruction involves a "propose, critique, iterate" cycle of repetitive thinking and learning which provides participants opportunity to develop skills of higher-order thinking and self-reflection. Further, SBL provides several movement opportunities for learners, compared to the typical classroom setting. SBL has previously been described as an undertaking, a collaborative, a discovery, an integration, an application and a sharing (Lackney, 1999). These descriptors communicate the active nature of SBL pedagogy, and demonstrate a consistency with the National Association for Sports and Physical Education standards 1 and 5 which require the physically literate to use motor skills and movement patterns as a part of learning and to value self-expression and social interaction. Likewise, the Monson and Poros definition emphasizes an increase in moderate to vigorous activity with multi-modal analysis, proposition, and critique in a space alive with movement (Monson and Poros, 2003). Learners have choices in a studio and are allowed to move about freely to consult and interact with the lived-in environment.

Within the present research setting, moderate to vigorous physical activity was incorporated by allowing participants to choose how they wish to design a physical activity into the academic regimen each day. Students were allowed to choose from a variety of equipment, games, partners, small group, large group, indoor and outdoor settings in which to consider movement as an act of redesigning self and redesigning school.

2.3. Anthropometry

Anthropometric variables were measured in duplicate by a single technician at Studio School Camp and again during the fall semester. Sitting and standing height were assessed using a portable stadiometer (Shorr, Maryland, USA). Weight was assessed using a digital scale that also calculated percent body fat via a foot to foot bioelectrical impedance analyzer (Tanita Corporation, Japan). Body mass index was calculated using weight and standing height. Waist circumference (WC) was measured in duplicate immediately above the iliac crest using a Gulick tape. Anthropometric measures were also used to calculate maturity offset (Mirwald et al., 2002), which was used to account for the various physiological differences due to maturity status.

2.4. Physical activity assessment

Accelerometer data collection took place during both weeks of camp and for one week during the school year. Upon arrival to camp, participants were fitted at the waist with an Actigraph GTX3+ accelerometer (Actigraph, Pensacola, FL). For the purpose of comparison, participants were given the same accelerometer during the subsequent fall semester to wear during the school day for one week, and only the hours corresponding with camp times were used in analyses. Accelerometers were distributed to participants before school and collected at the end of each day. Physical activity was reported as minutes spent in sedentary, light, moderate, and vigorous levels. Data were analyzed with Actilife 6 software using Evenson cut points (Evenson et al., 2008), in accordance with recent data processing recommendations (Trost et al., 2011).

2.5. Assessment of metabolic health parameters

An automated blood pressure cuff was used to determine systolic and diastolic blood pressures (Dinamap). To ensure resting measurements, participants sat quietly for at least ten minutes prior to assessment. Blood pressure was assessed twice, averaged, and used to calculate mean atrial pressure (1/3 Pulse Pressure + DBP).

Participants arrived at camp in a fasted state on the day of the blood sample. A 35 μL sample was collected and analyzed using a desktop analyzer (Cholestech LDX System) for blood glucose, triglycerides (TG), and lipoprotein cholesterol. The calibration of the analyzer was checked each day of use and accuracy is within industry standards (Bastianelli et al., 2017).

A composite risk factor, or metabolic syndrome score (MetS), was derived by summing the age-standardized residuals (*Z*-scores) for glucose, mean arterial pressure, high density lipoprotein cholesterol (HDL−C), TG, and WC (Brage et al., 2004). Because metabolic syndrome typically does not manifest until later in life, the use of a composite risk score allows each subject to have a risk indicator based on his/her current cardio-metabolic characteristics. A lower score is indicative of a better metabolic risk factor profile relative to the study sample.

2.6. Academic achievement

Academic achievement was determined using results from