STRESS AND UNSTRUCTURED PLAY IN 3RD GRADE CHILDREN

by

Heather N Buckley

Submitted in partial fulfillment of the

requirements for Departmental Honors in

Nursing

Texas Christian University

Fort Worth, TX

December 13, 2021

STRESS AND UNSTRUCTURED PLAY IN 3RD GRADE CHILDREN

Project Approved:

Supervising Professor: Ann Johnson, Ph.D., APRN, CPNP-CP

Department of Nursing

Debbie Rhea, Ph.D.

Department of Kinesiology

Paul King, Ph.D.

Department of Communications

Abstract

The LiiNK (Let's inspire innovation ‘N Kids) project implements more unstructured play into a child's daily school schedule; totaling at least 60 minutes per day. With the additional unstructured playtime, the LiiNK project has seen significant improvements in children's behavior, listening, and ability to stay on task during classroom learning. The purpose of this study was to measure children's cortisol levels in both a LiiNK intervention school and a nonintervention school to see how more unstructured play affects their cortisol levels. This study specifically looked at 3rd graders and measured their cortisol levels using hair samples and a subjective stress test, the Stress in Children Questionnaire (SiC). The purpose of this study was to examine the effects of unstructured play on children perceived and physiological stress levels, designed as a pilot study to determine feasibility of the study methods in young children.

This study is part of a larger LiiNK Project and participants in this study include children in the 3rd grade at a LiiNK intervention elementary school and nonintervention elementary school. Salimetrics hair collection kits were used to measure the cortisol samples from the hair, specifically, the ELISA kit. A team member used the CORT extraction procedure to get the cortisol measurement from the hair. This study is among the first to examine the relationship between unstructured play (physical exercise) and hair cortisol measurements in the school-aged child. While the group difference in cortisol was not statistically significant, it is clinically relevant. The findings suggest that the hypothesis that the students who have more unstructured play time will have lower cortisol levels, may be correct.

Acknowledgments

The student author would like to thank her committee members for the support, time, and mentorship she received:

Dr. Johnson, I cannot thank you enough for the countless hours you have spent assisting me with this research. You have guided me to the successful completion of my first research project and have made the experience both enjoyable and rewarding. You have helped shape me into the nurse I am today and will be in the future, from a health assessment student through the acceptance of my NICU position, I beyond grateful for your mentorship and encouragement.

Dr. Rhea, thank you for challenging me my nursing skills beyond the realm of the classroom and for allowing me to be a member of your incredible LiiNK team. It was a privilege to get to work with you and contribute to the advances you are making in childhood education. You have taught me that anyone and everyone should be an advocate for children, for the Whole Child, and I will take this lesson with me into my nursing practice. I look forward to my continued participation with LiiNK.

Dr. King, thank you for seeing my potential before I even knew it myself, and for pushing me in all aspects of school. I only had the honor of being in one of your classes freshmen year, but the impact your class had on me led to this research project. With your encouragement and guidance from an early point, you bestowed the confidence in me to complete Upper Division Honors. You have taught me more lesson than you realize, and it was an honor to have you a part of my research thesis.

Dr. Cheek I truly enjoyed the opportunity to work in your lab and have the opportunity that only few Harris students are granted. Thank you for taking the time to

guide me through the lab and answer all my questions. It was a pleasure to get to work with you beyond the walls of our pathophysiology class; I ever never forget the importance of endothelial cells.

Contents

Stress and Unstructured Play in 3rd Grade Children

Exposure to stress is common, but the exposure to stress during vulnerable stages of child development can have lasting effects on physical health and brain structure (Pervanidou & Chrousos, 2018). Stress can also trigger problems in areas such as: memory, cognition, learning, immune system functions, cardiovascular functions, obesity, and endocrine functions (Tajik et al., 2014; Yaribeygi, et al., 2017). In contrast, physical activity can improve one's ability to cope with stressors and improve well-being (Stults-Kolehmainen & Sinha, 2014). Based on our review of the literature, it is evident there are few studies demonstrating physical activity's impact on children's stress levels (Brown et al., 2011).

In today's culture, physical activity in children frequently occurs in the form of free play. In the school setting, free play can occur during the school recess period. Recess is defined as "regularly scheduled periods within the elementary school day for unstructured physical activity and play" (Kohl & Cook, 2013). Many elementary schools throughout the United States have cut back on recess time to maximize time in the classroom (Kohl & Cook, 2013). The LiiNK (Let's inspire innovation 'N Kids) Project implements unstructured, outdoor play into a child's daily school schedule. The LiiNK project defines unstructured play as "activity that is freely chosen and self-directed by the child, with no adult influence" (Clark & Rhea, 2017, p. 55).

As part of the LiiNK intervention, unstructured, outdoor play totals at least 60 minutes daily. The students receive four 15-minute unstructured play breaks and one 15-minute character development lesson daily (Rhea & Rivchun, 2018). The nearby non-intervention schools receive 30 minutes of recess daily, usually one 15-minute break before lunch and one 15 minute break after lunch. With the additional unstructured play, the LiiNK project has seen significant improvements in children's off-task behavior, listening effort, and ability to stay on task during classroom learning (Clark & Rhea, 2017). In the schools that have implemented the unstructured, outdoor play breaks in combination with character development lessons, improvements in the student's classroom behaviors and cognitive functioning have been seen (Rhea & Rivchun, 2018).

In addition to cognitive function, emotional function is a component of a child's mental health. One of the key assessment tools to measure mental health is stress. Stress can be assessed using a physiological measurement, the cortisol biomarker, and exploring how the individual perceives stress with psychological questionnaires. We hypothesized that elementary children's cortisol levels and perceived stress reflect higher school-day stress and that the intervention of increased physical activity would decrease these levels. The purpose of this study was to examine the effects of unstructured play on children's perceived and physiological stress levels, designed as a pilot study to determine feasibility of the study methods in young children. Specifically, the study aims were:

- Collect and analyze hair cortisol samples and self-reported stress levels in current LiiNK program 3rd graders.
- Examine the differences in mean perceived stress levels between students in a structured versus an unstructured play environment.
- Examine the difference in mean stress biomarker levels between students in a structured versus an unstructured play environment.

- Explore the relationship between perceived stress levels and the biomarker of stress (hair cortisol) among students in a structured or unstructured play environment

Theoretical Framework

This study utilized the Whole Child Framework, shown in Appendix A (Darling-Hammond & Cook-Harvey, 2018, p. 14). The whole child approach understands the overlap between all the areas of a child's development and the practices implemented in schools to support their unique stages. The goal of child education is to aid each individual in reaching their full potential. The combination of environmental, educational, relational, social, cognitive, and emotional processes influence children’s learning and overall development; this is the basis of the whole child approach (Darling-Hammond & Cook-Harvey, 2018). Physical exercise or unstructured play is a critical part of a child's development. For this study, the emotional and physical aspects of the Whole Child Framework were the focus. The LiiNK project itself is focused on the whole child approach, not just on their academic outcomes in school (Rhea & Bauml, 2018).

Social-emotional learning coincides with processing and managing challenges; this can be about perceived stress and physical stress. Perceived stress is an individual’s thoughts about how much stress they are under, while physical stress is the lasting effects stress has on the body. The framework's core physical aspect includes physical activity, in this case, unstructured play with the LiiNK intervention. One of the LiiNK project's goals is to improve the whole child, including academic outcomes and social, emotional, and physical health (Clark & Rhea, 2017). Long term, lowering student perceived stress will reduce their development of chronic health conditions, improve their focus in the classroom, and influence their overall academic success.

Conceptual Definitions

The definition of recess is "regularly scheduled periods within the elementary school day for unstructured physical activity and play" (Kohl & Cook, 2013). LiiNK intervention schools have increased the number of recesses students receive. Play and recess are used interchangeably; both signify the act of physical activity. LiiNK's definition of unstructured play is "activity that is freely chosen and self-directed by the child, with no adult influence" (Clark & Rhea, 2017, p. 55). In this study, a biological health measurement to measure stress is a biomarker; as such, cortisol is the stress biomarker. The term perceived stress signifies a relationship between the person and the environment that is appraised as affecting well-being (Lazarus & Folkman, 1984).

Review of the Literature

The literature search criteria included studies that examined the benefits of increased physical activity related to children's stress or cortisol levels and previous LiiNK intervention studies. The search was performed in the following databases: CINAHL Complete, PsychINFO, and PubMed. The search terms utilized to conduct a thorough search of these databases included "child", "children", "unstructured play", "physical activity", "recess", "stress", "cortisol", "biomarker", and "LiiNK". The inclusion criteria considered for this literature included full-text, English, studies published between 2010 and 2020, and both quantitative and qualitative study designs. Additional pivotal literature is included to strengthen understanding of the conceptual framework of the study. Although this honors study included children of a certain age group, to understand the literature gaps, the student researcher included studies with children in kindergarten through high school.

Stress and Children

Chronic stress exposure can have negative consequences on children because the brain is particularly vulnerable to the effects of stress during early childhood and adolescent development (Fox et al., 2010). Clinicians are curious as to how children's perception of stress relates to their physical well-being. A study using 882 participants aged nine to thirteen investigated the child's perception of busy and stress using a questionnaire on a handheld device (Brown et al., 2011). By 'busy' they wanted to know what children thought of their schedules. For example, was there too much activity, too much homework, or was it their parents who had a busy schedule? The questionnaire consisted of ten questions: two demographic questions and eight questions related to the amount and type of activities. The results showed: children who partake in three or more extracurricular activities were twice as likely to say they are stressed, students with two hours of homework were twice as likely to say there were stressed, and students who had three or more hours of homework were five times as likely (Brown et al., 2011). Children's ability to report on their own perceived stress is a valuable tool for researchers to understand how certain activities or the amount thereof are affecting the child.

Condon's (2018) research discusses the need for studying biomarkers in pediatric clients to explore their physiologic pathways and how their exposure to stressful experience may link to chronic stress and later health problems. In addition to cortisol, Condon (2018) discusses the other biomarkers that may be used in the study of chronic stress, such as leptin and fibrinogen. Condon concludes that more biomarker studies are needed to obtain a better understanding of the effects of chronic stress on children so that future interventions may be developed to better protect and promote overall health in children (Condon, 2018).

Physical Activity and HPA Axis

According to a study conducted with 258 8-year-old children in Finland (Martikainen et al., 2013), children who partake in an increased amount of physical activity have improved physical health and mental health. The researchers examined whether objectively measured daytime physical activity and diurnal hypothalamic-pituitary-adrenocortical axis (HPAA) activity and HPAA responses to psychosocial stress had any associations. The researchers gave each of the participants accelerometers (worn on the wrist) to measure their amount of physical activity and explored whether 1) overall daytime physical activity had any association with diurnal salivary cortisol patterns, 2) overall daytime physical activity and salivary cortisol aligned with the information gathered from a psychosocial stress test, 3) children who had a higher percentage of vigorous physical activity showed a change in diurnal patterns of salivary cortisol and a change in salivary cortisol responses to stress (Martikainen et al., 2013). The authors concluded that increased physical activity levels are associated with decreased HPAA (cortisol) (Martikainen et al., 2013). These researchers suggested as a result of their study that physical activity may play a role in a child's psychological well-being by regulating their neuroendocrine reactivity to stress (Martikainen et al., 2013).

Cortisol as a Biomarker of Stress

Cortisol is a frequently used biomarker for stress. In recent years, hair cortisol samples have become more common because of their reliability and noninvasive measurements. Hair cortisol allows us to read average levels over a more extended period compared to a serum or urine sample (Eythorsdottir et al., 2020). The investigators used the ActiGraph tool to measure and track 54 children aged 2-6 years old's physical activity and sleep; they also used a hair cortisol sample to obtain the participant's chronic stress measurements. An ActiGraph track's a person's movements through an accelerometer (Eythorsdottir et al., 2020). After five consecutive days of data collection, the researchers analyzed the data and concluded that neither sleep quality nor physical activity influenced overall cortisol levels. However, the investigators only considered the children's physical activity during those five days. These researchers acknowledged they were one of the first to conduct this type of research and that more longitudinal studies needed to be done with similar measurements (Eythorsdottir et al., 2020).

A 2013 study from the Netherlands found cortisol in the scalp to be a sufficient source for long-term measurement of cortisol and utilized it as a biomarker for stress in children who were entering school (Marleen et al., 2013). The study evaluated the hair samples of 42 children (mean age 4.2 years) after two months of school enrollment. The hair analysis was completed using two 2-cm long segments, the first 2-cm from root-end reflected the first two months of school entry, about a centimeter gap and a second 2-cm section signifying about 2 months prior to school entry. The study concluded that hair cortisol concentrations were higher after school entry than before school entry (Marleen et al., 2013).

Cortisol as a biomarker of stress has historically been measured by salivary sample collections. Dubose and McKune (2014) measured physical activity, salivary cortisol, and the MetSyn score in females (aged 7-10 years). The researchers used correlational analysis to examine the associations between physical activity, salivary cortisol, and the MetSyn score. The MetSyn score is a group of specific cardiovascular risk factors that include high blood pressure, high glucose, dyslipidemia, and central obesity (Dubose & McKune, 201, p. 221). The participants completed two visits where the researchers collected the data eight days apart and included: resting blood pressure, anthropometrics (height, weight, skinfolds, and circumferences), fasting blood draw, sexual maturity assessment, and collection of activity level through ActiGraph monitors (Dubose & McKune, 2014). The participants in this study wore monitors for five days to obtain their physical activity reading. This study's results were inconclusive as they could not find a correlation between physical activity, salivary cortisol, and the MetSyn score (Dubose & McKune, 2014). These study participants had an average of 30 minutes of physical activity per day, and the overall sample size was small. The difference between this study and Marleen and colleagues (2013) is that they measured cortisol levels using hair cortisol rather than saliva. Several factors can influence daily stress levels and cause fluctuations in salivary cortisol levels, resulting in a less reliable form of measuring cortisol when exploring the long-term effects of physical activity and stress levels.

A similar study examined the associations of the Morning Cortisol after Awakening (MCA) and morning perceived stress with moderate-to-vigorous physical activity (MVPA) in children using a perceived stress survey and saliva measurements

(Naya et al., 2021). The study included 143 children, each child provided four saliva samples, and wore accelerometers to assess MVPA minutes across four days (two weekdays and two weekend days). The results included four study waves beginning in October 2015 and ending in January 2017. The researchers concluded that self-reported stress and physical activity were correlated, meaning the more self-reported stress, the more MVPA the participant engaged in. However, the researchers did not find a correlation between the MCA saliva sample and the amount of MVPA (Naya et al., 2021). When the individual perceived they had more stress, they were more active, even though their saliva sample may not have shown a higher level of cortisol.

LiiNK

The LiiNK Project was founded by Dr. Debbie Rhea, of the Harris College of Nursing and Health Sciences at Texas Christian University in Fort Worth, TX in 2013 (Rhea, 2015). The project was founded on the principles Dr. Rhea learned while studying school systems in Finland. LiiNK's mission is to "bridge the gap between academics and social, emotional, and healthy well-being" (Rhea, 2015). In the 2013-2014 school year, Dr. Rhea's team implemented LiiNK into two Texas private schools. After seeing improvements in behavior and academic performance, LiiNK opened in four more public schools in the fall of 2015.

In the first years of LiiNK , Rhea and Rivchun (2018) found classroom behaviors and listening skills improved after implementing character lessons and four 15 minutes recesses daily in 528 kindergarten through 2nd-grade students. The methods used to measure the data included a classroom observation, a listening comprehension curriculum measurement, and a teacher observation report (Rhea & Rivchun, 2018).

The study also found that students moved less through the classroom, they stared into space less often, and fidgeted less. The investigators found that overall classroom conduct, the ability to focus, and academic on-task behavior was higher in students who received the intervention than those who did not receive the intervention (Rhea & Rivchun, 2018).

The LiiNK intervention has been studied in other research projects examining the impact of physical activity on emotions (Clark & Rhea, 2017). The researchers used a pedometer (Robic M339 3D Motion Sensory Memory Pedometer) to measure the exact amount of physical activity the students were accumulating. The child wore the pedometer like a necklace where it counted the student’s steps taken throughout the day. While at recess, the researchers randomly selected children to observe their facial, bodily, and vocal expressions to measure their emotional states, according to the modified Durbin’s method (Clark & Rhea, 2017). The researchers concluded that the increase in physical activity also positively impacted a child's emotions (Clark & Rhea, 2017).

Methods

Design

A Quasi-experimental design was used to examine the stress levels among 3rd grade students engaged in structured compared to unstructured play**.**

Setting

This study's setting is part of a larger LiiNK Project and occurred at an intervention (unstructured play) elementary school and a nonintervention elementary school. Currently, the LiiNK Project's principal investigator has a contractual agreement and Institutional Review Board permission to conduct the LiiNK Project within these schools, located in the Dallas-Fort Worth Metroplex.

Sample

Participants in this study included a total of 18 children in the 3rd grade, 14 students at a LiiNK intervention elementary school and four students from a nonintervention elementary school. For inclusion in this study, parent consent and child assent was required. Participants were also required to understand English

Consent procedures

Parent consent at the participating schools was obtained for this current phase of the study collecting stress data. The students also had the option to give assent or opt-out at the time of hair collection and the stress survey.

Data Collection

Hair Collection

The research team collected all data in person at the schools in May of 2021. The team followed the procedure for hair collection and samples were collected by the first author or trained faculty member (Meyer et al., 2014). Excess hair was clipped up and a section no more than half the width of a pencil was collected from the back of the child's head, as close to scalp as possible. The back of the head location is important because this area has less repeated exposure to sun and hair products. Cutting as close to the scalp as possible and collecting at least three centimeters captures the cortisol that was deposited in the hair over the last three months, assuming hair growth of approximately one centimeter per month (Meyer et al., 2014). The sample was taped to a piece of aluminum foil with the scalp end marked. The aluminum foil was labeled with the participant's deidentified number and placed in a large envelope with the matching deidentified number. After collection the samples were stored at room temperature in the locked honors faculty's office until analysis.

Stress in Children (SiC) Questionnaire

At the data collection site, the students also completed their SiC questionnaire on the computer, ranking each item on a Likert scale (Osika et al., 2007). The Stress in Children (SiC) Questionnaire is 21-items, and divided into three factors or subscales: Well-being (Factor 1), Distress (Factor 2), and Social support (Factor 3). For the purpose of this study, the team chose to only use Factors 1 (Well-being) and 2 (Distress) for a total of 15-items. The response categories listed for each item were (0) never, (1) sometimes, (3) often, and (4) always. The participants' responses were de-dentified and assigned a study ID number. Researchers were available if the students needed any assistance defining terms on the questionnaire.

The SiC allowed us to obtain answers related to the child's own perceived stress and then compare to their physiological measure of stress to gain a better understanding of their overall stress levels. Original psychometric studies with 181 participants ranging from ages nine to 12 used the Beck Youth Inventories of Emotional and Social Impairment (BYI) to demonstrate validity of the questionnaire. Significant associations were found between the SiC Mean Score and the BYI subscales questionnaire (Osika et al., 2007).

Another study from Greece utilized the SiC Questionnaire to verify whether or not it was valid in a Greek student sample (Emmanouil, et al., 2020). The study utilized three subjective questionnaires, the SiC Questionnaire, a simple demographic questionnaire, and the State and Trait Anxiety in Children Questionnaire. There was a total of 100 participants, 54 boys and 46 girls, and the results of the study support the validity of the tool. Emmanouil et al. (2020) validated the tool when the researchers found a high correlation between the SiC Questionnaire and the State and State and Trait Anxiety in Children Questionnaire, concluding their Greek version to be sufficient to use in Greek children.

Confidentiality Statement/Data Protection

The hair samples were stored in a faculty's office under a locked key to secure the data. The researcher and faculty were the only ones to have access to the SiC questionnaires, which remain on a password-protected study computer program. The team assigned study ID numbers to the hair samples and questionnaires and recorded no names with the sample to ensure the collected data remained confidential. The samples were all labeled with a de-identifier number upon collection that corresponded to the hair sample and questionnaire. The research team did not keep any coding sheet or sample in the same place as the consent forms.

Hair processing

Hair was processed for cortisol in the Texas Christian University Harris College of Nursing and Health Sciences Research Lab using the adapted protocol described in the paper of Meyer et al. (2014). From the hair samples, the team utilized the first 3 to 4 cm from root end of each sample. Each centimeter of hair represents the prior month and was analyzed to view the average stress response over 3 to 4 months. Hair longer than 3 cm was laid next to a ruler and cut to be 3 cm. A screw-cap polypropylene tube was weighed on a SCALE and the scale zeroed. The hair sample as placed in the tube and weighed again to get the sample weight, which could range from 10 to 50mg of hair. Two 6 mm chrome steel beads were added to all tube containing samples. A SPEX® SamplePrep Homogenizer was used to pulverize the hair for at least a minute until it reached sufficient form. Once the sample was in a powder form, 2.0 mL of HPLC-grade methanol was added to the polypropylene tube and were left to incubate for 24 hours at room temperature on a Labnet Rocker 25.

The methanol was removed using a centrifuge machine at 45 °C. Using a pipet, 1.0 mL of the supernatant was transferred to a microcentrifuge tube. The team ensured not to dip the pipet into the powdered hair. After the methanol was removed from the tubes, the cortisol extract was reconstituted using immunoassay cortisol analysis diluent buffer (Meyer et al., 2014).

Using the Salimetrics ELISA kit, the reagents were prepared, and the standards, controls, and hair samples were laid out on the plate and run in the microplate reader (Salimetrics, & SalivaBio, 2013). The microplate reader software analyzed the cortisol levels in µg/dL and then converted to pg/mg using the formula provided (Meyer et al., 2014).

Analytical Plan

The following represents the data analysis plan for the objectives of the proposed honors project.

- Descriptive statistics and an independent samples t-test was conducted to examine the differences in mean perceived stress levels between students in a structured versus an unstructured play environment

- Descriptive statistics and an independent samples t-test was conducted to examine the difference in mean stress biomarker levels between students in a structured versus an unstructured play environment
- Bivariate correlations were conducted to explore the relationship between perceived stress levels and the biomarker of stress (hair cortisol) among students in the sample.

Results

When analyzing the results, a double data entry was conducted before analysis using SPSS version 26 (IBM Corp., 2017) The total score of the SiC reflects the amount of perceived stress, the higher the number the more perceived stress. The highest score possible for the total questionnaire is 45. The minimum score from our participants was 16 and the maximum score was 33 (*M*=24.78, SD=4.95) (see Table 1). For the total SiC score, 55.6% of the participants scored above a 24.

On Factor 1 (Well-being), the higher the score the more well-being, the lower score represents more stress. The highest score possible for Factor 1 is 21, the minimum score from our participants was 5 and the maximum score was 19 (*M*=10.6, SD=3.66) (see Table 1). For the total Factor 1 score, 50% of the participants scored above a 10.

On Factor 2 (Distress), the higher the score the more perceived stress. The highest score possible for Factor 2 is 24, the minimum score from our participants was 6 and the maximum score was 19 (*M*=14.28, SD=3.53) (see Table 1). For the total Factor 2 score, 61.1% of the participants scored above a 15.

The lowest weight of any hair sample was 14.5 mg and highest was 65 mg (*M*=27.78, SD=11.86). The lowest amount of Cortisol in any sample was 1.23 pg/mg of hair and highest amount was 19 pg/mg of hair (*M*=4.89, SD=4.37) (see Table 1). Of the participants, 50% had a cortisol measurement of 3.10pg/mg of hair or higher.

Comparing the intervention to the control group, there were 14 intervention and 4 control participants. For the intervention group, the SiC total had a *M*=23.29, SD=4.58. For the control group, the SiC total had a *M*=30, SD=1.15. For the intervention group, the Factor 1 (Wellbeing) had a *M*=9.79, SD=3.75. For the control group, the Factor 1 had a *M*=13, SD=2.16. For the intervention group, the Factor 2 (Distress) had a *M*=13.5, SD=3.59. For the control group, the Factor 2 had a *M*=17, SD=1.41. For the intervention group, the cortisol had a *M*=4.25, SD=2.73. For the control group, the cortisol had a *M*=7.13, SD=8.22 (see Table 2).

An independent-samples t-test was conducted to compare groups for differences. Assuming unequal variances between the groups, there was a significant difference in the scores for SiC questionnaire for the intervention group (M= 23.29; SD=4.58) and the control (M= 30; SD=1.15470); t(-4.960); p=.00. There was also a significant difference in the Wellbeing (Factor 1) scale between the intervention group (M=13.5; SD= 3.59) and the control (M=17; SD= 1.41); t(-2.937); p=.011. There were no significant differences in the Distress (Factor 2) subscale or cortisol (see Table 3).

Bivariate analysis revealed a significant (p<.05) positive correlation between unstructured play status and SiC (r=.57). This analysis was performed by using the Pearson correlation test in which intervention (unstructured play) status was a dichotomous variable, with intervention group membership equal to one and control (structured play) equal to two. Thus, the higher the group membership, the higher the stress. In addition, there were nonsignificant but moderately sized correlations between structured play and the SiC subscales (r=.45) (See Table 4).

Discussion

This study is among the first to examine the relationship between unstructured play (physical exercise) and hair cortisol measurements in the school-aged child. Our findings suggest that the hypothesis stating students who have more unstructured play time will have lower cortisol levels, was partially supported. While the group difference in cortisol was not statistically significant, it was clinically relevant. These findings are consistent with a study on adults in which physical exercise decreased the participants salivary cortisol levels. The research suggests that physical activity can reduce cortisol secretion during psychosocial stress and that more physical activity can decrease the negative effects of cortisol on overall health in adults (Wood et al., 2018).

The average age of third grade students is eight or nine years old. The reference ranges cited in prior hair cortisol studies of this age group, suggest the intervention group as well as the total sample has a lower amount of cortisol. A previous study found the reference mean cortisol for children of this age group was 6.8pg/mg of hair (Noppe, et al., 2014). Could this be due to some type of unintentional effect on the control school? In other words, because of the results of the LiiNK study, are any teachers in the control school already incorporating extra breaks during the day?

This pilot study demonstrated the self-reporting of stress in the school-aged child and the collection of their hair sample is feasible in the school setting. The hair weight minimum necessary for laboratory analysis was possible in 100% of the participants.

The findings in this study suggest that this protocol could be successfully implemented in a larger sample of child participants.

Based on the data, the Distress scale (Factor 2) and SiC totals were different for intervention (unstructured play) and control, with the intervention group showing a lower mean score (*M*=9.7) than the control group (*M*=13.0), thus indicating the intervention group has less perceived stress. To support the finding, the correlation between the intervention status and SiC total was 0.58 (high correlation), meaning structured play was strongly associated with higher stress. Similarly, there was a moderate (0.38) correlation between the intervention status and Factor 2 (Distress), meaning structured play was moderately associated with distress.

The Factor 1 (Wellbeing) mean for the intervention group was *M*=13.5, and for the control group *M*=17.0. For the Wellbeing scale, the higher the score the more well-being, the lower score represents more stress. Therefore, there is a contrast between the results seen in the Distress/Total scale and the Wellbeing scale. The intervention group has less perceived stress and not as high well-being, while the control group has higher perceived stress and higher well-being. The reason for these findings may be due to the inconsistent sample size between the intervention and control groups, or the events occurring in the intervention school that could be contributing to their wellbeing scores being lower than those of the control group. The results need to be interpreted with caution based on the study's limitations.

Our study has several limitations. Our intervention and control groups were uneven, having 14 participants in the intervention group and 4 participants in the control group. These participant numbers totaling 18 does not allow for us to make definite conclusions after data analysis. In order to draw better conclusions, the study will need to be repeated in a larger sample. The clinical significance of the data may be more meaningful than the statistical significance because of the small sample size. These results must be viewed with caution until a larger sample size can be tested. Also, in the control group, there was an outlier for cortisol measurement (19.34 pg/mg). While the outlier was out of normal range for our data and for published reference ranges, the outlier's measurement may reflect a medication or a condition we were unaware of that caused their cortisol to be higher. There was also a sample with non-detectable cortisol in the intervention (unstructured play) group, we processed it as 0 pg/mg when generating the data. Lastly, we did not ask our participants about what else is going on with home life, after school activities, etc. that may cause their stress or cortisol to be low or high. Despite these limitations, the findings suggest the need for further studies to be conducted on the amount of physical activity children receive and how it affects their hair cortisol measurements. Should findings continue to draw similar conclusions to this study, it may be reasonable to suggest that schools will need to redefine their current curriculums to incorporate more unstructured play and character-building, thus leading to a population of children with lowered perceived and physiological stress.

Nursing Implications

The present study yielded results intended to promote further research into physical activity or unstructured play and its effects on cortisol levels. Caring for the whole child and ensuring an environment where they can thrive not just academically but psychosocially contributes to the child's well-being. Part of the whole child is their health, and it is important to promote an environment in which the child may achieve optimal health, including cortisol levels. Chronic stress can lead to problems in areas such as: learning, immune system functions, cardiovascular functions, and obesity (Tajik, et al., 2014; Yaribeygi, et al., 2017). As we begin to start caring for the whole child, lasting positive health effects will be evident in multiple body systems and brain function.

Health promotion and advocacy is part of the nursing scope of practice; nurses can be health advocates for child well-being, not just in the hospital, but in their communities as well. A variety of nurse positions, such as a school nurse or nurse in a primary care setting, can provide education to children and their parents as to what practices may best improve the child's overall health. Pediatric nurses also care for patients with obesity and emotional disorders and could advocate for more unstructured play to help improve the child's health in areas such as weight management, cardiovascular health, and brain function.

Using biomarkers for stress such as hair and salivary cortisol may allow nurse researchers to measure biobehavioral differences in child populations (Granger et al., 2012). When selecting a biomarker in the pediatric population, it is essential to consider the feasibility of collecting of biomarker collection. The present study has tested a protocol and shown that hair collection is feasible in the pediatric population, in children as young as third grade. Further research will not only aid in understanding the impact of physical activity and other stressors that occur during childhood, but it will also contribute to future policies and intervention to improve childhood health.

References

Brown, S. L., Nobiling, B. D., Teufel, J., & Birch, D. A. (2011). Are kids too busy? Early adolescents' perceptions of discretionary activities, overscheduling, and stress. *The Journal of School Health*, *81*(9), 574–580. https://doi.org/10.1111/j.1746-1561.2011.00629.x

Center for Disease Control, (2019, May 29). *Recess*. https://www.cdc.gov/healthyschools/physicalactivity/recess.htm

Clark, L., & Rhea, D. (2017). The LiiNK project®: Comparisons of recess, physical activity, and positive emotional states in grades K-2 children. *International Journal of Child Health and Nutrition, 6*(2), 54-61. https://doi.org/10.6000/1929-4247.2017.06.02.1

Condon, E. M. (2018). Chronic stress in children and adolescents: A review of biomarkers for use in pediatric research. *Biological Research For Nursing*, *20*(5), 473-496. https://doi.org/10.1177/1099800418779214

Darling-Hammond, L., & Cook-Harvey, C. M. (2018). *Educating the whole child: Improving school climate to support student success.* Learning Policy Institute. https://learningpolicyinstitute.org/sites/default/files/product-files/Educating_Whole_Child_REPORT.pdf

Dubose, K. D., & Mckune, A. J. (2014). The relationship between objectively measured physical activity, salivary cortisol, and the metabolic syndrome score in girls. *Pediatric Exercise Science, 26*(3), 221-230. https://doi.org/10.1123/pes.2013-0109

Emmanouil, C., Bacopoulou, F., Vlachakis, D., Chrousos, G. P., & Darviri, C. (2020). Validation of the Stress in Children (SiC) Questionnaire in a Sample of Greek Pupils. *Journal of molecular biochemistry*, *9*(1), 74–79.

Eythorsdottir, D. Y., Frederiksen, P., Larsen, S. C., Olsen, N. J., & Heitmann, B. L. (2020). Associations between objective measures of physical activity, sleep and stress levels among preschool children. *BMC Pediatrics, 20*(1). https://doi.org/10.1186/s12887-020-02108-7

Fox, S. E., Levitt, P., & Nelson, C. A., 3rd (2010). How the timing and quality of early experiences influence the development of brain architecture. *Child development, 81*(1), 28-40. https://doi.org/10.1111/j.1467-8624.2009.01380.x

Granger, D. A., Johnson, S. B., Szanton, S. L., Out, D., & Schumann, L. L. (2012). Incorporating salivary biomarkers into nursing research: an overview and review of best practices. *Biological research for nursing*, *14*(4), 347–356. https://doi.org/10.1177/1099800412443892

Groeneveld, M. G., Vermeer, H. J., Linting, M., Noppe, G., van Rossum, E. F., & van IJzendoorn, M. H. (2013). Children's hair cortisol as a biomarker of stress at school entry. *Stress (Amsterdam, Netherlands), 16*(6), 711-715. https://doi.org/10.3109/10253890.2013.817553

IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.

Kohl, H. W., & Cook, H. D. (2013). *Educating the student body taking physical activity and Physical Education to school*. National Academies Press.

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer Publishing Company.

Martikainen, S., Pesonen, A., Lahti, J., Heinonen, K., Feldt, K., Pyhälä, R., Tammelin, T., Kajantie, E., Eriksson, J. G., Strandberg, T. E., & Räikkönen, K. (2013). Higher levels of physical activity are associated with lower hypothalamic-pituitary-adrenocortical axis reactivity to psychosocial stress in children, *The Journal of Clinical Endocrinology & Metabolism*, *98*(4), 619–627. https://doi.org/10.1210/jc.2012-3745

Meyer, J., Novak, M., Hamel, A., & Rosenberg, K. (2014). Extraction and analysis of cortisol from human and monkey hair. *Journal of visualized experiments: JoVE*, (83), e50882. https://doi.org/10.3791/50882

Naya, C. H., Zink, J., Huh, J., Dunton, G. F., & Belcher., B. R. (2021) Examining the same-day relationship between morning cortisol after awakening, perceived stress in the morning, and physical activity in youth. *Stress, 24*(3), 338-347. https://doi.org/10.1080/10253890.2020.1804852

Noppe, G., Van Rossum, E. F., Koper, J. W., Manenschijn, L., Bruining, G. J., de Rijke, Y. B., & van den Akker, E. L. (2014). Validation and reference ranges of hair cortisol measurement in healthy children. *Hormone research in paediatrics*, *82*(2), 97–102. https://doi.org/10.1159/000362519

Osika, W., Friberg, P., & Wahrborg, P. (2007). A new short self-rating questionnaire to assess stress in children. *International Journal of behavioral medicine*, *14*(2), 108–117. https://doi.org/10.1007/BF03004176

Pervanidou, P., & Chrousos, G. P. (2018). Early-life stress: From neuroendocrine mechanisms to stress-related disorders. *Hormone research in pediatrics*, *89*(5), 372–379. https://doi.org/10.1159/000488468

Rhea, D.J. (2015). *Putting Play, Character Development, Creative Time, and Academic Content in Perspective.* Kinesiology, Texas Christian University. https://liinkproject.tcu.edu/wp-content/uploads/2020/05/U-S-Play-Coalition-Featured-Presentation-Feb-2015-Rhea.pdf

Rhea, D. J. (2016) Recess: The forgotten classroom. *Instructional Leader, 29*(1), 1-4.

Rhea, D. J., & Bauml, M. (2018). An innovative whole child approach to learning: The LiiNK project. Childhood Education, *94*(2), 56–63. https://doi.org/10.1080/00094056.2018.1451691

Rhea, D. J., & Rivchun, A. P. (2018). The LiiNK project®:: Effects of multiple recesses and character curriculum on classroom behaviors and listening skills in grades K–2 children. *Frontiers in Education, 3*. https://doi.org/10.3389/feduc.2018.00009

Salimetrics, L. L. C., & SalivaBio, L. L. C. (2013). Saliva Collection and Handling Advice.

Stults-Kolehmainen, M. A., & Sinha, R. (2014). The effects of stress on physical activity and exercise. *Sports medicine*, *44*(1), 81–121. https://doi.org/10.1007/s40279-013-0090-5

Tajik E., Zulkefli N. A, Baharom A., Minhat H. S., Latiff L.A. (2014). Contributing factors of obesity among stressed adolescents. *Electronic Physician*. *6*(1), 771-778. https://doi.org/10.14661/2014.771-778

Wood, C. J., Clow, A., Hucklebridge, F., Law, R., & Smyth, N. (2018). Physical fitness and prior physical activity are both associated with less cortisol secretion during psychosocial stress. *Anxiety, stress, and coping*, *31*(2), 135–145. https://doi.org/10.1080/10615806.2017.1390083

Yaribeygi, H., Panahi, Y., Sahraei, H., Johnston, T. P., & Sahebkar, A. (2017). The impact of stress on body function: A review. *EXCLI journal*, *16*, 1057–1072. https://doi.org/10.17179/excli2017-480

Table 1

Descriptive Statistics of Sample

	N	Minimum	Maximum	Mean	Std. Deviation
Sample size	18				
SiCTotal	18	16.00	33.00	24.7778	4.95338
Factor 1 (Well-being)	18	6.00	19.00	14.2778	3.52813
Factor 2 (Distress)	18	5.00	19.00	10.5000	3.66622
Cortisol (pg/mg)	18	.00	19.35	4.8878	4.37306
Hair wt. mg	18	14.50	65.00	27.7811	11.86339

Table 2

Group Statistics

	Intervention	N	Mean	Std. Deviation	Std. Error Mean
SiCTotal	Yes	14	23.2857	4.58138	1.22442
	No	4	30.0000	1.15470	.57735
Factor 1 (Well-being)	Yes	14	13.5000	3.58951	.95934
	No	4	17.0000	1.41421	.70711
Factor 2 (Distress)	Yes	14	9.7857	3.74533	1.00098
	No	4	13.0000	2.16025	1.08012
Cortisol (pg/mg)	Yes	14	4.2486	2.72593	.72854
	No	4	7.1250	8.22115	4.11057

Table 3

Independent Samples T-Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
SiCTotal	Equal variances assumed	2.285	.150	-2.847	16	.012	-6.71429	2.35836	-11.71379	-1.71479
	Equal variances not assumed			-4.960	15.997	.000	-6.71429	1.35372	-9.58408	-3.84449
Factor 1 (Well-being)	Equal variances assumed	2.608	.126	-1.875	16	.079	-3.50000	1.86695	-7.45775	.45775
	Equal variances not assumed			-2.937	13.586	.011	-3.50000	1.19178	-6.06343	-.93657
Factor 2 (Distress)	Equal variances assumed	1.045	.322	-1.618	16	.125	-3.21429	1.98612	-7.42467	.99610
	Equal variances not assumed			-2.183	8.858	.057	-3.21429	1.47263	-6.55376	.12519
pg/mg of hair	Equal variances assumed	9.311	.008	-1.173	16	.258	-2.87643	2.45234	-8.07515	2.32229
	Equal variances not assumed			-.689	3.191	.538	-2.87643	4.17464	-15.72387	9.97101

Table 4

Correlations

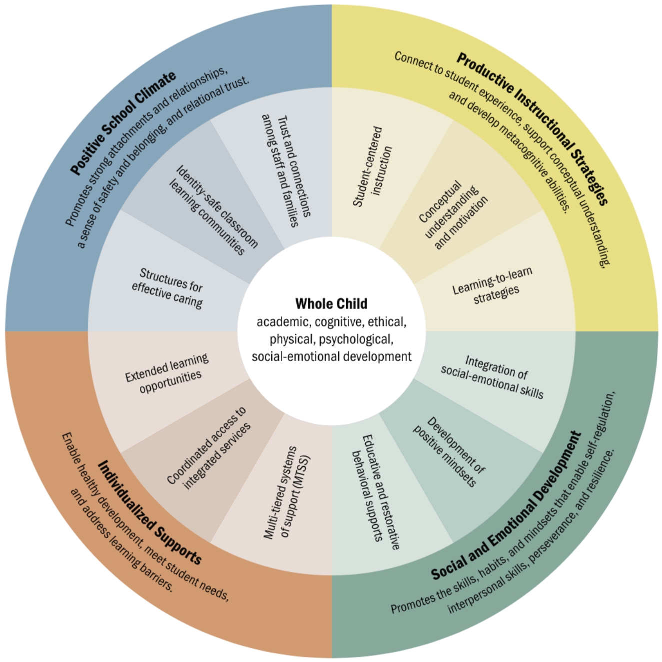
		Intervention vs Control	Cortisol	SiC Total	Well being	Distress
Interv vs Control	Pearson Correlation	1	.281	.580*	.424	.375
	Sig. (2-tailed)		.258	.012	.079	.125
	N	18	18	18	18	18
Cortisol	Pearson Correlation	.281	1	.183	.257	.001
	Sig. (2-tailed)	.258		.467	.304	.998
	N	18	18	18	18	18
SiCTotal	Pearson Correlation	.580*	.183	1	.674**	.703**
	Sig. (2-tailed)	.012	.467		.002	.001
	N	18	18	18	18	18
Wellbeing	Pearson Correlation	.424	.257	.674**	1	-.052
	Sig. (2-tailed)	.079	.304	.002		.837
	N	18	18	18	18	18
Distress	Pearson Correlation	.375	.001	.703**	-.052	1
	Sig. (2-tailed)	.125	.998	.001	.837	
	N	18	18	18	18	18

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 1

A Framework for Whole Child Education



Darling-Hammond, L., & Cook-Harvey, C. M. (2018). *Educating the whole child: Improving school climate to support student success.* Learning Policy Institute. https://learningpolicyinstitute.org/sites/default/files/product-files/Educating_Whole_Child_REPORT.pdf