The Effects of a Yearlong Recess Intervention on Body Fat Shifts in Elementary-Aged Children

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Abstract: *Introduction*: Obesity has continued to rise in recent years due to a lack of physical activity. The school environment contributes to this problem as opportunities for physical activity are eliminated for more classroom time. Recess, defined as unstructured, outdoor play, can increase MVPA and improve current obesity trends. This study aimed to examine body fat category shift differences in children who received 40-60 minutes and those who received 30 minutes. A secondary purpose was to examine differences by district, sex, grade, and race across both groups since they received more than the national average for recess.

Methods: Students in 2nd-5th grade (7-11 years old) (N=393) were selected from schools serving as an intervention (N=190) or control school (N=203) in a larger longitudinal intervention titled Let's Inspire Innovation N' Kids (LiiNK). Bio-electrical impedance analysis was used to categorize students as either underfat, healthy, overfat, or obese. These categories were then used to determine if students shifted a category between pre and post-measurements.

Results: At least 30 minutes of recess was significantly associated with a body fat shift in 2nd graders and females. Additionally, the percentage of obese students did not change over the school year. There was no association between the group, sex, or race.

Conclusion: Due to this study occurring during COVID-19, it is hard to make definitive conclusions on the effects of increased recess time on obesity. However, some positive trends are pointing towards recess as a successful method of preventing a rise in childhood obesity.

Keywords: Body fat, recess, unstructured play, school, children, obesity, bio-electrical impedance analysis.

INTRODUCTION

Childhood obesity has nearly tripled over the last three decades and currently has reached epidemic levels, making it one of the leading health concerns of this generation of children [1, 2]. Over 340 million children aged 5-19 worldwide are considered overweight or obese, of which 14.4 million in the United States are obese [3, 4]. Obesity can increase a child's chances of developing high cholesterol, asthma, muscle and bone disorders, liver degeneration, sleep apnea, and cardiovascular disease [2]. Obese children also run the risk of experiencing poor self-esteem, body image, self-confidence, and discrimination from their peers [5]. These experiences can eventually lead to the development of depression, anxiety, eating disorders, and substance abuse [5]. Previous studies have highlighted the main behavioral risk factors leading to the development of obesity, including low levels of physical activity (PA) and sedentary lifestyles [6].

According to the Centers for Disease Control and Prevention (CDC) [7], children should be participating in at least 60 minutes of moderate to vigorous physical activity (MVPA) per day to yield optimal physical and psychological benefits and combat obesity. However, only 24% of children today between the ages of 6-19 actually meet those recommendations, whereas, in contrast, they spend up to eight hours daily in sedentary activities [7, 8]. These sedentary lifestyle habits result from increased dependence on technology, as 34-39% of children will exceed the recommended two hours or less of screen time daily [8, 9]. The school setting also contributes significantly to sedentary behaviors as many children spend over 60% of the school day sitting in the classroom and on technology, which equates to almost five hours daily [10]. Since most children in the United States attend school daily, it can be the ideal setting to increase MVPA and possibly reverse the current trends in obesity seen across the country [11]. Unfortunately, the results of many school-based interventions do not provide concrete evidence of support that increasing PA during the school day can effectively reduce obesity.

Most of these school-based interventions include adult-led structured PA activities, emphasize increasing MVPA during classroom time, before/after school, physical education, and recess [11]. Classroom-based PA includes teacher-directed activities such as jumping jacks, dancing, or running in place for approximately 4-20 minutes twice per day [12]. Physical education or before/after school sessions focus on fitness activities, sports, or adhering to a teacher-developed physical

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education curriculum [13, 14]. Recess interventions, typically structured, add activities that promote PA through teacher direction of games and sports that have rules and strategies and usually need equipment or markings on the hardtop or field areas [11, 15].

All four types of interventions only report a 2-14% daily increase in MVPA, which equates to only about 2-10 minutes and still does not lead to children meeting the recommended amount of MVPA [12, 13, 15, 16]. Children are not taking advantage of the extra time that they have for PA in these types of interventions. This may be due to the structured design since adult-led PA may not increase levels of MVPA as children are not always interested in the selected activity [17]. Liu *et al*. [18] discovered that the effectiveness of PA interventions strengthened when the participant's enjoyment was also emphasized. Providing enjoyable PA may increase the effectiveness of school-based interventions to improve MVPA and combat obesity in children.

Unstructured, outdoor play opportunities, especially in school settings through recess, have been shown to improve MVPA while being enjoyable and building intrinsic motivation and whole child health [19-21]. Whole child health development encompasses enhancing motor skills, rebooting their brains, socializing with peers, and regulating emotions like empathy and happiness [20, 22]. Additionally, unstructured, outdoor play provides more opportunities for PA, exploration, and learning through nature and their peers [22]. During this type of play, children are active upwards of 40% of the time and increase their chances of reaching higher levels of MVPA [23]. Unfortunately, opportunities for recess continue to be sacrificed in favor of increasing classroom time to meet academic demands for student performance [24, 25]. Finding a balance between daily play breaks and classroom time is essential to allow children opportunities to engage in a sufficient amount of MVPA and combat the development of obesity.

Brusseasu *et al*. [26] examined the differences between MVPA when children are given one 20-minute or multiple 15-minute outdoor recesses during the day. Students averaged about 4-minutes more MVPA when given multiple outdoor, unstructured opportunities for recess, with some even doubling their activity time [26]. Additionally, Razark *et al*. [27] examined differences in MVPA of children aged 3-6 who either received one 60-minute or three 15-minutes unstructured, outdoor play breaks during childcare. Their results revealed that children with multiple breaks averaged 6-minutes more MVPA during play and 20-minutes more MVPA throughout the day. In addition, Lee *et al*. [20] and Farbo *et al*. [28] found that unstructured play was a consistent way to improve MVPA in children in schools. Providing children with outdoor, unstructured free play is a more effective way to increase PA patterns during school than structured recess [20, 26, 28]. However, there is inconclusive evidence to support the effectiveness of these interventions in decreasing obesity [11, 18].

If the focus shifts to interventions that impact obesity, some PA interventions report significant differences in body mass index (BMI) between groups. However, the magnitude of these differences is marginal, 0.5 kg/m^2 or below [11, 18]. Even when given at least 20-minutes of outdoor, unstructured play daily, children only experience a 0.74 unit BMI score decrease by the end of a school year [29]. Similar results are seen when increasing the amount of recess as Casolo *et al*. [30] did. They examined BMI in 2nd and 3rd-grade students who received daily 15-minute outdoor structured recesses or two 15-minute outdoor unstructured recesses. Their findings revealed no significant differences in BMI between the groups after 12 weeks, and BMI actually increased within groups by the end of the intervention [30]. Howe *et al*. [31] also implemented 30-minutes of either structured or unstructured play in 3rd-grade students, and BMI was measured pre and post intervention. The researchers found no significant differences in BMI in either group after 9 weeks of implementation. With such wide variability in the success of these interventions at decreasing obesity rates, some researchers are speculating why this may be the case.

Ansari *et al*. [32] suggest limitations in the number of times children are given for unstructured, outdoor play is to blame for these inconsistencies. In an analysis of the relationship between time for outdoor play and BMI, they discovered at least 60-minutes of outdoor play was the point at which BMI begins to decrease in children aged 5-12 [32]. Other researchers have identified insufficient intervention lengths as a limitation [11, 18]. Most of these intervention types have been implemented for 6 months or less, which may not be long enough to see a decrease in obesity. The third limitation is the use of BMI to assess differences in obesity rates. BMI does not directly measure body fat, which is needed to properly assess if an individual is obese or not [33]. A high BMI score may result from more muscle mass than fat, which may help explain why so many interventions are not seeing any differences and, in some cases seeing increases in obesity. Based on these findings, interventions should implement 60-minutes of unstructured, outdoor play for at least 6 months and use a more accurate assessment of body fat to determine their effectiveness on obesity rates in children.

The LiiNK Project (Let's Inspire Innovation N' Kids) is a whole child development recess intervention that addresses all the gaps identified in other school-based PA programs. The intervention introduces teachers and students in grades K-5 to four 15-minute unstructured, outdoor play breaks daily and daily character development lessons each year they are in school, beginning in kindergarten [21]. The LiiNK project defines unstructured play as outdoor free play that is child-directed and child controlled within a safe environment and with no adult influence [34]. LiiNK Project first and second-grade students have been shown to take 900 more steps and achieve 25-minutes more of MVPA per day than control school students with 30-minutes of the recess [28]. Similar to other play and PA interventions, it is inconclusive from previous data examining BMI if this increase in MVPA is helping decrease obesity rates in children [35]. However, a recent LiiNK study using bio-electrical impedance analysis (BIA) suggests that BMI is not an accurate way to assess obesity rates in children with consistently higher levels of PA [36]. BIA is able to directly measure body fat percentage (BF%) and then classify students as underfat, healthy, overfat, or obese. The results revealed BMI and BIA categorized children differently almost 30% of the time, with the biggest difference in the overfat category at 40% [36]. Using a more accurate assessment of body fat such as BIA may generate more conclusive obesity results with longitudinal interventions like LiiNK.

Therefore, this study aimed to examine the effects of 30 to 60 minutes of recess, defined as unstructured, outdoor play daily, on body fat shifts from the beginning of the year to the end of the year in elementary-aged children. It was hypothesized that children with up to 60-minutes of recess daily would shift significantly more from an unhealthy to a healthy body fat category than students with 30-minutes of recess daily. It was also hypothesized there would be body fat category shift differences by district, sex, grade, and race. A healthy body fat category is defined as underfat and healthy students, while unhealthy students are those in the overfat or obese body fat categories. Since both groups received more than the national average for recess, the second purpose of this study was to examine the effects recess and body fat category shift had on the district, sex, grade, and race.

METHODS

Participants

Participants were selected from ten north and south-central Texas schools participating in the LiiNK Project as either an intervention school or a matching control school. These particular intervention schools (I) (N=5) received a revised number of minutes of outdoor, unstructured play daily for 4th and 5th graders than the 60-minutes typically required. The daily character lessons were still delivered daily for 15-minutes. The difference in time for recess with this study is due to the administration feeling these two grade levels needed to gradually phase out that much playtime to adjust for middle school, which provides less time for breaks in the day. So, students in 2nd and 3rd grade received 60-minutes (four 15-minute time slots), 4th grade 45-minutes (three 15-minute slots), and 5th grade 40-minutes (two 20-minute slots) of recess daily. The control schools (C) (N=5) only received 30-minutes (two 15-minute time slots) daily. Each intervention school was similarly matched by location and demographics with a control school. Only children in 2nd through 5th grade (7-11 years old) were recruited to participate. Six of the schools (District 1, I=3, C=3) were from the Dallas-Fort Worth metroplex and consisted of approximately 40% White, 40% Hispanic, 15% Black, and 5% other. Four of the schools (District 2, I=2, C=2) were from south-central Texas and consisted of 70% Hispanic, 20% White, 5% Black, and 5% other. Others included Asian, Pacific Islander, American Indian, Alaskan Native, or two or more races. Participant distributions (N=393) are provided in Table **1**, and pre (beginning of school year) descriptive statistics of height, weight, BMI, BF%, and percentage of students in each BF% category are provided in Table **2**.

Originally, 497 students in grades 2-5 received parental consent to collect their data during the 2020-21 school year. Students needed to have data at both pre (fall) and post (spring) to be included in the final data analysis. A total of 73 participants (I=37, C=36) did not have data at the post, so they were excluded from the analysis. Reasons for lack of data would include being absent on collection days, not giving consent, moving to a new school, or their class moving to an online format due to COVID-19. In addition, 31

Table 1: Participants by School, Grade, and Gender

Grade	Gender	District 1		District 2		Total
		Intervention	Control	Intervention	Control	
		N	N	N	N	
2nd	M	0	0	27	32	59
	F	0	0	21	37	58
3rd	M	15	8	21	47	91
	F	21	4	33	34	92
4th	M	9	2	0	0	11
	F	17	13	0	0	30
5th	M	8	11	0	0	19
	F	18	15	0	0	33
	Total	88	53	102	150	393

Table 2: Pre Descriptive Statistics

	N	Weight		Height		BMI		BF%		BF% Categories			
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	UF	H	OF	OB
Group													
Intervention	190	73.61	21.75	52.02	3.42	18.87	3.94	23.78	8.40	6%	52%	12%	30%
Control	203	71.26	21.75	51.64	3.42	18.52	3.87	23.60	8.31	5%	53%	18%	24%
District													
District 1	141	79.33	23.78	54.00	3.37	18.87	4.07	22.66	8.71	10%	57%	7%	26%
District 2	252	68.52	19.53	50.61	2.79	18.59	3.80	24.26	8.10	3%	50%	19%	28%
Gender													
Male	170	70.00	21.10	51.38	3.52	18.35	3.57	24.35	7.36	6%	60%	12%	22%
Female	223	74.22	22.11	52.17	3.31	18.96	4.12	23.18	9.01	5%	47%	17%	31%
Grade													
2nd Grade	127	64.23	16.12	49.40	2.52	18.35	3.50	24.31	7.46	2%	48%	20%	30%
3rd Grade	173	71.91	20.49	51.83	2.56	18.62	3.93	23.57	8.54	5%	54%	15%	26%
4th Grade	41	82.56	25.96	54.02	3.18	19.62	4.54	23.99	9.50	7%	49%	12%	32%
5th Grade	52	85.97	24.75	55.99	2.86	19.05	4.15	22.28	8.83	13%	60%	6%	21%
Race													
White	139	72.02	22.56	52.47	3.65	18.12	3.84	21.69	7.80	7%	61%	13%	19%
Black	28	84.23	25.17	53.52	3.40	20.42	4.70	26.88	10.24	7%	40%	14%	39%
Hispanic	209	71.13	20.74	51.11	3.15	18.90	3.82	24.79	8.24	3%	48%	17%	32%
Other	17	71.54	16.49	52.59	2.65	18.04	2.98	21.15	6.86	18%	59%	0%	24%
Total	393	72.40	21.75	51.83	3.42	18.69	3.90	23.69	8.35	6%	52%	15%	27%

Note: UF=Underfat, H=Healthy, OF=Overfat, OB=Obese.

students (I=9, C=22) were eliminated due to errors in their height data. These children either had a smaller height at post than at pre or an unrealistic increase in height as some students appeared to grow 9 to 10 inches between semesters. This was most likely due to an error made when measuring their height or entering their data into the BIA software. An inaccurate height would cause the BIA scale to inaccurately assess body fat and properly categorize students.

Measures

Bio-Electrical Impedance Analysis

Body composition was measured using BIA. The BIA device used for the current study was the Tanita BF 2000, which is shown to have high specificity in assessing overfat and obese children [37]. In addition, the scale has a moderate to strong correlation when compared to the most accurate assessments of body composition, such as dual-energy x-ray absorptiometry [37]. The scales use an unnoticeable electrical current to detect body fat, which has low water content and will cause impedance in the current. Upon completion of the measurement, the participant's fat-free mass, fat mass, BF%, and BMI are calculated. The scale will then use this information to classify students as underfat, healthy, overfat, and obese based on age and sex [38].

Procedures

The LiiNK intervention BIA protocol received IRB approval from a North Texas university where the intervention originated. Since this project was approved during the COVID-19 pandemic, special precautions were taken to abide by university COVID-19 guidelines, including wearing face shields and masks and disinfecting the scales between participants. Principals were then notified to obtain approval to be on campus, and parental consent letters were sent home, signed, and returned by parents. Child assent was also collected by asking children if they were comfortable removing their socks and shoes and then standing on the scale. Any child who did not receive parental consent or did not provide permission was excluded from the collection.

Once consent was collected, principals and teachers were notified to coordinate a day researchers could be on campus to begin data collection. In addition, class rosters with sex, grade, date of birth, and height were provided by physical education teachers to be entered into the BIA software program. Height was measured in inches, and any student who did not have their height collected beforehand was measured on collection day. Physical education teachers collected height earlier in the fall semester as an ongoing measure collected for the LiiNK Project.

On the data collection day, height and scale stations were set up in a private, centrally located section of the hallway near the classrooms of students participating in data collection. Students who had parental consent were pulled from their classroom in groups of five and were asked if they agreed to participate. They were requested to remove their socks and shoes and wait for their name to be called if they did. Students stood on the scale for approximately 5-10 seconds as their data was calculated when it was their turn. The scale would flash a green light to signify that a participant's data was being collected and then would disappear once the measurement was complete. Students put their socks and shoes back on and returned to class while the scale was disinfected. The next student was called, and the procedures were repeated. If a student was absent on the collection day, a researcher returned on an alternate day to collect their data. The same procedures were followed during the spring semester for post-data collection. Ideally, BIA measurements should be taken when participants are in a fasted state and fully hydrated. However, these requirements are hard to implement consistently as students have highly variable schedules and needs throughout the day. Attempting to account for this variability, students were measured at the same time of day in the fall and spring semesters.

At the end of each day, data was saved on the BIA software program on a secure computer. Once all schools were collected, data was downloaded to an Excel file and then combined with a master datasheet. The data downloaded from the BIA software included ID, grade, sex, height, weight, BMI, BF%, and body fat category. Each school only required one day of collection to complete measurements for all students, excluding post days for students who were absent. These measurements were completed over the course of three weeks in the fall and spring semesters.

Data Analysis

Data were analyzed using IBM SPSS statistics version 26. The characteristics of the sample by group, district, sex, grade, and race were determined using descriptive statistics. To test the first and second hypotheses, students were first categorized and coded as either (1) underfat, (2) healthy, (3) overfat, or (4) obese according to normative values provided by McCarthy *et al*. [38]. Then, a new variable was computed to assess body fat category shifts between pre (fall) and post (spring) data points. This new variable was calculated by subtracting the post-body fat category from the pre-category. For example, if a student was overfat at the post and healthy at pre, their new variable would be coded as 1 since 3-2=1. A value of -1 indicated that the participant decreased a body fat category, 0 was no shift, and 1 indicated an increase in a body fat category. Three students received a score of -2, which means they decreased by two body fat categories. However, these students were recoded as -1 since only a few met this classification, which would result in violations of the assumptions of chi-square tests. In addition, students who shifted from underfat to healthy or from healthy to underfat were coded as a 0 since they were still considered healthy with either of those shifts. Although these shifts demonstrated either an increase or decrease in BF%, this study was more focused on shifts from the unhealthy categories of overfat and obese to a healthy category.

The first hypothesis was tested using a non-parametric chi-square test with an alpha value of $p<.05$ to examine any association between group and body fat category shift. The second hypothesis was also tested using a non-parametric chi-square test. However, intervention and control groups were combined with having a large enough sample size to examine differences by district, sex, grade, and race. A significant chi-square statistic indicates a difference between the observed count, what was actually measured, and the expected count if there was no relationship between the independent and dependent variables. Adjusted standardized residuals (AR) are then used to determine which observed values are different from the expected values in the chi-square model. An AR greater than 1.96 indicates that the observed values are significantly more or less than expected with $p<.05$, which means there is a significant association between the independent variable and body fat category shift.

RESULTS

Descriptive Statistics

Descriptive statistics were used to determine the means and standard deviations of height, weight, BMI, BF%, and percentage of students in each BF% category by group, district, sex, grade, and race. Due to the smaller sample size when dividing group x sex, group x district, etc., descriptives are only provided by main effects. At post, the following differences from fall data were found between groups and by sex, grade, and race. The intervention students had slightly higher BF% (1.75%) and those classified as obese (7%) than control school students. District 1 students had higher BMI (0.42) but lower BF% (0.94%) and obesity prevalence (4%) than District 2 students. Males had lower BMI (0.56) and obesity prevalence (8%) but higher BF% (1.46%) than females. Across grade levels, BF% was slightly higher in younger students (~24%) until they reached 5th grade, where it decreased by ~1.2% and reported the lowest percentage of obese students (21%). Black and Hispanic students had the highest BF% (28.11%, 25.38%) and percentage of students who were obese (39%, 31%); white and others had the lowest BF% (22.09%, 19.78%) and obesity prevalence (18%, 18%). However, blacks and other students had smaller sample sizes compared to other groups, so caution should be used when interpreting their results. Between semesters, weight, height, BMI, and BF% increased for all groups except control students and others who demonstrated a slight decrease in BF% (0.3%). Table **3** provides descriptives for data collected at the end of the year.

Hypothesis 1: Body Fat Category Shift by Group

Non-parametric chi-square tests were used to determine the group's pre- to post-body fat category shift differences. Chi-square assumptions were met as no values within the contingency table had an expected count of less than five. The chi-square test revealed no significant association between group and body fat category shift, $x^2(2)=1.05$, $p=0.59$. Table **4** provides details reflecting no group differences for increasing (1), decreasing (-1) or maintaining a body fat category (0). The observed column includes the actual number of participants in each group who shifted in the body fat category from pre to post. The expected column represents the expected number in the chi-square model if the null hypothesis were true and there was no relationship between the independent and dependent variables. Finally, the AR column indicates if the observed and expected count differences are significant at $p<0.05$. If significant, this means that the group (intervention or control) had a significant effect on body fat category shift. For example, the chi-square model expected 15 students to decrease a body fat category (obese to overfat or overfat to healthy) in the intervention group. There were actually 13 students who decreased a body fat category at post, which is two less than expected. According to the AR (-0.7), the difference between the observed (13) is not significantly different from the expected (15). This means that the intervention had no effect on decreasing the body fat category that was significant.

Hypothesis 2: Body Fat Category Shifts by District, Sex, Grade, and Race

Non-parametric chi-square tests were also used to determine pre to post-body fat category shift

Table 3: Post Descriptive Statistics

	N	Weight		Height		BMI		BF%		BF% Categories			
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	UF	H	OF	OB
Group													
Intervention	190	78.90	23.65	52.79	3.36	19.63	4.29	25.08	8.88	4%	53%	13%	30%
Control	203	76.33	23.02	52.99	3.35	18.85	4.06	23.33	8.77	10%	51%	16%	23%
District													
District 1	141	84.48	25.59	54.81	3.39	19.50	4.37	23.57	9.03	9%	56%	11%	24%
District 2	252	73.71	21.06	51.82	2.82	19.08	4.08	24.51	8.76	6%	49%	17%	28%
Gender													
Male	170	75.30	22.65	52.48	3.54	18.91	3.78	25.00	7.49	6%	57%	15%	22%
Female	223	79.31	23.75	53.20	3.18	19.47	4.46	23.54	9.74	8%	48%	14%	30%
Grade													
2nd Grade	127	69.15	17.89	50.78	2.66	18.68	3.71	23.97	7.97	5%	50%	17%	28%
3rd Grade	173	77.22	21.89	52.75	2.58	19.32	4.24	24.72	9.16	6%	51%	15%	28%
4th Grade	41	88.19	28.38	55.15	3.19	20.06	4.91	24.20	10.01	7%	56%	10%	27%
5th Grade	52	90.96	26.37	56.75	2.84	19.63	4.43	22.82	9.01	15%	52%	12%	21%
Ethnicity													
White	139	76.88	24.20	53.46	3.56	18.63	4.12	22.09	8.15	11%	59%	12%	18%
Black	28	90.84	28.13	54.39	3.27	21.34	5.39	28.11	11.33	3%	54%	4%	39%
Hispanic	209	76.41	22.08	52.20	3.12	19.45	4.04	25.39	8.67	4%	46%	19%	31%
Other	17	75.65	16.87	54.24	2.70	17.95	2.94	19.78	7.04	23%	59%	0%	18%
Total	393	77.57	23.33	52.89	3.35	19.23	4.18	24.17	8.86	7%	52%	14%	27%

Note: UF=Underfat, H=Healthy, OF=Overfat, OB=Obese.

Table 4: Body Fat Category Shift by Group

Group	-1			0			1		
	Observed	Expected	AR	Observed	Expected	AR	Observed	Expected	AR
Intervention	13	15	-0.7	161	161	0	16	14	0.8
Control	18	16	0.7	172	172	0	13	15	-0.8

Note: AR=Adjusted Standardized Residual.

differences by district, sex, grade, or race, as seen in Table **5**. The chi-square test revealed no association between district and body fat category shift, x2(2)=3.08, p=0.22. There were no values with an expected value of less than five within the contingency table by district.

When analyzing the relationship between sex and body fat category shift, the assumptions of chi-square were met as no cells within the contingency table had an expected count of less than five. The chi-square results revealed no association between sex and body fat category shift, $x^2(2)=4.33$, p=0.11. However, females had a significantly more (23) than expected (17.6) decrease in the body fat category, while males had a significantly smaller (8) than expected (13.4) decrease.

By grade level, 4th and 5th graders had multiple contingency table cells with an expected value of less than five, so caution should be used when interpreting grade level results. The chi-square test revealed a significant association between grade level and body fat category shift, $x^2(2)=12.90$, $p<0.05$. Students in 2nd grade had a significantly higher (17) than expected (10) decrease or maintain body fat category, while students

Table 5: Body Fat Category Shift by District, Gender, Grade, and Race

Group	-1			0			1		
	Observed	Expected	AR	Observed	Expected	AR	Observed	Expected	AR
District 1	7	11.1	-1.6	125	119.5	1.6	9	10.4	-0.6
District 2	24	20	1.6	208	213.5	-1.6	20	18.6	0.6
Male	8	13.4	-2.0*	148	144	1.1	14	12.5	0.6
Female	23	17.6	2.0*	185	189	-1.1	15	16.5	-0.6
2nd Grade	17	10	2.8*	101	107.6	-2.0*	9	9.4	-0.2
3rd Grade	8	13.6	-2.1*	150	146.6	1.0	15	12.8	0.9
4th Grade	4	3.2	0.5	37	34.7	1.0	0	3	-1.9
5th Grade	2	4.1	-1.2	45	44.1	0.4	5	3.8	0.7
White	10	11	-0.4	121	117.8	0.9	8	10.3	-0.9
Black	3	2.2	0.6	25	23.7	0.7	0	2.1	-1.5
Hispanic	17	16.5	0.2	171	177.1	-1.7	21	15.4	2.2*
Other	1	1.3	-0.3	16	14.4	1.1	0	1.3	-1.2

Note: AR=Adjusted Standardized Residual; *=p<0.05.

in 3rd grade had a significantly lower (8) than expected (13.6) decrease in body fat category.

The results by race also had chi-square assumption violations, with Black and other students having cells with an expected count of less than five. Chi-square tests revealed no race by body fat category shift association, $x^2(2)=6.85$, $p=0.34$. Although the race was not associated with a body fat category shift, Hispanics did have significantly more (21) than an expected (15.4) increase in a body fat category.

DISCUSSION

This study examined body fat category shift differences in grades 2-5 children who received 30-minutes daily (control) versus 40, 45, or 60 minutes daily (intervention) of recess. Although no significant group differences were found between pre and post-data using BIA assessments, having 30-60 minutes of recess daily showed some positive results [21, 24, 25]. In addition, recess is often taken away in other schools due to behavioral issues or to increase instruction time in the classroom [24, 25]. Neither the intervention nor the control schools in the current study were allowed to withhold recess for any reason, so all students in the control schools received 30-minutes of recess daily, and the intervention schools received between 40 and 60 minutes daily depending on grade level.

Positive trends in obesity rates for both groups are worth noting. Providing at least 30-minutes of recess daily seems to aid in preventing obesity rate increases during a full school year. The percentage of obese students in the intervention group remained stable at 30%, while the control group decreased from 24% to 23%. This could mean that students in both groups were taking advantage of the time that they had for recess to be active and engage in sufficient MVPA to prevent body fat from increasing. The control schools for this study clearly had a lower percentage of obesity at the pre-test than the intervention schools, so other variables may have played a part in why obese students were obese, i.e., active lifestyles outside of the school setting, food choices at school and home. Ideally, groups should be equal at baseline to successfully identify if there is any intervention effects post measurement. However, this study utilized a convenience sample of students who received parental consent instead of using all students in a grade level. This could have resulted in a healthier selection of control school students simply because their parents approved their participation and may not be a true representation of the rest of the population. The healthy (59%), overfat (14%), and obesity (27%) prevalence across both groups is similar to healthy (54%), overweight (17%), and obesity (29%) rates reported across the state of Texas using BMI in the same age group [39]. However, until other studies assess body composition with a true body fat measure such as BIA, we won't know children's true body fat results outside of this intervention. Farbo and Rhea [36] assessed children with both measures and found that BMI can have up to a 30% chance of misclassifying students when compared to BIA, especially those in the overweight category [36]. In the current study, BMI had a 42% chance of misclassifying overfat and a 14% chance of misclassifying obese when compared to how BIA categorized students. So, further investigation is needed to determine if the overweight/obese statistics reported across states and nationally using BMI have been misleading over the years, especially in active children.

One other interesting point is that this data was collected in the midst of the COVID-19 pandemic. Lange and colleagues [40] examined obesity rates of 2-19-year-olds during the pandemic as well and found obesity prevalence increased from 19.3% to 22.4%, and the monthly rate of BMI increase was double during the pandemic than before. This results from lifestyle changes, including an increase in sedentary time and poorer eating patterns that were heightened during the pandemic [41]. These factors outside of school could have altered the true results of the current study. Further investigation is needed to determine the effects of the intervention during a normal school year when children attend school more consistently and academic pressures facing children decrease.

Due to both groups receiving more time for recess than the national average, we also wanted to analyze body fat shifts by sex, grade, and race. By sex, more females than expected in both groups decreased a body fat category, whereas males did not. This is consistent with Podnar and colleagues [42] systematic review that showed many school-based programs demonstrate a strong intervention effect in females and only borderline effects in males. This is interesting as females are commonly shown to engage in less MVPA than males throughout the day [28, 43]. In addition, body fat has shown to steadily increase across both sexes until about age 11, then males begin to decrease, and females continue to increase [44]. Females may have been lacking sufficient MVPA at the pre-data point, so they were able to take advantage of extra time for recess to increase MVPA and decrease body fat. The males may have engaged in sufficient amounts of MVPA at the pre-data point, and the additional recesses did not increase MVPA enough to burn body fat. More research is required to determine the parameters needed in school-based interventions to see positive results in male students.

At least 30-minutes of recess is also effective in decreasing obesity rates in 2nd-grade students as they had a significantly more than expected decrease in the body fat category. This contradicts the work of Casolo *et al*. [30], who found no differences in BF% in 2nd-grade students who received two 15-minute unstructured recesses throughout the day. The decrease in body fat in 2nd graders suggests that additional time for recess may be an effective way to prevent body fat from increasing in younger children within a school year.

There was no association with body fat category decrease in students in 3rd, 4th, and 5th grade. These students may not have engaged in sufficient MVPA to decrease body fat as MVPA has been shown to gradually decline in children beginning at 7 years old [45]. However, obesity prevalence was the lowest in the older grade levels as 4th, and 5th-grade students had only 27% and 21% of children who were obese. Children in 4th and 5th grade were entering their fifth or sixth year receiving additional recess each day that they were in school, suggesting there may be a larger intervention effect after multiple years of implementation. For children in the older grade levels, additional investigation is needed to examine the longitudinal impact of increased time for recess on obesity rates, as one year may not be sufficient to see significant differences.

Finally, body fat categories did not shift significantly by race. This may be a result of Hispanic students, who represented over half of the sample, having the highest overweight (19%) and second-highest obese (31%) percentages than the other races. In general, Hispanic children typically have higher obesity rates than other races, followed by White, Black, and Other [46]. Other researchers have found Hispanic children will consume fewer fruits and vegetables, more sugary sweetened beverages, and more fast food than children of other races [47]. Reducing obesity in Hispanic children has repeatedly shown not to be effective with a PA/play school-based intervention alone, even when given for a complete school year. Chavez and Nam [48] support our findings and state multi-component interventions that include 1) PA/play, 2) reducing calorie intake and improving dietary components, and 3) involving families in changing behaviors at home are more effective in reducing obesity prevalence in Hispanic children. Further research is needed to examine the influence variables such as sedentary behaviors and dietary patterns outside of the school environment may have on obesity rates by race.

LIMITATIONS

The first limitation of this study is it took place in the midst of COVID-19. Evidence shows obesity rates, poor eating habits, and sedentary behaviors were heightened during the pandemic [41]. These changes in lifestyle habits could have minimized the true effects of the intervention. Another limitation is the way in which students were measured using the BIA scale. Participants should be in a fasted state and fully hydrated when using BIA. However, this was not possible with this population as there were many differences in schedules and the needs of students throughout the day. If a student was not fully hydrated, it could have resulted in a higher BF% due to a lower water content leading to additional resistance in the electrical current. Another limitation is aging that occurred between the pre and post-measurements. A secondary analysis of the data not included here examined body fat category shifts of children who maintained or increased in age between measurements. The data showed more students than expected decreased a body fat category when they increased in age and more than expected increased when they remained the same age. Whether or not a student shifted a body fat category could have been influenced by their age at the time of pre-collection. The final limitation is the lack of collection of other variables that could affect obesity, including sedentary behaviors, socioeconomic status, and eating patterns. Collecting and controlling for these variables could provide a clearer picture of the true effects of the intervention on body fat.

FUTURE DIRECTIONS

Since data collection occurred in the middle of the COVID-19 pandemic, it is hard to make a definitive conclusion on the effects of increased time for recess on obesity rates. Future studies need to examine the effects of increased time for recess on body fat during a non-pandemic school year. Larger sample size would allow for analyses examining interaction effects between the intervention and sex, grade, or race, which were not possible in the current study. Additionally, future research should consider the effect of variables outside of school, including sedentary behaviors, eating patterns, and socioeconomic status. Adding a true control school with 20-minutes or less for recess would also be valuable to examine in future studies. The additional time for recess in the control group could minimize the differences between the two groups. Finally, future studies should examine the effects of aging on body fat classification in children. Age seemed to have an effect on body fat classification in the current study, as children who increased in age between measurements were more likely to display a decrease in body fat category. More research is needed to ensure the most accurate assessment of obesity is being used in children.

CONCLUSION

The results of this study revealed no differences in body fat category shift between students who receive either 30 or 60 minutes daily for recess. However, definitive conclusions cannot be made due to this study occurring during the COVID-19 pandemic, which had a significant effect on the normal lifestyle habits of children. Despite this limitation, providing at least 30-minutes of recess seems to significantly associate with decreasing body fat categories in 2nd graders and females. In addition, at least 30-minutes of recess is a useful way to deter higher obesity levels as neither the intervention nor the control group had an increase in the number of students who were obese at post measurements or individual students who increased in body fat percentage. These results show that at least 30-minutes of outdoor, unstructured play is a promising strategy for controlling obesity rates in children. Instead of taking away time for outdoor, unstructured play, it should be incorporated as a regular part of the school day. Further research is needed to examine the effects of 30 vs. 60 minutes of recess during a non-pandemic school year with a school schedule that typically has 20-minutes or less of recess daily.

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LIST OF ABBREVIATIONS

BIA = Bio-electrical impedance analysis

BMI = Body mass index

PA = Physical Activity

MVPA = Moderate to vigorous physical activity

BF% = Body fat percentage

UF = Underfat

H = Healthy

OF = Overfat

OB = Obese

AR = Adjusted residual

I = Intervention

C = Control

CONFLICT OF INTEREST

The authors declare no conflict of interests.

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