Journal of Exercise Science & Fitness 16 (2018) 37–42

Contents lists available at ScienceDirect

Journal of Exercise Science & Fitness

journal homepage: www.elsevier.com/locate/jesf

The differences in physical activity levels in preschool children during free play recess and structured play recess

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ARTICLE INFO

Article history:
Received 5 June 2017
Received in revised form
7 December 2017
Accepted 9 March 2018
Available online 26 March 2018

ABSTRACT

Background/Objective: Physical activity (PA) is important in reducing childhood obesity, yet a majority of children are not meeting PA guidelines. Schools have been identified as a place to promote childhood PA. The purpose of this study was to determine the best type of physically active recess period to increase preschool-aged children's PA.

Methods: PA was measured via accelerometers in preschool-aged children ($n = 29$) during three, 30-min recess conditions (control; structured play; free play) on separate school days. Tertile splits were performed based on PA during the *free play* condition and children were divided into three groups: highly, moderately and least active.

Results: For the aggregated sample, children were more ($p \leq 0.001$) active during the *free play* (1282 ± 662 counts· min^{-1}) and *structured play* (1416 ± 448 counts· min^{-1}) recess versus the *control* condition (570 ± 460 counts· min^{-1}) and activity was not different between the *free play* and *structured* conditions. However, children who were the most active during *free play* (1970 ± 647 counts·min^{-1}) decreased ($p \leq 0.05$) activity during *structured play* (1462 ± 535 counts·min^{-1}), whereas children who were moderately active (1031 ± 112 counts·min^{-1}) or the least (530 ± 239 counts·min^{-1}) active during *free play* increased activity during *structured play* (1383 ± 345 counts·min^{-1} moderately active, 1313 ± 413 counts·min^{-1} least active).

Conclusion: Providing a physically-active recess period will contribute to preschool-aged children meeting the recommended PA guidelines; however, different children may respond in a different way based upon the structure of the recess period.

Introduction

Obesity is associated with negative health outcomes in both children and adults, and approximately 80% of overweight children become overweight adults.[1] For these reasons, experts have recommended that obesity prevention should begin with our youngest children such as those in pre- or early-elementary education.[17] Physical activity is an important component in the prevention of obesity as it results in increased energy expenditure and greater resting metabolic rate.[9] In addition to obesity prevention, participation in adequate physical activity in children has been shown to improve cognitive skills, attention, behavior, and social interaction.[1,10] Unfortunately, many children do not participate in the American College of Sports Medicine's (ACSM) recommended 60 min of moderate to vigorous intensity physical activity (MVPA) each day.[16] Therefore, programs which successfully increase physical activity participation in children are greatly needed.

Schools have repeatedly been identified as a setting in which childhood physical activity promotion can be achieved as over 95% of children are enrolled.[2] Unfortunately, many American schools have reduced the amount of daily physical education required of students.[17] Because time in physical education is often limited, recess is scheduled more frequently throughout the day and/or on a daily basis.[23] Therefore, since these recess periods may represent

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https://doi.org/10.1016/j.jesf.2018.03.001

the only physical activity children participate in during the school day, how best to organize the recess periods to increase physical activity behavior in children becomes an important topic of inquiry.

During recess periods, elementary-school aged children often participate in *free play* in a gymnasium or an outdoor setting where they are given access to age appropriate physical activity equipment and/or sedentary alternatives (e.g. coloring books, puzzles) in any pattern or amount they choose. However, children have been shown to spend less than 50% of a *free play* period participating in physical activity.[23] It has also been reported that adding structure to these recess periods may increase the amount of physical activity children participate in during recess.[3,13,20,21,23] Structure during recess could include the provision of equipment and/or games with instruction, prompts or encouragement from teachers as to how to use this equipment or play these games.[3,13,20,21,23] Therefore, it is possible that providing some *structured play* during recess periods may foster greater physical activity in children than an unstructured *free play* recess period. While previous evidence suggests that providing *structured play* during recess may promote physical activity behavior in elementary/middle school students, there is very little research examining this relationship in preschool-aged children. Investigations focusing on preschool-aged children are crucial because early childhood physical activity participation has been linked to physical activity behavior and obesity risk later in life.[11,14] It is at this point that children are starting to develop habits that they may carry into adulthood.

Furthermore, none of the previous studies examining physical activity during recess have assessed how structured play may differentially affect children who are highly-active during *free play* versus those children who are not. It is possible that *structured play* may be most beneficial for increasing physical activity in children who, during *free play*, would elect primarily sedentary activities (i.e., children who are not intrinsically motivated to be physically active) as they may require some form of encouragement and/or modeling from a teacher or coach to maximize physical activity participation.[5] This is potentially important as these children who elect non-physical activity leisure activities during *free play* may be the most at-risk for developing obesity.[6]

Therefore the purpose of this study was two-fold. The first was to assess the amount of physical activity preschool children participated in during three different, in-school recess conditions on separate days: *free play*, *structured play* and a *control* (non-active) condition. The second purpose was to identify how *structured play* may differentially affect the most active children during the *free play* condition versus the least active during *free play*. We hypothesized that the *structured play* recess period would increase the amount and intensity of physical activity in preschool-aged children relative to control and *free play* recess conditions. Additionally, we hypothesized that this increase in physical activity during *structured play* would be greatest in children who were the least active during the *free play* condition.

Methods

Subjects

Fourteen boys and 15 girls (Ethnicity: Caucasian $n = 11$; Hispanic $n = 1$; Asian $n = 4$, African American $n = 9$; Other $n = 4$) between three to five years old (3.9 ± 0.7 mean and SD years of age) from a morning ($n = 15$) and afternoon ($n = 14$) preschool program in the Midwestern United States were enrolled in the study. Students in the morning class attended school from 8:30 to 11:15 a.m. whereas the afternoon class attended from 12:30 to 3:15 p.m. Participants were free from any contraindications (e.g. cardiovascular, metabolic disorders) to engage in physical activity. All participants completed three different in-school recess period conditions (*free play*, *structured play*, *control*) per week, each on a separate day and for a period of 10 weeks. Both the morning and afternoon classes completed didactic learning activities before and after recess, which was a part of the regularly scheduled school day. Specifically, recess sessions occurred at 10am and 2pm for the morning and afternoon classes, respectively. Both the morning and afternoon classes had the same classroom, instructor, classroom aide, and recess conditions. The Kent State University Institutional Review Board approved the study. Parental consent and child assent forms were sent home with the child before the initiation of the program. Parents reviewed the forms and provided written consent. Children were asked to provide verbal assent to research personnel. Parents were also asked to complete a medical health history questionnaire for their child to determine if the child was eligible for the study (i.e. the child has none of the aforementioned contraindications) and to report the ethnicity and age of the child.

Pre-experimental testing

Participants' height and weight was measured with a balance beam scale and stadiometer (Health O Meter, Chicago, Illinois) by trained research personnel. Children removed shoes and any thick layer clothing prior to measurement.

Experimental procedures

The current investigation employed a within-subjects design. Participants completed three separate recess period conditions (*free play*, *structured play*, *control*, described below) each on a different school day but all during the same week. Morning and afternoon preschool classes participated in these recess sessions separately from one another. Therefore, recess sessions consisted of $n = 15$ for the morning class and $n = 14$ students for the afternoon class. On the days children participated in the three recess sessions, they wore an ActiGraph GT1M accelerometer (ActiGraph, Pensacola, Florida) on their hip, snug against the body. The ActiGraph is a valid and reliable tool for quantifying physical activity in children.[8]

The three recess periods each lasted 30 min and consisted of a *control* day, *free play*, and *structured play*. During the *control* recess condition, children had access to age-appropriate books, computer activities and learning stations in the classroom setting. During the *free play* recess condition, children were taken to a small, 1500 square foot gymnasium within the school and they were given free-choice access to age-appropriate gymnastics equipment (e.g. mats and pads), scooters, cycles, and sports balls. Finally, during the *structured play* recess condition, children were in the same gymnasium as the *free play* condition but participated in a series of structured physical activities (e.g. running, jumping, stretching) lead by a fitness instructor as part of a commercially-available, children's physical activity promotion program ("Stretch-n-Grow").[22]

According to information provided by the company, the "Stretch-n-Grow" program was designed to provide "fun ways to engage children in physical activities while teaching them about health" and to encourage preschoolers to improve strength, cardiovascular fitness, motor skills, spatial awareness, and cognitive abilities. All of the exercises and activities utilized in the program were developed under the supervision of an advisory board that consisted of pediatricians, nutritionists, educators, and fitness professionals.[21] The "Stretch-n-Grow" instructor was also certified in both CPR and first aid.

While each child in the class participated in all three recess sessions each week throughout the 10-week data collection period, only three to five children had their data collected during a given

week. Once data collection was completed for those children, another three to five children were assessed the following week. This ensured that the research personnel could make the necessary assessments while minimizing disruption to the daily class routine. The children participated in each recess session in the same order each week; *free play* (Mondays), *structured play* (Tuesdays), and *control* (Wednesdays).

Instruments

Physical activity assessments

Physical activity was measured via the validated ActiGraph GT1M accelerometer (ActiGraph, Pensacola, Florida).[8] The accelerometers were worn on the child's hip fitted snug against the body. Each child being measured during a given week wore the same accelerometer during each of the three measurement days described above. The accelerometer was placed around the child's waist when they arrived at school, was worn throughout the day, and then collected at the end of the school day. At the end of each week, the accelerometer data was downloaded and the following variables were calculated for each of the three conditions (*free play*, *structured play*, *control*): total day physical activity (i.e., activity counts from the entire school day), physical activity before recess (i.e., activity counts from the portion of the school day preceding recess), physical activity during recess (i.e., activity counts during the recess period), and physical activity after recess (i.e., activity counts from the portion of the school day proceeding recess).

Preference

At the completion of the final recess condition, children were asked by research personnel which of the three recess sessions they preferred: *free play*, *structured play* or *control*. When assessing preference children were reminded of the activities in which they participated, where the conditions took place (i.e., in the gymnasium or in the classroom) and whether or not the "Stretch-N-Grow" instructor was leading the recess period. Children were then asked, "Which recess did you like the best?" Liking of physical activity is a predictor of physical activity behavior.[7,8]

Statistical analysis

Independent samples t-tests were used to examine the differences between boys and girls for participant characteristics (age, height, weight, and Body Mass Index [BMI]).

Physical activity assessments

Four separate, two sex (boys, girls) by three recess condition (*free play, structured play, control*) analyses of variance (ANOVAs) with repeated measures on recess condition were performed to examine differences in physical activity at the following times: before recess, during recess, after recess and daily total. Post-hoc *t*-tests were performed on any significant main effects and/or interactions. Tertile splits were then performed based upon children's accelerometer counts during the *free play* recess condition in which they were assessed and children were assigned to one of three groups: those below the 33rd percentile (least active, $n = 10$), those between the 33rd and 66th percentile (moderately active, $n = 9$), and those above the 66th percentile (most active, $n = 10$). The *free play* condition was the first of the three recess conditions completed each week and it was selected for the tertile split as children were able to self-select their physical activity levels during the recess period. Therefore, *free play* likely represents the best depiction of children's natural intrinsic activity behavior. A three group (least, moderately, most active) by two recess condition (*free play, structured*) ANOVA was then performed to assess differences in accelerometer counts between groups and across the two physically-active recess conditions. All accelerometer count data were then converted to metabolic equivalents (MET's) to categorize physical activity intensity across conditions.[8] Finally, the proportion of the recess periods children indicated a preference for was compared to a null hypothesis of 33% utilizing a chi-square test. All statistics were conducted using Statistics Package for the Social Sciences (SPSS), version 17.0 or higher. The level of significance was set a priori at $\alpha \leq 0.05$.

Results

Participant characteristics

There were no significant differences ($p \geq 0.23$) between boys and girls in morning or afternoon classes for age, height, weight, or BMI (See Table 1).

Physical activity analyses

Average per-minute accelerometer counts before recess

There was a significant sex by recess condition interaction for pre-recess physical activity ($p = 0.045$). Boy's per-minute activity counts (639 ± 249 counts·min^{-1}, 3.2 MET's) were significantly greater during the pre-recess period preceding *structured play* than girls (357 ± 156 counts·min^{-1}, 2.8 MET's). There were no pre-recess physical activity differences ($p \geq 0.08$) between boys and girls in the remaining two conditions. There was a main effect of sex ($p = 0.018$) as boys (542 ± 249 counts·min^{-1}, 3.1 MET's) were more active than girls (385 ± 142 counts·min^{-1}, 2.9 MET's) overall. There were no significant main effects for condition ($p = 0.177$) (See Table 2).

Average per-minute accelerometer counts during recess

There was a significant main effect for condition ($p < 0.001$) for physical activity during recess. Post-hoc *t*-tests revealed that children were significantly ($p < 0.001$) less active during the *control* (570 ± 460 counts·min^{-1} or 3.1 METs) than either the *structured play* (1416 ± 448 counts·min^{-1}, 4.3 MET's) or *free play* conditions (1282 ± 662 counts·min^{-1}, 4.1 MET's). No significant differences ($p = 0.313$) were found between the *structured play* and *free play* conditions. There were no main or interaction effects for sex ($p \geq 0.75$). (See Table 2).

Average per-minute accelerometer counts after recess

There was a significant main effect for condition ($p = 0.002$) for physical activity after recess. Post-hoc *t*-tests revealed a significant difference ($p = 0.032$) between the *structured play* (412 ± 162 counts·min^{-1}, 2.9 MET's) and the *control* conditions (525 ± 338 counts·min^{-1}, 3.1 MET's) and the *structured play* and *free play* conditions (565 ± 268 counts·min^{-1}, 3.1 MET's). No significant differences ($p = 0.313$) were found between the *control* and *free play* conditions. There were no main or interaction effects for sex ($p \geq 0.512$). (See Table 2).

Table 1
Children's physical characteristics.

	Boys (N = 14)	Girls (N = 15)
Age	3.92 ± 0.65	3.95 ± 0.72
Height (cm)	106.8 ± 8.86	96.82 ± 7.07
Weight (kg)	17.75 ± 3.04	15.68 ± 1.49
BMI	15.8 ± 3.76	16.85 ± 2.01

(Data are Mean ± SD).
There were no significant differences ($p \geq 0.23$) between boys and girls in morning or afternoon classes for age, height, weight, or BMI.

Table 2
Mean Accelerometer Counts.

Physical Activity Analyses	Control	Free Play	Structured Play
Counts per-minute before recess	418 ± 197	463 ± 208	493 ± 248
Counts per-minute during recess	570 ± 460	1282 ± 662[a]	1416 ± 448[a]
Counts per-minute after recess	525 ± 338	565 ± 268[b]	412 ± 162[a]
Counts per-minute throughout school day	462 ± 200	632 ± 232[a]	629 ± 200[a]

(Data are Mean ± SD).
($p \leq 0.05$).
[a] Significant difference from *control* condition.
[b] Significant difference from *structured play* condition.

Average per-minute accelerometer counts throughout the entire school day

There was a significant main effect for condition ($p < 0.001$) for physical activity throughout the entire school day. Post-hoc *t*-tests revealed significantly ($p < 0.001$) lower physical activity during the *control* condition (462 ± 200 counts·min^{-1} or 3.0 MET's) versus the *structured play* (629 ± 200 counts·min^{-1} or 3.2 MET's) and *free play* conditions (632 ± 232 counts·min^{-1} or 3.2 MET's). No significant differences ($p = 0.946$) were found between the *structured play* and *free play* conditions. There were no main or interaction effects for sex ($p \geq 0.23$). (See Table 2).

Activity groups

There was a significant ($p = 0.0002$) group by recess condition interaction for accelerometer counts across the two physically-active recess conditions. Children in the least and moderately active groups from the *free play* condition significantly ($p \leq 0.02$) increased their physical activity from the *free play* (530 ± 239 counts·min^{-1} or 3.1 MET's least active, 1031 ± 112 counts·min^{-1} or 3.8 MET's moderately active) to the *structured play* (1313 ± 413 counts·min^{-1} or 4.18 MET's least active, 1383 ± 345 counts·min^{-1} or 4.27 MET's moderately active) recess conditions. Conversely, children in the most active group from the *free play* condition decreased ($p = 0.05$) their physical activity from the *free play* (1970 ± 647 counts·min^{-1} or 5.07 MET's) to the *structured play* (1462 ± 535 counts·min^{-1} or 4.38 MET's) condition. There was also a main effect for activity group ($p < 0.001$). However, this was expected as this is how the groups were established. (See Fig. 1).

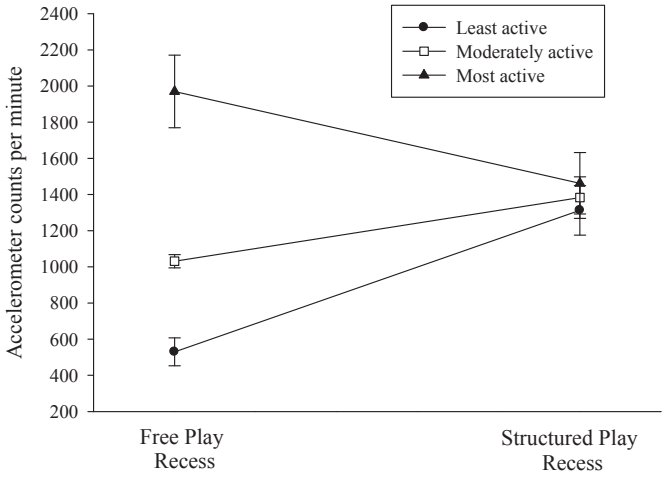

Fig. 1. Illustrates physical activity behavior during *free play* and *structured play* recess conditions in the three physical activity groups (least, moderately, most active). The most active children decreased ($p = 0.05$) physical activity during *structured play* relative to *free play* whereas the least and moderately active groups both increased ($p \leq 0.02$) physical activity.

Preference

There was a significant ($p = 0.001$) difference in the proportion of children indicating a preference for the *structured play* (55%) and *free play* (45%) recess conditions versus the *control* condition (0%). There was no difference ($p = 0.60$) in the preference for *structured play* versus *free play.*

Discussion

The current investigation was designed to assess the differences in the amount and intensity of physical activity during three recess conditions in preschool-aged children, as well as identify how *structured play* may affect children with differing levels of physical activity during *free play*. The results demonstrated that relative to the *control* condition, average physical activity for the aggregated sample of children was significantly greater during the *structured play* and *free play* recess conditions. Surprisingly, physical activity after recess was significantly lower during the *structured play* condition than either the *control* or *free play* conditions. It is possible that children were more fatigued after *structured play* than the *control* condition as they were significantly more active during *structured play* recess. However, children were also more active during *free play* recess than the *control* recess yet post-recess activity was not different between these conditions. Therefore, this reduced physical activity post *structured play* recess is likely not only due to fatigue and it is unclear why this difference occurred. Despite the reduced physical activity post *structured play* recess, the greater physical activity during both the *free play* and *structured play* recess conditions was large enough to result in greater physical activity for the entire school day relative to the *control* condition. Furthermore, relative to the *control* condition, all children indicated a preference for one of the two physically active recess conditions (*free play, structured play*). While the physical activity of the aggregated sample of children did not differ between *free play* and *structured play*, these recess conditions did appear to affect the most and least active children from the *free play* condition differently. Children who were highly active during *free play* exhibited a significant reduction in physical activity during *structured play*. Conversely, children who were moderately active and those that were the least active during *free play* condition significantly increased their physical activity during *structured play*. In other words, for children who were highly active during *free play* and *structured play* may have restricted physical activity behavior whereas for children who were less active during *free play*, *structured play* appeared to enhance participation.

It was hypothesized that children's physical activity levels during *structured play* recess would be significantly greater than the *control* and *free play* recess conditions. The results for the aggregated sample of children confirmed this hypothesis as it pertains to the *control* recess however, there was not a significant difference between the *free play* and *structured play* recess periods. While some previous studies have shown significant increases in physical

activity when more structure was present relative to free play,[3,13,20,21,23] they did not provide as much structure as the present study (i.e., "Stretch-*n*-Grow" program). While this structure may increase some children's physical activity participation and *structured play* may be necessary for the development of motor skills, this type of recess could actually limit physical activity behavior in those children who are highly active without structure.[12] It is possible that for children who are not highly motivated to participate in physical activity, structure and encouragement is necessary to promote physical activity. However, if a child is highly physically active without any structure or encouragement, it is possible that the provision of structured physical activity environment would constrain their physical activity or make it less appealing. This notion was supported in the present results when examining children grouped based upon the amount of physical activity they participated in the *free play* condition.

Intrinsic motivation to participate in physical activity relative to sedentary alternatives is a significant predictor of physical activity behavior in that children who are the most motivated are the most physically active.[6,18] Therefore, the most active group from the present study may have possessed greater intrinsic motivation for physical activity participation than their less active classmates. If true, these highly-active students would not require much extrinsic motivation to participate in physical activity. Conversely, the moderately and least active children from the *free play* condition in the present study may have been less intrinsically motivated and therefore benefited significantly from the encouragement, modeling and structure (i.e., extrinsic motivation) that was offered in the *structured play* condition. This is a potentially important finding for the development of programs designed to maximize physical activity participation in preschool-aged children. A "one size fits all" approach does not appear to be ideal as some children (i.e., the most active group) may actually benefit from having less structure whereas structure may provide a significant benefit to children who are less active during *free play*.

Interestingly, despite these group differences in physical activity participation, the preference for *structured play* versus *free play* recess was almost identical across the three activity groups. In the least active group, six children preferred *free play* and four preferred *structured*. Four of the moderately active children preferred *free play* and five preferred *structured*. Finally, among the highly active children, there was an equal number that preferred *structured* and *free play* (five each). While this lack of a difference in preference among groups is surprising given the differences in physical activity behavior, it is possible that the preference in the present study is similar to assessments of liking or hedonics.[4,15,18] While liking of physical activity is a significant predictor of physical activity behavior it is not as strong a predictor of behavior as motivation.[6,7] It is possible there were aspects of the *structured play* (e.g., learning about the body) and *free play* (e.g., talking with a friend) that positively affected children's liking of the conditions but did not positively affect physical activity behavior. For example: a child who was highly active in the *free play* condition but indicated a preference for the *structured play* condition may have enjoyed listening to the instructor explain how a muscle works. Conversely, one of the least active children in the *free play* condition may have preferred that condition because they were able to sit and talk with a friend. In each scenario, what made the given recess condition preferable (e.g., listing to the instructor, sitting with a friend) likely also decreased physical activity behavior.

While we feel this study provides novel information regarding the pros and cons of structured versus free play recess in preschool-aged children, there are some limitations. Children were only monitored during the school day. Assessing in-school physical activity is an important endeavor, however we cannot comment on any physical activity before or after the school day across the three recess conditions. Future research should consider examining physical activity throughout the entire day (in school and out of school) to determine if increasing activity during the school day affects children's physical activity outside of the school day. Additionally, the sample size of the study was small, children all came from the same school, data collection lasted for only 10 weeks and while all *structured play* sessions were led by the same instructor, the activities, while similar, did vary somewhat from session to session to keep the children interested. This could have led to varying physical activity intensities across the 10 weeks of structured play. Future studies should examine larger sample sizes and multiple schools for longer periods of time and consider keeping structured play protocols consistent throughout the intervention. Finally, both the *structured play* and *free play* conditions were conducted inside the school in order to control for the influence of fluctuations in climate throughout the study period. Sallis et al.[19] found that time spent outdoors, regardless of season or milieu, was positively correlated with physical activity in children, suggesting that children are more active while outdoors compared to indoors. Because many schools utilize outdoor recess periods, future studies may wish to consider repeating the present protocol in an outdoor setting.

The current investigation was designed to assess the differences in physical activity during three, in-school recess conditions in preschool-aged children. The results demonstrated that relative to the *control* condition, children's physical activity levels were significantly greater during both the *structured play* and *free play* recess conditions. Contrary to our hypothesis, when examining the aggregated sample of children, physical activity was not different between the *structured play* and *free play* recess conditions. However, *structured play* did significantly increase physical activity behavior in children that were moderately to least active during *free play*. This was not the case for children who were highly active during *free play*.

In conclusion, providing children with access to a physically-active recess periods appears to increase physical activity during the school day relative to a sedentary recess period. Whether or not to include structure in the recess period may depend upon the child. For children who are highly active during *free play*, structure is not necessary and may actually limit physical activity. For children who are less active during *free play*, structure may have a positive impact on physical activity during recess.

Acknowledgements

The investigators have no financial interest in the "Stretch-n-Grow" program. "Stretch-n- Grow" had a pre-existing relationship with the elementary school that was studied. However, for the 10-week period of data collection, the costs of the "Stretch-n-Grow" program were paid for by a grant provided to the research personnel. This grant was from the College of Education, Health, and Human Sciences Kent State University.

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