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Effects of a Physical Activity Intervention on the Stress Reduction of Underserved Adolescent Youth

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PHYSICAL ACTIVITY AND STRESS

Effects of a physical activity intervention on the stress reduction of underserved adolescent youth

By

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Abstract

Stress levels of American teenagers are rising. Studies show that teens are reporting higher stress levels than what they perceive to be healthy and that these levels are higher than the levels of perceived stress reported by adults (APA, 2013). In addition to reporting unhealthy levels of stress, adolescents are also reporting feeling overwhelmed and depressed due to their stress (APA, 2013). Consequently, about half (49.5%) of U.S. adolescents meet DSM-IV criteria for at least one class of mental disorder (Merikangas, 2010). These findings are especially true for underserved adolescents who are more likely to have exposure to violence, discrimination, racism and conditions of poverty in addition to experiencing the typical stressors associated with adolescence such as academics and peer pressure (American Academy of Child and Adolescent Psychiatry, 2019; APA, 2013; CDC, 2017 Youth Risk Behavior Surveillance). Underserved youth also face barriers that prevent them from engaging in PA such as a lack of support and safety concerns (Dubow et al., 1997). Physical activity (PA) has long been known to benefit physical health and has more recently been shown to improve mental health, specifically stress. However, little research has examined how an intervention to increase youth PA can reduce perceived stress and related internalizing symptoms among adolescents. The current study set out to 1) examine the degree to which youth within underserved communities are stressed and experiencing internalizing symptomology considering variations by key youth characteristics (i.e., race, gender, age) and 2) to examine whether youth in the PA intervention have greater reductions in stress and internalizing symptoms as compared to youth in the control from baseline to post-intervention, controlling for individual variances in race, gender, age, and program site. With alarmingly high rates of stress among adolescents, particularly among underserved youth, implementation of a PA intervention within after school programs (ASPs) offers potential to reduce youth stress through improving adolescent PA engagement. ASPs offer a safe, educational and positive environment for students after normal school hours. Because ASPs are tasked with promoting positive behavior and attitudes in a large number of youth and because physical activity has been shown to improve health through stress-reduction, implementing a PA intervention in ASPs is especially important. Findings from the present study determined that in a sample of 338 adolescent youth from underserved communities in the southeast region, baseline stress levels were at similarly high levels compared to national averages and that there were no statistically significant differences by gender, age, race or intervention versus control. However, findings from the study found no differences in students perceived stress or internalizing symptoms between the control and interventions at baseline and endpoint. This project has applications in the fields of healthcare, public health and education because it will have a direct impact on the mental and physical health of middle-school youth.

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Effects of a Physical Activity Intervention on the Stress Reduction of Underserved Adolescent Youth

The finding that stress has damaging effects on both physical and mental health has been consistently supported by scientific literature. Despite these findings, *Stress in America*, an online poll of over 1,000 U.S. adolescents aged 13-17, found that the average adolescent reported higher perceived stress than their adult poll counterparts and higher levels of stress than what adolescents perceive to be healthy (APA, 2013). Specifically, adolescents reported stress at a 5.8 on a 10 point scale, compared to adults rating at 5.1 and adolescents' perceived healthy level of stress at a 3.9 (APA, 2013). Evidence suggests that chronic stress in adolescence leads to poor long-term mental and physical health, proving a significant need to reduce adolescent stress (WHO, 2019). In addition to reporting unhealthy levels of stress, 31% of teens indicated feeling overwhelmed, and 30% felt depressed as a result of stress, corroborating previous evidence that stress has damaging effects on mental health (APA, 2013). These findings are especially true for underserved (low socioeconomic, minority status) adolescents who are more likely to be exposed to violence and conditions of poverty in addition to experiencing traditional/typical stressors associated with adolescence such as academics and peer pressure. In a study conducted by the Center for Disease Control and Prevention (CDC), titled the Youth Risk Behavior Surveillance, 46.8% of female Hispanic adolescents and 40.7% of black female adolescents reported feeling sad or hopeless almost every day for 2 or more weeks so that they stopped doing usual activities, as compared to only 38.2% of white female adolescents (CDC, 2017-Youth Risk Behavior Surveillance). These adolescents are also more likely to have exposure to violence and conditions of poverty, evidenced by 6.5% of black adolescents and 5.9% of Hispanic adolescents reporting carrying a gun (for reason other than hunting/sport) at least once in the past 12 months, compared to 4.1% of their white counterparts (CDC, 2017). Disadvantaged youth also face barriers that prevent them from engaging in PA such as a lack of support and safety concerns (Dubow et al., 1997; Romero, 2005). Physical activity (PA) has numerous benefits on both physical and mental

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health including reduced risk of disease, lowering of blood pressure, mood enhancement and reduction of stress hormones (cortisol and adrenaline; Gerber & Pushe, 2009; Harvard Health, 2018; Strong et al., 2005). Despite this backing, little research has been conducted on PA as an effective mechanism to reduce adolescent stress. 10.2 million youth are annually enrolled in after school programs (ASP) during the school year (Afterschool Alliance, 2014). These programs offer a safe, educational and positive environment for students after normal school hours (Afterschool Alliance, 2015; Youth.gov, n.d.). Given that school-aged youth spend 80% of their waking hours outside of school, ASP's are uniquely positioned to impact youth behavior including PA, particularly in underserved areas (Afterschool Alliance, 2014). Because ASPs are tasked with promoting positive behavior and attitudes in a large number of youth and because physical activity has been shown to improve health through stress-reduction, implementing a PA intervention in ASPs has great promise/potential for supporting youth health and well-being. The goal of this thesis is to test the secondary impact of a physical activity intervention on reducing the stress of underserved middle school youth. The PA intervention aims to increase PA by establishing a supportive social-motivational climate for PA (e.g., inclusive, autonomy-supportive). The present research will test a secondary benefit of the PA intervention, a reduction in youth stress. Specifically, this project has two aims: 1) to examine the degree to which youth within underserved communities are stressed and report internalizing and peer problems, considering variations by key youth characteristics (i.e., race, gender, age) and 2) to examine whether youth in the PA intervention have greater reductions in stress and internalizing/peer problems as compared to youth in the control from baseline to post-intervention, controlling for individual variances in race, gender, age, and program site.

Adolescence: A Unique Developmental Period

Adolescence is a unique period of development between childhood and adulthood characterized by significant changes in the brain (Arian et al., 2013) and body (Berk, 2014). This period typically begins around

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age 10 and lasts roughly until age 19 (WHO, 2014-a). Numerous factors influence the adolescent brain maturation process including heredity, environment, hormone levels as well as economic, physical and psychological/mental status (Arian et al., 2013). While changes in brain structure and function facilitate adolescents' cognitive and emotional maturity, this neural plasticity also increases adolescents' vulnerability to make risky decisions (Arian et al., 2013) and to develop physical (WHO, 2014-b) and psychological problems (Arian et al., 2013; Kessler et al., 2005). The presence of psychological and mental disorders during adolescence offer cause for particular concern given the increasing prevalence and potential to carry into adulthood.

In a study conducted by the National Comorbidity Survey-Adolescent Supplement (NCS-A) which surveyed over 10,000 U.S. adolescents aged 13-18, almost half (49.5%) of adolescents met DSM-IV criteria for at least one class of mental disorder (Merikangas et al., 2010). The most prevalent disorders identified within the sample were anxiety disorders (31.9% met criteria), which include Generalized Anxiety Disorder, Post-Traumatic Stress Disorder, Panic Disorder, Separation Anxiety Disorder, and various phobias. Merikangas and colleagues (2010) concluded, "...the majority of mental disorders in adults emerge prior to adulthood." Among affected adolescents, 50% recorded onset of anxiety disorders by age 6, which is consistent with prior evidence suggesting that half of all lifetime cases of psychological disorders start by age 14 (Kessler et al., 2005). Given the onset and prevalence of psychological disorders in adolescence, it is critical to develop effective prevention strategies that can support youth mental health during this vulnerable time in the lifespan.

Why Stress Is Worthy Of Study

While an abundance of research exists that examines mental health within the context of internalizing disorders such as depression and anxiety (Bonhauser et al., 2005; Kim et al. 2019), mental health is broader than simply the presence or absence of psychological disorder (Seligmen, 2014) and is not solely impacted by

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genetic factors. Mental wellbeing in adolescence is affected by a variety of environmental and social factors at the personal, familial, community and national levels (Viner et al., 2012). Such factors influencing adolescent mental health include family characteristics (i.e. parental education, divorce; Merikangas et al., 2010), peer relationships, and school environment (Viner et al., 2012). One particular environmental factor that plays a critical role in an individual's wellbeing is the presence or absence of stress defined as an individual's response to an external stimulus (APA, 2019).

Stress has been implicated as a risk factor in a number of poor health outcomes like depression and anxiety (NIMH, n.d.). One prominent theory, the diathesis-stress model, implicates stress (along with genetic predisposition) as influential in the development of both mental and physical health disorders (APA, 2018). Furthermore, evidence suggests that this relationship between stress and mental health outcomes is particularly relevant during the adolescent developmental period, as about one-third of U.S. adolescents report feeling depressed (30%) or overwhelmed (31%) due to their stress (APA, 2013). This relationship between adolescent appraisals of stress and internalizing mental health concerns consistent with anxiety or depression appears to be positively correlated. In one study, Schmeelk-Cone & Zimmerman (2003) determined that adolescents who report higher levels of stress also report higher levels of depression and anxiety whereas those who report the lowest levels of stress report the lowest levels of depression and anxiety.

Prevalence of adolescent stress. Given the potential for poor outcomes due to the presence and duration of stress, particularly during developmental periods of high plasticity like adolescence, it is critical to understand the rates and degree to which adolescents report high stress. Throughout adolescence, individuals experience unique stressors such as school demands and frustrations, negative feelings about themselves, increased expectations (American Academy of Child and Adolescent Psychiatry, 2019), and social pressures (APA, 2013). These unique stressors augment adolescents' pre-existing feelings of uncertainty and frustration

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(Ciccarelli & White, 2015), putting them in positions of high stress, unequipped with effective coping mechanisms (APA, 2013). In an online poll of over 1,000 U.S. adolescents aged 13-17, the average adolescent reported higher perceived stress than their adult poll counterparts and higher levels of stress than what they perceive to be healthy (APA, 2013). Specifically, study participants were asked to rate their stress levels on a 10-point scale, with higher values indicating greater stress. Adolescent respondents, on average, self-appraised their stress levels to be 5.8 out of 10, compared to adult respondents' self-appraisals of stress at 5.1. Despite higher rates of stress than adults, adolescents are significantly less aware than adults of the impact stress has on their physical and mental health (APA, 2013). Further, while 40% of U.S. adolescents already demonstrate signs of chronic stress (Schmeelk-Cone & Zimmerman, 2003), 34% of adolescents predict their stress levels will increase in the next year (APA, 2013).

Appraisals of stress among average U.S. adolescents remain high, but societal status (i.e. underserved) in particular can play a crucial role in determining risk for high rates of stress among adolescents. Youth from socioeconomically disadvantaged (underserved) families are two to three times more likely to develop mental health problems than their socioeconomically advantaged peers (Reiss, 2013). Reiss and colleagues (2019) determined that indicators of low socioeconomic status (SES) like lower household income, lower parental education, and parental unemployment are associated with higher rates of mental disorders in children and adolescents. In addition to typical stressors faced in adolescence, underserved (minority status, low-income) adolescents are disproportionately exposed to greater numbers of stressful life situations, including parental health concerns (serious physical illness or mental illness), parental separation, trouble with the law, financial concerns, parental loss of employment (Reiss et al., 2019), violence, safety concerns (Dubow et al., 1997) and racism/discrimination (Sellers et al., 2006). Increased stressful life situations experienced by underserved youth place them at greater risk for high levels of stress and increased prevalence of mental health problems (Reiss et al., 2019). Underserved youth are not only at greater risk for chronic stress and related mental health disorders

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due to disproportionate high exposure to stressors, but exposure to chronic stress during this time may be particularly damaging given the numerous mental and physical changes associated with adolescence that can limit one's ability to properly address/cope with stress (Arian et al., 2013; Berk, 2014).

Adolescent response to stress. 42% of U.S. adolescents report that they are unsure if they are doing enough to manage their stress or are unsure how to cope with their stress (APA, 2013). Adolescents (aged 11-12) also demonstrate greater physiological responses (i.e., heightened arousal to stress as measured by cortisol levels) than children (aged 9-10; Yim et al., 2010), indicating a biological vulnerability to stress during the adolescent period. When asked to perform age appropriate speech tasks, adolescents exhibit increased stress related behaviors such as fidgeting, avoidance of eye contact and shaky voice compared to adults despite assessing the same situations as similarly stressful (Yim et al., 2010). Corroborating this finding, evidence suggests that adolescents are more bothered by daily hassles than adults who are able to differentiate between unavoidable day-to-day stressors and the severity of such annoyances (Dumont & Provost, 1999). These findings indicate that adolescents are more aroused than younger children by stressors and less equipped than adults to handle their increased stress, proving the significant and harmful impacts of stress on the neural plasticity and impressionable state of adolescents.

Dangers of chronic stress. While the human body's response to short-term stress is an adaptive response to immediate dangers, the body's response to chronic stress is overwhelmingly negative (Benjamin et al., 2019; Mayo Clinic, 2019; NIMH, n.d) and may play a role in the development of psychopathology. During chronic stress, the "fight or flight response" that is usually self-limiting does not take cues to shut off, causing the body to remain in a heightened state, signaling continual release of the stress hormone cortisol (Mayo Clinic, 2019). The long-term cortisol release associated with chronic stress disrupts major biological systems including reproductive, immune, cardiovascular, digestive, and sleep (NIMH, n.d.). Due to the disruptions in those

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systems, individuals are at higher risk to develop high blood pressure, diabetes, depression, anxiety, and heart disease, the latter of which is the leading cause of death in the United States (Benjamin et al., 2019; Mayo Clinic, 2019; NIMH, n.d.). This finding has mirrored effects in adolescence: left untreated, chronic stress in adolescence leads to poor long-term physical and mental health outcomes in adulthood (WHO, 2019).

Benefits of Physical Activity

The positive relationship between PA and physical health is a widely accepted phenomenon in child, adolescent, adult, and elderly populations that has circulated scientific literature for decades (Brown & Seigel 1988). As summarized by the U.S. Department of Health and Human Services Physical Activity Guidelines (2018), individuals who are physically active have decreased risk of various life-threatening conditions including heart disease, diabetes, certain cancers and strokes as well as have better functional capacity and brain health. Engaging in PA during adolescence is especially important as it has been found to prevent the development of chronic disease in adulthood, improving bone health and weight status (U.S. Dept of Health and Human Services, 2018). Along with its physical health benefits, engaging in PA has more recently been linked to mental health benefits. Such benefits include mood enhancement (Gerber & Pushe, 2009; Harvard Health, 2018; Strong et al., 2005), improved mental health (Kim et al., 2019) reduced anxiety and increased levels of self-esteem (Calfas & Taylor, 1994). PA plays a unique role in enhancing self-esteem specifically during the developmental stage of adolescence through skill mastery and success with PA (Calfas & Taylor; 1994). Self-esteem has been studied as “an important predictor for an array of human behaviors including academic importance to antisocial activities” (Calfas & Taylor; 1994).

Thus, the mental health benefits of improving adolescent self-esteem through PA may concurrently function as a mechanism to reduce stress. PA has been shown to reduce stress hormones (cortisol and adrenaline; Gerber & Pushe, 2009; Harvard Health, 2018; Strong et al., 2005) and perceived levels of stress (Calfas & Taylor, 1994;

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Kim et al., 2019). In adolescent populations, moderate and high intensity aerobic exercise shows significant decreases in perceived stress across a 10 week PA intervention period (Norris et al., 1991). Given that PA buffers against the negative effects of stress, PA can be considered a protective resource for individuals to constructively cope with stress, rendering it an adaptive coping mechanism (Gerber & Pushe, 2009). Adaptive coping mechanisms are problem-solving mechanisms that effectively address the stressor at hand and are positively correlated with higher levels of self-esteem (Dumont & Provost, 1999). When adolescents opt into appropriately adaptive coping skills, stress becomes more manageable or can even subside. Adolescent youth, however, do not always utilize these skills, as it is estimated that only a little more than one-third of adolescents (37%) exercise or walk as a means of coping with stress (APA, 2013). Despite the presented evidence surrounding the benefits of PA, particularly examining its effects in decreasing stress, only 20% of adolescents report sufficient activity to meet the current recommendations of 60 minutes of PA per day (U.S. Department of Humans and Health Services, 2018).

Uncertain of how to address their stress and lacking appropriate responses to stress, many adolescents turn to sedentary activities as a means of avoidant coping (APA, 2013). Unlike adaptive coping mechanisms such as PA, avoidant coping mechanisms are strategies to deal with stress that decrease physiological discomfort without solving the underlying issue or stressor at hand (Dumont & Provost, 1999). These coping mechanisms such as watching T.V., playing video games or eating, are positively associated with higher levels of stress and distress but lower levels of self-esteem (Dumont & Provost, 1999). Evidence suggests that youth who are more reactive to stress (measured by change in heart rate) are on average 31% less active and spend more time watching T.V. (McGlumphy et al., 2018). As technology like smartphones, tablets, TVs, and computers has become more accessible, the opportunity to engage in largely sedentary behaviors has increased. In 2018, 95% of U.S. teens have access to smartphones and approximately half (45%) are online almost constantly, suggesting increased dependence on technology and sedentary behaviors as a means of coping (Anderson & Jiang, 2018).

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Increased levels of stress and lowered self-esteem associated with avoidant coping mechanisms are problematic particularly during adolescence because individuals who adopt such strategies to deal with stress are at greater risk to develop psychological distress, depressive symptoms and engage in risky social activities (Dumont & Provost, 1999). The prevalence of sedentary coping and lack of active coping among adolescents highlights the need for interventions focused on improving effective coping strategies in early to middle aged adolescents, especially because habits and lifestyle choices made in adolescence can carry into adulthood (WHO, 2019).

Role of ASPs in Promoting PA

One such avenue to engage more adolescents in PA is through after school programs (ASP). School aged youth spend 80% of their waking hours outside of school and must rely on this time to achieve sufficient PA and adopt appropriate coping mechanisms. Throughout the school day, only 64.1% of middle schoolers and 26.5% of high schoolers participate in regular PA breaks, indicating a lack of time for youth to stay active (CDC, 2015). During out of school time (OST), increased technological access provides increasingly sedentary opportunities for youth meaning fewer opportunities to engage in PA. This is especially true for underserved adolescents who lack safe environments and support to engage in regular PA (Dubow et al., 1997). However, ASP can be instrumental in engaging youth in PA. For 10.2 million youth every year ASPs provide academic support, mentorship, youth development and PA opportunities during the critical after school hours of 3 to 6 PM (Afterschool Alliance, 2015; Youth.gov, n.d). Highest participation rates are among underserved adolescents (Afterschool Alliance, 2014; Dubow et al., 1997) many of whom, without ASP, would be left without parental support and opportunities for PA engagement after school. Underserved (low-income) parents value and endorse that ASPs should contribute to their child's PA with 79% agreeing ASPs should offer PA (Afterschool Alliance, 2015). However, only 1 in 3 low-income parents report their child gets the recommended 60 minutes of exercise (Afterschool Alliance, 2015). Thus, ASP's are uniquely positioned to impact youth

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behavior through creating inclusive PA climates and promoting positive peer interactions (Zarrett, 2012) particularly among underserved adolescents (Afterschool Alliance, 2014). Through creating opportunities to increase youth PA, ASP's support youth psychological well-being, such as reducing students perceived stress and improving internalizing and peer problems.

Current Study and Project Aims

The goal of the present study is to test the secondary impact of a PA intervention on reducing the stress and internalizing symptomology of underserved middle school youth. The intervention aims to increase PA by establishing a supportive social-motivational climate for PA (e.g., inclusive, autonomy-supportive). The present study will test a secondary benefit of the PA intervention, a reduction in youth stress. To this end, this study had two primary research questions: "How stressed are underserved adolescents?", and "To what extent does an ASP physical activity curriculum that is centered on social connection (friendship, belonging) reduce reported stress and internalizing symptomology"? Thus, aims of the study were two-fold: 1) to examine levels of youth stress and internalizing and peer problems at baseline and possible variations in stress by key youth characteristics (i.e., race, gender, age), and; 2) to examine whether youth in the PA intervention, compared to youth in the control, have greater reductions in stress, internalizing and peer problems from baseline to post-intervention, controlling for individual variances in gender, age, and variations by program site.

Methods

Overview

The present study is a part of a larger project: Connect Through PLAY (Connect). Connect is an NIH funded, 5-year randomized controlled trial assessing the efficacy of a novel PA intervention with the aim to improve staff capacity for implementing effective PA programming in underserved, underrepresented middle school after school programs (U.S. Library of Medicine, 2018; Zarrett, PI). The Connect

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intervention team partners with pre-existing ASP's who are randomized to receive either the PA intervention focused on increasing PA through friendship/connection, group belonging and staff connection, or an educational control health curriculum (U.S. Library of Medicine, 2018; Zarrett, PI). Across the duration of the larger Connect study, 30 ASPs in total will be recruited for study inclusion, with half randomized to the PA intervention condition and the other half randomized to the control condition. The current study examined the Y2 (second year) cohort of Connect, which includes youth and ASP staff participants in 6 underserved communities (3 control vs. 3 intervention sites).

Participants & Setting

The Y2 intervention (6 programs; 3 intervention vs 3 control) was implemented within school-based aftercare programs for youth between the ages 9-14 within a southeastern city in the United States.

School recruitment criteria was three-fold: schools were required to have an ASP that included time allotted for PA/recreation in their curriculum, were considered "underserved" (ie, 50% or more of the school student body were of minority status and/or received free/reduced lunch), and had a "Positive Youth Development" framework (eg, program mission/curriculum fostered overall well-being rather than a specified set of skills; eg, 4H, Boys and Girls Club of America; Eccles & Gootman, 2002).

Similar to other developmentally based ASPs, the daily curriculum of the ASPs in our study included a short 15-minute snack/social time, a 1-hour homework session, and a 1.5-hour recreational session.

Incorporated into the regular weekly curriculum of ASPs, all youth enrolled in the ASP were invited and encouraged to participate in the Connect programming. However, to be eligible for participation in the study's data collection (eg, youth surveys, accelerometers), youth were required to (a) be currently enrolled in the ASP, (b) be between the ages of 9-14, (c) have parental consent and youth assent to participate, and (d) available for baseline and post-intervention measurement. Adolescents were excluded from participation if they (a) had a medical condition that would interfere with participation in

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PA or (b) were developmentally delayed such that the intervention/measurement materials were not appropriate. Programs were randomized to either the intervention or a wait-list control post-baseline data collection (ie, parallel randomized controlled trial [RCT] design). At baseline, a total of 344 youth (54.4% female, 44.7% male and 0.9% unknown/not reported) were recruited across 6 afterschool programs in underserved South Carolina communities. 338 youth at baseline completed surveys assessing thoughts and attitudes toward a range of topics, including relationships with ASP staff, attitudes toward physical activity, and appraisals of stress. The majority of youth in the sample identified as Black or African American (71.6%), with only 18% identifying as White, 9.2% as more than one race, and less than 2% as American Indian, Asian, Native Hawaiian or Other/Pacific Islander. 7.7% identified their ethnic category as Hispanic or Latino. The sample consisted of youth ages 9-14 with an average age of 11. All youth in the sample had received parent consent and provided their own assent to participate in the study. All procedures performed in this study were approved by the University's institutional ethics committee (Pro00037559) and were performed in accordance with the ethical standards of the APA.

Characteristics of ASP at baseline are presented Table 1.

Table 1

Characteristics of ASP at Baseline

Site	Youth Participants (# Surveys received)	Grades served	Location of ASP
A- Intervention	105	6-8	School
B-Control	44	6-8	School
C-Intervention	50	4-8	School
D-Control	85	4-8	Community Center
E-Intervention	27	5-8	School
F-Control	27	5-8	School

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Procedure

Intervention sites received one hour (60 minutes) of a PA curriculum co-facilitated by ASP and Connect staff three times a week for 16 weeks. In addition, ASP staff participants at intervention sites received weekly staff health support focused on the attainment of individualized staff health goals. The novel PA intervention “expands on social developmental theory and the social mechanisms highlighted by Self-Determination Theory, Achievement Goal Theory and Social Cognitive Theory” (U.S. Library of Medicine, 2018; Zarrett PI) with the purpose of increasing and sustaining PA in ASP staff and underserved youth. The key social mechanisms identified by the PI (Dr. Nicole Zarrett) to increase PA include: friendships/connection through PA, group belonging and staff connection (U.S. Library of Medicine, 2018; Zarrett PI). Alongside the hour-long PA curriculum, intervention sites received 30-minute small group sessions once a week to encourage peer youth connectedness and youth-staff connectedness. Control sites received one hour (60 minutes) of a health-wellness curriculum co-facilitated by ASP staff and Connect staff once a week for 16 weeks. In contrast to the ASP staff at intervention sites, ASP staff at control sites did not receive weekly staff health support.

Data Collection

Data used in the current study was collected using a large written survey given by Connect at baseline (pre-intervention or control) and endpoint (post-intervention or control). As part of the large survey, students were asked to report on their perceived stress levels, internalizing problems, peer problems and youth key characteristics (gender, age, ethnicity, racial characteristics).

Measures

Youth Perceived Stress. To determine students’ perceived levels of stress, a survey adapted from *The Perceived Stress Scale (PSS)* (See Appendix A) was conducted at two discrete points (pre-and post intervention). The original *PSS* consists of 14 questions that aim to measure the extent that certain

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events in an individual's life are perceived as stressful (Cohen et al., 1983). An example item from the PSS includes "In the past month, how often have you felt nervous or stressed" (Cohen et al., 1983). Each item is rated on a 5-point Likert scale (ranging from never to very often), with each response assigned a numeric value for scoring (0-4; 0 indicating never and 4 indicating very often). Four items were reverse coded before scoring the scale, so that a high score indicates high levels of stress (Schmeelk-Cone et al., 2003). Since the inception of the scale, the PSS has been modified to include 10- and 4-item versions. The 10-item version has an internal reliability of 0.91 (according to Cronbach's alpha) (Cohen & Janicki-Deverts, 2012). The present study used the 10-item version of the *PSS* in order to limit repetitiveness and number of questions asked of adolescents as this survey was a part of a larger Connect survey (Questions 4, 5, 12 and 13 were omitted). The *PSS* was chosen for this study as it is proven to be reliable and valid irrespective of gender and is appropriate for youth populations (Cohen, 1983). Furthermore, the 14 item *PSS* has been used effectively to determine a correlational relationship between increased exercise and decreased perceived stress in adolescent populations (Norris et al., 1991). The scale is brief and simple to administer to large groups of students. The variety of questions in the survey reflect different aspects of stress allowing students an opportunity to rate their reported stress.

Youth Mental Health. A portion of the Strengths and Difficulties Questionnaire (SDQ) was used in tandem with the PSS as a means of measuring whether youth have "significant emotional or behavioral difficulties" and the "extent to which these difficulties result in social impairment or distress" (Goodman, 1997). The SDQ is rated using a 3 point Likert scale (ranging from not true, somewhat true or very true). Two of the possible five subscales were used to measure emotional symptoms and peer relationship problems (total of 7 items). The SDQ is a valid measure of youth strengths and difficulties, peer relationships and prosocial behaviors (Goodman, 1997).

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Analytical Procedure

Preliminary tests, namely Kolomogrov-Smirnov [K-S], Shapiro-Wilk, visual inspection, measures of kurtosis and skewness were conducted to determine whether the distribution of PSS scores followed a normal distribution.

To measure the first aim, the degree to which youth are stressed and how that varies by key characteristics (gender, race, age and site), composite PSS scores were computed for each survey completed and the means, standard deviations, and mode were assessed. An independent t-test was computed to determine any potential differences by gender (male and female). To determine if and how PSS scores varied by race, a one-way ANOVA was computed between the 3 most commonly reported groups (White, Black/African-American or Other/Multi-racial). Correlational analyses were used to determine if there was any significant relationship between PSS score and age, and SDQ subscales (internalizing symptoms, and peer problems). To determine if PSS and SDQ subscale scores varied based on intervention or control a one-way ANOVA was conducted between the sites. Additionally, the means, standard deviations, minimum and maximum SDQ scores were calculated and assessed. Lastly, a mixed model using school site as the independent variable, age as a covariate, and stress as a dependent variable was utilized to determine any effects between age, school site, and PSS score.

To measure the second aim, whether youth in the intervention reported greater reductions of stress than those in the control groups from baseline to post-intervention, a hierarchical linear regression was run controlling for age, gender, and program sites to account for the nested design in the first step of the model. In the second step, baseline stress was entered as an independent variable in the model to determine change in stress, and participants' intervention condition (control group=0; intervention group = 1) was entered as the primary independent variable of interest to determine possible differences between groups in the change of stress from baseline to post. To measure whether

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youth in the intervention reported greater reductions of internalizing symptoms than those in the control group from baseline to post-intervention, a hierarchical linear regression was run controlling for age, gender, and program site to account for the nested design in the first step of the model. In the second step, baseline internalizing symptomology (SDQ) was entered as the independent variable to determine changes in participants SDQ ratings and individual's intervention condition (control group=0; intervention group=1) was entered as the primary independent variable of interest to determine potential differences between groups in the change of SDQ scores from baseline to post.

Results

Preliminary analysis

Visual inspection of the distribution of baseline PSS scores appears normally distributed despite a slight positive skew. While the Shapiro-Wilk test of normality was not significant ($p = .09$), the K-S test was significant ($p = .01$), indicating that the baseline data significantly deviates from a normal distribution. However, when dividing the skewness (-.02) and kurtosis (.39) values by their standard error (skew $SE = .13$, kurtosis $SE = .27$), they were both within the normal range of ± 1.96 (Ghasemi & Zahediasl, 2012), Z skew = -.12, Z kurtosis = 1.46 indicating values within a normal distribution.

Aim 1

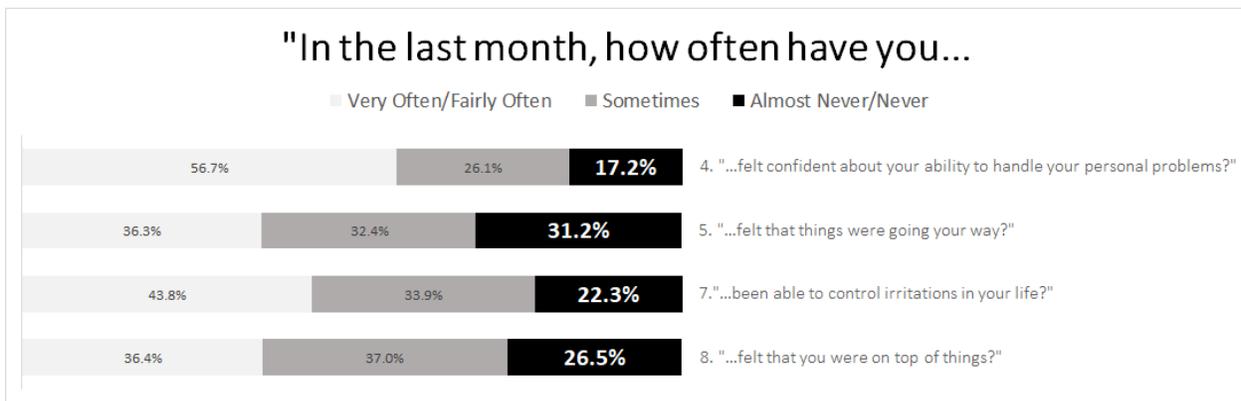
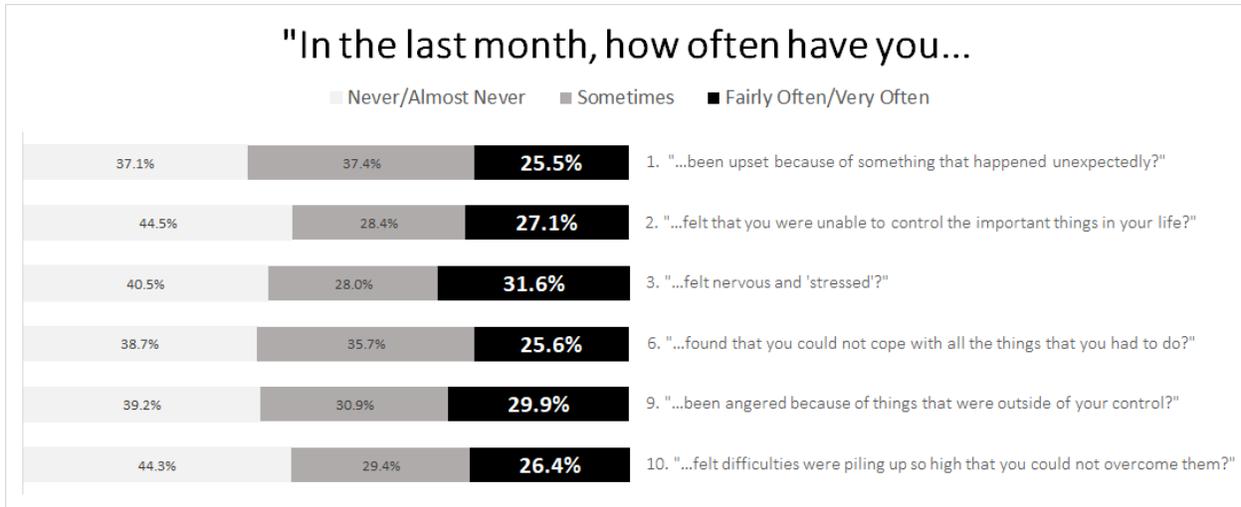
Baseline PSS scores of the sample of 337 adolescents ranged from 0 to 38 (out of the possible 40 indicating the highest level of stress) with the average score of 17.8 and mode of 20.0. Of specific note, 31.6% of students reported feeling nervous or stressed either fairly often or very often, 29.9% reported having been angered fairly often or often because of things that were outside of their control and 27.1% felt fairly often or very often that they were unable to control important things in their life. Across all PSS items that measure perceived helplessness (questions 1, 2, 3, 6, 9, 10), at least 25 % ($\frac{1}{4}$) of students reported responses fairly often or very often, indicating high levels of perceived stress. Contrastingly,

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questions 4, 5, 7, 8 measured students perceived levels of self-efficacy. 17.2% of adolescents almost never or never felt confident about their ability to handle personal problems, 31.2% almost never or never felt things were going their way, 22.3% almost never or never felt they were able to control irritations in their life and 26.5% almost never or never felt they were on top of things. Thus, across the items reporting participants perceived self-efficacy, about ¼ of students reported the lowest scores (never or rarely) indicating low levels of self-efficacy. Baseline scores for the SDQ Internalizing scales were broken down into two subscales, the Emotional Symptoms scale ($M = 1.686, SD = 0.542$) and Peer Problems scale ($M = 1.548, SD = 0.377$). Added together, the SDQ Emotional Symptoms scale and SDQ Peer Problem scale form the SDQ Internalizing scale ($M = 1.617, SD = 0.387$). The present study found strong correlations between the PSS scale and the SDQ Emotional Symptoms scale (0.565) and the SDQ internalizing scale (0.539). This evidence suggests that much of the stress adolescents report seems to come from internalizing negativity. Our finding that out of all of the SDQ questions the PSS scale had the strongest correlation with depression stating “I am often unhappy, depressed or tearful” at a correlation of 0.508 supported previous findings that stress can be implicated as a risk factor in depression (NIMH, n.d.).

Figure 1. Breakdown of PSS response by question.

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Breakdown by key characteristic through an independent samples t-test indicated that there were no significant differences in perceived stress found for males ($M = 17.23$, $SD = 6.50$) and females ($M = 18.09$, $SD = 5.83$) in our underserved sample of middle school youth [$t(332) = -1.27$, $p = .20$]. A one-way ANOVA was conducted to analyze any potential differences in stress due to race. Given the low number of people reporting mixed races, Asian, Native Hawaiian/Pacific Islander, or other, all of these categories were merged into a singular "Mixed/Other" category. The analyses therefore included three categories: Black/African-American ($n = 241$, $M = 17.64$, $SD = 5.98$), White ($n = 61$, $M = 18.52$, $SD = 6.74$), and Mixed/Other ($n = 34$, $M = 17.50$, $SD = 6.81$). Despite the unequal group sizes, homogeneity of variance was still maintained, Levene's $F(2, 333) = .29$, $p = .75$. No group differences were found by race, [$F(2, 333) = .54$, $p = .59$]. Additionally, the correlational analysis conducted to analyze potential

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links in stress due to age found no significant correlation, $r(338) = .04, p = .43$. Similarly, the one-way ANOVA conducted to determine differences in stress and school site found no significant differences, $F(5, 332) = 1.41, p = .22$, indicating no difference in baseline stress between intervention or control sites. The mixed model conducted to test for effects between school sites with age as a covariate also was not significant, $F(6, 331) = 1.17, p = .32, \text{partial}\eta^2 = .02$, and as expected, neither age nor school site were significant predictors of stress ($p = .94$ for age, $p = .27$ for school).

Aim 2

To examine aim 2, a hierarchical linear regression was performed to measure both the PSS and SDQ Internalizing scales. For each regression, the endpoint scale score was regressed on the baseline scale score and whether the student belonged to either a control (coded as 0) or intervention program (coded as 1). Several variables were entered in block one as controls – age, gender (female = 1, male = 0), race (African-American = 1, all other races = 0, given that the majority of the sample was African-American), ethnicity (Hispanic/Latino = 1, non-Hispanic/Latino = 0), and baseline SDQ score. In block two, baseline PSS score and intervention condition (intervention = 1, control = 0) were added to the model. The initial block of the regression was significant, $R^2 = .15, F(5, 273) = 9.29, p < .001$. The only significant predictor was baseline SDQ score, $b = 6.38, SE = 1.00, t = 6.26, p < .001, 95\% CI [4.31, 8.26]$. The second block was also significant, $R^2 = .32, F(7, 271) = 17.77, p < .001$ and resulted in a significant model improvement, $\Delta F(2, 271) = 33.45, p < .001$. The baseline SDQ score was no longer a significant predictor in, $b = 1.52, SE = 1.08, t = 1.41, p = .16, 95\% CI [-.60, 3.63]$. However, the added PSS baseline variable in block two was significant, $b = .56, SE = .07, t = 8.17, p < .001, 95\% CI [.42, .69]$. Lastly, the addition of intervention condition in block two was nonsignificant, $b = -.17, SE = .72, t = -.24, p = .81, 95\% CI [-1.58, 1.24]$.

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The overall regression for the SDQ Internalizing scale was significant, $F(2, 276) = 58.86$, $p < .001$, $R^2 = .30$. Unlike for the PSS, however, there was a significant effect of program, $b = .08$, $SE = .04$, $t = 2.07$, $p = .04$.

Table 2

Average PSS score at baseline and post intervention/control by site

Site	Mentorship Status	Baseline	Post
A	Intervention	16.9714	17.9341
B	Control	17.4318	20.0278
C	Intervention	19.0600	19.9231
D	Control	18.1412	17.9744
E	Intervention	16.6667	18.9375
F	Control	19.3704	21.0500

Discussion

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This paper set out to explore the prevalence of stress in underserved youth and to examine how a PA intervention may impact students reported stress as well as internalizing and peer problems. Findings indicated that youth in the sample showed stress rates similar to the alarmingly high national averages and that poor mental health was associated with perceived stress. Although PA has been shown to help buffer youth from stress and poor mental health (Calfas & Taylor 1994; Gerber & Pushe, 2009; Strong et al., 2005) in the current study we found no significant differences between youth in the intervention as compared to the control in their changes in stress levels or internalizing/peer problem symptomology from baseline to post intervention. Rather, the present study found that stress increased across all youth in the study at post intervention.

Aim 1

In the present study, youth 10-item PSS scores at pre- and post-intervention were indicative of high levels of stress, with an average baseline score of 17.8. Findings in the present study are consistent with previous research stating that adolescents are reporting increasingly high levels of stress. The present sample of adolescents reported higher average stress than did adults in prior studies, where average PSS scores were found to be 17.8 compared to adult samples of 12.1 (adult males) and 13.7 (adult females; Cohen & Williamson, 1988). A score of 17.8 places adolescents in a category of moderate stress (scores ranging from 14-26) whereas adult scores fall into a category of low stress (categories are taken from the State of New Hampshire EAP).

While our findings corroborated previous research indicating adolescents report high levels of perceived stress, the present study did not find PSS scores to reveal any statistically significant differences by key characteristics (gender, age, ASP site, or race) or by program mentorship type (intervention versus control). Regarding gender, our findings were inconsistent with prior research that state females report higher levels of stress than their male counterparts (APA, 2013; Cohen & Janicki-

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Deverts, 2012; McGlumphy et al., 2018; Schmeelk-Cone & Zimmerman, 2002). The present study found no statistically significant differences between male and female PSS scores. This could be explained by females in our study underreporting their perceived stress or males in our study overreporting their perceived stress or may be indicative of a unique characteristic of our sample. It is equally important to look at the breakdown in gender in the context of race given that a majority (71.6%) of our sample identified as Black/African American. This population in particular shows increasing levels of stress. New research identifies significant increase in suicide rates among African American (AA) male children over the span of nineteen years (1993-2012) whereas suicide rates among white male children decreased significantly during that same period (Bridge et al., 2015). Given the recent shifts in suicide rates among AA male children, the present research may be indicative of new patterns of high levels of perceived stress and poor mental health among AA males. Previous research also identifies a two-fold difference in male and female reports of feeling sad or helpless where 41.1% of females and 21.4% of males reported those feelings.

A breakdown of PSS scores by race showed inconsistencies with previous research as well. It would be expected that minority students would report higher levels of stress, as evidenced by the CDC Youth Risk Behavior Survey (2017) wherein underserved adolescents were more likely experience violence and conditions of poverty. However, the present sample saw no significant difference between PSS score by youth race. While this finding does not corroborate previous research, a possible explanation arises based on our unique population. All ASP that were a part of this study were considered underserved, meaning that 50% or more of the school student body were of minority status and/or received free/reduced lunch. Thus, youth in our study sample disproportionately identified as African American or multiracial (80.8%) and from low-income households (free reduced lunch status ranged from 50%-100% across sites) Furthermore, new research indicates a closing gap between

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differences in stress levels of adults based on race. Researchers Cohen and Janicki-Deverts (2012) found that over a twenty-six year span, the difference in stress levels between races actually shrunk, offering another potential cause for our results.

While it was expected that younger students would report lower levels of stress, the present sample saw no significant differences in a correlation between age and PSS despite the age range of 9-14. The present research finding may be attributable to Bridge et al., (2015) study that determined increasing suicide rates among AA male elementary school students. When compared to the older students in the present study, the elementary aged students may be experiencing increasing levels of stress. It was expected that the present sample would report greater levels of baseline stress than national averages due to the underserved status of all ASP, regardless of intervention status. However, the ASP may be effective in buffering youth stress and thus buffering these students from experiencing even higher levels of stress than, despite their underserved status.

Despite a lack of differentiation between key characteristics and PSS scores the present study found strong correlations between the PSS scale and the SDQ Emotional Symptoms scale (0.565) and the SDQ internalizing scale (0.539). This evidence suggests that much of the stress adolescents report is highly associated with internalizing negativity. The strong correlation between stress and internalizing negativity may support that along with the typical external stressors adolescents face (school, peers), adolescent stress is equally mediated by their internal response to such stressors. The present research corroborates Yim et al., (2010) who determined that adolescents have a greater biological vulnerability to stress, explaining why adolescent stress would have strong correlation with internalizing negativity. Rather than being able to compartmentalize their stress, adolescents in the present study experienced high levels of stress in tandem with feeling unhappy, depressed or tearful.

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Aim 2

The second aim of this study was to examine whether youth in the PA intervention, compared to youth in the control, have greater reductions in stress, internalizing and peer problems from baseline to post-intervention, controlling for individual variances in gender, age, and variations by program site. It was expected that the intervention group would report greater reductions in stress from pre- to post as compared to the control group. However, the only significant predictor of post intervention stress was baseline levels of youth stress. A high baseline PSS score was correlated with a high post intervention PSS level. As referenced in Table 2, average PSS score at every intervention site and all but one (Site D) control site saw an increase in average PSS score. The finding that perceived stress increased among both intervention and control samples, suggests that the intervention curriculum is not buffering these increases. No key characteristic such as gender, race, age or being in the control/intervention condition was a determinant of changes in youth stress. While there were no significant differences in PSS score between intervention and control at post intervention, the significant effect of program on SDQ offers promising results that PA may buffer against the detrimental effects stress has on mental health. Youth may have experienced increasing levels of stress throughout the study, but this increase did not pose a threat to their mental health. Thus, while the PA curriculum did not directly reduce youth stress levels, it had a positive effect on limiting poor mental health outcomes associated with high levels of stress.

The intervention aims to increase PA by establishing a supportive social-motivational climate for PA (e.g., inclusive, autonomy-supportive). Connect offered effective opportunities for intervention youth to engage in inclusive, autonomy-supportive PA, resulting in decreased internalizing and peer problems as evidenced by the positive relationship between program site and SDQ scores. Additionally, in order to preserve the ethics of this research study and to recruit ASP partners, the control group was not entirely a control. While they did not receive any PA intervention, this group was still intervened on and received mindfulness and stress management therapies. While not PA, these interventions can still be useful in reducing adolescent stress levels, equipping

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them with positive coping mechanisms to handle their stress.

Future Directions and Limitations

The first major limitation to this study is the use of the PSS as a means of measuring youth perceived stress. While the PSS has been utilized in many studies with adolescent populations, the PSS was initially designed with intention for individuals with at least a middle school education (Cohen, 1983). However, our sample had individuals ranging as young as 9 years old. Additionally, the present study examined a secondary impact of a PA intervention. Resultantly, the present research is not a thorough examination of the PA intervention and its effects on adolescents. For instance, the larger study used accelerometers to measure individuals' exact PA level whereas the present study only accounted for PA by means of whether adolescents were exposed to the intervention or control. In the present study students in the control that were active outside of the ASP were not accounted for as being physically active. Furthermore, while referenced literature indicated the negative effects of chronic stress and its potential to carry into adulthood (WHO, 2019; Schmeelk-Cone & Zimmerman, 2003), the present study did not have a means of capturing chronic stress as the PSS measures students perceived stress. Future research should continue to examine PA and its relation specifically chronic stress.

Another avenue of new research would be to examine the stress levels of these adolescents during/post Covid-19. This research was conducted prior to the onset of Covid-19 shutdowns, where the adolescents were able partake in the ASP in person. Given the lack of PA opportunities many of these youth face, it would be important to determine if their stress levels changed during the period of quarantine where PA and ASP programs had to function virtually.

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[lab/publications/scalesmeasurements/pdfs/cohen,-s.--williamson,-g.-1988.pdf](https://www.cmu.edu/dietrich/psychology/stress-immunity-disease-lab/publications/scalesmeasurements/pdfs/cohen,-s.--williamson,-g.-1988.pdf)

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Appendix A. Perceived Stress Scale-10 Item Version.

PSS-10 item
Normal Scored (4 indicates high stress)
1. Upset because of something that happened unexpectedly
2. Unable to control the important things in your life
3. Felt nervous and “stressed”
6. Could not cope with all the things that you had to do
9. Angered because of things that were outside of your control
10. Felt difficulties were piling up so high that you could not overcome them
Reverse Scored (4 indicates low stress)
4. Felt confident about your ability to handle your personal problems
5. Felt that things were going your way
7. Able to control irritations in your life
8. Felt that you were on top of things

PHYSICAL ACTIVITY AND STRESS

Appendix B. Strengths and Difficulties Questionnaire (SDQ)

SDQ
Peer Relationship subscale
I have one good friend or more.
Other people my age generally like me.
Other children or young people pick on me or bully me.
I get along better with adults than with people my own age.
Emotional Symptoms subscale
I am often unhappy, depressed, or tearful.
I am nervous in new situations. I easily lose confidence.
I have many fears, I am easily scared.

Note: Adaptation from full 25 item SDQ version